ENERGY TRANSITION PARTNERSHIP

REPORT

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

2025 | Comprehensive guide and roadmap to support stakeholders accelerating energy transition

RFP/2023/49848

Prepared by:
Hartree Consultores and Kolibri

Hartree® KOLIBRI

UNOPS | 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

Comprehensive guide and roadmap to support stakeholders accelerating energy transition – Deliverable 3
"Supply Chain Integration of Battery Value Chain for Energy Transition in Indonesia" - Project

RFP/2023/49848
June 2025

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
1	1	Comprehensive guide and roadmap to support stakeholders accelerating energy transition – Deliverable 3	04/05/2025	GS

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

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

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

The overall objective of the "Supply Chain Integration of Battery Value Chain for Energy Transition in Indonesia" project financed by ETP is 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 will assist:

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

[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.

Developed through four workstreams, this report from **Workstream B and Workstream C** targets the analysis of Indonesia's current battery supply chain, zooming in on every link of the chain. This report presents 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 explores the integration of supply chains, evaluates current incentive scheme, assesses the compatibility of the policies in place with national targets, and suggests an implementation plan.

The project will be composed of two additional reports that will complement this one. They will include additional topics such as the environmental and social impact assessment and will expand on certain topics covered in this report, like the comprehensive roadmap and recommendations for future policies.

Contents

Acronyms

ASEAN	Association of Southeast Asian Nations
BESS	Battery Energy Storage Systems
CAPEX	Capital Expenditure
CBA	Cost-Benefit Analysis
DPR	Dewan Perwakilan Rakyat Indonesian House of Representatives
ETM	Energy Transition Mechanism
EV	Electric Vehicles
EPR	Extended Producer Responsibility
FF	Fossil Fuel
GHG	Greenhouse Gas
IEA	International Energy Agency
JETP	Just Energy Transition Partnership
KEN	*Kebijakan Energi Nasional* National Energy Policy
KPI	Key Performance Indicators
LCE	Lithium Carbonate Equivalent
LFP	Lithium Iron Phosphate Batteries
MEMR	Ministry of Energy and Mineral Resources *Kementerian Energi dan Sumber Daya Mineral*
MoE	Ministry of Environment *Kementerian Lingkungan Hidup dan Kehutanan*
MoF	Ministry of Finance *Kementerian Keuangan*
MoI	Ministry of Industry *Kementerian Perindustrian*
MoInv	Ministry of Investment *Kementerian Investasi dan Hilirisasi/ Badan Koordinasi Penanaman Modal (BKPM)*
MoT	Ministry of Transport *Kementerian Perhubungan*
NDC	Nationally Determined Contribution
NMC	Nickel Manganese Cobalt Batteries
OPEX	Operational Expenditure
PV	Photovoltaic
RE	Renewable Energy
ROI	Return of Investment
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
RUKD	*Rencana Umum Ketenagalistrikan Daerah* Regional Electricity Master Plan
RUKN	*Rencana Umum Ketenagalistrikan Nasional* National Electricity Master Plan
RUPTL	*Rencana Usaha Penyediaan Tenaga Listrik* National Electricity Supply Business Plan
R&D	*Research and Development*
SPKLU	*Stasiun Pengisian Kendaraan Listrik Umum*
TOE	Tonne of Oil Equivalent
TWh	Terawatt Hours

List of Tables

List of Figures

Executive summary

Reaffirming its commitment to accelerating its energy transition, Indonesia has revised its national targets through key policy documents. However, the pace of implementation remains misaligned with the level of ambition articulated in these documents. The country's latest Nationally Determined Contribution (NDC) reflects heightened ambition, setting new greenhouse gas (GHG) emissions reduction targets of 31.89% (unconditional) and 43.2% (conditional)[2], with the overarching goal of building a clean energy ecosystem across all sectors. Still, there are significant gaps in the penetration of renewable energy (14.1% realization vs. 19.5% target in 2024), EV production (68,695 vehicles vs. 98,746 target for 2025) and charging stations (3,233 stations installed vs. 5,810 target for 2025).

In the power sector, Indonesia has set a long-term target for solar photovoltaic (PV) to supply one-third of its total electricity generation by 2060. However, progress remains limited, despite the recent addition of a 6 GW target of battery storage by 2034 in RUPTL 2025-2034. According to the Ministry of Energy and Mineral Resources, installed solar PV capacity stood at only 911.5 MW as of the end of 2024, and contributed just 0.9% of electricity generation in 2024. In terms of battery energy storage systems (BESS) to support the integration of variable renewable energy sources in the grid, there are no legislative measures adopted that would specifically regulate storage beyond the RUPTL 2025 target for 2034.

In the transport sector, Indonesia has the target to locally produce almost 1,000,000 (4W) and 9,000,000 (2W) EV units by 2030. representing an estimated demand of 100 GWh of NCM batteries. A notable gap remains between current capabilities and projected demand. Currently, Indonesia's battery production capacity is at 10 GWh of NMC battery cells (from PT HLI Green Power) and 100 MWh of LFP battery cells (from PT Gotion Green Energy Solutions Indonesia and PT International Chemical Industry). Geographic distribution of charging points remains uneven, with 88% of current charging infrastructure concentrated in Java and Bali.

The Ministry of Investment, Ministry of Energy and Mineral Resources, and the Ministry of Industry are key actors due to their influence and interest in the battery ecosystem, and must cooperate closely with the private sector to co-create projects that derive in infrastructure development. Stakeholders in the battery space have different levels of influence and interest on developing the supply chain in Indonesia. The more interest and influence, the more important it becomes for them to get involved with each other, and to meet their needs. PLN, as the sole power utility of the country, has a lot of influence due to its control over Battery Energy Storage Systems (BESS). Financial entities are also important due to the influence they can have by

[2] *Enhanced Nationally Determined Contribution: Republic of Indonesia*. United Nations Framework Convention on Climate Change, Sept. 2022. Link

providing capital and funding for projects, but they may not necessarily be interested in developing the supply chain.

The development of the battery ecosystem in Indonesia relies heavily on the so-called downstream policies. The main tool in this regard is undoubtedly the nickel export ban. Additionally, the country has a series of fiscal incentives in place for the nickel industry: tax holidays for nickel processing facilities, direct subsidies for smelters and refining plants, import duty exemptions for equipment and materials for nickel refining, and regulation of domestic nickel ore prices. According to data from S&P Global, prices surged in 2022 as a result of Indonesia's renewal of the nickel export ban[3]. While the country exports less product, the value of the exports is higher. Additionally, the number of nickel smelters in the country increased from two in 2016 to 54 smelters operating by 2025. In manufacturing, Indonesia has implemented local content policies designed to progressively increase over time, with targets set for different time periods.

End-use incentive schemes are mostly targeted toward EVs and have been successful in boosting demand and attracting investment to Indonesia. However, if annual EV sales remain at current levels (around 72,000 units), only 432,360 additional EVs will be on the road by 2030—far below the 2 million deployment target, indicating the need for greater efforts. Indonesia's strategy has relied heavily on local content requirements to encourage domestic production, which seems to have stalled, with numbers dropping in the first quarter of 2025. In contrast, the import tax exemption for EVs has been a huge success, with fully assembled EVs imports skyrocketing. 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.

Indonesia's lack of domestic lithium reserves creates a strategic dependency that threatens the stability of its battery and EV supply chain. With no viable reserves as of today, Indonesia is fully reliant on lithium imports from Australia—an unavoidable input for both NCM and LFP battery chemistries, which require consistent volumes and high-quality lithium carbonate or hydroxide. To meet projected demand under an NCM-based battery strategy, Indonesia would require approximately 72,000 kMT-LCE of lithium by 2030—equivalent to the output of three mid-sized lithium projects or over ten long-term supply contracts of 5,000 MT-LCE each. Given current market conditions, securing such volumes presents a significant challenge and highlights the urgent need for a resilient lithium procurement strategy. Given the urgency of the current targets related to BESS (most of them with a 2030 deadline) it is not feasible to wait until more reserves are proven or discovered, especially with Australia already being a reliable trading partner.

[3] Guberman, D. et. al. "Export Restrictions on Minerals and Metals: Indonesia's Export Ban of Nickel" USITC (Feb 2024). pp.20 https://www.usitc.gov/publications/332/working_papers/ermm_indonesia_export_ban_of_nickel.pdf

In the processing sector, policy instruments introduced were designed to promote national interest and downstream industrial development, but 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. 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.

Indonesia is largely self-sufficient in nickel and marginally in cobalt, giving it a strategic advantage in meeting domestic battery material demand for EVs and BESS. As the world's leading producer of nickel and its derivatives, Indonesia is well-positioned to cover its own raw material consumption under any strategy aimed at increasing EV and BESS deployment. By 2034, the raw material needed to meet the country's projected 6 GWh of battery demand is significantly lower than what would be required solely for EV targets—estimated between 62,000 to 82,000 tonnes of nickel for EVs and 3,120 tonnes for BESS. Cobalt availability is also favourable, with sufficient feedstock to meet domestic needs ranging from 10,000 to 23,000 tonnes for EVs and 1,380 tonnes for BESS. While lithium remains a critical gap, manganese poses less of a risk due to its lower volume requirements (9,000 to 20,000 tonnes for EVs and 1,200 tonnes for BESS) and greater sourcing flexibility in global markets. Additionally, repurposing retired EV batteries for energy storage could further strengthen supply resilience and support circular economy goals.

Being the world's largest nickel exporter and holding the largest nickel reserves in the world makes Indonesia an attractive location for battery cathode manufacturers. The two battery manufacturing plants HLI Green Power and Energy Baru could cover Indonesia's projected 2030 domestic battery demand if production capacity is ramped up according to planned. However, it is important to develop each link of the supply chain at the same pace, meaning that raw material extraction should be developed at the same time as refining and battery manufacturing capacities, to guarantee supply and demand across all the supply chain.

Mining projects face significant difficulties in securing financing due to the large upfront capital required and market risks such as fluctuating commodity prices. Currently, mining ventures struggle to obtain funding mainly because of the substantial initial investment needed. Commodity price volatility further exacerbates this challenge; particularly, low prices increase perceived market risks, making investors hesitant. In Indonesia, where domestic nickel ore prices are regulated, the government should carefully consider these dynamics. Often, the estimated capital expenditure for developing mining projects —sometimes around USD 500 million— exceeds the market valuation of the companies involved, which can be below USD 100 million. This disparity renders traditional financing structures, such as debt-to-equity ratios of 60:40, impractical. However, pension and infrastructure funds might find these projects attractive since they typically accept investments with ROI expectations of 12-30% and prefer low-risk, guaranteed returns over a 10-year horizon. In contrast, private equity investors usually target moderate ROI of 3-10%, with longer-term horizons and risk-adjusted expectations.

This study proposed a roadmap with recommended actions centered around five key action areas: Policy and Regulation, Production Capacity & End-of-life management, Procurement Traceability for Compliance and Export Readiness, Expansion of End-use Segments, and Financing and Bankability.

As Indonesia moves forward to support the next phase of the EV industry, it is critical that a thorough review and ex-post impact assessment are conducted to the national legislative framework to ensure that the current measures are aligned with national priorities and objectives. Establishing mechanisms for regular monitoring and evaluation of policy implementation and impact will help identify challenges and areas for improvement. Under the prevailing policy framework, Indonesia has significant fiscal losses from foregone tax revenues related to the prohibition of nickel ore exports, compounded by the tax holidays extended to processing entities. Concurrently, Indonesian mines, predominantly domestically owned due to the domestic-oriented approach on mining ownership[4], are compelled to sell their ore at prices regulated by the government, which are lower than international prices.

Indonesia should adopt strategic stockpiling measures to secure battery material feedstock and strengthen resource supply reliability. To ensure a stable supply of critical minerals, Indonesia should implement stockpiling strategies during periods of low prices, which can mitigate the impact of future supply chain disruptions. Additionally, stockpiling can help manage mineral oversupply effectively. Clear regulations are needed to govern critical mineral stockpiling, including setting maximum stockpile limits and considering smelter moratoriums. These actions will enhance national resource security and boost investor confidence in Indonesia's battery material sector.

Indonesia should update its waste management legislation to classify battery waste as a strategic resource, encouraging the growth of a secondary raw materials market. This formal recognition is vital to stimulate the development of a robust recycling market and to align waste policies with both industrial growth and environmental goals. Given the rapidly evolving nature of the battery sector, recycling targets should be designed to be 'future-proof'—meaning they can be adjusted upward over time as conditions change—while maintaining legal certainty, which is essential for attracting capital-intensive investments

Battery Energy Storage Systems (BESS) have emerged as a promising option to facilitate the integration of renewable energy into the national electricity grid, particularly given the intermittent nature of solar and wind energy. The significant decline in battery prices—by as much as 90% over the past 15 years—presents a major opportunity for Indonesia. However, BESS investments require substantial upfront capital, and their success is highly dependent on a well-defined revenue framework. To

[4] The Constitution of Indonesia stipulates that the country's natural resources are controlled by the state and must be used for the maximum benefit of the Indonesian people. This principle is further detailed in Article 482) of Law No. 4/2009 on Mineral and Coal Mining, which grants the central government to control mineral mining activities.

support this, Indonesia would greatly benefit from the development of a comprehensive roadmap outlining clear, long-term BESS targets. Such a roadmap would provide strategic direction to optimize the deployment of BESS and variable renewable energy (VRE), improve energy access and electrification in remote areas, and guide future investment needs**.**

Indonesia should examine the implementation of the battery passport into the national legislative framework and closely follow the ongoing developments globally, to ensure that domestic initiatives follow global standards, and batteries can be easily exported. Originally developed by the Global Battery Alliance, it was given legal status in the EU's Sustainable Batteries Regulation, and the US and China are also considering its adoption. The Battery Passport serves as a 'digital twin' of the physical battery, providing detailed information about the battery's material provenance, chemical composition, manufacturing history, and sustainability performance. The data provided is stored in a QR code which links to a unique identifier that the economic operator placing the battery on the market attributes to it.

Government intervention is crucial to de-risk investments and unlock new financing pathways for the sector. Indonesia could implement alternative funding mechanisms such as streaming agreements, royalty deals, pre-payment structures and the creation of Special Purpose Vehicles (SPV) to avoid equity dilution. The Government of Indonesia could also be a strong counter party that could assume large risks, providing stability by ensuring predictable revenue streams, making large-scale projects more attractive to financiers. Projects need to show strong, bankable counter parties on the off take. For mining and refining projects, the most bankable off takers are usually the end users of the contract, with automotive companies being the strongest ones, since their interest is getting supply chain stability and price visibility.

1. Batteries in Indonesia's energy transition: State of play

Indonesia is advancing efforts to achieve a renewable energy mix target of 22% by 2030 and to reduce greenhouse gas (GHG) emissions intensity, as outlined in its national development planning documents, including the Draft Law on National Energy Policy (RUU KEN)[5,6]**.** 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. This chapter explores 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.

To bridge this gap, batteries play a critical role. 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. The development and deployment of batteries not only allows transport electrification but also supports the deployment of renewables. Batteries are a key enabler of renewable energy adoption, particularly for energy storage, which is crucial for addressing the intermittency of variable renewable sources (VRE), such as wind and solar PV. A well-integrated and sustainable battery ecosystem can significantly contribute to Indonesia's achievement of its energy transition targets.

According to the 2024 data from the United States Geological Survey[7], Indonesia holds the largest nickel reserves in the world (55 million tons of nickel or 42.3% of the global total) and dominates nickel ore mining, accounting for up to 60% of the global supply. In addition, Indonesia also contributes 39.8% of the world's semi-finished nickel products, such as ferronickel, nickel pig iron (NPI), mixed hydroxide precipitate (MHP), matte, and others[8]. This gives Indonesia a huge 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.

---

[5] KEN Updated Version, *Draft Government Regulation on the National Energy Policy*, as of July 1, 2024. Link

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

[7] U.S. Geological Survey, Nickel, in Mineral Commodity Summaries 2025 (Reston, VA: U.S. Geological Survey, March 2025). Link

[8] Ministry of National Development Planning/National Development Planning Agency (Bappenas), Roadmap for Decarbonization of the Nickel Industry in Indonesia (Jakarta: Bappenas, 2025). Link

1.1 Targets for EVs

In the transportation sector, which represents 26% of Indonesia's total GHG emissions[9], the government is pushing for electrification as a decarbonisation strategy. 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)[10]. Although there 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.[11]. Recently, the Government of Indonesia (GoI) issued regulatory reforms to strengthen local content requirements (TKDN)[12]. 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.

1.1.1 Policies and instruments supporting EV targets

To boost EV penetration, the Indonesian government has enacted a range of regulatory frameworks aimed at establishing a comprehensive EV ecosystem[13]. These have been followed by both fiscal and non-fiscal incentives for EVs[14], including purchase subsidies[15], corporate income tax reductions[16], R&D incentives[17], vehicle tax reductions[18], tax

[9] According to Agus Nurrohim, Senior Researcher at PRKKE BRIN, the transportation sector accounted for approximately 26% of Indonesia's total greenhouse gas emissions. In 2022, the sector consumed 429 million SBM or 60 million TOE, equivalent to 36.74% of the country's final energy consumption. Link

[10] 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

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

[12] 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

[13] Government of Indonesia, *Presidential Regulation No. 55/2019 jo.* No. 79/2023 *on the Acceleration of Battery Electric Vehicles for Road Transportation*, and Ministry of Industry regulations: Regulation No. 36/2021 (Low Carbon Vehicle Development), *No. 6/2022 jo.* No. 28/2023 (EV Specifications and Local Content), No. 29/2023 (CKD and IKD Schemes), *No. 6/2023 jo.* No. 21/2023 (Two-Wheel EV Subsidies), No. 37/2024 (Industry Verification).

[14] Government of Indonesia, *Ministry of Investment Regulation No. 6/2023 jo.* No. 1/2024 on Guidelines and Governance for Granting Import and/or Delivery Incentives for Four-Wheel Battery Electric Vehicles to Accelerate Investment

[15] Government of Indonesia, *Minister of Finance Regulation (PMK)* No.8/2024 on Value-Added Tax Borne by the Government (VAT-DTP) for Electric Cars and Buses in Fiscal Year 2024.

[16] Government of Indonesia, PMK No. 12/2025 on Tax Facilities for the Development of Battery Electric Vehicles.

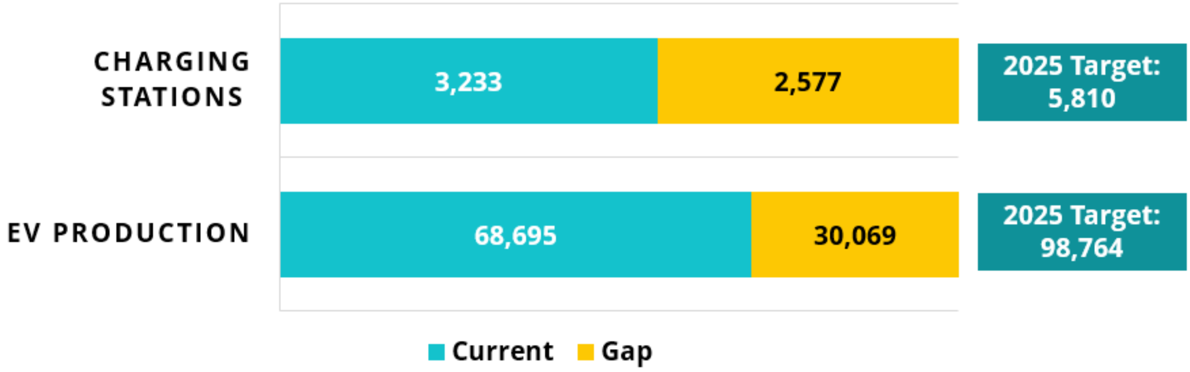
[17] Ibid.

[18] Government of Indonesia, PMK No. 9/2024 on Luxury Goods Sales Tax Borne by the Government (PPnBM-DTP) for Certain Four-Wheel Battery Electric Vehicles in Fiscal Year 2024

allowances[19], import and customs duty incentives[20], as well as support for charging infrastructure development[21].

To attract investment and fill in the gaps to meet EVs' ecosystem targets (Figure 1.1) the government has introduced a range of incentives—such as tax relief[22, 23], simplified licensing, and streamlined permitting processes—especially for battery and EV manufacturers. Strategic partnerships with key international players, including China[24], South Korea, Japan[25], and the European Union, further boost Indonesia's competitiveness by enabling technology transfer and strengthening local industry capacity.

Figure 1.1 Electric Vehicle Ecosystem Targets and Current Gaps



Source: MEMR, PLN

Beyond EVs themselves, the government is also promoting upstream-to-downstream development of the battery supply chain. Incentives for battery development have so far included Tax Holidays and Tax Allowances[26]. However, the pace of project implementation remains gradual, with notable room for improvement—as ecosystem development is still in its early stages. Persistent barriers and constrained progress continue to limit the sector's full potential.

Indonesia has implemented several instruments to promote domestic manufacturing capacity for EVs, as well as CAM and LIB cells. The key initiatives in this regard are shown in Figure 1.2.

---

[19] Government of Indonesia, PMK No. 12/2025 on broader tax facilities including income tax relief, R&D incentives, and other fiscal support for BEV development.

[20] Government of Indonesia, PMK No. 10/2024 amending PMK No. 26/PMK.010/2022 on Harmonized System (HS) Code Classification and Import Duty Tariffs, facilitating reduced or exempted duties for EV components and vehicles.

[21] Government of Indonesia, *Ministry of Investment Regulation No. 6/2023 jo.* No. 1/2024, which includes non-fiscal support for EV infrastructure development including charging stations; *Minister of Energy and Mineral Resources Regulation No. 1/2023* on Provision of Electric Charging Infrastructure for Battery Electric Vehicles; and *Ministerial Decree of Energy and Mineral Resources No. 24.K/TL.01/MEM.L/2025* on Technical Guidelines for Charging Infrastructure Implementation.

[22] ASEAN Briefing, Indonesia Issues New Tax Incentives to Spur EV Production and Sales, 2024

[23] PERMITINDO, Accelerating Indonesia's Electric Vehicle Industry: Insights into TKDN and Presidential Regulation No. 79/2023. Link

[24] Reuters, Indonesia Battery Corp, CATL unit sign JV deal, state media says. Link

[25] Reccessary, Indonesia bolsters EV battery ties with Japan, South Korea amid U.S.-China tariff risks. Link

[26] Government of Indonesia, *Minister of Finance Regulation (PMK) No. 130/2020* on Corporate Income Tax Reduction Facility; and *Investment Coordinating Board (BKPM) Regulation No. 7/2020* on Details of Business Fields and Types of Pioneer Industries as well as Procedures for Granting Corporate Income Tax Reduction.

Figure 1.2 Indonesian policies to promote domestic manufacturing

Policy and regulatory framework	• Industrial policies aimed at fostering the growth of the EV and battery manufacturing sectors • Local content requirements mandating specific percentages of local content in manufacturing processes, encouraging the use of domestic materials and labor
Fiscal incentives	• The government offers tax breaks and incentive for companies invet in the production of EVs and battery components, subject to local content requirements • Subsidies are provided to support research and develoment in battery technology and EV manufacturing
Strategic partnerships	• Indonesia has attracted significant foreign investments from companies like CATL, LG Energy Solution, and Hyundai, which are establishing manufacturing facilities in the country • Collaborations between local and international companies help transfer technology and expertise to domestic manufacturers
Infrastructure development	• The establishment of dedicated industrial zones for battery and EV manufacturing provides the necessary infrastructure and facilities for production.

These policies aim to promote collectively the development of a strong domestic manufacturing capacity across the battery supply chain and for EVs and should be viewed together with other instruments further upstream and downstream. The following table presents the instruments implemented related to EVs.

Table 1.1 Legislative instruments for EVs

Instrument	Objective
Presidential Regulation No. 55/2019	Accelerate the adoption and production of battery electric vehicles, establishing dedicated industrial zones. Accelerate the uptake of EVs through various measures, including providing competence to implement relevant legislation. Includes a provision for the development of end-to-end EV supply chain, from raw materials to finished end-products.
Regulation of the Ministry of Industry *(Permenperin)* 6/2022, amended by MoI 21/2023	Mandate progressive TKDN targets for EVs, requiring a certain percentage of components to be sourced locally; Specifications, Development Roadmap, and Provisions for Calculating Domestic Component Level Values for Battery Electric Vehicles. Manufacturing TKDN Requirements: - 2020–2029: A minimum of 50% local content is required for main components, including at least 40% for battery components. - Starting in 2030: The requirement increases to 60% local content for main components, with 50% for battery components. - In addition, supporting components must account for at least 10% of the total product value
Presidential Regulation No. 79/2023	Amend previous policies to expedite the adoption and production of battery electric vehicles
Ministry of Industry automotive production target	Setting production targets for low carbon emission vehicles, including electric 2W production target
Decree of the Ministry of Energy and Mineral Resources, Pmen ESDM No. 24.K/TL.01/MEM.L/2025	Outlines the roadmap for public EV charging stations from 2025 to 2030. It sets targets for the number and distribution of public charging stations in Indonesia, including types of chargers (medium, fast, ultra-fast) and locations (malls, offices, toll rest areas etc.)
Presidential Instruction No. 7 of 2022	Mandates the use of battery electric vehicles as operational state vehicles for central and regional government institutions.

1.2 Targets for renewable energy (RE)

Indonesia's commitment to a low-carbon future is firmly embedded in its national energy policy landscape. The National Energy Policy (KEN) outlines long-term energy transition targets, which are further reinforced through international and multilateral frameworks, including the Paris Agreement**,** Enhanced Nationally Determined Contribution (ENDC), and 2030 Agenda for Sustainable Development (SDGs)**.** These ambitions are systematically translated into national planning instruments such as the National Medium-Term Development Plan (RPJMN)[27] and the National Long-Term Development Plan (RPJPN)[28]—anchoring the energy transition as a central pillar of Indonesia's *Indonesia Emas 2045* vision.

Indonesia has also 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[29], 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[30] has been revised to:

- 19–22% by 2030 (368 million TOE to 440 million TOE)
- 36–40% by 2040 (468 million TOE to 583 million TOE)
- 70–72% by 2060 (665 million TOE to 776 million TOE)[31]

The pace of implementation has not matched the level of ambition. As illustrated in Figure 1.3 there remains a considerable gap between Indonesia's renewable energy targets and current progress.

---

[27] Ibid.

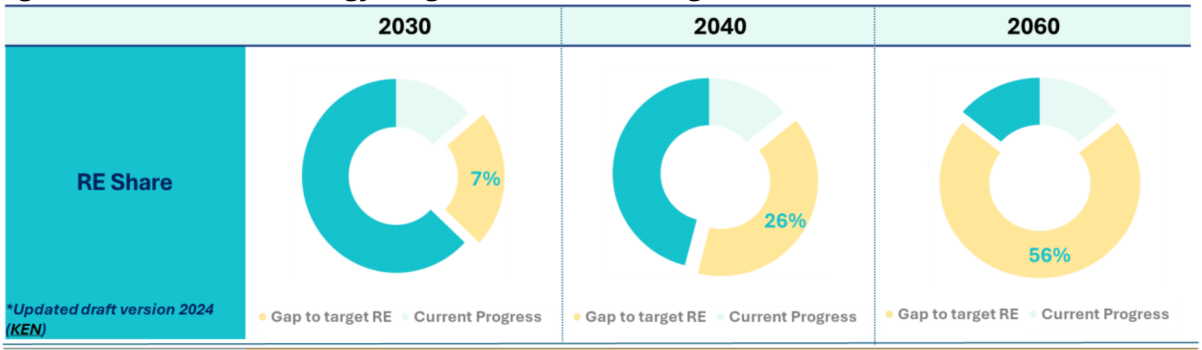
[28] Republic of Indonesia, *Law No. 59 of 2024 on the National Long-Term Development Plan (RPJPN) 2025–2045* (Government of Indonesia, 2024). Link

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

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

[31] *Ministry of Energy and Mineral Resources of the Republic of Indonesia*, "Approve RPP KEN, Minister of ESDM: Aligned with Economic Growth Targets and Net Zero Emission Commitments

Figure 1.3 Renewable Energy Target and Current Progress



RE Share *old version KEN, PP/79/2014*	Previously, the renewable energy (RE) share target was set at 23% by 2025 and 31% by 2050
Target E-NDC **Enhanced National Determined Contribution (E-NDC) greenhouse gas*	31.89% Reduction (Unconditional – BAU Scenario), 43.20% Reduction (Conditional – with International Support) in 2030
Visi Indonesia Emas 2045 *RPJPN 2045	93.5% Greenhouse Gas Emission Reduction

Source: Compiled by the authors from the RPJPN 2045, ENDC, and the latest Draft KEN – July 2024

1.2.1 Policies and instruments supporting RE targets

As of the drafting of this document, the Indonesian House of Representatives (DPR) has approved the revision of the Government Regulation on the National Energy Policy (KEN), which includes updated targets for renewable energy (RE) to support the achievement of net zero emissions by 2060. This adjustment reflects the challenges in scaling up renewable energy deployment, it also demonstrates Indonesia's serious commitment to accelerating energy transition efforts[32].

The revisions to the KEN have been integrated into the latest version of the RUKN for the 2025–2060 period, which replaces the previous 2019–2038 version, as well as into the latest RUPTL for 2025–2034, which replaces the 2021–2030 version. This update ensures that the latest documents are aligned with the new national energy policy and Indonesia's economic growth targets, maintaining an integrated and strategic approach. The RUKN was established through Ministerial Decree No. 85.K/TL.01/MEM.L/2025 and the RUPTL through Ministerial Decree No. 188.K/TL.03/MEM.L/2025. In this document, the renewable energy has been projected to reach around 19-21% by 2030.[33] [34]

In KEN, Indonesia set ambitious RE targets. Considering recent developments and the various challenges encountered, the annual realization of renewable energy targets has proven to be difficult. As illustrated in the table below, the discrepancy between Indonesia's RE share targets and actual achievements over the past five years remains

---

[32] KEN Updated Version, Draft Government Regulation on the National Energy Policy, as of July 1, 2024. Link
[33] Ministry of Energy and Mineral Resources, Ministerial Decree No. 188.K/TL.03/MEM.L/2025 on RUPTL 2025–2034 (Jakarta, 2025). Link
[34] Ministry of Energy and Mineral Resources, Ministerial Decree No. 85.K/TL.01/MEM.L/2025 on RUKN 2025 (Jakarta, 2025). Link

substantial. This persistent gap has become a critical factor in Indonesia's decision to undertake a revision of its renewable energy targets.

Table 1.2 Comparison of RE Share Target & Realization in Indonesia

Year	RE Share	
	Target (%)	Realization (%)
2018	11.6	8.6
2019	12.2	9.2
2020	13.4	10.9
2021	14.5	11.8
2022	15.7	11.9
2023	17.9	13.3
2024*	19.5	14.7

Source: EBTKE MEMR, 2024 data

In the power sector, accelerating the deployment of renewable energy (RE) is a critical pillar of the transition. Indonesia has set a long-term target for solar photovoltaic (PV) to supply one-third of its total electricity generation by 2060. The government has set ambitious targets for installed solar power capacity: 32 GW by 2030, and 420 GW by 2060[35] [36]. Solar energy is thus positioned as the country's primary strategy for achieving its RE targets. However, current progress remains limited: as 2024, installed solar PV capacity stood at only 717.7 MW[37]—less than 2.5% of the 2030 target—and contributed just 0.9% of electricity generation in 2024. Solar module production also remains stagnant at 2.3 GW/year[38] [39]. 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[40].

There are three main instruments that Indonesia has set related to RE targets and Battery Energy Storage Systems (BESS). These are listed in the following table:

---

[35] IEA and MEMR, Energy Sector Roadmap to Net Zero Emissions (NZE). (MEMR, 2022). Link
[36] Institute for Essential Services Reform (IESR), Indonesia Solar Energy Outlook 2025 (IESR, 2025). Link
[37] PV Tech. Indonesia surpasses 700MW installed solar PV capacity, but progress is 'inadequate'. 2024. Accessed April 2025. Link
[38] Institute for Essential Services Reform (IESR), *Indonesia Solar Energy Outlook 2025* (IESR, 2025). Link
[39] George Heynes, "Indonesia Surpasses 700MW Installed Solar PV Capacity, but Progress Is 'Inadequate'," *PV Tech*, October 21, 2024, Link
[40] IESR, Indonesia Solar Energy Outlook (ISEO) 2025, Link

Table 1.3 Legislative instruments for RE - 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 2029–2034 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)

1.3 Alignment of the battery supply chain development with energy transition goals

This section assesses how well current and planned battery supply chain initiatives align with national energy transition targets. It draws on key indicators to evaluate the compatibility of investments and policy measures, providing a clear benchmark for success. While several projects are already underway, there is a clear opportunity to refine and strengthen their design to maximize their impact on Indonesia's energy transition.

To help evaluate how current initiatives are contributing to these goals, this section proposes a structured approach to assess the alignment of ongoing efforts with national targets. The aim is to provide a clear lens through which stakeholders can understand how different elements of the battery ecosystem are supported by regulation, whether they reflect national priorities, and whether they are scalable over time.

The analysed variables are: (i) Financial incentives, (ii) Battery cell management, (iii) Infrastructure, (iv) Investment, and (v) Battery recycling. These variables have been selected as they represent critical factors in determining the success of Indonesia's EV battery supply chain[41]. Additionally, this assessment incorporates selected key indicators from the 2024 Southeast Asia (SEA) Progress Assessment Matrix[42] while adapting them to the scope and limitations of this report. The results of this alignment review are presented in Table 1.4 below.

Table 1.4 Assessment of Project Compatibility with Energy Transition Targets

● **Low**: In early stages; significant challenges and barriers remain
● **Medium:** Shows potential; further action required for full alignment
● **High**: Ready for adoption; strong regulatory support and alignment with targets

	Overall assessment	Regulatory support	Scalability	Target alignment
Financial incentives	**Medium**	**Medium**	**High**	**Low**
Battery cell management	**Low**	**Low**	**Medium**	**Low**
Infrastructure	**Medium**	**Medium**	**Medium**	**Low**
Investment	**Low**	**Low**	**Low**	**Low**
Battery recycling	**Low**	**Low**	**Medium**	**Low**

Key observations and analysis of the overall assessment for each variable are as follows:

- **Financial Incentives** – refers to direct subsidies, import duty exemptions, financial metrics, tax incentives, tax breaks, subsidies, and grants, as outlined in the state of play of the battery supply chain in Indonesia. Overall, financial incentive is rated at **Medium** readiness as Indonesia has introduced fiscal and non-fiscal incentives since the issuance of the Presidential Regulation on electric vehicles. Although regulatory frameworks such as the Electricity Supply Business Plan (RUPTL) 2025–2034 offer a solid basis for supporting investments, existing cost-reduction measures remain inadequate. Key challenges include an investment climate that is still less attractive to investors, relatively high interest rates for commercial projects, and the limited application of innovative financing schemes in the power sector.[43] [44][45]
- **Battery Cell Management** – refers to strategies for battery cell and pack assembly, including R&D support and operational feasibility. incompatibility in this area is rated **Low** as it remains at an early stage. Clear regulatory guidance and technological readiness are still emerging, while national production capacity for battery materials continues to face challenges related to cost, infrastructure, and technological maturity. Despite Indonesia's rich mineral resources—suggesting medium potential for scalability—there remains a notable gap between current capabilities and projected demand. To meet MEMR's projection of 943,764 EV units by 2030, Indonesia needs to scale up its battery production capacity. Assuming the average 4W EV SUV

[41] AEML dan AC Ventures, *Indonesia's Electric Vehicle Outlook: Supercharging Tomorrow's Mobility* (Juli 2023); Link
[42] Bain & Company, Southeast Asia's Green Economy 2024 Report. Link
[43] Ministry of Energy and Mineral Resources, Ministerial Decree No. 188.K/TL.03/MEM.L/2025 on RUPTL 2025–2034 (Jakarta, 2025). Link
[44] Ministry of National Development Planning/National Development Planning Agency (Bappenas), Roadmap for Decarbonization of the Nickel Industry in Indonesia (Jakarta: Bappenas, 2025). Link
[45] Institute for Essential Services Reform (IESR). *Indonesia Electric Vehicle Outlook 2023: Electrifying Transport Sector—Tracking Indonesia EV Industries and Ecosystem.* IESR, February 2023. Link

type requires a 39 kWh battery capacity per unit[46], Indonesia would need to have at least 36.8 GWh of battery production capacity. Currently, Indonesia's battery production capacity is at 10 GWh of NMC battery cells (from PT HLI Green Power) and 100 MWh of LFP battery cells (from PT Gotion Green Energy Solutions Indonesia and PT International Chemical Industry)[47], which is less than half of the required minimum capacity.

- **Infrastructure** – EV-related infrastructure such as charging stations, private installations, and battery exchange facilities. The compatibility of this efforts is rated **Medium** with target compatibility. Development in this area is steadily progressing, supported by growing government attention. However, geographic distribution remains uneven, with 88% of current charging infrastructure concentrated in Java and Bali[48]. While regulatory frameworks are in place and the sector shows strong growth potential, meeting the national EV sales target will require a more rapid and widespread expansion of infrastructure. As of Dec 2024, there were 1,902 public charging stations installed which remain well below projected needs given than the target reflected in the MEMR plan considers the installation of 62,918 public charging stations by 2030.[49] [50]
- **Investment** – refers to policies and partnerships aimed at scaling up renewable energy and battery value chain development. In 2024, total energy investment globally was expected to increase to $3 trillion with some $2 trillion set to go toward clean technologies. Meaning clean energy spending surpassed fossil fuel spending at a ratio of 2:1[51]. Only six years ago the ratio was 1:1. However, while interest in clean investments in Indonesia is growing, particularly from international actors, much of this investment remains in exploratory stages, which is why this area is rated as **Low**. Policy frameworks are still largely centred on fossil fuels (FF), which has impacted investor confidence in clean energy projects. In terms of target alignment, investment in renewable energy has consistently lagged fossil fuel investments over the past six years, with no significant upward trend (see Figure 1.4). Bridging the gap between targets and actual investment levels will require more consistent, targeted reforms that foster long-term confidence and signal a strong commitment to energy transition goals.

[46] Based on an ICCT study (2023) where the unit in question is a Hyundai Kona 2023 model that is available in the Indonesian market. This number does not account for other EV models mentioned in the study, such as A-segment or MPV models

[47] A more detailed elaboration of Indonesia's resource and production capacity is reported in "Comprehensive report on the analysis of the supply chain of batteries - Deliverable 2"

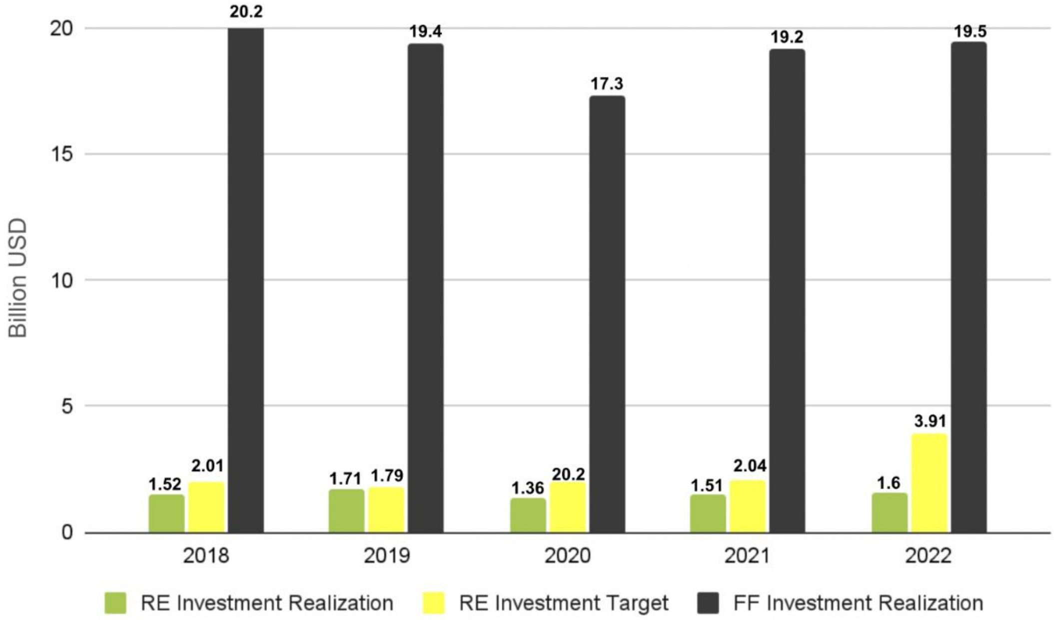
[48] IESR, Indonesia Electric Vehicle Outlook 2023, Link

[49] Ministry of Energy and Mineral Resources of the Republic of Indonesia, Decree No. 24.K/TL.01/MEM.L/2025 on the Development Plan for Public Electric Vehicle Charging Stations for Battery Electric Vehicles for 2025 to 2030. (Ministry of Energy and Mineral Resources, 2025). Link

[50] PricewaterhouseCoopers. (n.d.). *Electric vehicles and the charging infrastructure: A new mindset? PwC, 2022*

[51] IEa (2024) World energy Investment Report. Link

Figure 1.4 Indonesia's RE vs Fossil Fuel (FF) Investment Realization 2018-2022



Source: MEMR, IESR, KataData, 2023

- **Battery recycling** – includes strategies for second-life battery use, circular economy integration, and Extended Producer Responsibility (EPR). While some industrial facilities, such as those in the Indonesia Morowali Industrial Park (IMIP), are laying groundwork for recycling, regulatory clarity is still evolving[52]. The classification of battery waste as hazardous adds complexity, and existing waste collection systems are not yet sufficient to support large-scale recycling, hence this area is rated **Low**.

Figure 1.5 Circular economy definition[53]

What is Circular Economy?

- Circular economy is a model of production and consumption that involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible with the objective of extending their lifecycles. It implies reducing waste to a minimum, and instead maintaining the value of products, materials and resources in the economy for as long as possible.

Why is it relevant?

- Its principles of redesign, repurposing and recovering, are considered to address many of the problems the fast-increasing volume of batteries present, particularly at the end-of-life stage. Given that the rate at which batteries reach their end-of-life is accelerating, disposal management is of key importance from both environmental and security of supply perspectives.

Source: Authors with information from the European Parliament

[52] IESR, Indonesia Energy Transition Outlook (IETO) 2024, Link

[53] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'Closing the loop: An EU action plan for the Circular Economy', Brussels 2.12.2015, COM(2015) 614 final.

1.4 The battery ecosystem players in Indonesia

The key policymakers, businesses, and context-setters and how they are involved in the battery supply chain integration are listed below:

Table 1.5 Key Policymakers, Businesses, and Context-setters Involved

Stakeholder Name		Description
Policy-maker	Ministry of Investment and Downstream Industry (MoInv) *Kementerian Investasi dan Hilirisasi/ Badan Koordinasi Penanaman Modal* (BKPM)	Facilitates domestic and foreign investment in the battery supply chain and promotes Indonesia as an attractive investment destination.
	Ministry of Energy and Mineral Resources (MEMR) *Kementerian Energi dan Sumber Daya Mineral*	Regulates the extraction and refining sectors and supports battery development as part of the energy transition agenda.
	Ministry of Industry (MoI) *Kementerian Perindustrian*	Oversees industrial development and issues permits for battery-related industries. Developed the national roadmap for BEV production.
	Ministry of Environment (MoE) *Kementrian Lingkungan Hidup*	Enforces environmental regulations and permits. Ensures battery-related activities align with sustainability goals and supports Indonesia's net-zero targets Previously part of the Ministry of Environment and Forestry (MoEF/KLHK), the Ministry of Environment (MoE) has been separated into an independent entity following institutional restructuring.
	Ministry of Forestry (MoFor) *Kementerian Kehutanan*	Has full authority over the national forestry estate. Mandates the issuance of forestry permits for business practices, particularly for nationally strategic programs. Previously part of the Ministry of Environment and Forestry (MoEF/KLHK), the Ministry of Forestry is now established as an independent ministry.
	Ministry of State-Owned Enterprises (MoSOE) *Kementerian Badan Usaha Milik Negara*	Oversees all SOEs in Indonesia, many of which are key players in the battery supply chain. SOEs serve as extensions of the government's mandates, including the national battery ecosystem goals.
	Ministry of Transportation (MoT) *Kementerian Transportasi*	Regulates national transportation, including electric mobility and related infrastructure.
	Ministry of Finance (MoF) *Kementerian Keuangan*	Designs financial policies, including incentives and tax schemes, to support battery industry growth and attract investment.
	Ministry of Manpower (MoM) *Kementerian Tenaga Kerja*	Regulates labor standards in all industries, particularly related to safety and local workforce policies.
	Coordinating Ministry of Economic Affairs (CMEA) *Kementerian Koordinator Bidang Perekonomian Republik Indonesia*	Coordinates strategic projects and economic policies, where the development of the battery supply chain falls into one of the national economic priorities.

	Stakeholder Name	Description
	Governors	Regional leaders that oversee permits, law enforcement, and public engagement, as well as significant offtakers to economic gains and social-environmental impacts from battery supply chain activities.
	Regional Agencies (ESDM, Environment, Manpower)	Operate under governors to regulate a number of affairs at the regional level, such as energy and mining activities (Dinas ESDM), environmental compliance (DLH), and labor affairs (Disnaker), all of which are crucial for local implementation of the battery industry.
SOE	Mining Industry Indonesia (MIND ID)	State-owned mining holding company. Its subsidiaries supply key minerals for the battery supply chain.
	Indonesia Battery Corporation (IBC)	State-owned battery company. Plays a strategic role in driving Indonesia's battery ecosystem.
	Perusahaan Listrik Negara (PLN)	The sole electricity provider in Indonesia. Supports the battery ecosystem through BEV charging stations and other joint ventures.
	Pertamina	State-owned oil and gas company transitioning into new energy sectors. Contributes to battery development through joint ventures and innovations like battery swapping and anode materials.
Business	Mining Companies	Players in the extraction sector. Notable companies include PT Vale Indonesia, PT Ceria Indotama Nugraha, and PT Merdeka Battery Materials.
	Smelting Companies	Players in the refinery sector. Major players include PT Huayue Nickel Cobalt and PT Halmahera Persada Lygend.
	Cathode Active Materials (CAM) and Anode Production Companies	Players in the CAM and anode production. Players include PT LBM Energi Baru Indonesia.
	Battery Cell Manufacturing Companies	Players in battery cell manufacturing. Players include PT HLI Green Power.
	EV Manufacturing Companies	Players in EV manufacturing. Brands like Hyundai, Wuling, and BYD lead the 4W EV market; Gesits, Smoot, and VKTR lead the 2W and commercial EV segments.
	Industrial Estates	Industrial estates where battery-related companies are industrialized, regulated, and commercialized. Notable companies include IMIP and IWIP.
Association	Electric Mobility Ecosystem Association (AEML) *Asosiasi Ekosistem Mobil Listrik*	Promotes the development of Indonesia's electric mobility ecosystem, including battery-related technologies.
	Gaikindo *Gabungan Industri Kendaraan Bermotor Indonesia*	Supports the growth of the automotive industry, including EV production and adoption, and facilitates the advocacy of the industries with government stakeholders.
Financial Institutio	Indonesia Investment Authority (INA)	Indonesia's sovereign wealth fund. Invests in strategic sectors including battery and EV-related industries.
	Daya Anagata Nusantara (Danantara)	Indonesia's second sovereign wealth fund. Manages finances from SOE dividends in order to optimize

	Stakeholder Name	Description
		government investment in economically strategic programs. Danantara was inaugurated on February 24th, 2025[54].
	Multilateral Development Banks (MDBs)	MDBs such as the ADB, WB, and EIB provide funding and policy support for EV and battery-related projects, promoting sustainable development in Indonesia.
	Banks	Banks finance various stages of the battery supply chain, including mining and EV production. They also offer consumer loans for retail EV purchases.
	Insurance Companies	Insurance firms support EV adoption by offering financial products such as automotive insurance and purchase-related coverage for consumers
Ecosystem player	Mass Transport Operators	Transjakarta and other operators integrate EVs to stimulate domestic demand and support the government's industrialization goals.
	Taxi Operators	Companies like Blue Bird, Grab, and Gojek include EVs in their fleets to support market creation and industrial roadmap.
	EV Charging Station Providers (SPKLU)	PLN and partners like Electrum and Volta provide EV charging stations, expanding with EV market growth.
Trade agreement	IK-CEPA	Bilateral Indonesia-Korea pact supports EV and battery ecosystem development cooperation, including MoUs and tech transfer.
	IA-CEPA	Indonesia-Australia agreement supports partnerships across the EV value chain from mining to manufacturing and infrastructure.
	Belt and Road Initiative (BRI)	China's BRI supports industrial development and investment, notably in IMIP and battery-related infrastructure.
	RCEP	Regional integration improves access to markets, investment, and technology for Indonesia's battery sector.
	European Battery Alliance (EBA)	Facilitates tech transfer and sustainable practices to modernize Indonesia's mining and processing sectors.
	Global Battery Alliance (GBA)	Supports ESG-compliant growth of Indonesia's battery industry through multi-stakeholder collaboration and circular economy initiatives.

The identified stakeholders above have different levels of influence and interest in the development of a battery supply chain in Indonesia. An influence/interest map analysis has been conducted and is presented in Figure 1.6. This type of map is helpful for identifying first movers that can be positioned as champions to increase level of interest

[54] Kompas, Danantara Diresmikan Presiden Hari Ini, Apa Saja yang Perlu Diketahui?, Link

of other actors[55]. It also helps to identify key players that push projects and set the pace at which the supply chain development moves.

The stakeholder map shown in Figure 1.6 was built only considering the actors listed in the previous table, and it is meant to show how they interact with each other, the role they play in deploying an end-to-end battery supply chain in Indonesia, and how they could influence future actions. The map is split in four quadrants depending on the level of influence and interest of each actor. Interest and influence were determined qualitatively according to the following criteria:

Interest: Refers to the priority an actor assigns to the development of the battery supply chain. Targeted actions, visibility in the sector, whether an actor has investments or not, and any regulations/guidelines published, are some of the indicators used to determine the level of interest. In this context, government agencies are considered the most interested actors, given the number of actions they have undertaken to support the development of the battery supply chain in the country, as well as companies investing in the sector.

Influence: Refers to the impact an actor's decisions affect other stakeholders and contribute to tangible progress in establishing a battery supply chain. An actor with limited impact on the broader ecosystem is considered to have low influence. Conversely, an actor with the ability to drive or halt investments, implement national initiatives, shape regulations, or send strong market signals is considered highly influential.

Based on the combination of interest and influence, stakeholders can be categorized into four engagement quadrants:

- **Co-create** (*High Interest – High Influence*):
  This group includes the most engaged and influential stakeholders in the battery supply chain. Key actors in this quadrant are policymakers and private sector companies. Their collaboration is essential: while ministries define targets, incentives, and regulations, the private sector is responsible for implementing and materializing these initiatives. Notable ministries in this group include: MoI, MEMR and MoInv. These institutions actively contribute to shaping the battery ecosystem by setting policy direction and enabling conditions for its development.

- **Meet their needs** (*Low Interest – High Influence*):
  Stakeholders in this group hold considerable influence but do not prioritize the battery supply chain as a strategic focus. To benefit from their influence, their requirements and expectations must be addressed. Stakeholders in this group include banks, which set investment criteria and financing conditions for projects, PLN that is responsible for power supply and grid operations, and regional government agencies that may implement complementary incentives or local initiatives.

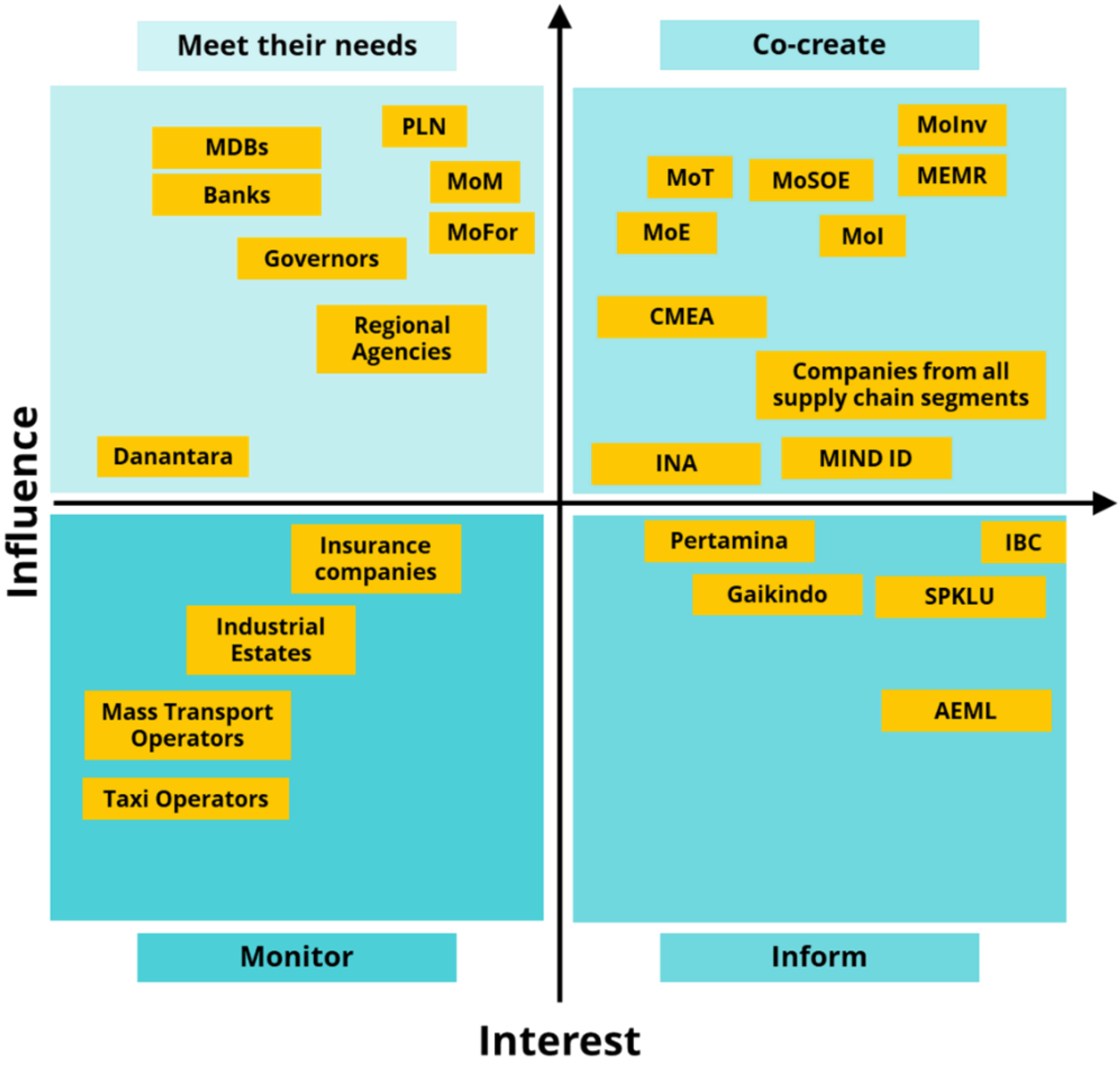
[55] Stakeholder Analysis. University of Leeds. https://change.leeds.ac.uk/change-toolkits/delivering-results/stakeholders/stakeholder-analysis/

- **Inform** (*High Interest – Low Influence*):
  These actors are highly interested in the battery sector but have limited ability to shape its development. This group includes: state-owned enterprises involved in project implementation, which must follow government directives and thus have limited autonomy, EV charging infrastructure providers, who are driven by commercial interest in expanding their customer base but must comply with policies set by more influential actors, and market and industry observers, such as Gaikindo, which collects and disseminates data on the EV market and should be kept informed of policy developments.

- **Monitor** (*Low Interest – Low Influence*):
  Actors in this group are generally neutral toward battery supply chain development but play a role in implementation. While they lack influence and interest, they must still be monitored and kept informed due to their operational involvement. An example of this type of actors are mass transport operators (e.g., bus or taxi drivers), who may not actively engage in policymaking but are ultimately responsible for adopting and operating new electric vehicles, replacing their internal combustion engine (ICE) fleets.

As seen on the figure below, the Ministries and private sector need to cooperate closely with each other to co-create projects that derive in infrastructure development. MoInv, MoI, MoSOE and MEMR are particularly important due to their influence and interest. State-owned companies are also important, although the level of influence of IBC and MIND ID is not as high since they are not as independent as private companies. However, PLN, as the sole power utility of the country, has a lot of influence due to its control over Battery Energy Storage Systems (BESS). On the other hand, financial entities are important due to the influence they can have by providing capital and funding for projects, but they are not necessarily interested in developing the supply chain.

Figure 1.6 Influence/Interest stakeholder matrix for the battery supply chain in Indonesia



2. Incentive scheme evaluation and identified challenges

As mentioned in Section 1, Indonesia has adopted an ambitious policy framework to support and guide the country's transition towards a more sustainable and low-carbon energy system. The policies implemented in Indonesia and described in this chapter aim to encourage investments, promote local manufacturing, and to develop national EV market. The policy landscape includes a mix of fiscal and non-fiscal incentives. These measures have been introduced to support upstream activities such as mining and refining, as well as midstream and downstream segments. The following sections examine incentives implemented in each stage of the battery supply chain and the impact its implementation has had.

2.1 Legislative framework for battery supply chain stages

Indonesia's policy priority is to establish a fully integrated electric vehicle (EV) ecosystem encompassing all stages from key mineral processing to EV manufacturing, within the nation's borders. This section will focus on a comprehensive policy mapping to identify the existing incentive mechanisms to support EV ecosystem development.

2.1.1 Mining and Refining

The Indonesian policy instruments to support the development of the battery supply chain ecosystem within the borders of the country rely heavily on the so-called downstreaming policies.[56] The main tool in this regard is undoubtedly the nickel export ban. Table 2.1 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.

[56] '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 2.1 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.
Fiscal	**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
Fiscal	**Direct subsidies** (Presidential Regulation No. 55/2019)	Financial subsidies to support the development of nickel smelters and refining plants
Fiscal	**Infrastructure grants** (Ministry of Public Works and Housing Regulation No. 10/2020)	Grants for infrastructure projects supporting the nickel industry
Fiscal	**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
Fiscal	**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.
Non-Fiscal	**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.
Non-Fiscal	**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.
Non-Fiscal	**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
Non-Fiscal	**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.

2.1.2 Manufacturing

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. For example, the US is providing additional benefits through tariff adjustments, investments in domestic manufacturing, export controls to secure critical materials and technologies, and strengthening strategic relationships.[57] The European Union (EU) has outlined in its Green Industrial Plan the importance to 'massively increase the technological development, manufacturing production and installation of net-zero products and energy supply in the next decade.'[58] The recently published Green Industrial Deal emphasizes the need for moving beyond traditional silo solutions and look at the entire value chain in developing industrial ecosystem.[59]

Similarly, Indonesia has taken several strategic steps to support the manufacturing segment. This section examines the midstream manufacturing stages, specifically the production of cathodes and anodes, lithium-ion battery (LIB) cells, and EVs. These stages are considered collectively due to the similarity in policy instruments employed to foster development within these segments.

Table 2.2 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

[57] The White House, 2021-2024 Quadrennial Supply Chain Review (December 2024), p. 4.

[58] Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, *A Green Industrial Plan for the Net-Zero Age*, COM(2023) 62 final, Brussels, 1.2.2023.

[59] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *The Clean Industrial Deal: A joint roadmap for competitiveness and decarbonization*, COM(2025) 85 final, Brussels, 26.2.2026.

Local content policies have faced a recurring interest lately in minerals, battery and EV markets.[60] The concept is also considered to involve foreign or domestic investors to source a certain percentage of intermediate goods from local sources.[61] Local content policies are frequently linked to fiscal incentives, such as subsidized export or investment financing, to enhance their effectiveness.[62] These measures help offset the cost associated with meeting local content standards.

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. Finally, the inclusion of employment and work equipment in the local content requirements ensures that the benefits of the policy extend beyond manufacturing to job creation and the development of local expertise.

The country also promotes the conversion of Internal Combustion Engine (ICE) vehicles to EVs through several legislative measures. The legal basis for converting ICE vehicles to EVs is provided by the Regulation of the Ministry of Transportation 65/2020 and mandates that all converted vehicles must undergo type testing and roadworthiness certification. Regulation 15/2022 amends the technical requirements for electric powertrain retrofitting including battery safety and electrical system integrity requirements. Furthermore, the Regulation requires conversion workshops to be certified and registered with the competent ministry, i.e. Ministry of Transportation. Converted vehicles must comply with national standards concerning, inter alia, battery packs and charging systems and pass type testing at a certified testing center. After these stages, the converted EV can be issued with a new registration certificate that indicates its EV status. After this, the vehicle may enjoy preferential treatment under various legislative measures, such as traffic exemptions.

2.1.3 End-use

The first policy instruments 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.[63] Taxation measures, most specifically vehicle registration tax exemption/reduction as well as vehicle purchase subsidies and/or exemption on vehicle purchase taxes, have proven the be key policy instruments in increasing EV sales. It is important to mention that while additional policy instruments have been introduced, such as different access schemes for

[60] See, e.g., G M Grossman and L Y Ing, 'Introduction' in L Y Ing and G M Grossman (eds), *Local Content Requirements: promises and pitfalls* (Routledge 2024), p. 1.
[61] Kuntze, J.-C. and Moerenhout, T. Local content requirements and the renewable energy industry – a good match? ICTSD.
[62] G M Grossman and L Y Ing, 'Introduction' in L Y Ing and G M Grossman (eds), *Local Content Requirements: promises and pitfalls* (Routledge 2024), p. 1.
[63] https://www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment

urban areas, these initial policy instruments have served as important tools having also spill-over effects on manufacturing.

The development of policy instruments to support the end use of EVs involves a multifaceted approach aimed at promoting adoption and infrastructure development simultaneously. 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. In turn, 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.

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. The fiscal and non-fiscal incentives implemented so far in Indonesia al presented in Table 2.3.

Table 2.3 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.

	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.

Regarding local initiatives, only some areas have adopted them to support EV uptake, such as Jakarta and Bali. [64] These key initiatives are outlined in the table below:

Table 2.4 Local government initiatives

Region	Key initiatives	Focus areas	Description
Jakarta	• EV parking incentives • Electric buses in TransJakarta • Charging stations • Odd-even licence plate restriction	Public transport, infrastructure	Jakarta is a pilot region under the ENTREV project[65] (2023-2027) supporting EV ecosystem development including charging infrastructure development and public transport electrification. The odd-even license plate restriction is a traffic management policy that excludes EVs
Bali[66]	• EVs for tourism • Pilot zones for green mobility • Public sector leading by example	Tourism, electric scooters, ecosystem development	Similarly to Jakarta, Bali is part of the ENTREV pilot for EV infrastructure and policy, focusing on tourism-based EV use and green zones. With the adoption of the Bali Governor Circular No. 8 of 2023 the region also seeks to initiate measures to support environmentally friendly transportation of government officials
West Java	• Municipal EV fleet • Charging infrastructure	Public services, infrastructure	Also part of the ENTREV pilot, with initiatives in public fleet electrification

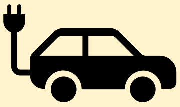
[64] https://wri-indonesia.org/en/insights/needs-policy-financing-and-market-support-e-bus-acceleration-indonesia; A Mahalana, Z Yang, F Posada, 'Indonesia transport electrification strategy' Workng paper 2021-36 (International Council of Clean Transportation, October 2021).

[65] 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

[66] Peraturan Gubernur Bali Nomor 48 Tahun 2019 tentang Penggunaan Kendaraan Bermotor Listrik Berbasis Baterai

Figure 2.1 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, summarized in Table 2.5, are designed to ensure safety, performance, and interoperability of EV battery systems. And they are part of a broader effort to build a safe and reliable EV ecosystem in Indonesia, aligned with international practices. In addition to these measures, there are no other legislative instruments.

Table 2.5 Indonesian Battery Standards

Standard code	Applicable category	Focus area	Description	Contribution to circular economy
SNI 8871:2019	Categories M and N (passenger cars, vans, trucks)	Safety	Safety requirements for rechargeable electrical energy storage systems	Imposing safety requirements reduces the risk of battery failure or accidents; Encourages battery design that are easier to disassemble, refurbish, or repurpose.
SNI 8872:2024	Category L vehicles (electric motorcycles)	Safety	Safety requirements for rechargeable electrical energy storage systems	
SNI IEC 62660	Battery cells	Safety, performance, testing	Internationally harmonized standard for battery cell safety, performance, testing	Alignment with international norms, facilitating cross-border compatibility and participation in regional and international battery value chains
SNI ISO 12405-4:2018	Battery packs in electric cars	Performance testing	Covers performance testing for battery packs in electric cars	Performance testing protocol requirements ensure consistent quality across manufacturers and support predictable degradation profiles
SNI 9102:2022	Battery packs in electric motorcycles	Performance testing	Covers performance testing for battery packs in electric motorcycles	

Standard code	Applicable category	Focus area	Description	Contribution to circular economy
SNI 8927 & SNI 8928 (2020)	Removable and swappable battery systems	Safety, technical specifications	Define safety and technical specifications for removable and swappable battery systems	Promote modular battery design; enable battery-as-a-service models

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. 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.[67] 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.

2.1.4 End-of-life

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 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. As mentioned before, 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 as follows:

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

Table 2.6 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. Lithium-ion batteries – the currently mainstreaming battery technology – 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.[68]

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

[68] 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.

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

Financial incentives used in other countries to support recycling infrastructure and collection of feedstocks are described in Annex 1.

2.2 Incentive assessment

As seen on the previous sections, Indonesia has a wide range of incentives for batteries and EVs along the supply chain. Incentives and policy instruments are notably missing for BESS. Therefore, the incentives evaluation is focused on raw materials, refining and processing, manufacturing and end-use segments of the supply chain.

Indonesia has implemented diverse incentive schemes, especially in the recent years, aiming to meet the national targets. An assessment of the effects that such incentives have had and could have in the future, are presented below.

Figure 2.2 Incentive's impact score card

H: High, **M:** Medium, **L:** Low

Battery supply chain incentives				
Incentive	**What has happened?**	**Impact on Investment**	**Future implications**	**Score**
Regulation of domestic nickel ore prices The GoI regulates nickel ore supply, so prices don't fall when demand is low	In 2024, Indonesia integrated nickel into SIMBARA, the national Mineral and Coal Information System, to enhance tracking and governance. The government also revised the mining quota application process, shortening permit validity from three years to one. Despite generally low prices, market fluctuations persist	Limiting demand has forced smelters to import nickel ore from places like Philippines when there are delays in announcing mining quotas or price fluctuations	Regulated prices may allow better financial planning when investor assess new projects as it provides certainty	M
Nickel export ban Implemented since 2014 and renewed in 2020	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	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.	This incentive, along with measures to develop Indonesia's battery and EV industries, is expected to attract further foreign direct investment.	H
Direct subsidies for smelters Financial subsidies to support the development of nickel smelters and refining plants, enacted in 2019	This incentive was **paired with the renewal of the Nickel export ban,** boosted domestic mineral processing. Before 2014, Indonesia had only two operational nickel smelters. By 2020, this number had increased to 13, and as of July 2023, a total of 43 nickel smelters were in operation[69]	According to ESDM ministry data, Indonesia has 190 nickel smelter projects: 54 operating by 2025, 120 under construction, and 16 planned[70]. **Operating smelters have quadrupled in five years,** driven by subsidies and the export ban	Although Indonesia's nickel production growth contributed to a short-term global surplus and a 26.1% price decline in 2024[69], government subsidies have supported continued expansion, aligning with its strategic goal of market dominance	H

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

[70] Indonesia Business Post (2025) 54 smelters in operation, 60 in the process of securing permits: BKPM. Link

Battery supply chain incentives				
Incentive	**What has happened?**	**Impact on Investment**	**Future implications**	**Score**
Import tax exemptions for EVs Manufacturers establishing domestic factories by 2026 get a 0% import duty on assembled EVs	After this incentive was implemented in 2024, EV imports surged from 474 units (Jan–Apr 2024) to 16,133 units in the same period in 2025, a **33-fold increase**	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[72]	The policy has increased EV market share and investment but favors fully assembled imports, potentially harming local producers and smaller firms and risking long-term goals	M
Progressing domestic content obligations for EVs Tax incentives for local content production of EVs, grants for EV-related infrastructure	Presidential Regulation No. 79/2023 extended the **local content threshold increase from 40% to 60%,** delaying the deadline from 2024 to 2027. According to Gaikindo, 6,523 EVs were produced in Indonesia from January to April 2025, a 33% decline from 9,674 in the same period of 2024. However, **2024 had seen a 230% increase from 4,187 EVs produced in 2023** during the same period	Data shows production has fluctuated 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.	Manufacturers - including potential entrants- may focus on assembling imported components, benefiting from the import tax exemptions rather than investing in domestic production capabilities	M
Incentives investments in domestic EV manufacturing facilities Tax holidays, allowances, and corporate tax cuts for battery production and smelting.	Between 2020 and 2025, seven companies—including **BYD, Citroen, AION, Maxus, Geely, FinVast, and Volkswagen—committed to investing in EV production facilities in Indonesia**. Hyundai and Wuling led, launching operations in 2022[71]	EV manufacturing companies entering Indonesia have commenced construction activities, with a **total committed investment of IDR 15.4 trillion**. These facilities are designed to support an **annual production capacity of 281,000 electric cars.**[72]	The growth in manufacturing investment is set to position Indonesia as a key exporter, especially to the EU and US, where >90% of EVs use nickel-based batteries[73] for their high energy density and cold-climate performance.	H
VAT reduction and 0% downpayment For EVs meeting local content requirements were introduced in 2024 and will continue through 2025	In 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.**	This incentive aims at reducing the price gap between EVs and fossil fuel vehicles catalyzing and scaling the EV industry. While it is hard to accurately attribute EV wholesale growth to each incentive, the collective impact has been significant	Although EV market share in Indonesia is still far from the national EV adoption targets (Chapter 1), the increase in EV national sales show promising growth	H

Source: Authors with information from different sources[74,75 ,76, 77, 78, 79]

[71] JLL (2025) Indonesia's rise as an EV hub. Link
[72] Bakrie Brothers (2025) Government Wants to Give Bigger Incentives to EV Manufacturers with High Local Content. Link
[73] Lowy Institute (2025) The future of Indonesia's green industrial policy. Link
[74] Guberman, D. et. al. "Export Restrictions on Minerals and Metals: Indonesia's Export Ban of Nickel" USITC (Feb 2024). pp.20 https://www.usitc.gov/publications/332/working_papers/ermm_indonesia_export_ban_of_nickel.pdf
[75] 29-05-2024 "Indonesia buying record amounts of Philippine nickel ore due to quota delays" https://www.mining.com/web/indonesia-buying-record-amounts-of-philippine-nickel-ore-due-to-quota-delays-sources-say/
[76] Gaikindo. Indonesian Automobile Industry Data. Imports, Production and Wholesale for 2023, 2024 and 2025. https://www.gaikindo.or.id/indonesian-automobile-industry-data/
[77] JustAuto (2023) Indonesia's new policy to attract BEV investment – a bumpy road ahead?. Link
[78] IISD (2025) Indonesian Electric Vehicle Boom: A temporary trend or a long-term vision?. Link
[79] Lowy Institute (2025) The future of Indonesia's green industrial policy. Link

Although Indonesia is actively developing its battery supply chain and strengthening the EV market, its strategy has relied heavily on local content requirements to encourage domestic production. Following the order in Article 8(2) of PR 55/2019, Minister of Industry Regulation No. 6 of 2022 as amended by Minister of Industry Regulation of No. 28 of 2023 on the Specification, Development Roadmap, and Calculation Provisions of Local Content Requirement for BEV (MOI Regulation 6/2022) specifies the composition of the local content requirement. It is divided into four categories where the composition is calculated out of the total local content requirement value. These values can be found on Annex 2[80]. On the other hand, the Acceleration of Battery-based EVs Road Transportation Program (PR 79/2023)[81] has ambitious EV penetration targets, as shown in Table 2.7.

Table 2.7 Target penetration on the Acceleration of Battery-based EVs Road Transportation Program (PR 79/2023)

Two-wheel and/or three-wheel BEV	
Target period	*Local content requirement (calculated as a percentage of the total value of the vehicle)*
2019-2026	40%
2027-2029	60%
2030 onwards	80%
Four-wheel (or more) BEV	
Target period	*Local content requirement (calculated as a percentage of the total value of the vehicle)*
2022-2026	40%
2027-2029	60%
2030 onwards	80%

However, recent studies have demonstrated that local content policy does not necessarily achieve its intended purpose of supporting the growth of the local industry in Indonesia.[82] Robust mechanisms to measure, monitor, and evaluate the outcomes of the policies is thus required.[83] For example, China's regulatory framework has had a strong emphasis on local manufacturing and technology transfer, with subsidies linked to the use of domestically produced batteries and components.

A list of the most used incentives to implemented worldwide to support EV uptake are presented in Annex 3. For example, many major cities in China have implemented a broad array of EV promoting policies. These range from car plate restrictions and EV direct access regimes to traffic restrictions and EV waivers to lower cost or entirely free parking.[84]

---

[80] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 7

[81] Peraturan Presiden Republik Indonesia No. 55 Tahun 2019 tentang Percepatan Program Kendaraan Bermotor Listrik Berbasis Baterai (Battery Electric Vehicle) untuk Transportasi Jalan 2019 art 8; Peraturan Presiden Republik Indonesia No. 79 Tahun 2023 tentang Perubahan atas Peraturan Presiden Nomor 55 Tahun 2019 tentang Percepatan Program Kendaraan Bermotor Listrik Berbasis Baterai (Battery Electric Vehicle) untuk Transportasi Listrik 2023 art 8.

[82] D Friawan, H Aswicahyono, I S Titiheruw, Y Rizal Damuri, A Fauri, C Mangunsong, J S Ngadiman, *Economic Impacts of Local Content Requirements in Indonesia*, (CSIS Indonesia, 2023), https://www.csis.or.id/publication/economic-impacts-of-local-content-requirements-in-indonesia/

[83] 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. 2.

[84] IEA, *Global EV Outlook* (IEA 2021), p. 54.

2.2.1 On local content policies in other countries

Proponents of local content policies consider such measures to 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.[85] Opponents, on the other hand, consider local content policies to undermine industrial competitiveness over the long-run and for the economy as a whole.[86]

Examples of local content policies in other countries:

(1) **United States**: The Inflation Reduction Act (IRA), adopted in the US in 2022, aims to develop a local supply chain to boost domestic production and sourcing. It offers tax credits based on fulfilling local content requirements. Starting in 2024, US vehicles cannot contain battery components from a 'foreign entity of concern', and from 2025, EV batteries cannot include any minerals from such entities. Instead, the legislation promotes local production within the regions covered by free trade agreements, including agreements with resource-rich countries like Chile. In addition to the tax credits, the US Department of Energy has allocated USD2.8 billion to companies involved in the domestic battery supply chain, supporting new and commercial-scale facilities and demonstration plants. Of USD 2.8 billion, 30% is dedicated to anode investments; 25% to pCAM and CAM covering both NMC and LFP technologies.[87] These funding mechanisms are considered to mark crucial advancements in establishing a domestic battery industry in the US.[88]

(2) **European Union**: The European Commission is proposing a set of measures to boost EV battery cells and components produced in the EU. The EU Commission has stated that legislation will be proposed at the end of 2025, and will specify the local content requirements for batteries and their components required to qualify for different support measures that will be adopted under a 'Battery Booster' package.[89]

(3) **Thailand:** Thailand seeks to support business operators transitioning to EVs and provides corporate tax deductions for the purchase of EVs, which is higher for domestically manufactured EVs compared to fully assembled imported EVs.[90]

The pros and cons of local content policies are summarized on the next figure.

---

[85] 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.

[86] 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.

[87]https://www.energy.gov/articles/biden-administration-doe-invest-3-billion-strengthen-us-supply-chain-advanced-batteries

[88] https://www.ey.com/en_fi/insights/strategy/how-europe-can-unblock-the-midstream-battery-materials-bottleneck

[89] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Industrial Action Plan for the European Automotive Sector*, Brussels, 5.3.2025, COM(2025) 95 final, pp. 12-13.

[90] https://www.wfw.com/articles/driving-the-future-how-thai-leadership-is-shaping-southeast-asias-ev-revolution/

Figure 2.3 Pros and cons of local content policies, a summary for the local content provisions [91]

+ **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

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.

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 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.[92] Nevertheless, any measure to be adopted should be 'risk-monitored' in preparation for possible future litigation.

[91] 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.

[92] 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.

2.3 Main challenges and policy gaps

2.3.1 Extraction and Refining

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 about inefficiencies and the potential risk 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 Chinese companies that currently dominate the nickel refining segment in Indonesia benefit from subsidized electricity prices.[93]

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 Government Regulation No. 79/2014 (GR 79/2014) on National Energy Policy KEN considers coal stockpiling[94] 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 access of people to Energy. 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.

2.3.2 Manufacturing

Regarding the manufacturing legislation, 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 the US and the EU can pose investment challenges, as demonstrated by the withdrawal

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

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

of German company BASF[95] and French company Eramet[96] from the Sonic Bay nickel and cobalt refinery project due to changing market conditions, and ESG-related concerns[97].

As previously mentioned in the incentives section, the policy favouring importers of fully assembled EVs may have distortive effects on the markets. In addition to this, the requirement for a periodic review of local content policies in the legislation is vague.

The conversion of ICE vehicles to EVs can support Indonesia's circular economy by extending the lifespan of existing vehicles and reducing the demand for resource- and energy-intensive manufacturing of new ones. However, as highlighted in discussions surrounding the B3 waste management framework, the absence of standardized guidelines for the reuse of parts and batteries, along with limited certification pathways for second-life components, threatens to constrain the integration of circular economy principles in conversion practices. Additionally, there is no national legislation that would mandate the use of manufacturing scrap for recycling within the country, thus supporting circular economy practices. And finally, while strategic partnerships are recognized, more structured engagement and facilitation might be required.

2.3.3 End-Use: EVs

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.[98] 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.[99] 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

---

[95] 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

[96] 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/

[97] 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/

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

[99] IEA, *Global EV Outlook 2018* (IEA 2018), p. 98.

Furthermore, the targets are not aligned with the pace at which manufacturing plants have started production. Hyundai's EV manufacturing plant took three years to open, from 2019[100] when the announcement was made, to 2022[101], when the plant began production. Karawang's battery plant followed a similar timeline (from 2021[102] to 2024[103]). Additionally, a diversification of actors is needed to avoid monopolies or dependencies on a single actor, as seen from the impact of the recent withdrawal of one of LG's investments on a new battery manufacturing plant[104] Still, the successful opening of both facilities means that indeed the Government of Indonesia has been successful in improving the investment conditions for the battery supply chain in the country. Further actions needed for improving investment conditions are discussed in Section 4.5.

2.3.4 End-Use: BESS

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[105]. Additionally, the lack of a 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.

The RUPTL 2025 does integrate BESS into its 2025-2034 planning, with 6 GW installed, and a total of 10.3 GW of storage installed by 2034[106]. This represents a positive initial step toward creating domestic demand for batteries used in BESS applications

[100] About HMMI. https://hyundaifactorytour.com/en/about
[101] 16-03-2022. "Supporting Hyundai's Future Mobility Strategy Hyundai Motor Company Inaugurates Its First Manufacturing Plant in Southeast Asia". Press release. https://www.hyundai.news/eu/articles/press-releases/first-manufacturing-plant-in-southeast-asia.html
[102] 30-07-2021. "Hyundai Motor Group and LG Energy Solution Sign MoU with Indonesian Government to Establish EV Battery Cell Plant". Press Release. https://www.hyundai.news/eu/articles/press-releases/hyundai-lg-energy-solution-mou-indonesian-government-ev-battery-cell-plant.html
[103] 03-07-2024. "Hyundai Motor, LG Energy Solution launch Indonesia's first EV battery plant". https://www.reuters.com/business/autos-transportation/hyundai-motor-lg-energy-solution-launch-indonesias-first-ev-battery-plant-2024-07-03/
[104] 21-04-2025. "LG cancels US$7.7 billion EV battery project in Indonesia". Indonesia Business Post. https://indonesiabusinesspost.com/4133/corporate-affairs/lg-cancels-us-7-7-billion-ev-battery-project-in-indonesia
[105] https://www.sciencedirect.com/science/article/pii/S0973082624001352
[106] "RUPTL PT PLN (Persero) TAHUN 2025-2034" https://gatrik.esdm.go.id/assets/uploads/download_index/files/4ec39-materi-paparan-ruptl-2025-2034.pdf

2.3.5 End-of-life

The are three main gaps as identified in the Indonesian legislative framework for the end-of-life sector:

- Indonesia does not have legislative measures supporting the integration of a circular economy approach to the battery value chain.
- The current regulatory framework on waste does not support the establishment of a circular economy of batteries and the classification of batteries as waste under the current legislation poses challenges for the procurement of materials in the recycling sector.
- There is a lack of clear incentives and governmental support to promote the adoption of circular economy practices in the battery sector.

2.3.6 Associated risks by supply chain stage

Broadly speaking, when considering any entities' risks, these can be categorized into various types, shown in the figure below:

Figure 2.4 Types of risks

Operational Risks:
- Risks related to day-to-day operations, such as equipment failure or supply chain disruptions.

Financial Risks:
- Risks associated with financial transactions, investments, and market fluctuations.

Compliance Risks:
- Risks arising from non-compliance with legal or regulatory requirements.

Strategic Risks:
- Risks related to strategic decisions, such as entering new markets or launching new products.

Reputational Risks:
- Risks that can impact the reputation of an organization, such as negative publicity or scandals.

The general aspects of a risk assessment can be found in Annex 4.

Although Indonesia already has a risk-based licensing system in place through the OSS platform (as mentioned in Section 3.4.2) there are other risks associated with the policy gaps previously identified and others associated to each link of the supply chain. These risks will be explored in the following sections. Each section presents the risks under a colour code: **Red** represents the highest risk for Indonesia, **Yellow** represents medium, and **Green** is Low risk.

- **Risks in Material Processing and Refining**

Once the raw materials are extracted, they undergo processing and refining to achieve the required purity and quality. Chemical processing plants and refineries play a crucial role in this stage, ensuring that the raw materials meet the stringent standards needed for battery production. They tend to be energy intensive and therefore particularly susceptible to the availability and pricing of energy. However other key factors that influence profitability at this stage include:

Figure 2.5 Risks in Material Processing and Refining

High risk, *Medium risk* and *Low Risk*

Operational Financial	Off-Spec Materials	Risk of increased waste, rework, and operational costs due to inadequate control of off-spec materials during the processing phase. High-quality control measures and stringent standards in the processing phase can reduce the occurrence of off-spec materials, which can otherwise lead to waste, rework, and increased costs.
	Technology	Risk of higher operational costs and inefficiencies due to delayed or insufficient adoption of advanced technologies such as automation, data analytics, and process optimization. Innovations in automation, data analytics, and process optimization can lead to better resource utilization, faster processing times, and lower operational costs.
Financial	Reagents	Risk of reduced profitability due to high costs or limited availability of reagents used in processing and refining operations. Efficient use and recycling of reagents can help control costs and improve the environmental footprint of the operation.
	Yield	Risk of reduced profitability and revenue due to low yield and recovery rates resulting from inefficient processing technologies or suboptimal operational procedures. High recovery rates mean more product is available for sale, enhancing revenue. Efficient processing technologies and optimized operational procedures can improve yield.

In Indonesia, there are no major risks identified for the Refining sector. Instead, it is vital that this link of the supply chain works seamlessly with Extraction and Manufacturing to avoid over or underproduction.

- ### Risks in Raw Material Supply

The foundation of the energy storage value chain lies in the supply of raw materials. Key business units in this stage include mining companies and suppliers of essential minerals like lithium, cobalt, nickel, and graphite. These materials are critical for manufacturing batteries and other energy storage systems.

There are several factors that influence the economics of a mining project, impacting its viability and profitability. These include the following:

Figure 2.6 Risks in Raw Material Supply

High risk, *Medium risk* and *Low Risk*

Financial	Grade	The grade of concentration of valuable materials directly impact the project's economics. For example, the higher the concentration of valuable minerals within the ore, the greater the potential revenue from the extracted material, thus boosting the economic viability of the project.
	Resource/Reserve Size	The reserve size may impacts the project's attractiveness for investors. Having a larger quantity of extractable minerals enhances the project's long-term sustainability and investment appeal by ensuring a steady supply over time.
	Life of Mine	Risk of reduced return on investment due to a shorter mine life, limiting revenue generation and financial planning capabilities.
	Processing and Recovery	Risk of reduced mineral yield and profitability due to ineffective processing methods, resulting in suboptimal extraction of valuable material from the ore.
	Commodity Prices	Risk of decreased revenue and compromised project feasibility due to fluctuations in market prices of the mined minerals.
Operationa	Equipment Selection	Selecting not very efficient equipment may pose signifcant risks for the project. Machinery and technology with low efficiency can increase operational costs, reduce recovery rates, and reduce overall economic returns.
Strategic and Financial	Imports dependency	Having a heavy reliance on imports of a specific and highly-used material in batteries e.g. Lithium, Graphite and Manganese poses an important risk because it increases the exposure to price volatility and lack of supply which could cause major impacts on the whole battery supply chain.
	Stockpiling of minerals	Strategic stockpiling measures for imported minerals may be convenient but may also present risks specially if no regulations for specific materials are in place. Establishing and maintaining stockpiles is expensive and it requires detailed management to avoid it becomes obsolete or waste of material.

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.

Indonesia currently imports lithium from Australia, although the volume remains relatively small —accounting for around 6% of Australia's monthly lithium exports and fluctuating throughout the year. In contrast, China received approximately 95% of

Australia's total lithium exports in 2024[107]. Both countries have taken steps to strengthen bilateral trade through the Indonesia-Australia Comprehensive Economic Partnership Agreement (IA-CEPA)[108] implemented in 2020, which paves the way for a closer collaboration when it comes to increasing lithium exports — a topic already under discussion[109]). The geographical proximity of the two countries further enhances their trade potential. However, Indonesia must carefully consider the type of battery chemistries it aims to produce, as this will determine the volume of lithium required for battery manufacturing (see Section 3.1 for more information on lithium content of NCM vs. LFP batteries).

Commodity prices can also become an issue, particularly for project finance, (see Section 3.4). Too low prices may be perceived as a risk by the market, complicating the securement of capital for new projects. Since Indonesia regulates domestic nickel ore prices, the GoI should be mindful of this.

- **Risks in Cathode Active Materials (CAM)**

Cathode active materials are integral to the production of energy storage systems. These materials, which include lithium, nickel, and cobalt compounds, play a vital role in determining the performance and efficiency of batteries. The manufacturing process involves complex chemical reactions and precise control of material properties to ensure high energy density and long cycle life. Specialized manufacturers and suppliers in this segment focus on innovation and efficiency to produce high-quality cathode active materials, thereby contributing significantly to the overall effectiveness of energy storage systems.

Therefore, a number of the shared risks are relevant to this part of the supply chain however some specific risks include:

---

[107] June 2025.Department of Industry, Science and Resources, Commonwealth of Australia. Resources and Energy Quarterly. Resources and energy quarterly: June 2025 | Department of Industry Science and Resources

[108] Department of Foreign Affairs and Trade. About IA-CEPA. Indonesia-Australia Comprehensive Economic Partnership Agreement | Australian Government Department of Foreign Affairs and Trade

[109] Petromindo.17 May 2025. Indonesia to increase lithium imports from Australia for EV battery industry. https://www.petromindo.com/news/article/indonesia-to-increase-lithium-imports-from-australia-for-ev-battery-industry

Figure 2.7 Risk in Cathode Active Materials (CAM)

High risk, *Medium risk* and *Low Risk*

Financial	Material Cost	Volatility in raw material prices poses a risk to the economic viability and cost control of CAM production. These materials include lithium, cobalt, nickel, manganese, and other elements essential for battery manufacturing. Fluctuations in the prices of these raw materials can substantially impact the financial model.
Financial	Chemistry	Fluctuations in the supply and prices of lithium, cobalt, and nickel can greatly impact financial performance. Achieving high yield rates and optimizing chemical formulations are essential for maintaining profitability.
Complian	Safety Hazards	The handling of raw materials and chemicals involved in CAM processing poses safety risks. Accidents or unsafe working conditions can lead to injuries, legal liabilities, and disruptions in production.
Operational	Equipment Failures	Inadequate selection or failure of processing equipment may compromise production efficiency and reliability, leading to operational disruptions and higher costs. Equipment breakdowns can lead to production delays, increased maintenance costs, and potential loss of materials.
Operational	Quality Control	Although this is a shared risk, it is worth reiterating here as maintaining high standards of quality in cathode active materials is crucial for the performance of lithium-ion batteries. Failures in quality control can lead to product recalls, reputational damage, and financial losses.

Only China has an integrated lithium-ion battery supply chain where all battery materials are refined, to supply pCAM and CAM, and finally to produce lithium cells and assembly cell packs. China has attempted to become self-sufficient through investment upstream and the development of secondary supply (recycling of scrap and cells). Other countries have tries to emulate the success case of China, but only to a certain extent since they account for a few battery materials and not all of them. This would be the case for Indonesia, since it lacks lithium reserves.

- **Risks in Component Manufacturing**

The next stage involves the production of various components that make up energy storage systems. This includes the manufacturing of battery cells, modules, and packs, as well as other components such as capacitors and power electronics. Specialized manufacturers and suppliers operate in this segment, focusing on innovation and efficiency.

Figure 2.8 Risk in Component Manufacturing

High risk, *Medium risk* and *Low Risk*

Operational	Capacitors and Power Electronics	The supply of capacitors and power electronics is critical to the component manufacturing operations. Shortages or quality issues in these components can lead to production delays and increased costs. Additionally, reliance on a limited number of suppliers for these high-demand components can exacerbate supply chain vulnerabilities.
Strategic	Compliance with international ESG standards	Risk of not complying with international standards which can result in low attractiveness for investors or even cause investment withdrawal of companies that have ESG requirements in its supply chain.

ESG compliance has already been an obstacle for developing infrastructure in Indonesia (see Section 2.3.2) with investments being cancelled due to concerns with it. Not only can companies keep withdrawing investments, but batteries may also be unable to be exported if they do not comply with the ESG criteria from the intended destination country (e.g. the European Union).

Collaboration across all levels of the supply chain is essential for reducing risk and maintaining economic stability while delivering value to the end user. Suppliers, manufacturers, logistics providers, and retailers must engage in open communication and coordinated planning.

Through transparent information sharing, stakeholders can anticipate disruptions and respond proactively, mitigating potential risks. Joint efforts in demand forecasting allow for better inventory management, reducing excess stock and avoiding stockouts, thus ensuring seamless product availability.

All the links in the supply chain must be properly sized to avoid overproduction of one battery component or having too much product with no demand for it. Indonesia must ensure its demand for batteries keeps up with their manufacturing production or guarantee exports. Indonesia also needs enough domestic demand, otherwise the country can end up like Europe or the US, with incentives but no real market.

- **Risks in Recycling and End-of-Life Management**

The final stage of the value chain deals with the recycling and disposal of energy storage systems at the end of their life cycle. Recycling companies and waste management firms play a crucial role in this stage, focusing on recovering valuable materials and minimizing environmental impact.

Again, there are a few relevant shared risks including reagents, energy and labour however some additional and worth repeating risks at this stage are worth discussing in greater detail due to their economic impact. These include technical, compliance and environmental risks such as:

Figure 2.9 Risks in Recycling and End-of-Life Management

High risk, *Medium risk* and *Low Risk*

Operational & Financial	Advancements in Recycling Technologies	Technological advancements in battery recycling can render existing processes and equipment obsolete. Investing in new technologies requires significant capital expenditure and can pose an financial risk if the technology fails to deliver the anticipated efficiencies or if competitors adopt superior technologies.
	Innovation in Battery Design	Innovations in battery design, such as the development of new battery chemistries, can impact the recycling process. New types of batteries may require different recycling methods, necessitating additional investments in research, development, and equipment to handle the new materials.
Compliance & Reputational	Pollution and Waste Management	The battery recycling process generates waste and emissions that need to be managed effectively to prevent environmental contamination. Impromer handling and disposal of batteries can lead to fires, environmental liabilities, cleanup costs, and damage to the facility's reputation.
	Community Opposition	Battery recycling facilities can face opposition from local communities concerned about potential environmental and health impacts.
Compliance & Financial	Compliance Costs	Battery recycling facilities must comply with stringent environmental and safety regulations. Compliance with these regulations can be costly, requiring investments in pollution control technologies, safety equipment, and regular monitoring and reporting. Non-compliance can result in hefty fines, legal liabilities, and reputational damage.
	Changing Regulations	New regulations or changes to existing ones can impose additional costs and operational challenges on recycling facilities. Keeping up with regulatory changes and ensuring compliance can strain the financial resources of the facility. Addressing policy gaps, improving coherence across sectors, and aligning domestic regulations with international standards and emerging best practices can help reduce this risk.

As mentioned in Section 2.3.5, Indonesia only has regulations in place for hazardous waste management under which batteries fall under. Therefore, most of the risks for the supply chain right now fall under the "Changing Regulations" category, since current legislation will need to be modified if the country implements recycling targets and strategies. International law seeks to balance the host state's right to regulate with investors' legitimate expectations. Investors can seek compensation in two primary situations: when there are claims of direct expropriation (transfer of ownership) and indirect expropriation (regulatory measures introduced that can have an effect similar to expropriation).

When introducing revisions to the existing legislative framework, it is crucial to balance investors' legitimate expectations with the state's right to regulate in the public interest (health, safety, environmental protection). Depending on the investment treaty in question, the formulation of the provision granting states' the right to regulate vary: some treaties provide broad protection for foreign investors whereas others include more balanced clauses that explicitly recognize the state's right to regulate.

Therefore, introducing any modifications to the existing framework should be carefully balanced with the investors' legitimate expectations by assessing (1) the proportionality (necessity, appropriateness) of the measure to achieve public policy objectives and whether they impose an excessive burden on investors; (2) the economic impacts of the proposed measure (the extent to which the proposed measure impacts the value of investments); and (3) the nature of the proposed measure (measures should be in conformity with the fair and equitable treatment standard, i.e. non-discriminatory, transparent).

On the other hand, operational and financial risks have the lowest priority since until now, technological advancements have been slow and thus pose no real obsolescence threat.

3. Reaching the targets: operational feasibility and financial viability

3.1 Operational Feasibility for EVs

As mentioned in Section 1, Indonesia has the target to domestically produce 943,764 EVs by 2030, which places a considerable challenge for each link of the supply chain. Local infrastructure and the local lithium-ion batteries (LIB) supply chain must be able to handle such plan, with the identification of bottlenecks and potential synergies as priorities. This subsection reviews key parts of the supply chain and highlights the bottlenecks that need to be overcome for Indonesia to become self-sufficient and develop their own LIB supply chain. The estimations and analysis done in this section assume the production of 1,000,000 EVs by 2030 (rounding up from the 943,764 EVs stated in the Ministry of Energy Decree No. 24/2025) as it is more likely for investors to develop production plants for rounded figures. Table 3.1 presents what is needed to develop such number of vehicles, which involves the following capacity to be built:

Table 3.1 EV production and associated battery capacity by plant – global examples

Item	Ford[110]	Tesla[111]	ACC[112]	VW[113]	CATL-Tesla[114]	Nissan-SK On[115]	Hyundai - LG[116]
Year	2022	2009	2022	2022	2021	2025	2023
Plant	Michigan	Nevada	Douvrin	Salzgitter	Shanghai	Seosan	Georgia
EVs (No. units)	600,000	500,000	500,000	500,000	800,000	300,000	300,000
Capacity (GWh)	60	35	46	40	80	20	30
Chemistry	NCM/LFP	NCA	NCM	ND	LFP	LFP	NCM
LIB size (KWh)	88	62	91	70	50	59	88

Source: Compilation of public information for each company listed in the table

The capacity required to be built to meet the national EV production target depends on the type of chemistry to be used (NCM, LFP or a mix of both). This will also determine the amount of feedstock and refining capacities to be built in Indonesia targeting 2030. The following scenarios consider a total of 100 GWh of NCM batteries; or an equivalent of 67 GWh of LFP batteries; or an intermediate capacity proportion. The following subchapter analyses the operational feasibility on each stage of the value chain from battery materials and its refining, cathode and active materials, and finally, LIB cells.

3.1.1 Battery raw materials

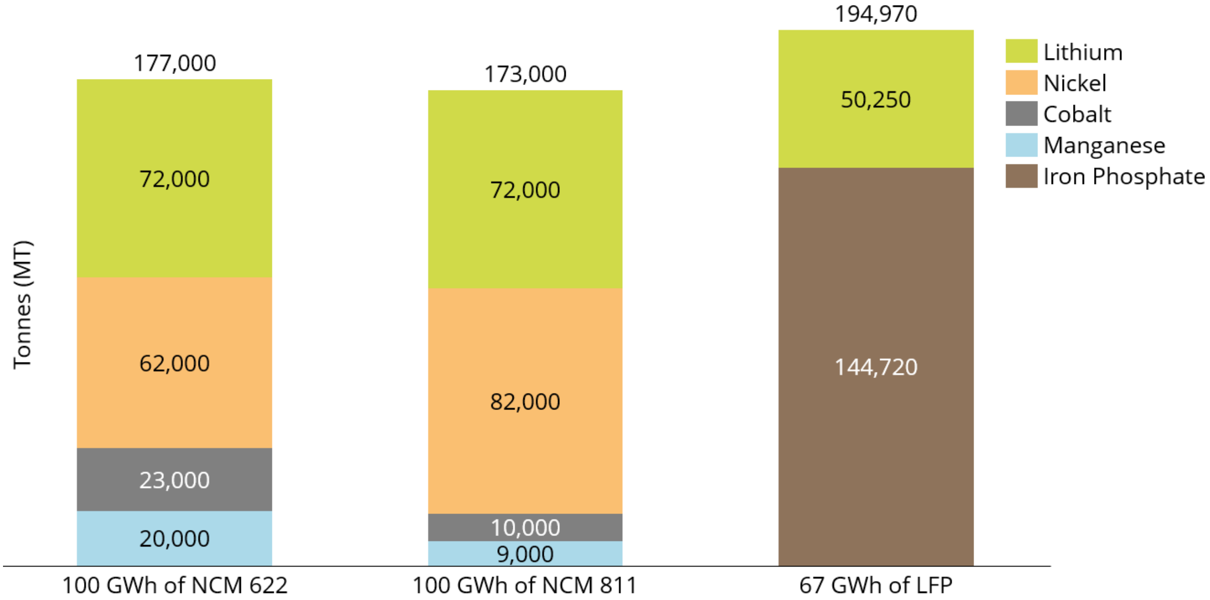
To achieve a consistent and comprehensive battery material strategy, all battery materials involved will be studied under a 2030 demand scenario. Therefore, quantities for battery materials {Li using Lithium Carbonate Equivalent (LCE) figures, Ni, Co, Mn, $FePO_4$} will be tested under three scenarios: i) NCM 622 capacity, ii) NCM 811 capacity

---

[110] CNBC (2021) Ford plans to increase EV production to 600,000 vehicles by 2023. Link
[111] Tesla Outfitters (2024) TESLA FACTORIES OVERVIEW. Link
[112] ACC (2023) ACC inaugurates its first Gigafactory in Billy-Berclau/Douvrin. Link
[113] Federal Government of Germany (2022) Transformation to a climate-neutral industry. Link
[114] Reuters (2021) EXCLUSIVE Tesla supplier CATL plans a major battery plant in Shanghai -sources. Link
[115] NikkeiAsia (2025) Nissan to buy batteries for U.S. EVs from South Korea's SK On. Link
[116] Hyundai (2022) Hyundai Motor the construction of the Metaplant America. Link

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 3.1. The results presented in tables can be found in Annex 5.
Required capacities by battery type are summarised in the figure below:

Figure 3.1 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

From the information shown in Figure 3.1, there are only two battery materials where Indonesia is self-sufficient: that is 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 3.1. 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 3.1). 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.

For Manganese, the situation is not as critical as Lithium, in the sense that quantities are lower and therefore, chances of sourcing Manganese in the open market are higher. Furthermore, building 20,000 MT-Mn content of manganese sulphate in Indonesia is quite straightforward considering the vast knowledge building Nickel Sulphate refineries have domestically.

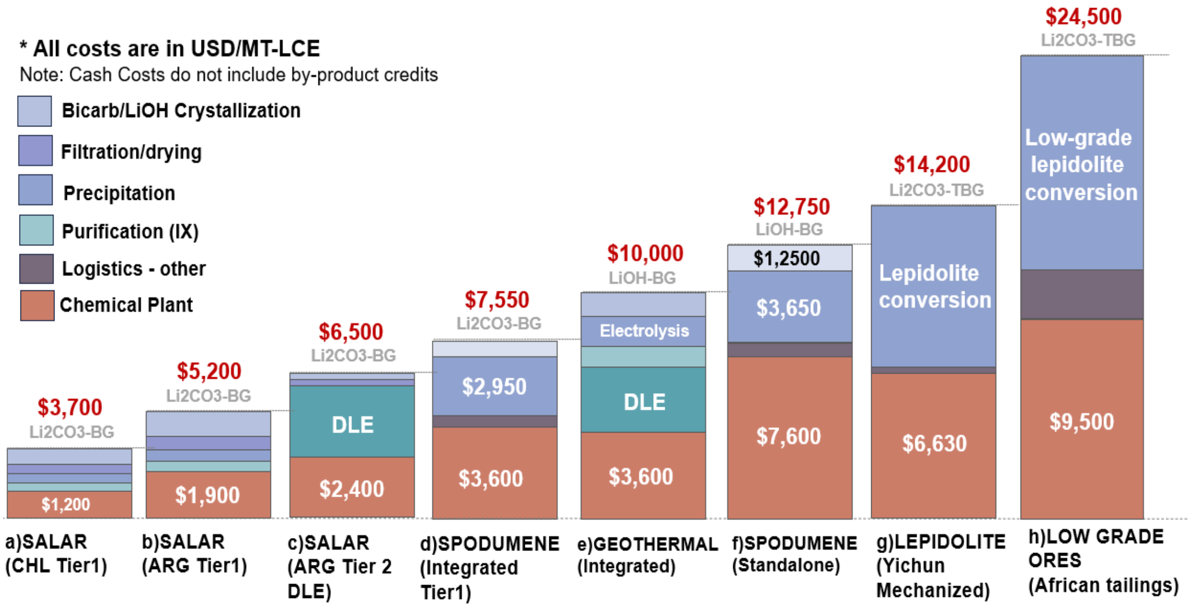
In the case of Iron Phosphate, quantities are larger than of any other battery materials. The two main constituents of Iron Phosphate (Phosphoric Acis and Iron Sulphate) are inputs that can be sourced easily from industrial processes. Whether the Indonesian government follows the NCM route or the LFP route, in either case the most critical additional input is Lithium Hydroxide and Lithium Carbonate.

3.1.2 Refining

To achieve security of supply, additional capacity for Indonesia needs to be focused on the development of refining of the following battery materials: Lithium, Manganese and Iron Phosphate.

Several feedstocks can be used for lithium, like lithium carbonate technical grade (Li2CO3-TG) from brine projects; spodumene concentrate with 6% grade (SC-6); or lower grade mineral concentrates such as lepidolite. Depending on each source, Operational Cost (OPEX) to upgrade Li2CO3-TG to battery grade or convert to lithium hydroxide battery grade (LiOH-BG) will be different than using spodumene concentrate. This is also a lot more convenient than converting from low grade lepidolite. The figure below includes a variety of different feedstocks and technologies. Hard rock projects tend to be more expensive than salars. Assumptions are: Spodumene @ LT incentive price = US$950/MT-SC6; Lepidolite @ current Chinese price = US$300/MT-Lep

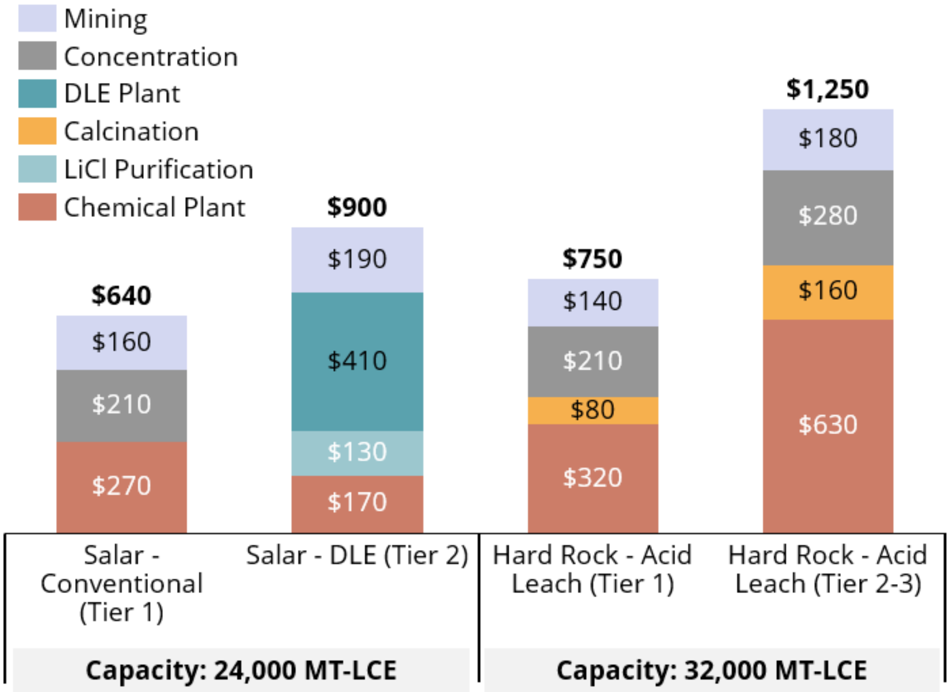
Figure 3.2 Cost Curve by technology for lithium chemicals (C1 Cash Cost)



Source: SC-Insights, based on real information for OPEX C1

There is a competitive advantage of brine projects in terms of operational costs. Nevertheless, there are drawbacks like yields and start-up times. If Indonesia would step into the refining business, then the only stage of interest would be the "Chemical Process", since feedstock would have to be procured abroad. A comparison between Lithium refining CAPEX technologies is presented below, comparing conventional evaporation with hard rock, but only for the chemical part of the process. If the government decides to source feedstock abroad, refining lithium feedstock domestically could cost up to mUS$630 for a capacity of 32,000 MT-LCE (the latter based only on a chemical plant to refine spodumene concentrate). Refining lithium carbonate technical grade (Li2CO3-TG) from a Salar operation is less intensive in terms of CAPEX, reaching up to mUS$270 for only upgrading the product to battery grade chemicals.

Figure 3.3 CAPEX comparison between Lithium refineries
All costs are in USD/MT-LCE



Source: SC-Insights based on real data from the PFS and DFS of representative projects including Pozuelos Pastos Grandes (PPG), Cauchari-Olaroz (Lithium Americas), Centenario Ratones (Eramet), Guben (Rocktech), and others[117] . CAPEX does not consider Sustaining Capital nor overruns.

In the case of Manganese, the analysis focuses on the metallurgical part of the process, excluding costs of mining, concentration and logistics. A set of Manganese projects and their respective CAPEX for leaching and other metallurgical costs are listed below:

Table 3.2 CAPEX comparison between Manganese projects

Item	Euro Manganese[118]	Giyani[119]	GMC[120]	Manganese X[121]
Year	2022	2022	2024	2022
Project	Chevaletice	K Hill	Nsuta	Woodstock
Country	Czech Republic	Botswana	Ghana	Canada
Product	HPMSM	HPMSM	HPMSM	HPMSM
Capacity (MT-Mn)	200,000	100,000	100,000	84,000
CapEX (mUS$)	753	281	240	350
Unitary CapEx (US$/MT-Mn	7,530	2,810	2,400	4,167

Source: Public information from each company

[117] Data regarding supply come either from trade stats or corporate information on capacities. The way production or capacities are spread out in time is proposed, revised and edited by the analysts of Supply Chain insights (SC Insights) or similar consulting companies. Usually mining/refining/CAM/cell project do not produce at full capacity at once, therefore it's necessary to simulate a reasonable ramp-up. Similarly, project also don't produce at nameplate capacity, since quality is compromised.
[118] Euro Manganese Inc (2022) Euro Manganese Announces Positive Feasibility Study Base Case Results for the Chvaletice Manganese Project. Link
[119] Giyani Metals Corp (2022) Giyani Announces the Results of its Feasibility Study for the K.Hill Battery-Grade Manganese Project. Link
[120] The Sikman Times (2024) GMC to build $450m refinery, advancing value addition in mining sector. Link
[121] Manganese X Energy Corp (2022) Manganese X Announces Positive PEA for its Battery Hill Project. Link

To fulfil the targeted 60 GWh by 2030, 12,000 tonnes of Manganese-contained are needed. The production of High Purity Manganese Sulphate (HPMSM) does not need a localized sourced of mineral, nor does require a large investment of capital. For an intermediate-cost Mn refinery, a US$160 million plant can produce 50,000 tonnes-Mn of Manganese Sulphate for the battery sector.

3.1.3 Cathode Active Materials (CAM)

On the cathode side, the strategic role of Indonesia in the nickel market and its competitiveness in terms of energy/reagent has attracted key player LG Chem. The company, PT HLI Green Power, is a joint venture between Hyundai Motor Company, LG Energy Solution, and the Indonesia Battery Corporation. This partnership has built a plant with 110,000 MT-NCM capacity, and it's planning a second train with 50,000 tonnes of NCM capacity to be ready by the end of the decade. In addition, the country's first LFP cathode facility, PT LBM Energi Baru Indonesia, entered the market with a production capacity of 30,000 tonnes of LFP. Table 3.3 below shows a potential scenario of capacity deployment, including both existing projects:

Table 3.3 CAM deployment in Indonesia (capacity in tonnes)

Company	Train	Chem	2024	2025	2026	2027	2028	2029
Energy Baru[122]	I	LFP	--	4,000	15,000	30,000	30,000	30,000
	II		--	--	--	15,000	30,000	30,000
	III		--	--	--	---	15,000	30,000
HLI Green Power[123]	I	NCM	--	12,000	50,000	110,000	110,000	110,000
	II		--	--	25,000	50,000	50,000	50,000
TOTAL			**--**	**16,000**	**90,000**	**205,000**	**235,000**	**250,000**

Source: Public announcement from Energy Baru and Green Power (LG)

Table 3.4 CAM production feedstock to LIB capacity for 2030 EV target

Item	Unit	NCM	LFP	Total
Production	**MT-CAM**	**160,000**	**90,000**	**250,000**
Conversion	**MWh/MT**	**0.44=(1/2.25)**	**0.61=1/1.65**	
Capacity	**GWh**	**70.4**	**60.3**	**130.7**

Source: Calculations based on Table 3.3 CAM deployment in Indonesia (capacity in tonnes)

From the tables above, it can be inferred that enough manufacturing capacity has been built to cover both NCM and LFP combined needs for 2030, in a scenario where both technologies are produced in Indonesia. However, if the country decided to produce only one type of technology (solely NCM or solely LFP) then this would not be the case. In case of NCM, both trains being set up by Green Power are not capable of covering the cathode feedstock demand of 100 GWh by the end of the decade. Similarly, for LFP both trains of Energy Baru cannot produce enough cathode active material to cover a demand close to 70 GWh. The challenge and risk for the country is the execution and delivery dates for the volumes depicted above.

---

[122] Petromindo (2025) LG energy Solution acquires stake in Lopal Tech's LFP cathode plant in Central Java. Link
[123] PT. HLI Green Power (2023) Number One Industry for Electric Vehicle Battery. Link

3.1.4 Anode Active Materials

The Anode space in Indonesia is dominated by the Chinese player BTR New Material Group. The company premiered during 2024 a brand-new plant in Kendal, Central Java, with an initial capacity of 80,000 MT and an investment of US$478 million. The second phase will double the capacity, and it's expected to start construction in 2025-2026. A plant of 80 kMT of anode can supply enough material for almost 90 GWh, so the local supply chain is well covered in terms of graphite. As long as BTR can ramp up that capacity on time.

3.1.5 LIB cells

To achieve the target to produce 1,000,000 EVs by the end of the decade, Indonesia can deploy cathode/cell infrastructure to support either NCM, LFP, or both. These two chemistries have become the most adopted families in the space and currently are essential to power the majority of new electric vehicles worldwide. Due to differences in battery sizes, reaching that objective translated to unsimilar capacity deployment: with an average NCM battery of 88 kWh, cell capacity in the country would require 60 GWh. On the other hand, with an average LFP battery of 55 kWh, cell capacity in the country would require around 40 GWh. The latter translate to two mid-size LIB manufacturing plants, or one big-size quite similar to the latest CATL development, as detailed in Table 3.5.

Table 3.5 Capacity needed for 2030 EV target

Item	Unit	NCM	LFP	Mix
EVs	2030 target	1,000,000	1,000,000	500,000/500,000
LIB size	kWh	88	55	88/55
Capacity	GWh	100	67	50 NCM+38.5 LFP = 88.5 in total

Source: Calculations based on Figure 3.1 Battery material feedstock for Indonesia 2030 by battery type

Hyundai and KIA are the only EV manufacturers currently using domestically produced batteries, mainly from LG Energy Solution (LGES). Despite being a strategic agreement, the JV brings online not more than 8 GWh, not sufficient to support the nation's agenda. Other producers like Phylion are focused on Lithium Manganese Oxide (LMO) prismatic batteries for portable devices. Finally, and with regards to Tesla, while there has been a lot of courting to establish a gigafactory in Indonesia, there is no concrete announcement or concrete plans for Tesla to land in the country.

3.2 Operational feasibility for BESS

Determining the level of storage required in the grid and the best sources for it is not a simple task. According to NREL, there is no rule-of-thumb for how much battery storage is needed to integrate high levels of renewable energy[124]. It depends on several factors like the planned generation mix, flexibility of current sources and demand profile, and interconnections with other power systems, among others.

BESS may not always be the best resource to help integrate renewable energy due to high upfront costs. Research suggests that 2-hour batteries are prioritized at lower renewable

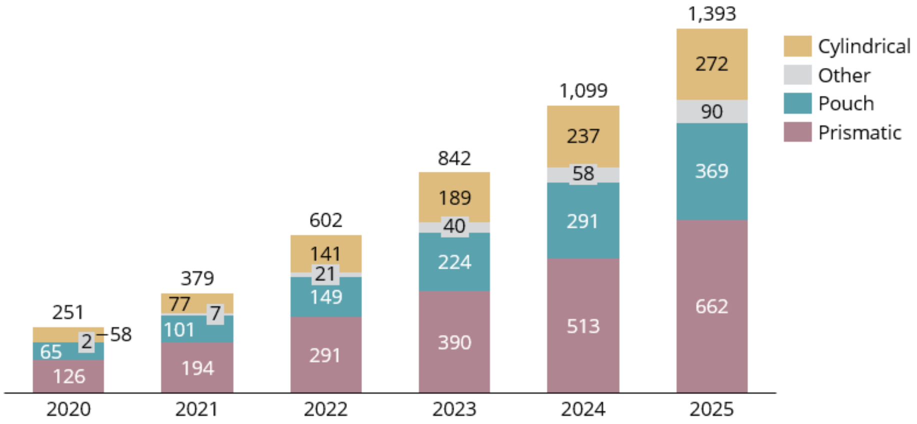
[124] Grid-Scale Battery Storage: Frequently Asked Questions

shares, while 4-hour and even 10-hour batteries become more cost-effective as renewable penetration increases[125].

Still, more and more countries are setting BESS targets and integrating them into their national electricity planning and decarbonization strategies. For example, according to Korea's Ministry of Trade, Industry and Energy, the country is projected to need 24.4. GW of short- and medium-duration capacity by 2036[126], while Germany will need 24 GW by 2037 according to the Bundesnetzagentur[129]. Germany has a RE target of 90% compared to around 30% in Korea[129]. It appears then that the latter will have a higher flexibilization need through batteries, despite having a lower VRE penetration. Vietnam has also established capacity targets for batteries[127] in the revised Power Development Plan VIII.

Battery manufacturing is the same regardless of the intended final use. It involves the same materials, even the shape of the cell can be the same. The main difference is the availability of active materials, where the majority of them go to the EV contracts, leaving less materials for BESS contracts. The figures below show the most common LIB cell type for both EVs and ESS. For the first one, prismatic types represented 47% of the total demand in 2024, followed by pouch types (27%). For EES, the predominant type is cylindrical, with 58% of the total demand in 2024. These percentages are projected to stay the same for both EVs and EES in 2025. The graphs also show the disparity in demand for EVs vs. BESS. For example, in 2024, the EV demand was of 1,099 GWh, while BESS represented only 54 GWh.

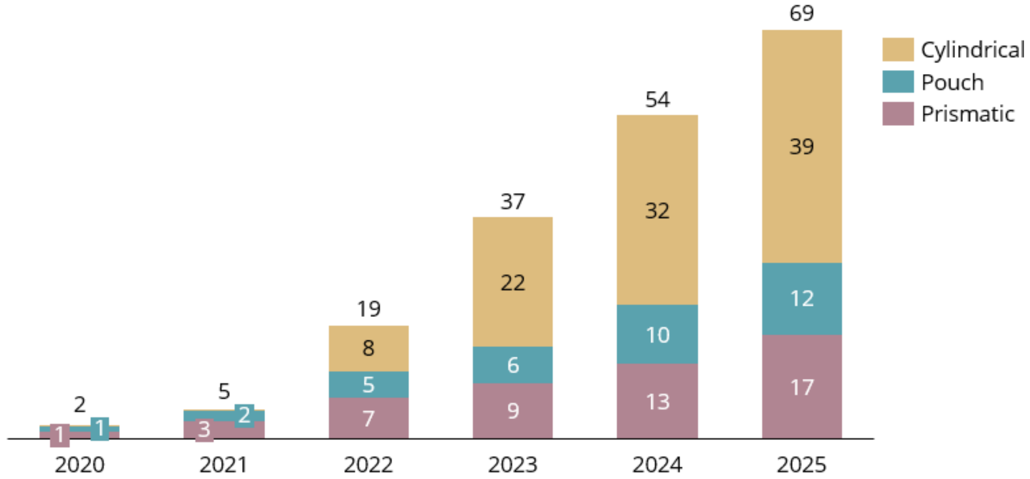
Figure 3.4 LIB cells demand (GWh) – EVs



Source: SC Insights[128]

[125] Dharik S. Mallapragada, et. al. "Long-run system value of battery energy storage in future grids with increasing wind and solar generation" Applied Energy, Volume 275, 2020, https://doi.org/10.1016/j.apenergy.2020.115390.
[126] Energiepartnerschaft (2025). Battery Energy Storage Systems in Korea and Germany. https://energypartnership-korea.org/fileadmin/korea/media_elements/Battery_Energy_Storage_Systems_in_Korea_and_Germany.pdf
[127] https://www.giz.de/en/downloads/giz2025-en-sector-analysis-vietnam-battery-energy-storage-systems.pdf
[128]Li-ion Battery Supply Chain Insights. https://sc-insights.com/services/

Figure 3.5 Global LIB cells demand (GWh) – ESS



Source: SC Insights[126]

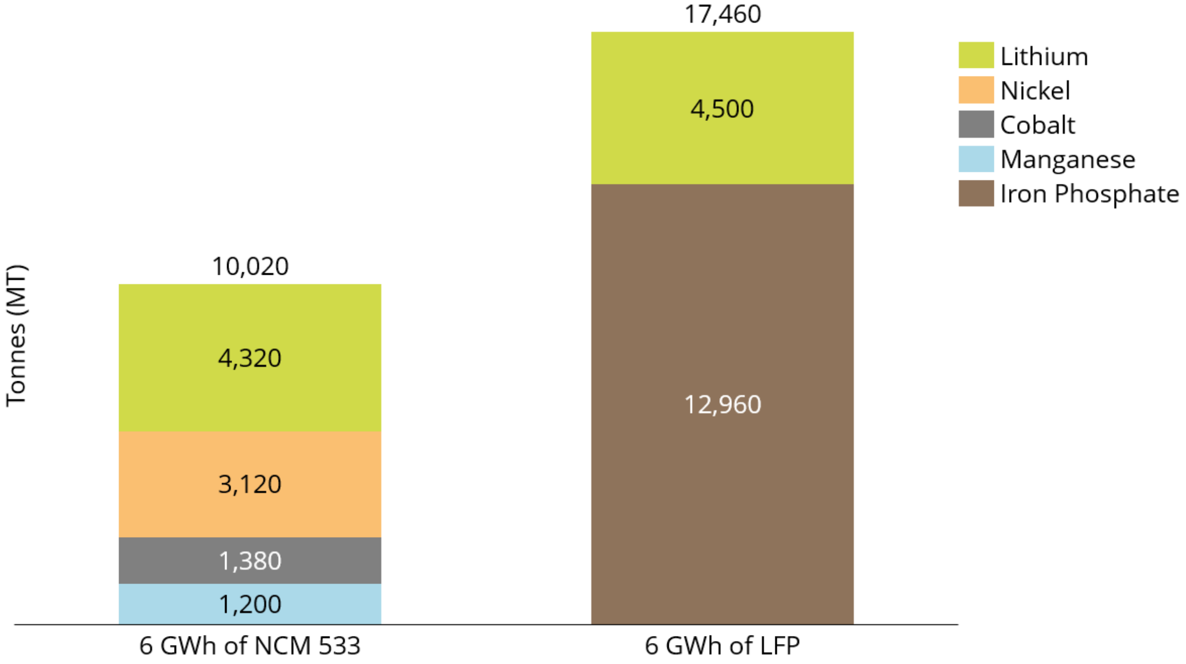
For Indonesia, this report echoes the RUTPL 2025 and encourages undertaking a specific study of the country's power grid to determine the penetration target for BESS, the timeframe for it, and possible locations. This would allow for manufacturing capacity to be expanded accordingly.

RUPTL 2025[129] includes in its projections the Accelerated Renewable Energy Development (ARED) scenario, which includes strategic programs such as the development of Green Enabling Transmission, Smart Grid, Smart Control System, Flexible Generation, co-firing, Carbon Capture Storage (CCU)/Carbon Capture Utilization Storage (CCUS), Battery Energy Storage System (BESS), or other emission reduction programs. It also includes a Strategy for Developing VRE with BESS. According to the strategy, BESS can be used as firm capacity paired with VRE sources. The BESS requirement for frequency smoothing is a minimum of 10% of the capacity of the VRE power plant or as determined by a study. The document also mentions that these VRE with BESS projects with firming requirements must technically compete with reliable baseload power plants e.g., geothermal power plants, combined cycle gas power plants, and hydroelectric power plants, and be financially equivalent to the operating costs of the base load or not higher than the system's marginal cost[129].

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 fir 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. Tables with full data calculations can be found in Annex 5.

[129] RUPTL 2025-2034. https://gatrik.esdm.go.id/assets/uploads/download_index/files/b967d-ruptl-pln-2025-2034-pub-.pdf

Figure 3.6 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. Additionally, the country could consider using retired EV batteries for storage. End-of-life grid storage consists of grouping batteries that have fallen below 80% of its original capacity and are therefore no longer useful for EVs (due to lower driving ranges) and using them as grid storage. This is already a common practice in some countries like Germany, Japan, and the US, and by automakers. In the UK, JLR will test a storage unit of 270 kWh of used EV batteries sourced from its plug-in hybrid Range Rover and Range Rover Sport vehicles[130]. ERCOT has been testing 900 used EV batteries since May 2024, with a storage capacity of 53 MWh[131].

Reused EV batteries do not have to undergo additional processing before being used in BESS.

3.3 Integration and implementation of the supply chain

Plans to seamlessly integrate the supply chains for batteries used in EVs and BESS with renewable energy power plants would allow Indonesia to adopt a holistic approach to tackle a number of their energy goals, while reducing the risk of each individual investment.

The government would need to strengthen policies to support battery manufacturing and supply chain development as discussed later in this document. This includes tax incentives, subsidies, and streamlined regulatory processes to improve permitting confidence, amongst other things. These initiatives align with the MEMR energy sector

[130] April 2024. "JLR unveils portable energy storage system made with used EV batteries" https://www.edie.net/jlr-unveils-portable-energy-storage-system-made-with-used-ev-batteries/
[131] November 2024. "Element Energy commissions 'world's largest' second life BESS at 53MWh, partners with LG ES Vertech". https://elementenergy.com/element-energy-commissions-worlds-largest-second-life-bess-at-53mwh-partners-with-lg-es-vertech/

roadmap for a Net Zero Emissions by 2060[132], the RUKN 2024 and the RUPTL 2025 frameworks emphasizing energy efficiency and sustainability.

Additional considerations for the integration of the supply chain for batteries include:

- **Cross-Sector Collaboration**: Foster collaboration between electric vehicle manufacturers, renewable energy companies, and battery producers to create a cohesive ecosystem. By sharing data and insights, these stakeholders can align their production schedules, anticipate demand fluctuations, and respond swiftly to market changes.
- **Flexible Manufacturing**: Establish adaptable manufacturing facilities capable of producing batteries for both electric vehicles and renewable energy applications. This flexibility allows for quick adjustments in production based on demand, reducing lead times and maintaining supply chain continuity.
- **Standardization and Compatibility**: Develop standardized battery designs and specifications that can be used interchangeably in electric vehicles and renewable energy systems. Standardization simplifies the supply chain, reduces production costs, and enhances the scalability of battery technologies. Indonesia could align its domestic standards with the ones of other countries it wishes to export batteries to, like China and Japan.
- **Advanced Inventory Management**: Utilize AI-driven inventory management systems to monitor stock levels, predict demand, and automate reordering processes. This approach ensures that battery components and finished products are consistently available, preventing bottlenecks and shortages.
- **Sustainable Practices**: Integrate sustainable practices throughout the supply chain, from raw material sourcing to recycling and disposal. By prioritizing eco-friendly materials and processes, Indonesia can minimize the environmental impact of battery production and support the circular economy.
- **Infrastructure Synergy**: Align infrastructure development plans for electric vehicle charging stations, solar PV installations, and other renewable energy projects. Coordinated infrastructure expansion ensures that the deployment of battery technologies supports the broader goals of energy transition and sustainability.

By adopting these principles, Indonesia can create a robust and integrated supply chain that supports the growing demand for batteries in both EVs and renewable energy power plants, while also promoting efficiency, innovation, and sustainability.

3.4 Financing of battery supply chain projects

As with any investment, it is essential to present a predictable and transparent risk and return profile to attract lenders and investors. Projects that are considered to have lower risk are more appealing and consequently can attract a broader spectrum of investors, often on more favourable and cost-effective terms. In contrast, projects with higher risk typically need to offer larger returns to secure investment.

To effectively track the financial attractiveness, health and progress of the battery supply chain, several key financial metrics should be considered. The indicators below are relevant regardless of the position in the supply chain and should be evaluated on a case-

[132] IEA. September 2022. An Energy Sector Roadmap to Net Zero Emissions in Indonesia. https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia

by-case basis, ideally as an integrated model to ensure the supply chain remains robust from beginning to end.

- **Return on Investment (ROI):** Measure the profitability of investments in battery supply chain projects to ensure they meet financial performance expectations and contribute to sustainable economic growth.
- **Cost-Benefit Analysis (CBA):** Evaluate the costs and benefits of various projects to prioritize initiatives that offer the most significant returns in terms of energy efficiency, environmental impact, and economic benefits.
- **Capital Expenditure (CAPEX):** Monitor the total investments made in infrastructure, manufacturing facilities, and technology acquisition to ensure alignment with budgetary allocations and strategic goals.
- **Operational Expenditure (OPEX):** Track ongoing operational costs associated with battery production, logistics, and recycling to optimize spending and achieve cost-efficiency.
- **Revenue Growth:** Analyse revenue trends from the sale of batteries, technology licenses, and international partnerships to assess the market's acceptance and financial viability.
- **Gross Margin:** Monitor the difference between revenue and the cost of goods sold to ensure profitability in the manufacturing and distribution processes.
- **Payback Period:** Calculate the time required to recoup initial investments in battery projects to assess financial feasibility and investment attractiveness.
- **Net Present Value (NPV):** Determine the present value of future cash flows generated by battery projects to evaluate their long-term profitability and sustainability.
- **Internal Rate of Return (IRR):** Assess the expected annualized rate of return on battery investments to compare with other investment opportunities.
- **Debt-to-Equity Ratio:** Maintain a balanced ratio to ensure the financial stability of battery supply chain projects, reflecting the project's reliance on debt versus investor equity.

Although all previously described metrics should be revised base on a project-by-project basis, the last one, Debt to Equity, should be paid special attention. Project financing traditionally relies on equity investment, supplemented by project finance mechanisms to ensure sufficient capital allocation. The debt-to-equity ratio is typically 60:40, though this varies based on the company's risk profile, contractual agreements, and overall financial strategy.

Equity financing can be sourced from various entities, including private equity firms, pension funds, hedge funds, infrastructure funds, high-net-worth individuals (HNWIs), and family offices. Each of these investors exhibits distinct risk-reward preferences, as shown in Figure 3.7.

Figure 3.7 Acceptable ROIs depending on the investor type

Investor type	Acceptable ROI
HNWIs and Family Offices	• This entities seek higher returns, desired ROI often ranges between **10-50% for HNWIs**, and **5-20%for family offices**. These entitited commonly require the investment opportunity to be significantly de-risked before committing capital
Pension Funds, Hedge Funds or Infrastructure Funds	• They commonly accept projects with **12-30% ROI. This fund usually seek to g**uaranteed low-risk returns over the 10-year period.
Private Equity and Institutional Funds	• Usually persue moderate returns with long investmeent horizons aiming for **3-10% ROI**, aligning their expectations with calculated risk exposure

Source: Common practices in the industry, provided by The CloudMiner[133]

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, which in many instances has become nearly unattainable. This situation is compounded by recent high-profile setbacks in the clean energy and battery sectors—such as the financial difficulties faced by Northvolt, Britishvolt, and Li-Cycle—which have significantly dampened investor confidence and reduced the risk appetite of both lenders and equity investors.

To address these financing constraints, alternative funding mechanisms such as streaming agreements, royalty deals, and pre-payment structures have emerged as viable options that avoid equity dilution.

- **Streaming and royalty agreements** provide upfront capital in exchange for a share of future revenues or profits. While these instruments enhance liquidity, they can significantly impact long-term earnings potential.
- **Pre-payment arrangements** involve receiving advance payments for future product deliveries, typically at discounted prices. This model improves short-term cash flow but may compress profit margins over time.

Each of these financing structures introduces financial trade-offs that influence a project's revenue outlook and EBITDA performance, depending on the specific terms negotiated and the project's underlying profitability.

As a result of these limitations, producers are increasingly turning to innovative financing models to unlock capital for mining and refining projects concurrently. For example, companies such as Castlepines[134] and The CloudMiner[135] are currently piloting the use of

[133] A Mineral Valuation Platform | TheCloudMiner
[134] Castlepines Equity – Funding secure investments
[135] A Mineral Valuation Platform | TheCloudMiner

Special Purpose Vehicles (SPVs) to mobilize funding. The SPV maintains an equity position in each entity as part of the return structure. After 10 years, full production rights are restored, enabling the assets to negotiate independently with the remaining ~60% of production. Additional clawback provisions may be included, such as equity adjustments or substitutable volumes, providing protection for the off taker. Once structured, the SPV can be financed by companies e.g., Castlepines, through a bankable fixed-income vehicle managed by a leading financial institution.

The structure of the SPV model is illustrated in Figure 3.8.

Figure 3.8 Special Purpose Vehicle (SPV) trials for mining and refining

Special Purpose Vehicle (SPV) for Mining and Refining

A portion of the off-take is secured through a credible, bankable off-take partner, such as an original equipment manufacturer (OEM) or, in specific cases, government entities, at a fixed price over a 10-year period. The price and volume of the off-take are strategically designed to repay the full capital investment over the designated period, with a targeted **internal rate of return (IRR) of 10-12%.**

The supplier (in this case the mine), converter, and off-taker must mutually agree on the terms. For example, **a percentage of the mineral produced by the mine could be committed to an OEM at a fixed price slightly above current market levels but well below medium-term forecasts**. This agreement also incorporates a tolling fee for the converter, allowing both assets to access capital immediately, eliminating the need to raise equity, negotiate valuations, or arrange debt, which would typically involve high fees and time-consuming processes. **The focus remains solely on execution and production.**

There is a large, untapped pool of low-risk money that could potentially be interested in this, such as pension and infrastructure funds that would be willing to settle for 10% ROI at low risk. However, to access this funding, projects need to show strong, bankable counter parties on the off take. For mining and refining projects, the most bankable off takers are usually the end users of the contract, with automotive companies being the strongest ones, since their interest is getting supply chain stability and price visibility.

Upon rating approval and market introduction, pension funds and infrastructure funds can participate, securing guaranteed low-risk returns over the 10-year period. According to TheCloudMiner, this SPV is critical for the development of new supply chains for critical minerals under the current low-price environment, since it offers a viable pathway, with increasing industry alignment around this approach.

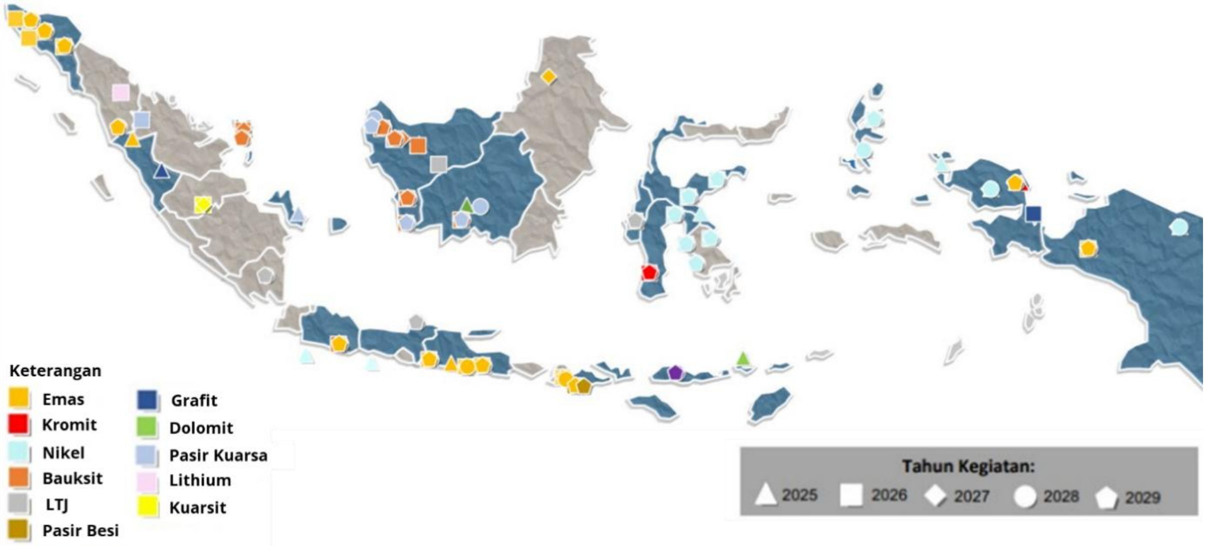
While Indonesia has experience in Nickel mining, changing market conditions, falling prices, and the need to increase mineral production globally to cover the rising demand of different battery types makes project finance for mining and refining critical to secure investments across all the supply chain, especially since contracts are usually tied to off takers as previously stated. 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).

3.4.1 Investment Opportunities in Indonesia

Indonesia presents a compelling investment landscape for the battery and renewable energy sectors, underpinned by its position as the world's largest in both mine production and reserves—accounting for 59% of total global nickel mine production and 42% of global reserves.[136] [137] The country's vast mineral wealth includes 15 mineralization belts stretching over 15,000 km. While roughly 7,000 km have been actively explored and developed, the remaining 8,000 km remain largely untapped, offering significant potential for future exploration.[138]

In support of this, Ministerial Decree No. 296.K/MB.01/MEM.B/2023 outlines Indonesia's critical and strategic mineral exploration roadmap for the 2025–2029 period (Figure 3.9), signalling clear opportunities for investment in upstream mineral development and downstream processing of battery-grade materials. Strengthening this value chain positions Indonesia to play an increasingly important role in global battery production.

Figure 3.9 Strategic Mineral Exploration Activity Plan 2025-2029



Source: [*Geology agency, MEMR*]

On February 2025, President Prabowo inaugurated Daya Anagata Nusantara (Danantara), Indonesia's sovereign wealth fund, backed by an initial investment of US$ 20 billion to finance strategic national projects—including nickel downstreaming[139]. This move signals strong public sector commitment and opens the door to private sector collaboration in industrial development.

Further reinforcing this trajectory, Presidential Regulation No. 12/2025 and the newly issued 2025–2029 National Medium-Term Development Plan (RPJMN) designate nickel downstream development as National Priority No. 5, highlighting the sector as a cornerstone of Indonesia's industrial and energy transition strategy.[140]

---

[136] U.S. Geological Survey, *Mineral Commodity Summaries 2025, ver. 1.2, March 2025 (Reston, VA: U.S. Geological Survey, 2025).* Link

[137] Ministry of Energy and Mineral Resources of the Republic of Indonesia, Press Release No. 646.Pers/04/SJI/2024: Minister Bahlil Reaffirms Presidential Directive on Downstreaming at Indonesia Mining Summit, December 4, 2024. Link

[138] Geological Agency, Ministry of Energy and Mineral Resources of the Republic of Indonesia, *GeoMap: Geological Map Services of Indonesia.* Link

[139] Tempo, 2024 ; Media Nikel Indonesia, 2024

[140] Presidential Regulation No. 12/2025, the 2025-2029 National Medium-Term Development Plan (RPJMN). Link

Indonesia presents a highly attractive investment landscape, supported by a metallogenic belt that stretches over 15,000 km and hosts 15 major mineralization corridors[141]. This provides exceptional potential, especially in nickel reserves, and positions Indonesia as a strategic player in the global battery supply chain.

To capitalize on this, adopting a clear strategy for diversifying investment sources and expanding international partnerships is essential. As mentioned before in this report, the current state of play presents Chinese actors dominating Indonesia's battery supply chain. Relying on a single actor introduces challenges to cost competitiveness and supply chain disruptions.

3.4.2 Regulatory pathway to invest in Indonesia

This section provides a snapshot of the series of steps companies must follow to set up business in Indonesia (Figure 3.10)[142]. Mining and battery manufacturing are included as an example, but any company that wishes to invest in Indonesia must follow steps 1 to 5, no matter its business line. Indonesia has established a risk-based licensing system[143] where the government evaluates the level of risk associated with the industry and company size, and derived from this analysis, a risk level is determined. Permitting and licensing requirements depend on the assigned risk. An Online Single Submission (OSS) system was created to facilitate the application procedure and share documents between various authorities in a simplified manner.

[141] Geology Agency, MEMR, Link
[142] ASEAN Briefing (January 2024) "Prospects for Electric Battery Production in Indonesia" pp. 12-15. https://admin.cacac.com.cn/profile/2024/04/26/1e57912d-fae8-40ca-b80a-23e019ea0c53.pdf
[143] 09-08-2021. "Gov't Launches Risk-Based OSS System for Business Licensing". Cabinet Secretariat of the republic of Indonesia. https://setkab.go.id/en/govt-launches-risk-based-oss-system-for-business-licensing/

Figure 3.10 Five step investor pathway

1	Comply with requirements for setting up a company	1. **Register in the OSS** and upload applicable registrations needed • Local tax office certificate • Company name registry • Key personnel (director ID and name) • Size of business (area and employees)	2. **Determine industrial business classification code** (KBLI) • For Nickel mining: 07295 • For Battery manufacturing: 27203
2	Obtain applicable permits - Risk-Based Licensing System	• **Nickel ore mining is classified as High risk**. Mining needs a Business License Required Standard Certificate to operate • **Battery manufacturing is classified as High risk** as well. Manufacturers need a Standard Certificate to operate, and must meet Battery Industry Standards For Electric Motor Vehicles	• Foreign companies are required to **have 10 billion rupiah in paid-up capital,** excluding land and buildings for business premises.
3	Preparation stage	• Land acquisition, AMDAL (Environmental Impact Assessment), recruitment, feasibility studies and procurement of supplies or other inputs must be done, according to applicable regulation that can be found in the OSS (mainly MoI and MERM regulations)	• **Mining needs permits** for exploration, production operation, and another permit if it will be paired with processing and/or refining activities • **Batteries must follow MoI regulations** for manufacturing processes
4	Commercial operation	• Start of commercial activities once all requirements are met • Comply with annual reporting as mandated (also done through OSS). Mining and batteries report to MEMR and MoI respectively	
5	Incentives claim	• Any applicable incentives must be applied for and/or requested through the OSS system during the established time frame (varies depending on the type of incentive).	

Source: Authors with information from OSS [144] [145] and BKPM [146]

To receive the benefits of a fiscal incentive, investors must follow a formal application process. All claims must be submitted through the Online Single Submission (OSS) system, which serves as the centralized platform for investment-related procedures. The process is standardized across all types of fiscal incentives and follows a uniform set of steps, as illustrated in the figure below.

[144] KBLI 2020 – 27203. Industri Baterai Untuk Kendaraan Bermotor Listrik. Klasifikasi Baku Lapangan Usaha Indonesia (KBLI) 2020. https://oss.go.id/informasi/kbli-detail/36281f3c-5a9b-45de-a5b8-a422fc0e90cf
[145] KBLI 2020 – 07295. Pertambangan Bijih Nikel. Klasifikasi Baku Lapangan Usaha Indonesia (KBLI) 2020. https://oss.go.id/informasi/kbli-detail/fb3ede94-145f-4eb7-b6e6-412af4634d30
[146] Dec 2023. INDONESIA INVESTMENT GUIDEBOOK. Ministry of Investment. https://kemlu.go.id/files/repositori/74487/1734183425675d8a01e23de_7b__BKPM_GuideBook_2023.pdf

Figure 3.11 How to make an incentive claim? – example

1. OSS portal: registration and selection of incentive type

- Business Identification Number and type of incentive is needed
- Some incentives may have a deadline, e.g. the Luxury Good Sale Tax, Value-Added Tax and Import Duty incentives for EVs must be applied for no later than 1 March 2025

2. Submission of documents

- Fixed asset investment plan, Debt-to-equity ratio analysis, Business plan and feasibility study, Tax compliance certificates

3. Verification and Review

- Conducted by BKPM and Ministry of Finance

4. Post-Approval Obligations

- Submit quarterly reports, comply with audits and reapply as needed

Source: Invest in Asia[147]

3.5 Key development areas

Indonesia has outlined an ambitious policy framework to advance its energy transition and build a domestic battery supply chain. The foundation for this direction is reflected in national targets and long-term development plans, which aim to support EVs adoption and improve BESS capacity. With its significant mineral reserves and renewable energy potential, the country has a strong basis for moving forward. However, the pace of progress remains uneven across different parts of the battery ecosystem. Thus, it becomes imperative to identify key strategic areas where targeted action will derive in enhanced opportunities for development, outlined below.

- ### Stakeholders and Funding

Given the complexity of the battery supply chain, which encompasses multiple stages, intricate regulations, and the involvement of diverse stakeholders, effective collaboration is critical to its successful development. As outlined in Table 1.5, the various stakeholders involved require a clear framework that can function as a strategic mechanism to strengthen Indonesia's battery supply chain. Empowering stakeholders can accelerate progress across all segments of the value chain. Collaboration between government institutions and the private sector can play a vital role in identifying and addressing bottlenecks at each stage of the supply chain[148].

[147] 09-05-2025 "How to apply for Indonesia Investment Incentives via OSS" Invest in Asia. https://investinasia.id/blog/applying-for-indonesia-investment-incentives-via-oss/
[148] RMI & Global Battery Alliance. (2025, January). Overcoming battery supply chain challenges with circularity (White paper). Link

The regulatory framework, notably Ministry of Industry Regulation No. 28/2023, mandates the participation of all relevant stakeholders, including industry players, government agencies, civil society organizations, and research institutions. The regulation emphasizes the importance of feedback and joint action to continuously improve procedures and ensure that they are inclusive and applicable across all sectors.

This collaborative imperative should be further supported by efforts to expand public-private partnerships. Several international initiatives, such as the Initiative for Responsible Mining Assurance (IRMA) and the Responsible Minerals Initiative (RMI), demonstrate the value of shared responsibility in addressing sustainability risks. Strengthening stakeholder collaboration through structured frameworks and global initiatives can facilitate ongoing dialogue to bridge gaps between expectations and challenges faced across the supply chain, from upstream to downstream[149].

- **Research and Development**

Research and development (R&D) is essential to ensure a sustainable battery supply chain. The sustainability of the supply chain can be measured through production capacity and the technological readiness of various components and processes involved. Continuous R&D and staying updated with recent technologies can improve industries' resource efficiency, adoption of local content, and good practices.

Furthermore, Indonesia could position itself as a world leader by implementing artificial intelligence (AI) in various aspects of the energy and battery strategy early which can significantly enhance efficiency and innovation. For instance:

- **Predictive Analytics**: Utilize artificial intelligence to forecast energy demands and optimize the integration of renewable sources such as geothermal, solar photovoltaic (PV), and wind power, ensuring stability and reliability in the energy supply.
- **Smart Grid Technology**: Deploy AI-driven smart grids to enhance energy distribution, monitor usage patterns, and reduce wastage, aligning with the objectives of the National Energy Policy (KEN) and the General Plan for National Energy (RUEN).
- **Supply Chain Optimization**: Apply artificial intelligence to streamline logistics, predict supply chain disruptions, and manage inventory for battery manufacturing, thereby reducing costs and improving efficiency.
- **Advanced Research and Development**: Use artificial intelligence to expedite research and development by simulating various battery technologies, predicting performance, and identifying the most promising innovations, thus supporting targeted investment in R&D.
- **Environmental Monitoring**: Employ artificial intelligence to track environmental impacts, manage recycling processes, and ensure regulatory compliance in battery production and disposal, promoting sustainability and adherence to national and international standards.

To ensure the success and sustainability of these supply chains, it is essential to assess the technological readiness of various components and processes involved. Technology Readiness Levels (TRLs) provide a systematic framework for evaluating the maturity of technologies, from initial concept through to full commercial deployment.

[149] European Bank for Reconstruction and Development. (n.d.). *Sector supply-chain guidance batteries: Environmental and social risk management toolkit for financial intermediaries*. Link

The application of TRLs in the battery value supply chain provides a structured approach to evaluating the readiness and reliability of technologies across the entire supply chain, from raw material sourcing to battery recycling. Each stage of the supply chain can be assessed using TRLs to ensure technological maturity and risk mitigation.

- **Raw Material Sourcing:** The sourcing of raw materials such as lithium, cobalt, and nickel is critical for EV battery production. At TRL 1-3, research focuses on identifying new sources and extraction methods both domestically and where necessary internationally to meet in country demands. As technologies progress to TRL 4-6, laboratory and pilot-scale validations are conducted to assess feasibility and environmental impact. At TRL 7-9, operational demonstrations and commercial-scale implementations ensure the reliability and sustainability of raw material supply.
- **Battery Manufacturing:** Battery manufacturing involves multiple processes, including electrode preparation, cell assembly, and battery module integration. At TRL 1-3, new materials and manufacturing techniques are conceptualized and tested. TRL 4-6 involves validating these processes in controlled environments. By TRL 7-9, full-scale manufacturing lines are established, and the technology is optimized for mass production.
- **Battery Testing and Validation:** Ensuring the safety, performance, and longevity of EV batteries is paramount. TRL 1-3 encompasses theoretical and experimental studies on battery behavior. TRL 4-6 includes laboratory and field testing under various conditions. At TRL 7-9, extensive validation and certification processes are undertaken to meet industry standards and regulatory requirements.
- **Battery Recycling and Reuse:** The end-of-life management of EV batteries is crucial for sustainability. TRL 1-3 focuses on developing recycling methods and reuse strategies. TRL 4-6 involves pilot projects and technology validation in relevant environments. At TRL 7-9, commercial-scale recycling facilities and reuse applications are implemented, ensuring a circular economy for battery materials.

The implementation of TRLs in EV battery supply chains offers several benefits as shown in Figure 3.12

Figure 3.12 Importance of TRLs in EV Battery Supply Chains

Risk Mitigation	By assessing the maturity of technologies at each stage, potential risks can be identified and addressed proactively
Informed Decision-Making	Stakeholders can make better decisions regarding investment, development, and deployment based on the TRL assessment
Resource Optimization	Efficient allocation of resources is ensured by focusing on technologies that are closer to commercial readiness
Regulatory Compliance	Adherence to industry standards and regulatory requirements is facilitated through systematic TRL evaluations

The application of Technology Readiness Levels in EV battery supply chains is crucial for ensuring the successful development, deployment, and sustainability of these technologies. By systematically evaluating the maturity of each component and process, stakeholders can make informed decisions, mitigate risks, and optimize resources. As the

EV industry continues to evolve, the use of TRLs will remain a vital tool in driving innovation and achieving a sustainable future for electric mobility.

An overall impact assessment of the supply chain should also be done in response to market pressures, especially related to ESG concerns. Indonesia's existing ESG framework is focused mainly on industrial-scope activities. Indonesia can benefit from embedding ESG requirements into local content policies, which can tap into a wider network of local suppliers and fill in the gaps. A battery supply chain equipped with the latest technology that demonstrates sustainability and good governance attracts foreign investment.

In addition, the government should review policy instruments related to battery cell development and domestic manufacturing. Policy implementation and goals should be regularly assessed against national priorities. With its many instruments and institutions and dynamic market changes, Indonesia can benefit from such regular review to continuously evaluate policy effectiveness and keep updated on market developments. Regular assessments and policy adjustments are essential to ensure consistency between adopted measures and Indonesia's long-term energy and industrial goals.

- **Infrastructure**

In recent years, significant progress has been made in developing Indonesia's battery and EV infrastructure ecosystem. However, infrastructure distribution and accessibility remain far from optimal. In 2024, battery and EV infrastructure is mainly developed in Java (966 public charging station units), a marked difference from its immediate second place of Sumatra (165 units)[150]. The national target of establishing over 60,000 public charging stations by 2030 remains difficult to achieve without substantial intervention[151]. Lack of battery and EV infrastructure leads to range anxiety by prospective consumers and hinders domestic EV adoption.

The Government of Indonesia should provide more targeted support to address these concerns, particularly through direct investment. Direct public investment in charging station development and incentives for private charging installations, as implemented in countries like the European Union and China, can help accelerate progress through streamlined approval processes and simplified regulatory procedures[152]. Better incentive schemes, grant mechanisms, and fund allocations can also improve this gap.

Regarding domestic EV manufacturing, in 2023 the country produced 15,358 fully electric 4-wheeled vehicles which shows how far the manufacturing capacity is from the current national targets (Section 1). The current annual manufacturing capacity is of around 53,300 for 4-wheeled vehicles and 1.5 million for 2-wheeled vehicles[153]. Chinese EV manufacturer BYD announced a new facility that will have an annual capacity of 150,000 EVs[154] by the end of 2025. However, to reach the targets, Indonesia must increase its manufacturing production around 18 times in under 5 years. This important challenge requires cooperation and coordination from several ministries, as the RACI matrices

[150] GoodStats, Jumlah SPKLU Indonesia Capai 1,3 Ribu di 2024, Link
[151] IESR, Indonesia Electric Vehicle Outlook 2023, Link
[152] International Council on Clean Transportation. (2024, January). *Charging up China's transition to electric vehicles*. Retrieved April 2025, Link
[153] Annual production capacity of electric vehicle (EV) manufacturing in Indonesia as of April 2024, by vehicle type. https://www.statista.com/statistics/1609642/indonesia-ev-production-capacity-by-vehicle-type/
[154] 20-01-2025. BYD is about to open another massive EV plant overseas with 150,000 vehicle capacity. https://electrek.co/2025/01/20/byd-open-new-ev-plant-overseas-150000-vehicle-capacity/

(Responsible, Accountable, Consulted, and Informed) from the roadmap in the following section show (Section 4). A periodic revision of incentives is necessary to guarantee locally produced EVs are competitive against imported ones, and that domestic demand keeps up with manufacturing. According to Gaikindo data, 6,523 BEV and PHEV had been produced in Indonesia from January to April 2025[155], from a total of 24,020 in sales, meaning around 27% of them were manufactured locally.

Additionally, if this level of EV sales continues (around 72,000 units sold annually), then by 2030 only 432,360 additional EVs will be on the road.

Mindful of Indonesia's broader national targets, infrastructure policies, financing mechanisms, and national strategies have to be aligned to ensure that battery technology deployment effectively supports national energy transition goals. Regularly reviewing policy implementation can help Indonesia keep track of its energy transition objectives. Poor policy implementation can lead to Indonesia being more focused on responding aggressively to the international markets and abandoning national battery ecosystem development, and ultimately, net-zero goals.

- **End-of-Life**

As electric vehicle (EV) adoption grows, managing batteries at the end of their life cycle will become a critical issue for Indonesia. Strategic measures are needed to address this challenge, including adopting Extended Producer Responsibility (EPR) schemes and incentives for reuse and recycling.

At the time of this study, Indonesia lacks specific regulations governing the battery end-of-life (EOL) stage. The government should develop policies to implement EPR schemes, revise existing waste regulations, particularly related to battery recycling, and provide dedicated financial support to ensure battery EOL infrastructure is ready by the time EV adoption has reached a scalable scope. The BEV roadmap has stated that EOL infrastructure shall be developed within the timeframe of 2022-2030[156].

In addition, Indonesia should actively participate in global standardization efforts, particularly in developing criteria for battery durability, reusability, and recyclability, to align domestic practices with international norms and promote circular economy principles. Producing batteries compliant with global standards increases product competitiveness and usability beyond Indonesia.

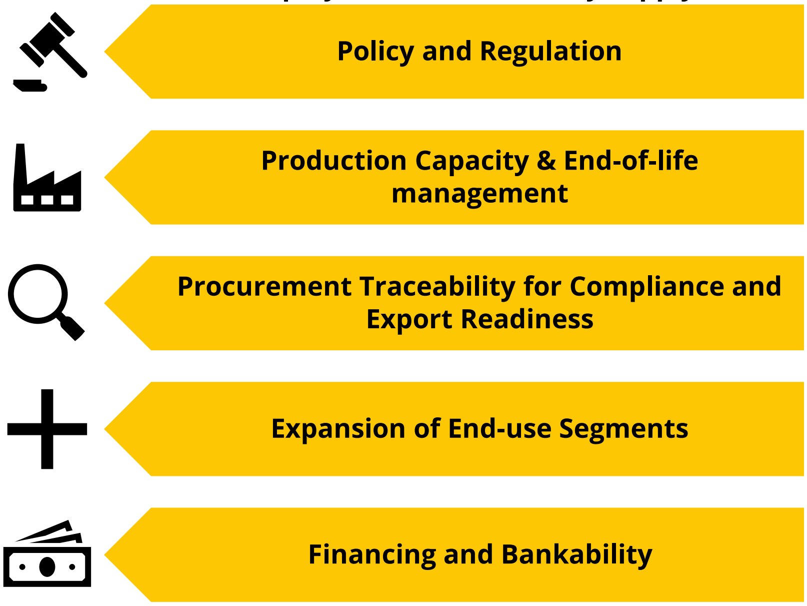
[155] Gaikindo production data. Jan-Apr 2025. https://www.gaikindo.or.id/indonesian-automobile-industry-data/
[156] MOI Regulation No. 28 of 2023 Appendix I

4. Roadmap implementation plan

As discussed in Section 2, key components such as battery cell management, battery recycling, and investment readiness continue to face gaps in regulatory support, scalability, and alignment with national targets. These issues limit the effectiveness of current initiatives and signal the need for more coordinated and targeted responses.

This study identified a series of risks and challenges concerning the supply chain battery deployment, as highlighted in Section 2.3. Five key action areas to address them have been defined, as described in Figure 4.1.

Figure 4.1 Key action areas for the deployment of the battery supply chain in Indonesia



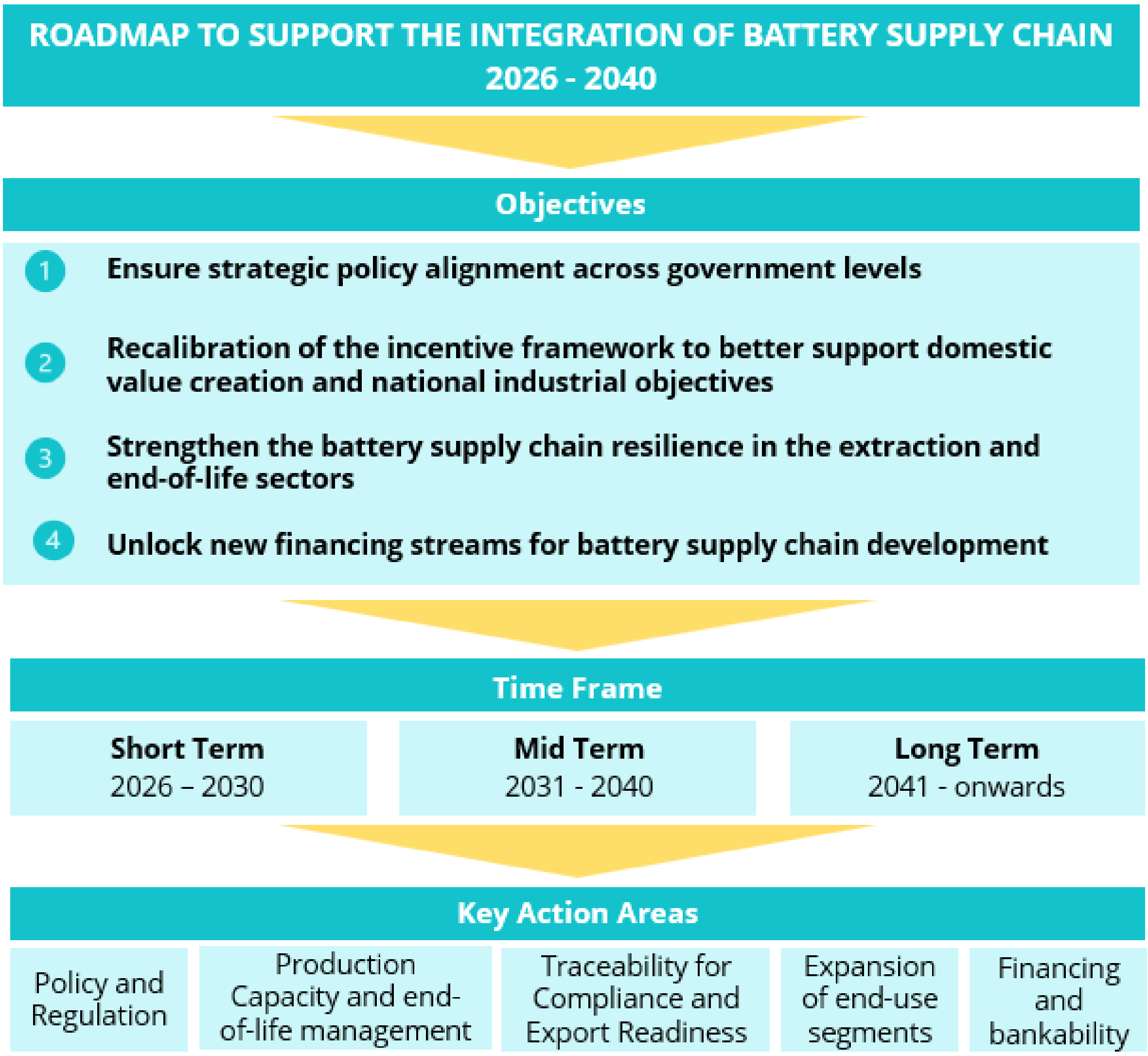
The identified challenges in each action area are described in Table 4.1, along with the recommended actions to address them.

Table 4.1 Challenges across the battery supply chain and proposed actions

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
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	

A roadmap has been developed (Figure 4.2) to recommend specific activities to address the challenges described in the short, mid and long term.

Figure 4.2 Roadmap to support the integration of battery supply chain (2026 - 2040)



Both the actions of the roadmap and the time frame at which each activity has been defined are based on national targets set for the electricity, transport and industry sectors. The Ministry of Energy and Mineral Resources (MEMR) published a Net Zero Emissions (RNZE) Roadmap in 2022[157]. According to the roadmap, with current policies, the electricity sector will account for approximately 35% of emissions growth through 2050, and remains the largest emitting sector through to 2060 (IEA, 2022. Electrification of transport and other end uses in the residential and building sectors is expected to significantly increase electricity demand. This reinforces the urgency of decarbonizing the power sector as a cornerstone of Indonesia's climate mitigation strategy.

[157] International Energy Agency. September 2022. An Energy Sector Roadmap to Net Zero Emissions in Indonesia. https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia

The Government of Indonesia (GoI) has begun integrating its net-zero-by-2060 target into key planning instruments, including the National Electricity Master Plan (RUKN 2025) and PLN's Electricity Business Plan (RUPTL 2025). Both documents highlight the need to align Battery Energy Storage Systems (BESS) and Variable Renewable Energy (VRE) deployment with the net-zero target. Under the RUPTL 2025, BESS targets are set at 2.5 GW by 2034 under the Renewable Energy Base Scenario, and 6 GW under the Accelerated Renewable Energy Development Scenario.

In the transport sector, the Ministry of Transport has recently introduced electrification targets for public transportation. Although not yet formalized through regulation[158], a roadmap published in 2024[159] outlines plans to electrify 90% of public transport in 42 cities by 2030, and 100% by 2040. Microbuses are expected to transition by 2045. For private transport, MEMR has set a target of deploying 62,918 EV charging stations by 2030.

In the industrial and mining sectors, additional targets also influence the battery value chain. MEMR has set a similar production target of 943,764 electric vehicles by 2030. Although the same regulation mandates the operationalization of a domestic battery recycling industry by 2023, it does not set specific targets or a defined implementation strategy. Additionally, the National Development Planning Agency (Bappenas) has published a roadmap that includes a target to reduce emissions from nickel production by 81% by 2045.

At the national level, Indonesia's updated Nationally Determined Contribution (NDC) sets an unconditional target to reduce greenhouse gas emissions by 31.89% by 2030, compared to a 2010 baseline[160].

Figure 4.3 below presents a consolidated view of these targets and suggests key actions related to the battery ecosystem to help achieve them. While the figure focuses primarily on end-use sectors, it is important to note that challenges exist throughout the battery supply chain—including upstream activities such as extraction and refining. As such, several recommended actions are not directly linked to specific end-use targets but will have a critical influence on achieving them.

---

[158] International Council on Clean Transportation. June 2023. Policy roadmap for accelerating public transit bus electrification in Indonesia. https://theicct.org/wp-content/uploads/2023/06/Bus-Electrification-in-Indonesia-Briefing-Paper-Final2.pdf

[159] Institute for Transportation and Development Policy. May 2024. Peta Jalan dan Program Insentif Nasional untuk Elektrifikasi Transportasi Publik Perkotaan Berbasis Jalan. https://itdp-indonesia.org/publication/peta-jalan-dan-program-insentif-nasional-untuk-elektrifikasi-transportasi-publik-perkotaan-berbasis-jalan/

[160] Republic of Indonesia. (2022). Enhanced Nationally Determined Contribution. https://unfccc.int/sites/default/files/NDC/2022-09/23.09.2022_Enhanced%20NDC%20Indonesia.pdf

Figure 4.3 Alignment of roadmap actions and national targets to support the integration of battery supply chain (2026 - 2040)

	Short term 2026-2030	Mid term 2031-2040	Long term 2041 - onwards
Electricity	19%-22% RE generation[1] 551 MW of BESS capacity (ARED Scenario)[2] 100% electrification ratio[2] Parallel investments to grid readiness to guarantee VRE and BESS absorption	36%-40% RE generation[1] 6 MW of BESS capacity (ARED Scenario)[2] Create a robust regulatory framework concerning battery energy storage to scale up targets	70%-72% RE generation[1] Net Zero emissions by 2060[3]
Transport	90% electrification public transport in cities[4] 62,918 EV charging stations[3] Policy review of local initiatives to ensure alignment with national priorities	100% electrification public transport in cities[4] Provide more targeted and wider support for charging infrastructure development to promote EV uptake Establish targets for other transport sectors like long-haul or last-mile	Microbuses "angkot" electrification by 2045[4] Net Zero emissions by 2060[3]
Industry	600,000 domestic EV Production[5] / 943,764 EVs on the road[8] Implement Regulatory Impact Assessments to determine new package of incentives Operational battery recycling industry[5,6] 60% Domestic Content Requirement for EVs[5] Evaluate establishing a dedicated local content entity	1,000,000 domestic EV Production[5] Secure battery material feedstock, with a special focus in lithium Establish targets and policy instruments for material recovery and reuse in battery production, in anticipation of increase of batteries reaching EOL Design and implement a battery passport	Reducing carbon emissions from the nickel industry by 81% by 2045[7] International regulatory cooperation to ensure that domestic initiatives follow global standards, guaranteeing battery exportability

National targets | Roadmap actions

[1] RPP KEN 2024; [2] RUPTL 2025; [3] MEMR 2030 roadmap; [4] MoT roadmap; [5] MoI 28/2023; [6] MoI 6/2022; [7] Bappenas roadmap; [8] MEMR decree 24.K/TL.01/MEM.L/2025

Based on the identified key challenges, a comprehensive roadmap has been 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. It details a series of strategic actions, each accompanied by designated stakeholder roles, structured according to the RACI (Responsible, Accountable, Consulted, and Informed) framework.

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.

4.1 Roadmap Actions for 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:

Short-term (2026-2030)

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.[161] This would be particularly important at the moment given the Indonesian government's aim to continue and extend the downstreaming policy approach.

Indonesian national legislation does not currently have a provision that would require introducing a periodic review on local content requirement. Therefore, given the pros and cons that relate to the implementation of local content policies, it is recommended that a provision requiring a monitoring and evaluation review is embedded in the national legislative framework that dictates a thorough review of the measures adopted. Currently, Article 5(2) and (3) of the Ministry of Industry Regulation No. 6/2022, as amended by Regulation No. 28/2023, stipulates that the Ministry holds the authority to coordinate industrial development and may conduct cross-sectoral evaluations at least once annually. However, the regulation lacks further elaboration on the conduct of such evaluations. Specifically, it does not provide details regarding the methodology, responsible entities, mechanisms for ensuring transparency, the types of data to be collected, or the procedures for data handling and reporting.

1.1 Evaluate establishing a dedicated local content entity: A significant barrier to the effectiveness of local content policies globally has been the institutional framework and lack of coordination between authorities. To address this, countries have established dedicated local content entities specifically with the task of designing, governing, managing, enforcing, monitoring, and evaluating local content policies are considered vital to accomplishing their objectives.[162]

1.2 Check for any possible cross-subsidies or opposing/conflicting incentives, especially in EV imports Vs. domestic production: As previously mentioned, some incentives can have opposing established targets and can be causing opposite effects than the ones they were implemented for (see Section 2.2) 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): While this action is not directly linked to a particular target, it does support the sets of policy instruments and incentives put in place to reach them. 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

[161] 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>
[162] J Korinek and P De Sa, 'Local content policies in the mining sector' in L Y Ing and G M Grossman (eds), *Local Content Requirements: promises and pitfalls* (Routledge 2024), p. 66.

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 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.

2.1 Ex-post evaluations: Ex-post evaluations play a critical role in assessing the effectiveness and real-world impact of regulations after their implementation. In light of the dynamic nature of the sector—shaped by rapid technological advancements and shifting geopolitical landscapes—Indonesia should adopt a continuous improvement approach to regulatory governance. To ensure regulations remain responsive to evolving economic and geopolitical conditions while aligning with national development priorities, ex-post evaluations should be institutionalized as a core component of the regulatory cycle.

This requires 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 the EV market continues to evolve, there will be need to recalibrate fiscal incentives to better reflect market maturity, social equity, and strategic industrial objectives. Initial policies will require adaptation as the market matures, and domestic industry starts to take off. And although Indonesia has no EV deployment targets set, it does have incentives that are aimed to increase the number of BEVs on the road that would benefit from being evaluated, such as the exemption of the import tax for fully manufactured EVs.

In the upstream segment and to support broader EV adoption and industrial development, differentiated incentives should be applied across vehicle types in a manner aligned with national policy goals and prevailing market conditions. Fiscal support can be strategically structured to promote technologies that advance Indonesia's long-term industrial and export objectives. For example, higher subsidies could be granted for EVs utilizing nickel-based battery chemistries over those using lithium iron phosphate (LFP) batteries, which are typically more affordable but less aligned with the preferences of key export markets such as the European Union and the United States. These markets tend to favor nickel-based EV technologies, which also align more closely with Indonesia's resource endowment and industrial policy priorities. Such an approach would not only encourage domestic value addition but also enhance Indonesia's competitiveness in global EV supply chains. Indonesia could also establish a date to phase out ICE vehicles with instruments like a sales ban, thus guaranteeing long-term domestic demand for batteries, and contributing to the NDC's GHG emissions reduction targets.

On the downstream segment, an approach that could be used is to redesign consumer incentives so that they are means-tested e.g., available only to buyers below a defined income threshold, thereby ensuring more targeted and equitable access to subsidies.

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 the ENTREV project (2023–2027)[163], which involves Jakarta and Bali and promotes the development of the EV ecosystem through charging infrastructure expansion and public transport electrification—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 exemptions from rules aimed at addressing congestion and air pollution in cities could be replicated across the country. The complete list of Local Government initiatives can be found in Table 2.4. Sharing best practices and lessons learned from such programs can foster greater policy coherence and accelerate EV adoption nationwide.

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.

4.1 Alignment of targets across policy instruments: The amendment to the Specifications, Development Roadmap and Provisions for the Calculation of the Value of the Domestic Component Level of BEVs done by the Ministry of Industry Regulation No. 21/2023 set the target to locally produce 600,000 four-wheeled EVs and 9 million two-wheeled EVs. On the other hand, the Ministry of Energy Decree No. 24/2025 mentions a projection of 943,764 four-wheeled EVs on the road by 2030. These two regulatory instruments refer to different targets but have no clear connection between them. It is unclear how the domestic manufacturing target and the deployment numbers used by MEMR to calculate the number of charging stations needed interact, or how one contributes to the other. Aligning target numbers in planning instruments is crucial to properly coordinate efforts at the national level.

[163] 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

Mid-term (2031-2040)

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. It also details some possible uses for BESS in the grid like frequency smoothing and firming capacity. However, it also states that BESS requirements for smoothing and firming still require further study due to the projected massive increase in VRE. 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[164]) 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.

Therefore, 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 generation by 2060. Without a national strategy or defined targets for BESS, industry growth is likely to remain fragmented as it has been so far.

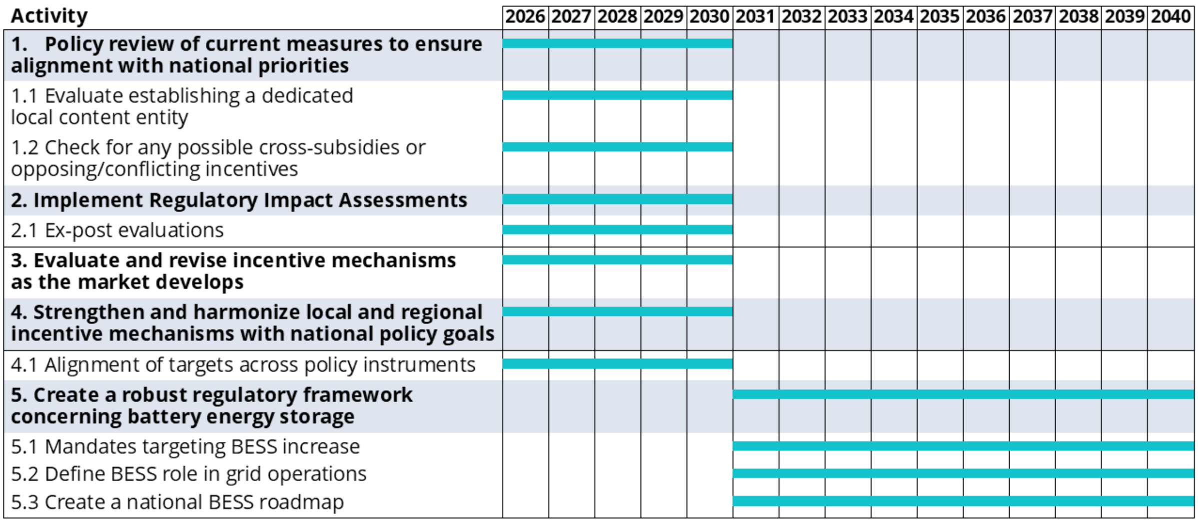
> **5.1 Mandates targeting BESS increase:** Given that Indonesia's power sector is still vertically integrated, the government could introduce realistic yet ambitious mandates requiring PLN, the Indonesian state-owned company that is the only utility in the country, to integrate a certain percentage 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 such as frequency regulation and voltage control would not only create a level playing field for BESS in the energy system but would further support the integration of variable renewable energy sources to the grid as their share in the energy mix increases. Reducing regulatory uncertainties could streamline procurement processes, derisking investments for BESS projects.

[164] 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

5.3 Create a national BESS roadmap: Indonesia does not currently have a roadmap that would be solely focused on BESS. A roadmap document that outlines targets and shows different use cases (e.g. grid support services, such as ancillary services, supporting access to energy and electrification in rural areas) would guide future investment needs and coordinated action in BESS integration.

Action plan for key area: Policy and Regulation

Figure 4.4 Gantt for activities for key area Policy and Regulation



Stakeholder roles

Table 4.2 RACI Matrix for Policy and Regulation

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

Action	MoInv	MEMR	MoE	MoI	MoT	MoF	MoSOE	Regional agencies	Private sector	PLN
1. Policy review of current measures to ensure alignment with national priorities	R/A	A	C	A	R	C	I	I	-	-
2. Conduct Regulatory impact assessments	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
4. Strengthen and harmonize local and regional incentive mechanisms with national policy goals	A	C	C	C	C	C	C	R	I	C
5. Create a robust regulatory framework concerning battery energy storage	C	R/A	C/R	C	-	I	I	I	I	R

4.2 Actions for 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:

Mid-term (2031-2024)

1. Secure battery material feedstock: Sections 3.1 and 3.2 highlight critical capacity gaps in Lithium refining and cell manufacturing, both essential for establishing an independent LIB supply chain in Indonesia. 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[165] 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

Common practice in the industry is to have five-year lithium supply contracts, with the option of renewing it for five more years. Key clauses to be evaluated when negotiating this type of contracts are Volumes, Specifications, Price Mechanisms, Logistics and Force Majeure. Volumes should detail the mix of products and ramp-up, while Specifications must include the list of all contaminants. In addition, Price Mechanism can widely variate between suppliers following diverse structures e.g., fix prices, escalated prices, bounded prices or spot prices.

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: As previously mentioned, 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:

[165] Indonesian REE, Lithium and Graphite Potency. Center for Mineral, Coal and Geothermal Resources. geologi.esdm.go.id/storage/publikasi/tQtg2X7Gd9JbfqO9Wnp7jFrT6rAuvWxyALhOojBo.pdf

- **The US** has federal legislation in place that provides for the acquisition and retention of stocks of certain strategic minerals required especially for national defense.[166] Acknowledging the importance of adopting additional measures, the Act itself encourages the development of domestic minerals sources.[167]
- Some **EU Member States** have had national stockpiling obligations for key minerals in place, but the recently adopted Critical Raw Materials Act[168] provides the authority for the EU Commission to 'suggest potential strategies that can be adopted by the public authorities and private actors to mitigate supply risks, such as building strategic stocks'.[169] As the first step, the Critical Raw Materials Act obliges EU Member States to inform the Commission about potential strategic national stocks.[170]
- **China** has stockpiling reserves of key minerals and rare earths. The country does not disclose the quantities of the resources and while estimates vary, there is a wide agreement that the reserves are substantial.[171] China's National Food and Strategic Reserves Administration manages these stockpiles, and the reasons behind the stockpiling obligations range is considered to range from strategic economic planning to potential military preparations.[172]
- **Japan** has a longstanding stockpiling policy. A key aspect of Japan's stockpiling policy is the encouragement of private companies to maintain reserves. The decision to stockpile is entirely voluntary for these companies.[173]
- **South Korea** announced it will specifically start to build up its strategic reserves on lithium.[174]

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, 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.

[166] Defense Production Act, 50 U.S.C. § 4533.
[167] Strategic and Critical Materials Stock Piling Act
[168] 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').
[169] Preamble para. 45 of the EU Critical Raw Materials Act.
[170] Article 22 of the EU Critical Raw Materials Act.
[171] Reuters, 'China plans to accelerate annual stockpiling of strategic commodities' (March 5, 2025); < https://www.reuters.com/markets/commodities/china-plans-accelerate-annual-stockpiling-strategic-commodities-2025-03-05/>; Mining.com, 'China's bulging commodity stockpiles show depth of economic woes' (September 1, 2024, *Mining.com*); <https://www.mining.com/web/chinas-bulging-commodity-stockpiles-show-depth-of-economic-woes/>
[172] B Girard, 'Why is China Stockpiling Key Resources' (June 28, 2024, *The Diplomat*); <https://thediplomat.com/2024/06/why-is-china-stockpiling-key-resources/>
[173] See JOGMEC (Japan Organization for Metals and Energy Security), 'Stockpiling, Metals'; <https://www.jogmec.go.jp/english/stockpiling/stockpiling_10_000001.html>
[174] A Lee and H Kim, 'South Korea said to build lithium reserves to aid battery sector' (May 20, 2024, *Mining.com*); <https://www.mining.com/web/south-korea-said-to-build-lithium-reserves-to-aid-battery-sector/>

Stockpiling can also help with the oversupply of minerals. Indonesia should develop clear regulations on critical mineral stockpiling, e.g., maximum stockpile caps, smelter moratoriums. These steps can improve national resource security and create confidence in potential investors.

Implementing a feedstock security strategy will bring several advantages, including:

- *Supply chain resilience* – Ensuring stable access to essential materials strengthens Indonesia's battery industry and reduces disruptions caused by supply shortages or geopolitical risks.
- *Investment attraction* – A well-structured feedstock strategy signals long-term industry stability, encouraging both domestic and foreign investment.
- *Export competitiveness* – Establishing a reliable and self-sufficient supply chain allows Indonesia to become a key global exporter of battery materials and finished products.
- *Sustainability & resource efficiency* – By optimizing sourcing strategies and integrating recycling initiatives, Indonesia can minimize environmental impact while maximizing resource utilization.
- *Strategic industry growth* – Aligning feedstock security with broader industrial policies ensures Indonesia's positioning as a major player in the global battery supply chain.

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. This could support Indonesia to position itself as a leader in battery waste management and resource efficiency.

To remove current barriers to recycling and reuse—outlined in Section 2.3.5—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. To establish minimum requirements, policymakers need to understand the physical capacities of commercial batteries, be aware of niche battery types, and anticipate future advancements. A comprehensive data foundation is essential for identifying these requirements. This will help ensure baseline durability for batteries, encouraging improvements in durability without compromising competition of the availability of specialized battery types and chemistries.[175]

  3.1 Define material recovery and recycling targets: Since Indonesia boasts a dominant role with regard to nickel and cobalt in the EV battery supply chain, it would be advisable to adopt provision in the national regulatory framework that on one hand provides targets for the recovery of materials from waste, and on the other, obligations concerning their reuse of those materials that are not domestic, in particular lithium and graphite[176]. Such targets should take into consideration the availability of waste from which such materials can be recovered, the technical feasibility of recovery and manufacturing processes, and as well as the timeframe required for manufacturers to adapt their supply and manufacturing processes. Such targets would also contribute to incentivizing the required recycling infrastructure.

  The regulatory framework should be accompanied by developing a recycling infrastructure, and the regulatory framework should aim towards building a recycling ecosystem. Progressively increasing targets reduce risk for recycling projects and provide a guaranteed market to stimulate necessary investments. Clear, long-term battery reuse, material recovery and recycling provision strategies and regulations that provide investment certainty are essential, as the facilities required are large and capital-intensive. It is essential to set up both targets for demand and supply to stimulate both sides of the emerging market.[177] It is critical to note that the battery ecosystem cannot be developed in silos; instead, it is crucial to simultaneously develop the midstream battery supply chain leading to some vertical integration of supply chain. A significant portion of the cathode and anode active material manufacturing capacity is in China – and is projected to be for the years to come – , which would signal that the main demand for recycled refined products is in China, which also leads to losing the domestic security advantages of material recovery.[178] Therefore, it is essential that the midstream supply chain stage is developed at the same time, to ensure domestic demand for the secondary

---

[175] 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.

[176] While graphite recycling is currently economically challenging, new low-cost recycling methods have been recently introduced, in addition to which some jurisdictions have provided financial support to improve the economics of graphite recycling, see IEA, *Recycling of Critical Minerals: Strategies to scale up recycling and urban mining* (IEA 2024), p. 60.

[177] Similar experiences on creating both supply and demand in addressing the initial 'chicken-and-the-egg' problem can be harnessed for example from the creation of the clean hydrogen market in the EU; see, e.g. Penttinen, S.-L., 'Navigating the hydrogen landscape: An analysis of hydrogen support mechanisms in the US and the EU' 33 (3) *Review of European, Comparative & International Environmental Law* (2024), pp- 397-411.

[178] IEA, Recycling of Critical Minerals: Strategies to scale up recycling and urban mining (IEA 2024), pp. 72-73.

supply. Naturally, it would similarly support the decarbonization of the power sector in Indonesia, given the possibilities provided by the reuse of EV batteries in stationary BESS.

The legislative measures that seek to integrate circularity into the battery supply chain do not solely focus on the end-of-life stage but instead resonate further up in the supply chain. This is illustrated on the next figure:

Figure 4.5 Circularity in the battery supply chain: areas of concern

Manufacturing	End use	End of life
• Minimum performance and durability requirements • Hazardous substance restrictions • Carbon footprint declarations (2024), battery performance classes, maximum CO2 thresholds • Recycled content declarations • Extended Producer Responsibility	• Collection targets for batteries	• Recycling targets • Recycling recovery targets

On-site collection targets could be introduced to manufacturing stage, including cathode and anode manufacturing, cell and EV manufacturing. As an example, to ensure feedstock supply for recycling, India has adopted a national rule providing a customs duty exemption on lithium-ion battery scrap.[179] In the absence of domestic cathode and anode production capacity, offtakers could be looking for recycled refined products internationally. To this end, the national legislation allowing for the imports of spent lithium-ion batteries should also be reviewed regularly to ensure that as national capacities develop, imports are not undermining national efforts.

3.2 Extended Producer Responsibility (EPR) to cover battery producers: the current EPR regulations in Indonesia primarily focus on packaging materials such as plastics, aluminium cans and glass. There is no specific mention of batteries in the main EPR-related legislative instruments, namely in Law No. 18/2008 on Solid Waste management or in the Regulation of the Minister of Environment and Forestry no. 75/2019. 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:

[179] 01-02-2025. Times of India. Budget 2025: Customs duty exemption on lithium-ion battery scrap announced by FM Sitharaman. https://timesofindia.indiatimes.com/business/india-business/budget-2025-customs-duty-exemption-on-lithium-ion-battery-scrap-announced-by-fm-sitharaman/articleshow/117822970.cms

Scope and coverage: The types of batteries covered by the regulation should be carefully considered, ensuring that the mandate is aligned with national priorities, in particular recycling targets, and the developing international rules.

Responsible party: The party under the obligation should be clearly mandated. Lack of clarity in mandating the responsible party may result to fragmentation in responsibilities and difficulties in coordinating the involved party effectively. It also complicates enforcement and penalties for non-compliance.

Reporting and transparency: Implementing robust reporting requirements to ensure transparency and accountability. Producers should regularly report on their collection activities and progress.

Information and communication campaigns: Implementing EPR regulations that hold producers responsible for the entire lifecycle of their batteries, including collection, recycling and disposal should be complemented with information and communication campaigns for consumers.

Government roles: Defining the roles and responsibilities of national, regional and local authorities. This includes oversight, compliance monitoring and potential infrastructure support.

Under the EPR obligations, producers have three responsibilities[180]:

- **Physical responsibility:** producers must collect waste products and ensure they are processed appropriately;
- **Financial responsibility**: Producers are responsible for covering the costs associated with the separate collection, transportation, and processing of waste products, as well as the expenses related to data collection and reporting to the relevant authorities;
- **Informational Responsibility**: Producers must provide information about the environmental characteristics of their products and disposal procedures. They also need to inform public interest stakeholders about the quantity of waste collected and how it is managed.

It is not enough to establish obligations in the regulatory framework; instead, at every node of the process, incentive tools as well as reward-punishment mechanisms have to be in place to ensure conformity with the obligations established.[181]

Similarly, lack of alignment between regulation among countries concerning waste criteria and secondary raw materials is widely identified as a barrier to efficient integration of circular economy approach. What this essentially means, is that a material might be categorized as waste in a country A, whereas in a country B the same material is considered as a product, impacting the international trade for such secondary raw materials, leading to complex regulatory hurdles and potential trade

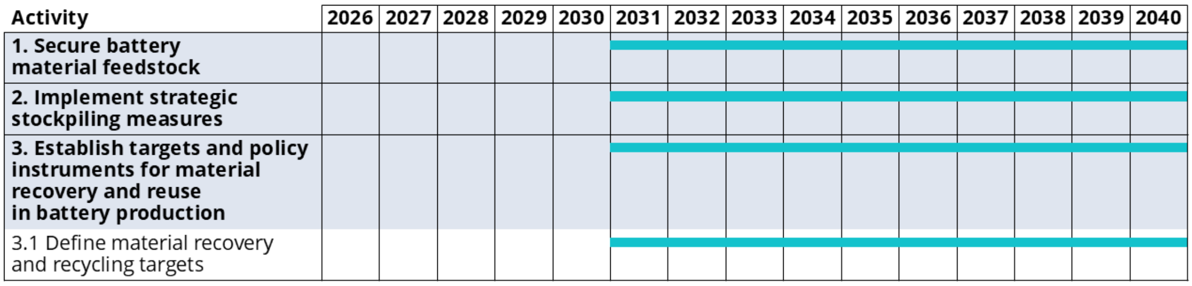
[180] J Yang, Q Jiang and J Zhang, 'Bridging the regulatory gap: A policy review of extended producer responsibility for power battery recycling in China' 86 *Energy for Sustainable Development* (2025), 101697.

[181] 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.

disputes.[182] Therefore, it is critical that Indonesia participates actively in the work of international standardization committees.

Action plan for key area: Production Capacity and end-of-life management

Figure 4.6 Gantt for activities for key area Production Capacity and end-of-life management



Stakeholder roles

Table 4.3 RACI Matrix for Production Capacity and end-of-life management

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

Action	MoInv	MEMR	MoE	MoSOE	MoI	MoF	Manufacturing companies	Trade Associations	MIND ID & IBC	Financial institutions
1. Secure battery material feedstock	C	R/A	C	R	A	I	I	I	C	-
2. Implement strategic stockpiling measures	R	A	C	C	C	C	I	C	R	C
3. Establish targets and policy instruments for material recovery and reuse in battery production	C	R	R/A	I	R	-	I	C	I	-
3.1 Define material recovery and recycling targets	I	C	R/A	C	R	I	I	C	I	I

4.3 Actions for Traceability for Compliance and Export Readiness

While there is no official target for battery exports, the public company Indonesia Battery Corporation (IBC) has the intention of reaching a capacity production of 140 GWh by 2030, of which 50 GWh are foreseen to be exported[183]. In order to guarantee battery exports, Indonesia needs to guarantee compliance with final destination countries and international standards. Material traceability is the first step when it comes to monitoring compliance across the supply chain. The roadmap proposes the following actions to do so:

[182] IEA, Recycling of Critical Minerals: Strategies to scale up recycling and urban mining (IEA 2024), pp. 43-44.
[183] IBC. 26 November 2021. IBC Targets 140 GwH Battery Production in Total by 2030. https://www.indonesiabatterycorp.com/en/news/ibc-targets-140-gwh-battery-production-in-total-by-2030

Mid-term (2031-2040)

1. Design and implement a battery passport to trace battery components: Implementing a system for tracking and reporting the materials used in batteries is crucial for the successful implementation of a circular economy approach. Traceability tools ensure that materials are efficiently recovered and reused and serve as proof that set targets have been met should targets for example for reuse of materials be set.

Traceability has emerged as a tool globally to support key policy objectives associated with the battery supply chains by providing ways to integrate data on origin, evolution and ownership of minerals as well as environmental, social and governance issues. Traceability refers to accurate and transparent data that provides the possibility to determine a product's origin, geographical path, chain of custody and physical evolution over time'.[184] Traceability is the key to allow for an understanding of a product movement along the supply chain together with its ESG performance.

Concerning labelling and traceability, Indonesia currently has three mechanisms in place that nevertheless do not specifically target batteries or battery end-of-life.

Table 4.4 Traceability mechanisms currently in force in Indonesia

Measure	Objective	Jurisdiction
EITI Standard Presidential Regulation No. 26/2010 regarding transparency of national/local extractive industries	International initiative of member countries committed to disclosing information about the extractive industry value chain.	International
SIMBARA digital platform	Enhance minerals traceability and transparency. Digital platform to connect multiple government ministries and institutions in monitoring, managing and optimizing mineral resources through data and supervision systems.	National
Green Industrial Standard Ministry of Industry Regulation 3/2014	The regulation sets out the criteria and guidelines for industries to achieve green certification.	National

The EITI (Extractive Industries Transparency Initiative) is a global benchmark for transparency and accountability in the extractives sector. It requires the disclosure of information along the extractive industry value chain. The traditional focus of the EITI has been on formal payments made by industrial extractive companies to governments, with the ultimate aim of corruption prevention.[185]

The SIMBARA Digital Platform was launched in 2022 with a view to connecting multiple government ministries and other public sector institutions in monitoring, managing and

---

[184] IEA, The Role of Traceability in Critical Mineral Supply Chains (IEA 2025) p. 10.

[185] OECD, Promoting coherence between standards on responsible mineral supply chains: The IECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas and the Extractive Industries Transparency Initiative Standard (OECD 2020), p. 13.

optimizing minerals and coal resources through unified data and supervision systems.[186] Similar to EITI, the main objective of the SIMBARA platform is to track mineral movements and prevent corruption.

Out of these transparency initiatives, the Green Industrial Standard is a national, product related standardization initiative. Currently, the green industry standard applies only to the manufacturing and packing sectors, including EVs.

These mechanisms are, however, very limited in scope. For example, the EITI primarily targets financial payments made by industrial extractive companies to governments. Similarly, the SIMBARA digital platform aims to monitor and manage mineral resources. The scope of the Green Industrial Standard is limited to certain sectors and does not extend, for example, to batteries. Each of these initiatives has a very specific, limited focus and they do not encompass other aspects of the supply chain. As the focus on environmental and social sustainability of the battery value chain has increased over recent years, there are several legislative instruments adopted that require the collection of data through the supply chain. For example, legislation detailing the carbon footprint assessment and due diligence that are required by the EU Sustainable Batteries Regulation are both detailed in Annex 6, as well as attributes to be included in the Battery Passport and related reporting requirements that will be rolled out over the coming years. This will be briefly discussed next.

- **The Battery Passport**

The Battery Passport is a digital framework designed to enhance transparency and sustainability across the battery value chain. It was originally developed by the Global Battery Alliance, but it was given a legal status in the EU's Sustainable Batteries Regulation.

The Battery Passport serves as a 'digital twin' of the physical battery, providing detailed information about the battery's material provenance, chemical composition, manufacturing history, and sustainability performance. The data provided is stored in a QR code which links to a unique identifier that the economic operator placing the battery on the market attributes to it.

As such, the battery passport enhances the general requirements of the EU battery regulation by collecting data in a digital format and ensuring it is easily accessible to all actors along the value chain.

The US as well as China are currently considering the adoption of national legislation implementing a battery passport.[187] Considering that the EU is a significant demand hub for batteries, ensuring the development of an EU-compliant battery passport is critical for both jurisdictions. Japan is requiring a disclosure of EV battery production emissions. To

[186] IEA, 'SIMBARA Inter-Ministry/Institutional Mineral and Coal Information System', available at https://www.iea.org/policies/25388-simbara-inter-ministryinstitutional-mineral-and-coal-information-system
[187] Global Battery Alliance, *GBA Battery passport, An Overview* (Global Battery Alliance 2024), p. 3; 'Chinese compliance solution for EU Battery Passport regulations' (November 11, 2024, *Batteries International*); <https://www.batteriesinternational.com/2024/11/11/chinese-compliance-solution-for-eu-battery-passport-regulations/>

facilitate the disclosure, Japan is considering the implementation of a digital battery passport that would track and record detailed information about the battery's lifecycle.[188]

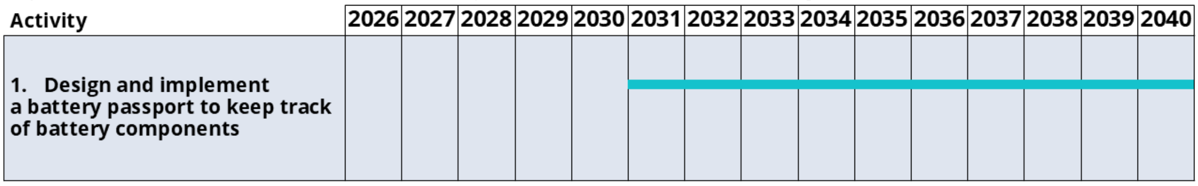
The EU is the first jurisdiction to implement the battery passport in its legislative framework, which impacts not only those batteries that are produced within the EU, but also those batteries that are imported to the EU market area. Therefore, the EU implementation of the battery passport serves as an important global precedent, significantly impacting the development of this area of law.

Despite some challenges and burden the practical implementation of the battery passports places on the industry to comply, the benefits of the passport are widely considered to outrun the burdens in terms of helping investors better understand how batteries can be used in various use cases, potentially leading to new areas of business.[189]

Since digital battery passports are anticipated to become a legal requirement for batteries globally, it is crucial for Indonesia to not only examine the implementation possibilities of the battery passport into the national legislative framework, but also to closely follow the ongoing developments internationally, to ensure that domestic initiatives in implementing the battery passport are in compliance with global standards.

Action plan for key area: Traceability for Compliance and Export Readiness

Figure 4.7 Gantt for activities for key area Procurement Compliance Processes



Stakeholder roles

Table 4.5 RACI Matrix for Procurement Compliance Processes

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

Action	MEMR	MoI	MoE	MoT	MoInv	SPKLU	IBC/Private companies	Battery cell companies	EV manufacturers
1. Design and implement a battery passport to keep track of EV components	A	R	R	C	C	I	I	I	I

[188] R Nagao, 'Japan to require disclosure of CO2 emitted by EV battery production' (May 9, 2023, *Nikkei*); < https://asia.nikkei.com/Spotlight/Environment/Climate-Change/Japan-to-require-disclosure-of-CO2-emitted-by-EV-battery-production >

[189] See, e.g., A Colthorpe, 'EU's Battery Passport 'will give energy storage investors more clarity on bankability' of projects' (February 20, 2024, *Energy Storage News*); <https://www.energy-storage.news/eus-battery-passport-will-give-energy-storage-investors-more-clarity-on-bankability-of-projects/>

4.4 Actions for Expansion of end-use segments

Setting clear targets for battery end use segments like transport electrification and BESS is essential to driving market confidence, infrastructure development, and investment in Indonesia's energy transition. This needs to be paired with EV charging infrastructure expansion beyond urban centers, addressing range anxiety and accessibility concerns for underserved areas, and parallel grid investment to support BESS integration. These actions are described below:

Mid-term (2031-2040)

1. Establish targets for electrification of other transport sectors in regulatory instruments: Although electric vehicle (EV) targets are already in place, expanding electrification to other transport sectors—including public transport, last-mile delivery services, and long-haul trucking—can further accelerate battery demand and strengthen Indonesia's battery supply chain. Setting clear adoption targets for these segments will drive infrastructure development and encourage market expansion. The public transport sector would benefit from the implementation of incentives and regulatory frameworks comparable to those supporting the EV industry, further contributing to emission reductions within the transport sector. The Ministry of Transport's roadmap outlines a target to electrify 90% of urban mass public transport by 2030[190]. To operationalize this goal, it should be formally incorporated into policy instruments, enabling the allocation of dedicated budgets and the development of supporting regulations. This approach would not only accelerate progress toward electrification but also stimulate domestic demand for batteries.

Similarly, establishing targets for Battery Energy Storage Systems (BESS) is essential to support renewable energy (RE) integration within the national grid. Given that BESS investments require significant upfront capital as mentioned in the RUPTL 2025, their viability depends on a revenue-generating framework. Indonesia's lack of a liberalized power market and limited private sector participation mean that BESS deployment is directly tied to the pace of RE generation growth. A structured approach to sector-specific electrification and grid-scale storage deployment will strengthen Indonesia's energy transition, attract investment, and establish a more resilient and sustainable battery industry. Implementing regional targets by sub-system can help identify locations where BESS enhances RE integration and electricity supply reliability while clarifying where battery storage may not yet be necessary.

2. Provide more targeted and wider support for charging infrastructure development: To reach the 2030 target of having 62,918 EV charging stations deployed, Indonesia currently has some policy instruments in place that seek support the charging infrastructure development. Most notably, the Decree of the Ministry of Energy and Mineral Resources No. 24.K/TL.01/MEM.L/2025 plays a strategic role in supporting the integration of EVs in Indonesia by laying out a national roadmap for the development of public EV charging infrastructure from 2025 to 2030. The decree mandates the planned development of charging stations across all provinces, targeting key locations such as

---

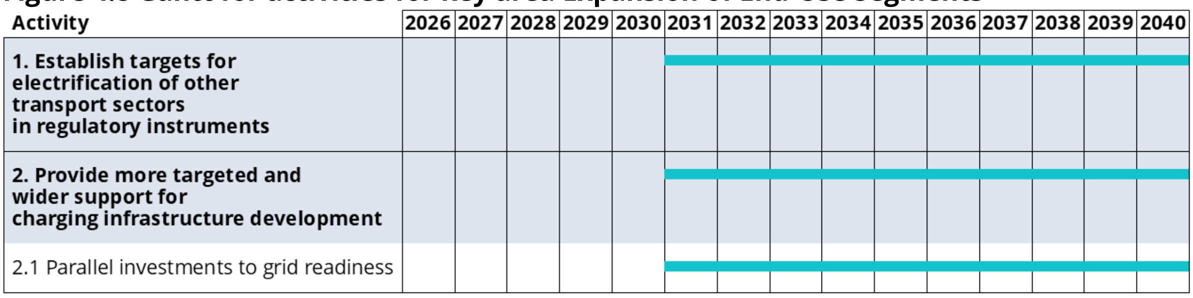
[190] ITDP Indonesia (2024) *Electrification, A Momentum for Public Transport Reform*. Link

shopping centers, office complexes, industrial zones, toll road rest areas, gas stations, tourist areas, hospital, train stations, hotels and so on. However, with the exception of toll road rest areas, these designated areas still support only a limited number of charging stations outside main urban areas. This leads to the exacerbation of range anxiety among consumers, limiting the domestic EV adoption. While the Decree mandates 'equal distribution' of charging stations, remote and low-density regions may still experience limited commercial interest and incentives regarding private investments, even though the Decree provides incentives for developers in particular in the form of reduced connection fees and access to bulk electricity tariffs. Cooperation with local governments to speed up the development outside the population hubs of main urban areas is crucial. Despite the positive developments with the adoption of the Decree of the Ministry of Energy and Mineral Resources No. 24.K/TL.01/MEM.L/2025, developing the charging network could be revised to provide even more targeted support for the development in more remote areas, sending signals towards wider electrification in these areas. In this respect, local communities should be involved in the planning and decision-making procedures to ensure that infrastructure development meets their needs, as each region and community faces unique challenges and constraints.

2.1 Parallel investments to grid readiness: While the recently adopted Decree of the Ministry of Energy and Mineral Resources No. 24.K/TL.01/MEM.L/2025 supports the expansion of fast and ultra-fast chargers, the expansion might be limited by grid capacity. The establishment of a 'super-charger' network requires significant upgrades, especially in rural or underdeveloped areas. Similarly, the connection point capacity and the capacity of the electricity system in the key locations as listed in the decree (hospitals, shopping malls etc) might limit in practice the possibility for the installation of the charging stations, and major upgrades might be expected. Without parallel investments in grid infrastructure, reaching the mandates might be difficult, in addition to which charging reliability and speed may be compromised. The grid also needs to have enough capacity for BESS and VRE integration.

Action plan for key area: Expansion of End-Use Segments

Figure 4.8 Gantt for activities for key area Expansion of End-Use Segments



Stakeholder roles

Table 4.6 RACI Matrix for Expansion of End-Use Segments

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

Action	MEMR	MoI	MoE	MoT	MoInv	SPKLU	PLN	IBC/Private companies	Battery cell companies	EV manufacturers
1. Establish targets for electrification of other transport sectors in regulatory instruments	A	R	C	A	I	I	R	C	I	I
2. Provide more targeted and wider support for charging infrastructure development	R	R	C	R/A	C	I	R/I	I	I	I
2.1 Parallel investments to grid readiness	R/A	C/R	C	-	C	I	R	I	I	I

4.5 Actions for Financing and Bankability

Three conditions need to be met for a new project to be successful: operational feasibility, social/permitting feasibility and financial feasibility. The first two have been displayed above in terms of roadmap actions. In the case of financing and banking support, the metrics used (by government and private players) are directly related to transparent risk and return profiles of the project for lenders and investors. Or rephrased; projects that are considered to have higher risk are less appealing and consequently won't have enough banking support to mature. There are no targets related to this area in the regulation. However, the financing and bankability of projects impact the battery supply chain as a whole. The roadmap highlights the following actions:

Short-term (2026-2030)

1. Ensure compliance with global standards to guarantee batteries can be exported worldwide: To facilitate Indonesia's battery exports worldwide, adherence to environmental, social, and governance (ESG) standards is critical. Strengthening cooperation with the Minerals Security Partnership (MSP) offers a strategic pathway to overcoming these barriers. By engaging with MSP, Indonesia can gain access to financing for sustainable supply chains, ensuring compliance with global ESG benchmarks while driving diversification in foreign investments and export destinations. Key strategies include: (i) Aligning Indonesia's battery industry with ESG policies in major markets such as the US and EU, (ii) Leveraging MSP partnerships to attract funding for sustainable extraction and refining and (iii) Implementing transparent and traceable supply chain mechanisms, enhancing investor confidence.

Similarly to other countries exporting batteries and EVs to the EU market area, the stringent regulations adopted by the EU have a significant impact on Indonesia manufacturers as well, imposing upon them obligations and compelling them to comply with relevant standards.[191] A proactive approach to regulatory alignment and industry cooperation will reinforce Indonesia's position in the global battery market, ensuring

[191] J He, 'The impact of EU's Regulation 2023/1542 on the Chinese Power Battery Industry' ANBOUND briefing; < http://www.anbound.com/Section/ArticleView_32416_1.htm>

long-term sustainability and competitiveness. It is recommended that this action is taken both in the short and long term to keep up with any regulatory changes.

Mid-term (2031-2040)

2. Establish a supply chain tracking platform for Indonesia's battery industry, identifying trade flows and capacity constraints: To enhance visibility and efficiency across Indonesia's lithium-ion battery supply chain, Indonesia should develop a tracking platform to monitor manufacturing plant operations, trade flows, and capacity constraints. As an operational-technological initiative, this recommendation requires significant investment in R&D and skilled expertise to ensure successful implementation.

The role of the government is to establish and govern a platform that would not only function as a 'matchmaking tool' but would contain up-to-date information and data on all segments of the supply chain, highlighting investment opportunities. This would provide a firsthand tool to also communicate with potential foreign investors. The work on the pilot should begin with a procurement process to find the developer for the IT platform, that ensures an effortless and easy interface while ensuring the confidentiality of the data collected.

For example, the EU is currently seeking to introduce under the EU Hydrogen Bank framework, a pilot mechanism with a view to 'accelerate investments by providing a clearer picture of the market situation of both off-takers and suppliers and facilitating contacts between them.'

In practice, this platform would serve multiple objectives:

- Strengthening domestic & global supply chain transparency – Identifying areas requiring strategic improvements.
- *Optimizing investment decisions* – Highlighting critical infrastructure gaps and priority investment areas.
- *Defining export strategies* – Once domestic demand is met, the government should assess key global markets for Indonesian-made battery products.

By establishing a data-driven framework, Indonesia can ensure strategic growth and efficient resource utilization within its battery industry.

3. Implement financial schemes for derisking investments: As mentioned in Section 3.4, mining and refining projects often struggle to find capital due to low prices of commodities and large investments needed. The GoI could implement mechanisms like SPVs or strong price floor and ceiling contracts, acting as a strong counter party that could assume large risks, and providing stability by ensuring predictable revenue streams, making large-scale projects more attractive to financiers.

Government intervention is crucial to de-risk investments and unlock new financing pathways for the sector. One effective approach is equipment financing, which remains feasible when supported by dedicated government-backed funding structures. Examples from Germany (KfW) and the United Kingdom (UKEF) demonstrate how strategic financing models can cover up to 80% of equipment costs through debt financing, allowing companies to access high-quality machinery without requiring immediate full capital commitments.

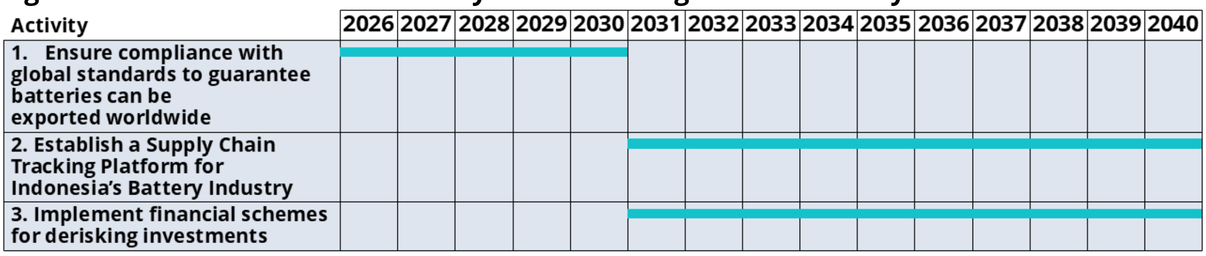
Another viable funding strategy is pre-payments, where products are forward-sold at a discount to secure liquidity upfront. This model can be particularly beneficial when paired with incentives that attract major trading houses willing to commit long-term financing. By deploying these risk-mitigation mechanisms, Indonesia can enhance financial security for mining and refining operations, ensuring that the sector remains competitive and well-positioned to support the country's battery supply chain production ambitions.

The reasons for the cancellation of LG's investment were cited to be due to changing market conditions and investment environment[192]. However, the company did not withdraw from other projects, like the joint venture with Hyundai for a battery plant. Thus, the cancellation does not mean the policies to attract investors in Indonesia have failed. Instead, it reflects the reality of the EV market, where sales in 2024 slowed down from previous years, as well as investments in batteries for EVs[193]. Therefore, the Ministry of Investment and Downstream Industry could deploy a series of measures to lower the risk of each project. It is important to maintain active discussion and communication between lenders, investors and policymakers. Minimum conditions to attract key players are ready in place in Indonesia (Nickel refining and downstream projects, for example), nevertheless, the key prerequisite is to develop each link of the supply chain organically and the same pace.

The government would need to strengthen policies that also support battery manufacturing, and not only their end-use. This includes tax incentives, subsidies, and streamlined regulatory processes to improve permitting confidence. Cases of beneficial tax breaks for large-scale investments are common, such as the Argentinian program for investments of more than US$200 million (RIGI in Spanish).

Action plan for key area Financing and Bankability

Figure 4.9 Gantt for activities for key area Financing and Bankability



[192] Reuters. April 21, 2025. South Korea's LG Energy Solution pulls out from Indonesia EV battery investment. https://www.reuters.com/business/energy/south-koreas-lg-energy-solution-pulls-out-indonesia-ev-battery-investment-2025-04-21/

[193] BloombergNEF. 18 June 2025. Global Electric Vehicle Sales Set for Record-Breaking Year, Even as US Market Slows Sharply, BloombergNEF Finds. https://about.bnef.com/insights/clean-transport/global-electric-vehicle-sales-set-for-record-breaking-year-even-as-us-market-slows-sharply-bloombergnef-finds/

Stakeholder roles

Table 4.7 RACI Matrix for Financing and Bankability Actions

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

Actions	MoE	MoInv	MoF	MoI	Coord. Ministry of Economic Affairs	MoM	MEMR	SOE	INA	Financial institutions	Trade associations
1. Ensure compliance with global standards to guarantee batteries can be exported worldwide	R	R/A	C	R/A	I	C	I	I	I	I	C/I
2. Establish a Supply Chain Tracking Platform for Indonesia's Battery Industry	C	A	C	C	C	-	C	C	R	C	C
3. Implement financial schemes for derisking investments	-	R	R/A	C/I	C	-	C	I	R/C	I	I

5. Recommendations and conclusion

Three general recommendations are drawn from activities described above in the roadmap to address key challenges Indonesia has to establish an integrated battery supply chain.

5.1 Recommendation 1: Advancing an integrated battery supply chain through coherent, adaptive, and aligned policy governance

To successfully implement an integrated and sustainable battery supply chain, the Government of Indonesia should adopt a coherent and adaptive policy governance framework that ensures alignment across institutions, sectors, and levels of government. The current regulatory foundation provides a strong starting point, but long-term success will depend on the government's ability to continuously refine policies based on evidence, reduce fragmentation, and strategically coordinate incentives and targets.

A central recommendation is to institutionalize a whole-of-government approach to battery and EV sector development, anchored by periodic policy reviews, cross-sectoral coordination, and adaptive regulatory tools. This approach should include three key pillars:

1. **Integrated Policy Evaluation and Adjustment**: Introduce a national mechanism for regulatory impact assessments (RIA) and ex-post evaluations to 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. This will prevent fragmentation and ensure that all actors are working toward unified national objectives, supported by clearly defined responsibilities and harmonized metrics.
3. **Forward-Looking Institutional Design**: Create dedicated institutions or strengthen existing ones to oversee the implementation, enforcement, and monitoring of local content policies and battery energy storage system (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 principles into its policy framework, Indonesia could be better equipped to steer the battery and EV sector toward inclusive industrialization, global competitiveness, and energy system resilience—while maximizing national value creation from its natural resource endowment.

5.2 Recommendation 2: Strengthening strategic partnerships to diversify and secure the battery supply chain

Indonesia possesses abundant nickel and cobalt reserves; however, its battery industry remains heavily reliant on the external supply and processing of key inputs such as lithium, manganese, and graphite. Australia is a major lithium supplier, yet much of the processing takes place in China, which also dominates the global anode and graphite markets. This concentration creates a structural vulnerability in Indonesia's battery value chain, increasing exposure to supply disruptions, price volatility, and limited access to downstream technologies.

To address this challenge and strengthen its position in the global battery ecosystem, Indonesia should adopt a comprehensive strategy to attract international investment, promote joint development, and secure long-term supply chain resilience through strategic partnerships. The recommendation is to follow an approach that focuses on (i) attracting investment and promoting industrial collaboration, and (ii) leveraging global cooperation platforms and public-sector agreements. This will support long-term supply chain security, enhance technological capabilities, and could reinforce Indonesia's role as a competitive and sustainable leader in the global battery sector.

(i) Attract Investment and Deepen Industrial Collaboration

Indonesia should actively engage leading players across the lithium-ion battery (LIB) supply chain—particularly in cathode active material (CAM), cell manufacturing, and battery recycling. These actors can help fill critical technological and material gaps, facilitate knowledge transfer, and scale domestic capabilities.

To attract high-quality investment, the government should:

- Prioritize joint ventures with a degree of local ownership by aligning fiscal incentives (e.g., tax holidays, VAT exemptions) with partnership depth, replicating the successful approach used in the EV VAT exemption policy. Additional incentives for foreign companies that collaborate with local partners could be designed, following a similar principle to the import tax exemption for fully assembled EVs from manufacturers that pledge to open a plant.
- Strengthen public–private partnerships through balanced frameworks that encourage private participation in mining, refining, CAM, and LIB projects without excessive state control, which could deter investment and distort market dynamics.
- Facilitate technology transfer through clear policy mandates and cooperation agreements that support AI integration, process innovation, and sustainability in domestic manufacturing.

(ii) Leverage international platforms and strategic public-sector agreements

Indonesia should intensify its participation in global cooperation frameworks and strategic intergovernmental initiatives to gain access to financing, policy knowledge, and regulatory alignment tools. Some of relevant platforms and how they could support Indonesia in developing a battery supply chain are:

- **Just Energy Transition Partnership (JETP)** – Providing blended finance for green industrial development.
- **Global Battery Alliance (GBA)** – Sharing global best practices and ESG standards in battery value chains.
- **Asian Development Bank (ADB) –** Offering technical and financial support for infrastructure and supply chain expansion.
- **EU Clean Trade and Investment Partnerships (CTIPs)** – Promoting targeted collaboration on clean technologies, raw materials, and sustainable trade mechanisms. Its cooperation is aimed at supporting partners in deploying clean tech, electrification, circularity, decarbonization standards as well as carbon pricing

Additionally, bilateral and multilateral partnerships on battery technology and critical mineral cooperation, as the following, offer replicable models for Indonesia to pursue:

- **US - Japan cooperation:** The US and Japan have collaborated on various projects to advance battery technology and EV manufacturing. This partnership focuses on sharing technological expertise, joint ventures in manufacturing, and securing supply chains for critical minerals.
- **Australia and South Korea:** Australia and South Korea have partnered to develop lithium-ion battery technologies and enhance EV manufacturing capabilities. This collaboration includes investments in mining and processing of critical minerals, as well as joint ventures in battery production.

5.3 Recommendation 3: Advancing a circular economy framework for battery end-of-life in Indonesia

Although Indonesia includes batteries in its Circular Economy Roadmap and National Action Plan[194], 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 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 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

[194] 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

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.

Despite the expected benefits associated with circular economy – improved resource efficiency, reduced extraction, reduced processing, and the disposal of scarce natural resources, new business opportunities for stakeholders – there are still several challenges that relate to battery recycling, such as high recycling costs, limited recycling infrastructure and variability in battery designs.

Currently the forerunner jurisdiction to integrate a circular economy approach to EV batteries is the European Union (EU). The EU adopted a first-of-its-kind Sustainable Batteries Regulation in 2023[195], a coherent piece of legislation that aims to ensure that batteries are sustainable throughout their entire lifecycle. This regulation has already had a significant impact on actors beyond the EU's borders.[196] For example, Chinese companies are actively restructuring their supply chains to comply with the strict regulatory standards: CATL is collaborating with Stellantis to construct a lithium battery manufacturing plant in Spain[197], and many battery manufacturers are focusing on enhancing product performance and managing carbon footprints.[198] These proactive measures introduced by companies indicate that policy management for batteries needs to evolve to support companies in navigating the complex landscape of international regulations, as global standards become more stringent, Beyond revising its national legislative framework, Indonesia could help the industry to navigate the global market and remain compliant by facilitating international partnerships and investing in research and development.

The circular economy framework for battery end-of-life should:

[195] Regulation (EU) 2023/1542 of the European parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020and repealing Directive 2006/66/EC, OJ L 191, 28.7.2023, p. 1-117 ('EU Sustainable Batteries Regulation').

[196] 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.

[197] Stellantis, 'Stellantis and CATL to invest up to €4.1 billion in joint venture for large-scale LFP battery plant in Spain' (December 10, 2024); <https://www.stellantis.com/en/news/press-releases/2024/december/stellantis-and-calt-to-invest-up-to-4-1-billion-in-joint-venture-for-large-scale-lfp-battery-plant-in-spain>

[198] [198] 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.

(i) **Build from the already established National Strategy for Circular Economy:** Indonesia has adopted a national circular economy strategy in 2024[199], which is the critical first step in the creation of a circular economy for batteries. This roadmap includes five priority sectors. Batteries are included in the priority sector of electronics, specifically as part of one of its four key strategies: Developing a Circular Economy Ecosystem for New Technology and Battery Electric Vehicles (BEVs).
While the adoption of the national strategy can be considered to form the backbone of the more specific implementation measures to follow, it should be noted that it is important to update the national strategy regularly. In addition, the circular economy framework draw and consider the Government Regulation No. 22 of 2021 Environmental Protection and Management specially regarding the (i) Licensing requirements for collection, storage, transport, treatment, and disposal, (ii) the national tracking system for B3 waste, and (iii) environmental permits.

(ii) **Integrate circular economy principles into B3 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**: Issue sector-specific guidance for handling different battery chemistries extended beyond the mere mandate for battery waste management, and define technical thresholds for when treated battery materials are no longer hazardous. Establishing a certification system for recovered materials would complement the end-of-waste legislation by enabling the legal re-entry of recovered materials into the market, creating more value to legally recovered materials.

(iv) **Establish regulatory sandboxes for innovations aligned with circular economy principles**: Establish controlled test beds where for example new recycling technologies can be trialed with temporary regulatory exemptions or loosened regulatory framework. Regulatory sandboxes allow for testing and learning not only for innovators but also for regulatory authorities. It encourages collaboration between research institutions, startups and regulators to accelerate safe innovations.

(v) **Embed product design standards that support reuse, repair, remanufacturing and recycling of spent batteries:** Reuse, repair, remanufacturing and recycling of products are often emphasized in the context of a circular economy. However, the design phase of products is also crucial given that it ensures efficient raw material usage, thus reducing waste streams, and impacts the entire life cycle by shaping the structure, properties and performance of solutions, thus resonating back to the manufacturing stage.[200] Therefore, regulations should establish mandates concerning

---

[199] 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>

[200] Uusitalo, T, Huttunen-Saarivirta, E, Hanski, J, Lima-Toivanen, Maria, Myllyoja, J and Valkokari, P, Policy Instruments and Incentives for Circular Economy – Final Report (EIT Raw Materials 2020), p. 5.

battery design and durability. Batteries should be designed for longevity, easy disassembly, and recyclability as well as safety. This includes setting minimum durability and performance standards.

5.4 Conclusions

Indonesia stands at a pivotal moment in its energy transition journey, where the integration of the battery supply chain is not merely a sectoral reform, but a strategic necessity. As the country aims to decarbonize its economy and achieve Net Zero Emissions by 2060, batteries play an indispensable role in supporting both electric vehicle (EV) deployment and renewable energy integration. This report has demonstrated that while Indonesia 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 government's ambitious targets for EV deployment—almost one million four-wheel and nine million two-wheel vehicles by 2030—reflect a strong national vision. Similarly, the push to utilize nickel reserves through industrial policies such as the nickel export ban illustrates Indonesia's determination to move up the global value chain. However, ambition alone cannot close the gap between current capacity and projected demand. The report 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.

Indonesia's heavy reliance on imported lithium represents a strategic vulnerability. Despite being the world's largest producer of nickel and having sufficient cobalt reserves, the absence of domestic lithium resources—and the fact that both NCM and LFP battery chemistries require lithium—exposes the entire EV strategy to international supply disruptions. Moreover, while Indonesia has successfully established itself as a global leader in nickel refining, the development of midstream and downstream components such as cathode and anode materials, lithium-ion battery cell production, and BESS lags significantly behind. This creates structural bottlenecks that must be resolved if Indonesia is to become a serious contender in the global battery supply chain.

Financial and investment-related barriers further constrain progress. Although various fiscal incentives have been introduced—including tax holidays, import duty exemptions, and subsidies—clean energy investment still trails far behind fossil fuel investment. Investor confidence remains hampered by regulatory uncertainty, limited project bankability, and weak coordination between national and regional authorities. As global clean energy investment trends shift rapidly, Indonesia would benefit from creating an environment that signals long-term stability, clear regulatory frameworks, and openness to international partnerships. The importance of vertically integrating the battery supply chain—by connecting upstream mineral production to domestic battery and EV manufacturing—cannot be overstated. It would not only reduce production costs and enhance competitiveness, but also support Indonesia's broader industrial development goals.

In terms of infrastructure, the expansion of public EV charging stations and localized battery manufacturing facilities has not kept pace with the scale of the government's ambitions. As of late 2024, only 1,902 charging stations had been installed, a fraction of the 62,918 targeted by 2030. The concentration of infrastructure in Java and Bali also highlights the need for geographic diversification. This imbalance risks exacerbating regional inequalities and stalling EV adoption across the country. Compounding these issues is a lack of legislative support for battery energy storage, which is essential for renewable energy integration. Although recent policies have begun to recognize the role of BESS, their implementation remains nascent and disjointed from the larger energy transition framework.

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.

What emerges from this report is a clear call for policy coherence and institutional coordination. Although multiple ministries and agencies are actively supporting the battery ecosystem, their efforts often work in isolation or even at cross-purposes. For instance, generous tax exemptions for EV imports can undermine domestic manufacturing incentives. Aligning sectoral policies, harmonizing targets, and establishing a centralized coordination mechanism—potentially housed within the Ministry of Investment or a dedicated battery authority—would create a more predictable and conducive environment for investors and developers alike.

At the same time, the government should focus on building domestic capabilities. Developing research and development infrastructure, nurturing skilled talent, and supporting local startups in the battery space are vital steps toward long-term competitiveness. Strategic international partnerships—especially with leading producers of cathode active materials and battery cells—can accelerate this process, provided they are aligned with national interests and include provisions for technology transfer and capacity building.

Ultimately, Indonesia's energy transition is not just a technological challenge, it is a socio-economic transformation that must be inclusive, sustainable, and equitable. The roadmap presented in this report offers a pragmatic and sequenced approach to achieving these goals. It identifies actionable steps across five pillars: policy and regulation, production capacity, procurement compliance, expansion of end-use segments, and financing and bankability. Each area includes a mix of short-term, medium-term, and long-term actions, designed to deliver tangible results while building institutional resilience.

In conclusion, Indonesia has the resources, ambition, and policy momentum to become a global leader in battery supply chains and clean energy technology. However, the journey from aspiration to realization demands bold decisions, coordinated execution, and continuous learning. The energy transition is a generational opportunity, not just to reduce emissions, but to redefine Indonesia's role in the global economy. The choices made today will shape not only the battery industry but the broader trajectory of national development. It is imperative that these choices are informed, inclusive, and future oriented. With the right mix of policy alignment, institutional leadership, and stakeholder collaboration, Indonesia can turn its energy transition into a cornerstone of sustainable prosperity.

Annex 1

Providing financial incentives to companies that adopt circular economy practices can encourage innovation and investment in more sustainable batteries. Financial measures introduced globally to encourage the establishment of recycling technology and expand domestic capacity can be divided into two distinct groups. The first ones include measures that seek to increase the capacity to generate and collect scrap. Examples of such are illustrated on the next table:

Examples of financial measures designed to support recycling infrastructure[201]

Country	Policy measure	Details
United Kingdom	CLIMATES programme	GBP 5 million in R&D projects focusing on REEs and sustainable processing
Canada	Strategic Innovation Fund	CAD 190 million for critical minerals projects, prioritizing advanced manufacturing, processing, and recycling applications
Japan	Critical minerals subsidy programme	Over JPY 1 billion to two recycling projects
United States	Inflation Reduction Act	Provides tax incentives to facilities recycling critical minerals or clean energy technology equipment containing critical minerals
China	Establishment of a state-owned enterprise	Establishment of a state-owned enterprise for resources recycling and reuse with a capital of CNY 10 billion

The second category includes measures adopted with the view to establish and/or increase the domestic processing capacity by providing feedstock, as illustrated on the next table.

Examples of financial measures designed to support the collection of feedstocks[202]

Country	Policy measure	Details
United States	Department of Energy funding	USD 15 million to drive recovery of spent consumer batteries at retailers for recycling
Australia	Critical Minerals Development Program	AUD 2.23 million grant supporting cobalt retrieval from mine waste

Fiscal incentives include measures such as taxation, subsidies, and financing. Examples of fiscal incentives include (1) measures leveling the playing field that enable circular business to compete in the market for example by implementing an environmental tax at different stages of the value chain or VAT reduction for reused products; (2) incentives for value chain collaboration to facilitate and reward efforts in optimizing circular economy solutions; (3) incentives for market participation to involve end-users in the value chain, such as deposit-refund systems or buy-back programs, (4) financing knowledge sharing and information campaigns to increase understanding; (5) identifying strategic projects and providing a 'first mover's action' incentives.[203] Given the uncertainties in terms of the future development of the battery chemistries, a condition for financial support designed to support the uptake of recycling facilities could include flexibility in terms of chemistry and cell format to prevent lock-in effects.[204]

[201] Data retrieved from IEA, Recycling of Critical Minerals: Strategies to scale up recycling and urban mining (IEA 2024), pp. 40-41.
[202] Data retrieved from IEA, Recycling of Critical Minerals: Strategies to scale up recycling and urban mining (IEA 2024), pp. 40-41.
[203] Uusitalo, T, Huttunen-Saarivirta, E, Hanski, J, Lima-Toivanen, Maria, Myllyoja, J and Valkokari, P, Policy Instruments and Incentives for Circular Economy – Final Report (EIT Raw Materials 2020), pp. 31-32.
[204] IEA, Recycling of Critical Minerals: Strategies to scale up recycling and urban mining (IEA 2024), p. 75.

Annex 2

Local content requirements as set out in MOI Regulation 6/2022

Manufacture for main component	
Target period	Local content requirement
2020-2029	50%
Four-tyred (or more) BEV[205]	
Body, cabin and or chasis	5%
Battery	40%
Electrical motor movement system	5%
Two-tyred (or more) BEV[206]	
Body and/or frame	5%
Battery	40%
Electric motor movement system	5%
2030 onwards	60%
Four-tyred (or more) BEV[207]	
Body, cabin and or chasis	5%
Battery	50%
Electrical motor movement system	5%
Two-tyred and/or three-tyred BEV[208]	
Body and/or frame	5%
Battery	50%
Electric motor movement system	5%
Manufacture for supporting components	
No timeframe	10%
Four-tyred (or more) BEV[209]	
Driving system	2%
Suspension	1%
Braking system	2%
Tyre and rims	1%
Seats and cable system	2%
Electronic system and air conditioner	2%
Two-tyred and/or three-tyred BEV[210]	
Driving system	2%
Braking system	2%
Tyre and transmission	2%
Electronic system	2%
Suspension	2%
Assembly[211]	
2020-2029	30%
Employment	15%
Work equipment	15%
2030 onwards	20%
Employment	10%
Work equipment	10%
Research and development	
No timeframe	10%

[205] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 10(1)
[206] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 11(1)
[207] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 10(2)
[208] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 11(2)
[209] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 10(3)
[210] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 11(2)
[211] MOI Regulation No. 6 of 2022 as amended by MOI Regulation No. 28 of 2023 Article 22

Annex 3

The next table provides an overview of the most used policy instruments to support EV uptake used worldwide:

Examples of policy instruments implemented worldwide to support EV uptake[212]

Measure	Description	Country/region
ICE ban/phase-out target	Sales ban on the sale of new ICE vehicles and/or targets to phase-out new ICE vehicles by a set date	Denmark, Chile, Argentina
Zero-Emission vehicle mandates	Requirement for automakers to sell a certain percentage of zero-emission vehicles	Norway, Canada, Chile, EU, UK, Netherlands, Ireland, Austria, Costa Rica, California
Support for domestic EV manufacturing	Government providing financial support to manufacturers for producing EVs and related components domestically, such as batteries.	The US, the EU, India, Morocco, Indonesia, Japan, Mexico
Low-Emission Zones or similar policies	Designated areas (usually in the city center) where access for certain polluting vehicles is restricted or deterred; other measures such as reduced road taxes, toll exemption, access to bus lanes or free parking for EVs	London, Milan, Amsterdam, Utrecht
Interest-free or low-interest loans	Loans with low-interest or interest-free to support for example the instalment of a home EV charger	Scotland, ACT, France
National plans for EVs	Setting targets for EV adoption	Norway, China, EU, Japan, Germany
EV purchase subsidies	Subsidies, tax credits and rebates reducing the upfront costs of EVs	Indonesia, the US, China, Norway
Fleet purchase programs	Incentives provided to companies and/or mandates to purchase EVs for their vehicle fleets	EU, US
Consumer outreach and education policies	Public awareness campaigns to raise knowledge of the public about the benefits of EVs and promote environmental and economic advantages of switching to EVs	Norway, Germany, China, UK
Support for charging infrastructure	Direct investment in public charging stations and incentives for private installations; public mandates incorporated in buildings codes to include EV charging points for new built, simplified property laws and accelerated approval procedures for EV owners to install and use private charging infrastructure at home	EU, China, Canada, India

[212] Based on data from IEA, *Global EV Policy Explorer* (2024); < https://www.iea.org/data-and-statistics/data-tools/global-ev-policy-explorer>

Annex 4

Risks can have a significant impact on the economic viability of a project as well as the overall supply chain. The below table looks at the overall sensitivity on the main financial metrics from low to high impact on each of the key variables that should be monitored:

Risk factors

Risk Factor	Low Impact	Medium Impact	High Impact
Cost-Benefit Analysis (CBA)	Minor variations in cost estimates	Moderate deviations in projected benefits	Significant misalignment with energy efficiency and economic benefits
Capital Expenditure (CapEx)	Slight budget overruns	Moderate increase in infrastructure and technology costs	Severe budget misalignment affecting strategic goals
Operational Expenditure (OpEx)	Minor increase in operational costs	Unexpected rises in logistics and recycling costs	Substantial operational cost inefficiencies
Revenue Growth	Slow but steady growth	Fluctuations in sales and partnership revenues	Significant decline in market acceptance
Debt-to-Equity Ratio	Minor imbalances	Moderate reliance on debt financing	Critical financial instability due to high debt levels
Gross Margin	Small variations in cost of goods sold	Moderate reductions in profitability	Severe impact on profitability margins
Payback Period	Slightly extended payback period	Moderate delay in investment recovery	Significant delay in recouping investments
Net Present Value (NPV)	Minor deviations in projected cash flows	Moderate variations in future cash inflows	Substantial negative impact on project profitability
Internal Rate of Return (IRR)	Small variations in expected returns	Moderate changes in annualized return rates	Severe decrease in investment attractiveness
Risk and Sensitivity Analysis	Minor uncertainties	Moderate risk exposure	High-risk challenges requiring strategic adjustments

Individual projects however will require thorough due diligence from competent teams to assess the risk for each investment, the sensitivity to the identified risks and ultimately make recommendations upon the right cause of action for mitigating each risk where possible.

Risk assessment is a crucial process in the management and mitigation of potential hazards within an organization, project, or any other operational entity. It involves identifying, analysing, and evaluating risks to ensure informed decision-making and the implementation of appropriate measures to minimize adverse impacts.

A typical risk assessment includes four aspects shown in the figure below.

Risk assessment aspects

- Identifying potential hazards
- Analysing the likelihood and severity of adverse outcomes
- Evaluating the overall risk level
- Determining appropriate risk management strategies

Effective risk assessment requires a comprehensive understanding of the context in which the assessment is being conducted, as well as the specific objectives and resources available. There are a number of international frameworks and guidelines to assist with. The International Organization for Standards (ISO) is one of the most followed. Their ISO 31000:2018 is a comprehensive guide to risk management. ISO31000 considers both the likelihood and impact of each risk to provide a risk score using their 5 by 5 matrix which is well established.

Areas of impact using ISO31000:2018

IMPACT	Rare (1)	Unlikely (2)	Possible (3)	Likely (4)	Highly Likely (5)
Very Severe (5)	Medium (5)	Medium High (10)	High (15)	Very High (20)	Very High (25)
Severe (4)	Low (4)	Medium (8)	Medium High (12)	High (16)	Very High (20)
Moderate (3)	Low (3)	Medium (6)	Medium (9)	Medium High (12)	High (15)
Minor (2)	Low (2)	Low (4)	Medium (6)	Medium (8)	Medium High (10)
Negligible (1)	Low (1)	Low (2)	Low (3)	Low (4)	Medium (5)

LIKELIHOOD

Risks with very high priority level → Risks with medium/low priority level

Source: ISO 31000:2018

While generic, the same principles can be applied to very niche and technically complex industries (such as the battery value chain) by individuals and organisations with the relevant backgrounds and depth of knowledge.

The risks which are repeated across the battery supply chain are summarised below and should be considered with any investment due diligence irrespective of which part of the supply chain is being studied.

Scale: The importance of scale in the supply chain cannot be overstated. It significantly influences economic performance and financial risk. Larger operations benefit from economies of scale, where the cost per unit decreases as the size of the operation grows. This is achieved through efficient utilization of equipment, enhanced negotiating power for raw material and energy purchases, and the ability to distribute fixed costs over a larger production volume. Consequently, large-scale operations often experience lower operational costs and higher profitability, making them attractive for investment and sustainable growth. Increased scale also enables the adoption of advanced technologies and optimized processes, further enhancing efficiency and reducing costs. In that sense, Indonesia can take advantage of the ambitious domestic manufacturing of EVs target the government has set. The creation of the state company Indonesia Battery Corporation (IBC) is a step in the right direction.

However, careful consideration should be given to the utilization of the facilities to ensure an efficient production volume. Many costs remain fixed regardless of production volume, meaning underutilized facilities may operate at a loss.

Maintenance and Repairs: The machinery and equipment used throughout the supply chain requires regular maintenance and occasional repairs. Unexpected breakdowns can lead to costly repairs and downtime, affecting the overall productivity and financial performance of the facility.

Availability of Energy: Reliable access to energy sources, whether through electricity grids or gas supplies, is essential for continuous operations at every level of the supply chain. Interruptions or shortages can lead to costly downtime and impact overall productivity and economics.

Price of Energy: Fluctuations in the price of energy, including electricity and gas, directly affect operational costs. Energy-intensive processes are particularly sensitive to changes in energy prices, making long-term energy contracts and investments in energy efficiency important for controlling costs. Factors such as geopolitical tensions, changes in energy policy, and shifts in global demand, all impact the price of energy will impact manufacturing costs.

Labor and Workforce Management: Access to a skilled and well-managed workforce is essential for maintaining high productivity and operational efficiency. Investment in training, safety, and employee well-being can lead to higher morale, lower turnover, and better overall performance which has a direct impact on the operating costs. It is also important to have local experts who possess the necessary technical skills but also have a good understanding of local dynamics.

Quality and Reliability: Producing high-quality components for the end user that offer long-term reliability is essential for customer satisfaction. Maintaining stringent quality control standards throughout the supply chain helps in reducing warranty costs and enhancing brand reputation.

Contracting Strategies: Effective contracting strategies throughout the supply chain can help manage costs and mitigate risks. Long-term contracts with end-to-end suppliers can ensure stable input prices and reduce exposure to market volatility. Performance-based contracts with service providers can align incentives and drive efficiency. Additionally, alternative markets for lower spec material could provide some financial relief where inefficiencies exist especially in the early years of production.

Scalability Challenges: Once in operation scaling up production to meet increasing demand requires significant investment. If not managed efficiently, these costs can outweigh the benefits of capturing larger market shares, thereby diminishing profit margins.

Innovation and Efficiency: Continuous innovation in technology and efficient manufacturing processes help reduce costs and increase profitability. Companies investing in R&D to develop cutting-edge components and improve production techniques achieve higher financial returns.

Market Demand Fluctuations: The energy storage market is highly dynamic, with demand influenced by technological trends, governmental policies, and economic conditions. An inability to adapt quickly to these changes throughout the supply chain can result in missed opportunities and decreased financial performance.

Environmental Sustainability: All sections of the supply chain and the companies within must embrace sustainable practices to avoid regulatory scrutiny and reputational damage. The costs associated with implementing these practices can impact financial returns but neglecting them poses a greater risk.

Regulatory Compliance: Adhering to various regulations governing production, safety, and environmental standards is essential to avoid fines and legal actions. However, compliance costs can be substantial and affect overall profitability.

Annex 5

All energy densities from SC Insights[213] and Cao et.al[214]. Capacity is defined to produce 1,000,000 EVs and 6 GW of BESS.

Battery material feedstock for Indonesia 2030 – 100 GWh of NCM 622 batteries for EVs

Item	Lithium	Nickel	Cobalt	Manganese
Capacity	100	100	100	100
Energy density	0.72	0.62	0.23	0.2
Demand	72,000	62,000	23,000	20,000
Detail	LCE	Ni+	Co+	Mn+

Battery material feedstock for Indonesia 2030 – 100 GWh of NCM 811 batteries for EVs

Item	Unit	Lithium	Nickel	Cobalt	Manganese
Capacity	GWh	100	100	100	100
Energy density	Kg/kWH	0.72	0.82	0.1	0.09
Demand	Tonnes (MT)	72,000	82,000	10,000	9,000
Detail		LCE	Ni+	Co+	Mn+

Battery material feedstock for Indonesia 2030 – 67 GWh of LFP batteries for EVs

Item	Unit	Lithium	Iron Phosphate
Capacity	GWh	67	67
Energy density	Kg/kWH	0.75	2.16
Demand	Tonnes (MT)	50,250	144,720
Detail		LCE	FePO4

Battery material feedstock for Indonesia 2034 – 6 GWh of NCM 533 batteries for BESS

Item	Unit	Lithium	Nickel	Cobalt	Manganese
Capacity	GWh	6	6	6	6
Energy density	Kg/kWH	0.72	0.52	0.23	0.2
Demand	Tonnes (MT)	4,320	3,120	1,380	1,200
Detail		LCE	Ni+	Co+	Mn+

Battery material feedstock for Indonesia 2034 – 6 GWh of LFP batteries for BESS

Item	Unit	Lithium	Iron Phosphate
Capacity	GWh	6	6
Energy density	Kg/kWH	0.75	2.16
Demand	Tonnes (MT)	4,500	12,960
Detail		LCE	FePO4

[213] Industry standards
[214] Cao, W., Zhang, J., Hong, L. (April 2020). Batteries with high theoretical energy densities. Energy Storage Materials. https://www.sciencedirect.com/science/article/abs/pii/S240582971931102X

Annex 6

The EU Sustainable Batteries Regulation

Product design

Product design requirements are crucial in promoting durability, repairability and recyclability of materials.

Recycling and material recovery targets

The regulation sets targets for recycling efficiency and material recovery of spent batteries. All collected waste batteries must be recycled, with high recovery rates set for critical raw materials like cobalt, lithium, and nickel.

Consumer information

Batteries will have labels and a QR code providing key data and access to a digital battery passport with detailed information on the battery's key metrics. This supports consumers making informed decisions.

Extended Producers Liability (EPR)

Manufacturers are responsible for the entire lifecycle of their batteries, including collection, recycling, and disposal. The EU's Sustainable Batteries Regulation is part of a wider regulatory framework in the EU that seeks to ensure the sustainability and security of certain products imported within the EU market area.

The EU Sustainable Batteries Regulation establishes minimum requirements for durability and performance[215], as shown in the figure below:

EU Sustainable Batteries regulation – Durability and Performance[216]

Article 10

- The EU Sustainable Battery Regulation provides in Article 10 performance and durability requirements to be introduced. There are two types of requirements: first, information requirements, which apply for EV, light means of transport, and rechargeable industrial batteries larger than 2 kWh; second, minimum requirements that are introduced by EU secondary legislation only for rechargeable industrial batteries larger than 2kWh and light means of transport batteries.

Annex IV, Part A

The information and minimum requirements' parameters as referred to in the EU Sustainable Batteries Regulation are set out in Annex IV, Part A of the EU Sustainable Batteries Regulation. Performance parameters include the rated capacity, power, internal resistance, and energy round trip efficiency. Durability parameters include capacity fade, power fade, internal resistance increase, and round trip efficiency fade. The international standardization bodies CEN and CENELEC have been requested by the European Commission under mandate M/579 to develop standards as regards the performance, safety and sustainability requirements of batteries, and the work is currently ongoing. Therefore, it is essential to closely follow the developments in this area as to the implementation of the essential parameters serving as a first international example.

[215] For an overview of the interpretation of these parameters in the EU Sustainable Battery Regulation, see 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, pp. 10-19.

[216] European Commission Implementing Decision of 7.12.2021 on a standardization request to the European Standardisation organization as regard performance, safety and sustainability requirements for batteries. C(2021)8614 – Standardisation request M/579 ; available at <https://ec.europa.eu/growth/tools-databases/enorm/mandate/579_en> . It should also be noted that performance and durability metrics are partially already addressed in current standards, stemming from the EU Battery Directive, predecessor of the EU Sustainable Batteries Regulation. These standards, however, require a thorough re-evaluation due to the new requirements set out in the EU Sustainable Batteries Regulation.

The EU Sustainable Batteries Regulation on Recycling is shown on the figure below:

Sustainable Batteries EU regulation - Recycling

The EU Sustainable Batteries Regulation - Recycling

It mandates a minimum recycling efficiency of 65% for lead-acid batteries and 75% for nickel-cadmium batteries. For other types of batteries, such as lithium-based batteries, the target is set at 50%. The EU Sustainable Batteries Regulation also aims to achieve high recovery rates for critical raw materials. By 2025, at least 95% of cobalt, copper, nickel, and lead must be recovered from waste batteries. For lithium, the target is 70%. Measures such as setting up take-back and collection systems, establishing collection points, and offering free collection services are mandated. Similarly, the EU Critical Raw Materials Act requires EU member states to increase the collection rates for products containing critical minerals. Finally, the EU Sustainable Batteries Regulation establishes a requirement for the level of recycled content in batteries using cobalt, lead, lithium and nickel in active materials, which should be met by 2031, with targets gradually increasing.

The Battery Passport

The Battery Passport provides benefits to the (1) industry by providing information of ESG related data (carbon footprint, due diligence report), information on the design and characteristics of the battery to facilitate dismantling and servicing, and performance and durability data to provide metrics on the residual value of the battery; (2) the consumer by providing information about the battery thus facilitating informed purchase-decisions; and (3) authorities by providing aggregated data to support informed policy impact assessment and policy design.

The obligation for creating the battery passport rests upon the manufacturer. For a battery that has been prepared for reuse, repurposing, or remanufacturing, the responsibility for meeting the obligations will be transferred to the economic operator who placed the battery on the market or put it into service. This battery will have a new battery passport linked to the original battery's passport(s). Similarly, when a battery becomes a waste battery, the responsibility for fulfilling the obligations will be transferred to either the producer, the producer responsibility organization, or the waste management operator. After the battery has been recycled, the battery passport ceases to exist.

The EU Sustainable Batteries Regulation provides the rules concerning the Battery Passport in Articles 77 and 78. According to Article 77 of the Sustainable Batteries Regulation, from 2027 onwards, each light means of transport battery, each industrial battery with a capacity greater than 2 kWh and each electric vehicle battery placed on the market or put into service shall have a battery passport. The information provided in the battery passport is divided into three groups:

1. Information accessible to the general public
2. Information accessible only to notified bodies, market surveillance authorities and the EU Commission; and

3. Information accessible only to any natural or legal person with a legitimate interest in accessing and processing that information.

The purposes for accessing and processing the information must concern (1) dismantling the battery, including safety measures to be taken during the dismantling, and the detailed composition of the battery model and be essential to allow repairers, remanufacturers, second-life operators and recyclers to conduct their respective economic activities; and (2) in the case of individual batteries, be essential to the purchaser of the battery or parties acting on the purchaser's behalf, for the purpose of making the individual battery available to independent energy aggregators or energy market participants. Part of the information to be included in the battery passport as enshrined in the EU Sustainable Batteries Regulation, Annex VII, is listed below as an example:

Information to be included in the battery passport relating to the battery model

Information category	Information to be included in the battery passport
Publicly accessible information	○ Information relating to the parameters for determining the state of health and expected lifetime of batteries (Annex VII, Part A of the EU Sustainable Batteries Regulation); ○ The material composition of the battery, including its chemistry, hazardous substances present in the battery, and critical raw materials present in the battery; ○ The carbon footprint information (Articles 7(1) and (2)); ○ Information on responsible sourcing (Article 52(3); ○ Recycled content information (Article 8(1)); ○ The share of renewable content; ○ Expected battery lifetime; ○ Capacity thresholds for exhaustion: ○ Temperature range the battery can withstand when not in use; ○ Initial round trip energy efficiency and at least 50% of cycle-life; ○ C-rate of relevant cycle-life test;
Information accessible only to persons with a legitimate interest	○ Detailed composition, including materials used in the cathode, anode and electrolyte; ○ Part numbers for components and contact details of sources for replacement spares; ○ Dismantling information; ○ Safety measures.
Information accessible only to notified bodies and market surveillance authorities	○ Results of test reports proving compliance with the requirements laid down in the Regulation or any secondary legislation adopted pursuant to the Regulation

Information and data requirements relating to an individual battery

Category	Information to be included in the battery passport
Information accessible only persons with a legitimate interest	Values for performance and durability parameters, when the battery is placed on the market and when it is subject to changes in its status (Article 10(1));
	Information on the state of health of the battery (Article 14);
	Information on the status of the battery, defined as 'original', 'repurposed', 're-used', 'remanufactured' or 'waste';
	information and data resulting from its use, including the number of charging and discharging cycles and negative events, such as accidents, as well as periodically recorded information on the operating environmental conditions, including temperature, and on the state of charge.

Article 10
(1) Document on performance and durability requirements of Annex IV, Part A

Article 14
(1) Up-to-date data on the state of health and expected lifetime of batteries as set out in Annex VII

The EU Commission is empowered to adopt secondary legislation to specify which persons are to be considered 'persons with a legitimate interest' and to which information they have access, and to what extent they can download, share, publish and re-use that information. The criterion for specifying the persons is as follows:

I. the necessity of having such information in order to evaluate the status and residual value of the battery and its capability for further use;
II. the necessity of having such information for the purpose of preparation for reuse, repurposing, remanufacturing or recycling of the battery, or for choosing between those operations; and
III. the need to ensure that the accessing and processing of information in the battery passport that is commercially sensitive is limited to the minimum necessary.

The EU Commission deadline for the implementation of those acts is August 2026. Furthermore, the Commission is granted the authority to review and add information to be included in the battery passport if technical and scientific developments are required.

Currently, there is very little empirical evidence available on the battery passport given its very recent emergence in the industry landscape. According to the EU's document *Implementing the EU Digital Battery Passport: Opportunities and challenges for battery circularity* [217], public access to battery-related information, such as carbon footprint data, can raise consumer awareness about the environmental impacts of batteries. The

[217] V Rizos and P Urban, Implementing the EU Digital Battery Passport: Opportunities and challenges for battery circularity (BATRAW, March 5, 2024).

document mentions some challenges in the implementation of the battery passport, particularly regarding data collection and sharing: while technical tools for data collection are available, obtaining comprehensive battery-related information remains particularly challenging especially due to the involvement of numerous supply chain actors. Data sharing poses significant obstacles, with companies generally reluctant to share information unless non-disclosure agreements or similar tools are in place. Trus issues arise from the competitive nature of the market and a lack of awareness about the importance of transparency and upcoming (global) legal requirements. Confusion over data access rights and concerns about confidentiality further complicate data sharing.

Finally, the document mentions that assessing the reliability and validity of collected data is another challenging topic. Reliable data, such as carbon footprint information, is essential for meeting one of the battery passport's objectives. However, the complexity of the battery supply chain, involving many companies across different continents, makes it difficult to assess the reliability of data from suppliers.

Carbon footprint declaration

The EU Sustainable Batteries Regulation requires a carbon footprint declaration for EV batteries, rechargeable industrial batteries with a capacity greater than 2 kWh and light means of transport batteries. The objective of the carbon footprint declaration is to ensure that batteries have a low carbon footprint throughout their lifecycle. Operators along the battery value chain (producers, importers, distributors alike) are obligated to report on their product's carbon footprint by relying on a life cycle assessment approach. The life cycle assessment approach is an internationally recognized methodology in product environmental characteristic analysis.[218]

The carbon footprint declaration must be created for each battery model per manufacturing plant, and it must include, inter alia, at least the following information: (1) administrative information about the manufacturer; (2) information about the battery model; (3) information about the geographic location of the battery manufacturing plant; (4) the carbon footprint of the battery, calculated as kg of carbon dioxide equivalent per one kWh of the total energy provided by the battery over its expected service life; (5) the carbon footprint of the battery differentiated according to life cycle stage; (6) a web link giving access to a public version of the study supporting the carbon footprint values.[219]

The EU Commission is granted with the competence to adopt an implementing act establishing the format for the carbon footprint declaration. Furthermore, based on the distribution of carbon footprint values in battery declarations, the Regulation calls for the establishment of a meaningful number of performance classes. What this essentially means is that for instance, category A would represent the highest class with the lowest life cycle carbon footprint, facilitating market differentiation among battery categories.[220]

[218] H Zhang, B Xue, S Li, Y Yu, Z Chang, H Wu et al, 'Life cycle environmental impact assessment for battery-powered electric vehicles at the global and regional level' 13 *Nature Scientific Reports* (2023).
[219] Article 7 of the EU Sustainable Batteries Regulation.
[220]Preamble para. 27 of the EU Sustainable Batteries Regulation.

The batteries that are required to have the carbon footprint declaration are also required to bear 'a conspicuous, clearly legible and indelible label indication the carbon footprint of the battery and declaring the carbon footprint performance class to which the relevant battery model per manufacturing plant corresponds.'[221]

The Joint Research Centre of the EU Commission published the guidelines for calculation of the carbon footprint of EV batteries.[222] The methodology for calculating and verifying the carbon footprint of batteries is based on the Environmental Footprint (EF) method developed by the European Commission, as outlined in EC Recommendations 2279/2021, and the Product Environmental Footprint Category Rules for Batteries. It provides comprehensive guidelines on methodological choices, modelling approaches, and documentation and verification requirements for the carbon footprint of batteries. The publication aims to establish a standardized approach for calculating and verifying the carbon footprint of batteries.

Main areas of carbon footprint calculation based on the Joint Research Center of the EU guidelines for calculation of the carbon footprint of EV batteries[223]

Section	Summary
Functional unit	The functional unit is defined as one kWh (kilowatt-hour) of the total energy provided by the battery over the battery's service life, measured in kWh. Different approaches are specified according to the vehicle type the battery is produced for.
System boundaries	The system boundaries define the processes that have to be modelled for determining the carbon footprint of batteries and those which shall be excluded. They comprise the whole life cycle excluding the use stage, i.e., raw material acquisition and pre-processing, battery manufacturing and end-of-life.
Impact assessment	Sets the life-cycle impact assessment methodology for quantifying the carbon footprint.
Data collection requirements	To allow a broad applicability to a different number of technologies, two different types of processes are distinguished, as mandatory company-specific processes and non-mandatory company-specific processes. The former comprises all processes where the use of company-specific data is mandatory as defined by the Regulation (active material and electrodes production, cell production, module and battery assembling). Non-company-specific processes are further subdivided into 'most relevant' processes and 'non-most relevant' processes.
Modelling requirements	Provides rules for the modelling of specific aspects of the carbon footprint of batteries model, such as electricity modelling, allocation, and end-of-life modelling.
Verification	Comprises all requirements regarding documentation and verification of the carbon footprint of batteries.

[221] Article 7(2) of the EU Sustainable Batteries Regulation.
[222] Andreasi Bassi, S., Peters, J. F., Cadelaresi, D., Valente, A., Ferrara, N., Mathieux, F., Ardente, F., *Rules for the calculation of the Carbon Footprint of Electric Vehicles Batteries (CFB-EV)* (EU Commission Joint Research Centre 2023).
[223] Andreasi Bassi, S., Peters, J. F., Cadelaresi, D., Valente, A., Ferrara, N., Mathieux, F., Ardente, F., *Rules for the calculation of the Carbon Footprint of Electric Vehicles Batteries (CFB-EV)* (EU Commission Joint Research Centre 2023).

Due diligence

Although not strictly a labelling requirement, information on compulsory due diligence reporting should be made available through labelling. Due diligence refers to the comprehensive process that involves investigating and evaluating a business or investment opportunity before decision-making. Due diligence is thus essential for identifying potential risks along the supply chain and ensuring informed decision-making.[224] Due to the risks inherent in the battery supply chain, including those that relate to environmental and social sustainability and the expected increase in the use of minerals used in battery manufacturing that might lead to additional pressure on extraction and refining operations, the increasingly stringent ESG requirements as set out in particular by the EU have led to the introduction of robust due diligence policies.

The transparency and sustainability of businesses has been on the agenda of the EU on multiple platforms during recent years. The increased regulation on this topic requires companies to be informed and transparently report on the environmental and social impacts of their actions. This is done mostly through corporate sustainability due diligence and closely related corporate sustainability reporting.

With relation to batteries, the EU Batteries Regulation imposes specific due diligence obligations on larger companies which place batteries on the market or put them into service. The EU Sustainable Batteries Regulation mandates due diligence measures to reduce environmental and social impacts throughout the battery lifecycle. These requirements do not apply to businesses with a net turnover below EUR 40 million in the previous financial year, provided they are not part of a larger group exceeding this threshold. By 2025, companies selling batteries must establish, implement, and verify due diligence policies. This involves creating and publicly sharing policies on raw materials and related social and environmental risks. Information on responsible sourcing must be made available to the public via the battery passport (discussed later), included in an annual battery due diligence report. Additionally, companies must adopt due diligence standards based on internationally recognized frameworks and develop a system for supply chain transparency and traceability. This requires documentation on traded raw materials, suppliers, countries or origin, and market transactions from raw material extraction onward. Companies must also assess risks of adverse impacts in their supply chains and implement appropriate prevention and mitigation strategies. Member States and EU market surveillance authorities will conduct regular compliance checks to ensure that the regulation's requirements are adhered to. The regulation includes provisions for penalties in cases of non-compliance. These penalties can range from fines to restrictions on market access.

According to Article 48 of the Regulation the Commission was to publish guidelines about the application of the due diligence by 18 February 2025. However, corporate sustainability and due diligence are facing a certain type of backlash in the form of the

[224] OECD, OECD Due Diligence Guidance for Responsible Business Conduct (OECD 2018), p. 16.

recent Omnibus proposal made by the Commission.[225] In this proposal the Commission aims to reduce the administrative burden caused by the sustainability rules in the EU. Undoubtedly, these proposed changes have most likely had an effect on the delay of the publication of the battery due diligence guidelines. This direction taken by the Commission increases also the all-around uncertainty around the implementation of the due diligence in the context of batteries, even though the Batteries Regulation was not included in this Omnibus proposal, at least yet.

In addition to the specific due diligence regulations, the EU Taxonomy Regulation[226] establishes a list of environmentally sustainable economic activities. The Taxonomy Regulation sets out specific requirements for individual sectors, including manufacturing of batteries.

In the US, due diligence requirements are embedded in the IRA Clean Vehicle Tax Credit, which offers incentives for the purchase of EVs. To qualify for the credit, manufacturers must comply with due diligence requirements concerning the sourcing of battery components and critical minerals. In addition, the US Securities and Exchange Commission (US SEC) has implemented rules that indirectly impact the battery sector, particularly through its focus on ESG disclosures.[227] However, the rule might be rolled back given the current administration's anti-ESG approach.[228] Similarly, Australia, Germany, and France among others require ESG reporting.[229]

As a notable example from the ASEAN countries, Thailand has just recently started to draft a mandatory supply chain due diligence law to strengthen corporate responsibility, business compliance, and supply chain accountability. Thailand is introducing the mandatory due diligence law to showcase a demonstrated commitment to responsible business conduct, which is a requirement for joining the OECD. In addition, strengthening human rights protection and supporting responsible business conduct is considered to enhance Thailand's reputation as a responsible business hub and ensure its alignment with emerging global standards.[230] Given Thailand's ambitions to emerge as the global hub for EV production, this policy development may be significant in encouraging in particular western investments in the neighboring ASEAN country.

---

[225] European Commission, Proposal for a Directive of a European Parliament and of the Council, amending Directives 2006/43/EC, (EU) 2022/2464 and (EU) 2024/1760 as regards certain corporate sustainability reporting and due diligence requirements. Brussels, 26.2.2025, COM(2025) 81 final.

[226] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, OJ L 198, 22.6.2020, p. 13-43.

[227] SEC Final Rule Release No. 33-11275, The Enhancement and Standardization of Climate-Related Disclosures for Investors.

[228] M Costa, 'Trump election victory could derail SEC's climate disclosure rule' (November 27, 2024, *Green Central Banking*); https://greencentralbanking.com/2024/11/27/trump-election-victory-could-derail-secs-climate-disclosure-rule/; M Costa, 'SEC moves to freeze its climate disclosure rule' (February 17, 2025, *Green Central Banking*); <https://greencentralbanking.com/2025/02/17/sec-moves-to-freeze-its-climate-disclosure-rule/>

[229] See e.g. M Asif, C Searchy and P Castka, 'ESG and Industry 5.0: The role of technologies in enhancing ESG disclosure' 195 *Technological Forecasting and Social Change* (2023) 122806.

[230] Business & Human Rights Resource Centre, 'Thailand: Govt. to introduce mandatory human rights and environmental due diligence legislation aiming to push for responsible business practices' (March 13, 2025); <https://www.business-humanrights.org/fr/derni%C3%A8res-actualit%C3%A9s/thailand-govt-to-mandatory-human-rights-and-environmental-due-diligence-legislation-aiming-to-push-for-responsible-business-practices/>

While mandatory due diligence policies are increasing, they often follow the internationally recognized due diligence standards and principles. The most notable example of such is the OECD Due Diligence Guidance for Responsible Business Conduct. The EU Sustainable Batteries Regulation refers to the OECD guidance as a framework on which the economic operator should base its due diligence policy. Companies are required by the due diligence policies to adhere to strict environmental and social standards, and by enforcing the due diligence requirements, the EU Sustainable Battery Regulation seeks to support responsible sourcing, environmental protection and social welfare in third countries. These issues will be examined in more detail in Deliverable 4, but considering due diligence reporting information is required in the following legislative tool, the battery passport, it is briefly discussed here.