ENERGY TRANSITION PARTNERSHIP

Powering Prosperity and Enabling Sustainability in South East Asia

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

Inception Report

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Hartree®

KOLIBRI

UNOPS - Energy Transition Partnership Inception Report

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ETP comments set out in 20240627_Inception Report_V1_Comments Matrix	V2	Comments on methodology, ISIC system and minor changes were addressed	July 2024	GS
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Project executed by:

Hartree Consultores, Kolibri and Fractal

Contents

Acronyms

2W	Two-wheeler/two-wheeled vehicle
4W	Four-wheeler/four-wheeled vehicle
ADB	Asian Development Bank
AFD	French Development Agency
BESS	Battery Energy Storage Systems
BEV	Battery Electric Vehicle
BEVs	Battery Electric Vehicles
CFPP	Coal Fired Power Plant
CIFF	Children's Investment Fund Foundation
EDVs	Electric-Drive Vehicles
EE	Energy Efficiency
ENDC	Enhanced Nationally Determined Contribution
ESIA	Environmental and Social Impact Assessment
ESS	Environmental and Social Safeguards
ETM	Energy Transition Mechanism
ETP	Southeast Asia Energy Transition Partnership
EU	European Union
EU CBAM	European Union Cross Border Adjustment Mechanism
FGDs	Focus Groups Discussions
GESI	Gender Equality and Social Inclusion
GGGI	Global Green Growth Institute
GOI	Government of Indonesia
Gt	Giga tons
GW	Gigawatt
GWh	Gigawatt-hour
HEVs	Hybrid Electric Vehicles
HS	Harmonized System
IBC	Indonesia Battery Cooperation

ICEV	Internal Combustion Engine Vehicle
IEA	International Energy Agency
IFC	International Finance Corporation
ISIC	International Standard Industrial Classification of All Economic Activities
MEMR	Ministry/Minister of Energy and Mineral Resources
MOEF	Ministry/Minister of Environmental and Forestry
MOI	Ministry/Minister of Industry
MOInv	Ministry/Minister of Investment
mt	million tonnes
PESTEL	Political, Economic, Social, Technological, Environmental, and Legal
PHEVs	Plug-in Hybrid Electric Vehicles
PT PLN	Perusahaan Listrik Negara (State-Owned Electricity Company)
RE	Renewable Energy
TKDN	Domestic Component Rate (*Tingkat Komponen Dalam Negeri)*
UK - FCDO	Foreign, Commonwealth and Development Office of the United Kingdom
UNOPS	United Nation Office for Project Services
US	United States
VAT	Value-Added Tax
VRE	Variable Renewable Energy
WTO	World Trade Organization

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About the consortium

Hartree Partners is a global energy and commodities firm, with finance and advisory capabilities within the space of oil and gas, electricity markets, and decarbonization. Hartree's subsidiary CHC, based in Singapore, specializes in delivering comprehensive battery solutions to partners and encompassing the optimization of asset bidding. Hartree Partners' investments cover a wide range of energy sectors, including energy storage projects.

Kolibri is an impact consulting, investment management, and digital enablement firm based in Jakarta and Singapore. The firm has strong knowledge and experience advising organizations on maximizing social and environmental impact including collaborations with the Indonesia Ministry of Industry and WWF. Kolibri also has experience in impact portfolio management, facilitating investments aligned with sustainable development goals and contributing to four impact portfolios across Southeast Asia.

Fractal is a specialized energy storage consulting and engineering firm that provides expert consulting, owner's engineering and advisory services for energy storage and hybrid projects. Its achievements include consultant services for over 10 GW of battery storage and hybrid projects, successful application and management of $12M in utility grant projects, and extensive work across North American markets as well as multiple islands and international locations using a variety of energy storage technologies.

About the Southeast Asia Energy Transition Partnership

The Southeast Asia Energy Transition Partnership (ETP) is a multi-donor partnership comprising of government and philanthropic funders, working to accelerate sustainable energy transition in Southeast Asia, in line with the Paris Agreement and Sustainable Development Goals. ETP focus is on empowering partner countries, Indonesia, Vietnam, and the Philippines to achieve a sustainable energy future that fuels economic growth and ensures energy security.

ETP works collaboratively to mobilize and coordinate resources, fostering a robust foundation for renewable energy, energy efficiency, coal phasedown and resilient infrastructure in Southeast Asia.

ETP operates through four strategic outcome areas: (01) Aligning policies with climate commitments; (02) De-risking renewable energy and energy efficiency investments; (03) Extending smart grids; and (04) Enhancing knowledge, awareness, and capacity building[1].

ETP is hosted by the United Nations Office for Project Services (UNOPS).

[1] For more information, please visit: https://www.energytransitionpartnership.org/

1 Introduction and project background

1.1 Introduction

On May 23rd, 2024, UNOPS and Hartree Consultores signed a Contract for Professional Services with the objective of supporting the supply chain integration of the battery value chain for the energy transition in Indonesia. Fractal and Kolibri join the consortium to conduct a comprehensive study.

This document corresponds to **Deliverable 1: Inception Report for the project "Supply Chain Integration of Battery Value Chain for Energy Transition in Indonesia."** This Inception Report aims to align the consortium's understanding of the project with the expectations of the South Asia Energy Transition Partnership (ETP). This Inception Report is an updated version of the submitted proposal, considering the latest comments and insights discussed during the project's kick-off meeting, and includes detailed explanations on the data collection strategies, communication plan, and project management approach.

1.2 Project background

Energy transition and batteries

Due to the global energy transition from fossil fuels to renewable sources, the demand for renewable energies has been continuously growing year by year over the last decade[2]. According to the International Energy Agency, global renewable electricity capacity additions in 2023 were almost 50% higher than in 2022, reaching an estimated 507 GW[3]. As renewable energy (RE) additions are expected to continue increasing in the next five years, new challenges will be faced in power system security, power system stability and power quality[4] due to the intermittent nature of renewable energy resources. Therefore, in a global economy that is continuously prioritizing efforts to decarbonize the energy sector, demand for renewable energy and battery storage systems has accelerated.

Battery Energy Storage Systems (BESS) is comprised of one or more rechargeable batteries that can store energy from different sources and discharge it when needed. In variable renewable energy (VRE) systems, such as wind, water, and tidal, BESS provides backup power, balances the electric grid, and improves grid stability. For utilities, BESS is often

[2]IEA (2024) Renewable Energy Progress Tracker; https://www.iea.org/data-and-statistics/data-tools/renewable-energy-progress-tracker

[3] IEA (2024) Electricity Global Forecast Summary; https://www.iea.org/reports/renewables-2023/electricity

[4] X. Liang, "Emerging Power Quality Challenges Due to Integration of Renewable Energy Sources," in IEEE Transactions on Industry Applications, vol. 53, no. 2, pp. 855-866, March-April 2017, doi: 10.1109/TIA.2016.2626253.

used in "off-grid areas" or areas where the country's main grid is unreliable. BESS projects can also provide Frequency Response and Reserve services at a much lower costs compared to conventional generators, thereby improving power quality and reducing energy costs for consumers. Archipelagic countries like the Philippines[5,6] and Indonesia could also benefit from BESS to overcome the challenges of connecting rural islands to the main grid.

For "behind-the-meter" applications, BESS is typically used for RE integration (i.e., rooftop photovoltaic), emergency or uninterruptable energy supply, and supporting EV charging stations. McKinsey[7] predicts a six-fold increase in global BESS usage from 110-140 GWh in 2023 to 520-700 GWh in 2030.

As crucial components in the energy transition, batteries play a pivotal role in storing cleaner energy, ensuring power is available while providing voltage stability, frequency stability and reliability, hence the cleaner energy is used even when the renewable energies are not available. As mentioned, batteries also support electric mobility by providing power to EVs from cleaner resources, thereby reducing local air pollutants and contributing to cleaner air.

Globally, the demand for batteries and critical minerals has been steadily rising, driven primarily by EV sales. The transportation sector is one of the largest contributors to global carbon emissions, accounting for 8 Gt of CO_2 emissions in 2021[8]. Switching from internal combustion engine vehicles (ICEV) to EVs can potentially reduce emissions by up to 100 g of CO_2 per km[9]. The IEA reported a substantial increase in EV battery volumes, from about 100 GWh in 2015 to approximately 2,300 GWh in 2023[10], alongside a 35% year-on-year increase in EV sales in 2023 compared to 2022[11]. As both EV and RE markets continue to increase, ensuring sustainable growth requires diversifying battery manufacturing and securing critical mineral supplies such as lithium, cobalt, nickel, manganese, and graphite. This approach aims to prevent bottlenecks and price hikes, while maintaining a sustainable battery production supply chain, i.e. from the critical minerals mining to the batteries end of life management.

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[5] Philippine Energy Plan 2020-2040 – Philippines' Department of Energy

[6] Distributed Solar-Storage is Going Great Guns in the Philippines – Solar Magazine, 2018

[7] Enabling renewable energy with battery energy storage systems – McKinsey & Co, 2023

[8] Transport – IEA (2023)

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

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

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

Battery supply chain

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

For instance, Lead-Acid, Nickel Metal Hydride, and Lithium-ion batteries are the commonly used types of batteries for Electric-Drive Vehicles (EDVs), including Battery Electric Vehicles (BEVs), Hybrid Electric Vehicles (HEVs), and Plug-in Hybrid Electric Vehicles (PHEVs). Such batteries are mainly used in automotive and traction applications. They also find their applications in backup and emergency power for electrical installations[12]. Hence, the lithium-ion batteries are known for their high energy density and efficiency and are a dominant choice for EVs. Lithium-ion batteries include nickel-based, iron-based (LFP), and solid-state batteries[13].

For BESS, battery technologies that provide scalability and long-duration energy storage are preferred, and sodium-ion batteries are known for their high energy capacity and thermal stability, also being explored. According to McKinsey's Stockholm office, sodium-ion is one technology to watch because this type of battery has the potential to be less costly and less prone to thermal runaway, moreover sodium-ion batteries environmental impact is lower than lithium-ion batteries[14].

The battery technologies can be analysed based on the raw materials they use. Most lithium-ion batteries use lithium for manufacturing cathodes and graphite for manufacturing anodes. The cathode require other raw materials besides lithium and its composition varies across different sub-chemistries of the lithium-ion technology. Nickel-based batteries typically use nickel, manganese, and cobalt. Iron-based batteries use iron and phosphorus[15]. Finally, the solid-state lithium-ion batteries offer an exception where they use

[12] Mohammadi, F., & Saif, M. (2023). A comprehensive overview of electric vehicle batteries market. e-Prime, Advances in Electrical Engineering, Electronics and Energy, 3, 100127. https://doi.org/10.1016/j.prime.2023.100127

[13] Solid-state batteries differ from liquid electrolyte battery in that they predominantly use a solid electrolyte, providing increased heat stability and a wide window of electrochemical stability.

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

[15] IEA (2023), Global EV Outlook 2023, IEA, Paris https://www.iea.org/reports/global-ev-outlook-2023, Licence: CC BY 4.0

lithium for anode, instead of graphite[16]. Cathode for solid-state lithium batteries includes nickel and cobalt based chemistries[17].

Sodium-ion batteries also include anode and cathode components. Manufacturing anodes typically uses sodium as a key raw material. Cathodes require sodium, manganese, iron, and nickel across various sub-chemistries. The sodium-ion battery technology is a promising alternative to lithium-ion. However, the industry lacks scale and maturity relative to lithium-ion batteries.

Therefore, a winning set of sub-chemistries is yet to be determined for sodium-ion batteries. The various material combinations (i.e. chemistries or subchemistries) lead to batteries unique performance, cost and safety characteristics. For instance, selected battery technologies combinations and characteristics are highlighted in the following table[18]:

Table 1-1 Comparison of selected battery technologies

	Battery technologies		
Key active material	**Lithium manganese oxide**	**Lithium iron phosphate**	**Lithium nickel cobalt aluminium**
Technology acronym	LMO	LFP	NCA
Cathode	$LiMn_2O_4$ (spinel)	$LiFePO_4$	$LiNiCoAlO_2$
Anode	C (graphite)	C (graphite)	C (graphite)
Safety	✓✓✓✓	✓✓✓✓✓	✓✓
Power density	✓✓✓✓	✓✓✓✓	✓✓✓✓✓
Energy density	✓✓✓✓	✓✓	✓✓✓✓✓
Cells costs advantage	✓✓✓✓	✓✓✓✓	✓✓
Lifetime	✓✓	✓✓✓✓✓	✓✓✓✓✓
BES system performance	✓✓	✓✓✓✓✓	✓✓
Advantages	Low cost Very good thermal stability Very good power capability	Very good thermal stability Very good cycle life Very good power capability Low cost	Very good energy and good power capability Good cycle life in newer systems Long storage calendar life

[16] Wang, H., Ozkan, C.S., Zhu, H. et al. Advances in solid-state batteries: Materials, interfaces, characterizations, and devices. MRS Bulletin 48, 1221–1229 (2023). https://doi.org/10.1557/s43577-023-00649-7

[17] ScienceDirect. Solid State Battery: An overview. From: Reference Module in Chemistry, Molecular Sciences and Chemical Engineering, 2023. Available at: https://www.sciencedirect.com/topics/materials-science/solid-state-battery#:~:text=Commonly%20used%20cathode%20materials%20for,used%20lithium%20metal%20based%20oxide.

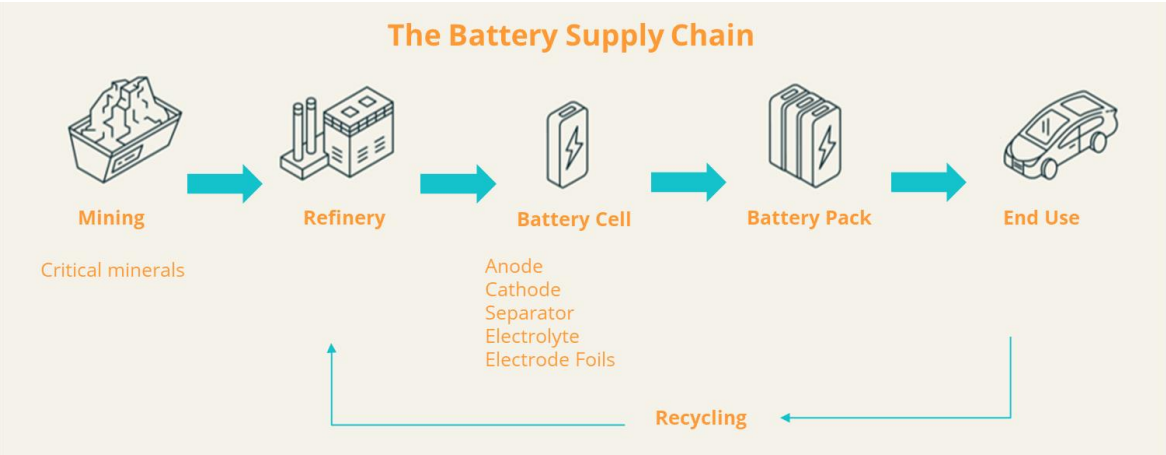
[18] Further information on battery technologies, the description of these types of batteries, including the composition proportions, quality and prices, is developed in Deliverable 2.

Key active material	Battery technologies		
	Lithium manganese oxide	**Lithium iron phosphate**	**Lithium nickel cobalt aluminium**
Disadvantages	Moderate cycle life Low energy performance	Lower energy density	Moderate charged state thermal stability which can reduce safety

Source: Extracted from Electricity storage and renewables: Costs and markets to 2030[19]

The battery industry covers a worldwide supply chain which encompasses various stages, including extraction, processing, manufacturing, end use, end of life, and distribution and transportation. The general overview of the supply chain is shown in Figure 1-1:

Figure 1-1 General overview of the battery supply chain



Source: own elaboration based on The Battery Supply Chain eBook (Minespider 2023)

Each stage is briefly described below:

1. **Raw materials, primarily nickel, cobalt and lithium, are extracted through mining**. Manganese, graphite, copper, and bauxite also play significant roles in the supply chain. The demand for batteries has driven an increase in extraction of these key minerals, leading to the opening of new mines or the extension of existing ones. Using drilling activity as an indicator of such extension, from 2020 to 2021, there was a 50% rise in nickel drilling activity and a threefold increase in lithium drilling worldwide[20].

[19] IRENA (2017), Electricity Storage and Renewables: Costs and Markets to 2030, International Renewable Energy Agency, Abu Dhabi.

[20] IEA (2023) Global supply chains of EV batteries, from https://iea.blob.core.windows.net/assets/4eb8c252-76b1-4710-8f5e-867e751c8dda/GlobalSupplyChainsofEVBatteries.pdf

2. **Raw ore is processed into refined materials through ore processing plants.** Refining the ore is important to ensure the minerals are ready to be manufactured in the next stage.

3. **Refined ore is then shipped to manufacturers for the production of battery cell components.** Batteries typically consist of cathode and anode materials, electrolytes, separators, and electrical foil. A key defining feature of batteries is their cathode chemistry as it determines the performance and material requirements. For example, nickel-based batteries' cathodes have become increasingly dominant as they offer high energy density, albeit requiring more complex and controlled processes. LFP batteries are lower cost and have a longer life cycle.

4. **Battery cells are assembled into packs,** which involves integrating them with electronics, sensors and battery management systems. This process may be completed by the cell manufacturer or by end-users such as automakers. Battery cell production is capital-intensive and concentrated primarily in Asia among a few major producers.

5. **Battery packs are integrated into ready-to-use end products** like electric vehicles, electronics, or battery energy storage systems. The end use stage is pivotal in the supply chain as it drives battery demand and therefore influences pricing. For example, EVs accounted for 47% lithium demand in 2021.

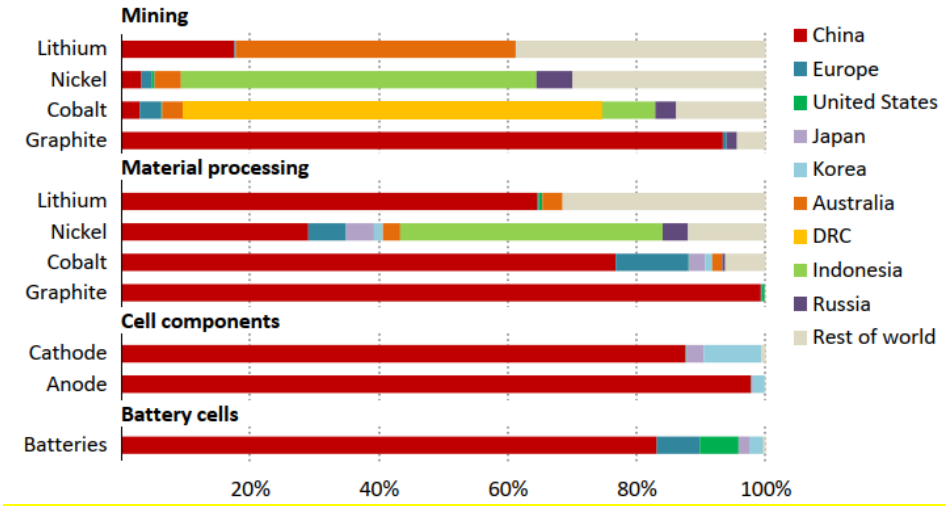
6. **Reuse or recycling efforts** are gaining momentum, aiming to extend the life of used batteries. In regions like the European Union, used batteries must undergo recycling to a certain extent and be equipped with a QR code battery passport. This passport informs subsequent users about the battery's contents, health status, and expected lifetime[21].

7. **Distribution** involves transportation activities throughout the entire supply chain, ensuring efficient movement of materials and products.

China dominates nearly all supply chain processes across various battery technologies. Figure 1-2 illustrates China´s significant role in the downstream battery supply chain. However, Indonesia is not so far behind, contributing approximately 40% to nickel processing within the supply chain and ranking as the second-largest producer of cobalt.

[21] 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) 2019/1020 and repealing Directive 2006/66/EC

Figure 1-2 Geographical distribution of the global battery supply chain



Source: IEA (2024), Batteries and Secure Energy Transitions, IEA, Paris

Indonesia's energy transition commitments

As the largest economy in Southeast Asia and the world's fourth most populous nation[22], Indonesia faces a rising energy demand. The country is the fourth largest coal producer and Southeast Asia's leading gas supplier[23]. Indonesia has declared an Enhanced Nationally Determined Contribution (ENDC) to reduce emissions from 2010 to 2030 by 31.89% unconditionally and 43.20% conditionally, with the conditional target dependent on the availability of international support for finance, technology transfer and development, and capacity building[24]. Given its significant role as a major energy producer and consumer in both regional and international markets, Indonesia's efforts to transition away from fossil fuels will be crucial to meet its international climate commitments.

The Indonesian government intends to gradually introduce more RE proportions in the primary energy mix until 2060. Table 1-2 shows policies and regulations stipulating Indonesia's target RE share between 2025 and 2050. Currently, the national target RE share is aimed at 23% in 2025 and 31% by 2050. The Draft Government Regulation on the National Energy Policy is reportedly in the works, with a RE share target of 70% by 2060[25]. The Ministry of Energy and Mineral Resources (MEMR) has targeted this Government Regulation to be issued in mid-2024.

[22] WB (2023) Outlook: The World Bank in Indonesia; https://www.worldbank.org/en/country/indonesia/overview#1

[23] IEA. Energy Systems in Indonesia; https://www.iea.org/countries/indonesia

[24] UNFCCC (2022). Enhanced NDC - Republic of Indonesia; https://unfccc.int/documents/615082

[25] MEMR Press Release (2024)

Table 1-2 Indonesia's renewable energy (RE) share commitments

Policy/Regulation	RE targeted share		
	2025	2050	2060
Government Regulation 79/2014 on National Energy Policy - Peraturan Pemerintah No. 79 Tahun 2014 tentang Kebijakan Energi Nasional (KEN)	23%	31%	-
Presidential Regulation 22/2017 on National Energy Grand Plan - Peraturan Presiden No. 22 Tahun 2017 mengenai Rencana Umum Energi Nasional (RUEN)	23%	31%	-
Draft of National Energy Policy - Rancangan Peraturan Pemerintah tentang Kebijakan Energi Nasional	-	-	70%

The Government of Indonesia (GOI) has initiated several ways to minimize its reliance on fossil fuels. In November 2022, the Government of Indonesia introduced *the Energy Transition Mechanism (ETM) Country Platform* to solidify and accelerate its energy transition commitment. Coal is set to phase out in the next 20 years, starting with Coal Fired Power Plant (CFPPs) Cirebon-1 and Pelabuhan Ratu in 2035 and 2037[26], respectively. In addition, the ENDC commits to developing renewable energy and cofiring technologies as fossil fuel replacements. Hard-to-abate industries, such as cement, ammonia, and steel, are encouraged to replace coal with natural gas as a lower carbon alternative. Fuel switching in public transportation, e.g., oil fuel switching from Research Octane Number (RON) 88 to higher RON and compressed natural gas (CNG) for public transport, has also begun gradually.

In relation to EVs and energy storage systems, Table 1-3 presents relevant Indonesian policies[27]. The MEMR governs all energy-related policies, while PLN operates as the state-owned enterprise under direct government mandate. The Ministry of Industry (MOI) is responsible for battery industrialization and has established MOI Regulations 6/2022 and 28/2023 as the framework for developing the domestic battery supply chain. Foreign investments in EVs and batteries fall under the oversight of the Ministry of Investment (MOInv).

Table 1-3 Selected Indonesia's regulations related to energy storage systems and EVs

Policy / Regulation[28]	Description
Law No. 30 of 2007 on Energy	The Law provides a basis for sustainable development, environmental preservation, and energy resilience in national energy management.
Law No. 30 of 2009 on Electricity	The primary legal basis for Indonesia's electricity. This Law establishes that PLN will remain vertically in control of the national transmission network,

[26] JETP Indonesia (2023)

[27] Deeply analysis will be carried out in Workstream C: Implementation plan tools – Policy roadmap.

[28] Detailed information regarding Indonesia's legislations can be accessed through this site: https://peraturan.bpk.go.id/.

Policy / Regulation[28]	Description
	such that it is the main provider of generation and the sole provider of transmission and distribution networks (although IPPs can own some transmission lines in remote locations)[29].
Law No. 11 of 2020 on Job Creation (Omnibus Law)	The Omnibus Law subjects government agencies, state-owned enterprises, private sectors, and other entities engaged in the electricity business to prioritize domestic products and potentials. This is the legal basis for industrial fulfilment of domestic content requirements (TKDN).
National Electricity General Plan (RUKN)	Issued by the MEMR. It provides a framework for energy-related plans, such as the Electricity Power Supply Business Plan (RUPTL) and the Regional Energy Plan (RUED), which will be executed by PLN as the sole state-owned electricity provider.
Electricity Business Plan (RUPTL) 2021-2030	The RUPTL is a direct mandate from the RUKN, issued by PLN. It provides a 10-year development plan for nationwide electricity generation, transmission, and distribution assets with a target of 943.15 MW by 2030. It also describes renewable energy development plans, including hybrid or microgrid systems, with either battery storage or backup diesel power plants.
Presidential Regulation 55/2019 on Acceleration of the BEV Program for Road Transportation	The presidential mandate to develop a domestic EV industry as a national priority to increase energy efficiency in the transportation sector[30]. Specifies technical requirements and standards for EVs, including battery charging and related infrastructure.
Presidential Regulation 79/2023 on Amendments to Presidential Regulation Number 55 of 2019 concerning the Acceleration Program of BEV for Road Transportation	It mandates boosting EV use in daily transportation. It additionally addresses technical requirements, safety standards, battery charging infrastructure, and incentives to support the production, distribution, and adoption of electric vehicles in Indonesia.
MOI Regulation 6/2022 on BEV Specification, Roadmap, and TKDN Calculation	It provides a 2020-2030 roadmap for BEV specification, supply chain development policies and strategies, and TKDN targets and calculations.
MOI Regulation 28/2023 on Amendments to MOI Regulation 6/2022 on BEV Specification, Roadmap, and TKDN Calculation	It provides several updates to the MOI Reg 6/2022, notably the inclusion of more EV categories (2W and trucks), revised battery capacity eligible for incentives, revised TKDN components, and the addition of more complex variables related to EV assembly activities.
Minister of Investment (MOInv) 6/2023 on Guidelines and Governance for Providing Incentives for Import and/or Delivery of Four-Wheeled Battery-Based Electric Vehicles in Accelerating Investment	This regulation governs guidelines and governance for providing incentives for the importation and/or delivery of 4W BEVs in order to accelerate investment in Indonesia's EV sector.

Indonesia's political landscape increasingly favours the development of RE and sustainable battery value chains. During the presidency of President Joko Widodo, he emphasized green energy investments particularly through PT PLN, the state-owned power utility company[31]. He also prioritized establishing an integrated domestic electric vehicles (EVs) supply chain[32]. Building upon these efforts, the elected President Prabowo Subianto's

[29] IEA. Policies database. Law No. 30 of 2009 on electricity. https://www.iea.org/policies/5683-electricity-law-no-302009

[30] CSIS (2022). Indonesia's Battery Industrial Strategy.

[31] Jokowi urges PLN to invest in green energy - ANTARA News

[32] Musk to 'Consider' Opening Battery Plant in Indonesia, Senior Official Says – The Diplomat

vision statement for 2024-2029 further underscores Indonesia's commitment to national defence, security, and self-reliance, particularly in critical sectors such as energy (including minerals) and the green economy.

The fifth mission of the elected president's vision statement focuses on continuing downstreaming and industrialization to increase added value domestically[33]. This initiative aims to leverage Indonesia's abundant reserves of nickel and copper to establish an integrated domestic EV supply chain. The envisioned chain spans across the value chain: from mining and processing battery metals to manufacturing precursor cathode materials, battery cells, and production of EVs. By 2030, Indonesia aims to achieve a substantial production capacity of 140 GWh per year in EV batteries, representing a significant leap from current capabilities[34].

Indonesia's mineral sector and establishing a national battery supply chain

Indonesia is one of the largest mineral producers in the world[35]. It holds the world's largest nickel reserves and is the world's top nickel producer, a critical mineral for batteries. The total nickel ore production is 175,617,182 mt in 2023, with reserves estimated at 5,028,909,381 mt[36]. Indonesia has enforced raw mineral export bans dating back to 2014 to push ore refining domestically[37].

As a result, Indonesia saw rapid development in smelters in the last decade[38]. For nickel alone, Indonesia has 54 operating nickel smelters per February 2024[39]. Most of them use pyrometallurgy, creating nickel products for steel production, accounting for 70% of total nickel demand. As a result, revenue from nickel export increased from US$941.75 million in 2023 to US$5.93 billion in 2022[40].

Indonesia recently seized the opportunity to respond to the global battery market. Global nickel demand for batteries is projected to overtake steel in the 2030s[41]. With nickel as its focus, the government is pushing the development of more smelters that use hydrometallurgy technology, such as high-pressure acid leaching (HPAL)[42]. HPAL smelters create

[33] 8 Program Kerja "Asta Cita" Prabowo-Gibran, Hilirisasi Jokowi Lanjut (bisnis.com)

[34] Indonesia's Battery Industrial Strategy (csis.org)

[35] Indonesia – Country Commercial Guide – Mining (ITA 2024)

[36] Geological Agency. 2023. Balance of Mineral and Coal Resources of Indonesia. MEMR.

[37] Between a mineral and a hard place: Indonesia's export ban on raw minerals (TNI 2023)

[38] Siaran Pers: Perkembangan Pembangunan Smelter dan Larangan Ekspor Nikel (MEMR 2019)

[39] Dua Teknologi Smelter Nikel di Indonesia, Mana yang Ramah Lingkungan? (Tempo 2024)

[40] Ekspor Nikel Indonesia Meroket pada 2022, Rekor Tertinggi Sedekade (Katadata 2023)

[41] Nickel demand for batteries to overtake stainless steel in late 2030s (Benchmark Source 2023)

[42] Cadangan Kobalt Melimpah, ESDM Dorong Investasi Smelter HPAL - Bisnis.com, 2023

nickel products for battery production. Indonesia also produces significant amounts of cobalt, manganese, copper, and bauxite (see Table 1-4 for more details).

Table 1-4 Overview of Indonesia's mineral production for battery supply chain

Mineral	Origin	Ore production (mt)[31]	Ore reserves (mt)[31]	Operating smelters	Future Plans
Nickel	Maluku, Sulawesi, Papua	175,617,183	5,028,908,381	Yes	Per 2024, Indonesia has 116 smelters, with 54 in operation[32].
Lithium	Import	-	-	-	There is possibility of lithium import[43].
Cobalt	Sulawesi, Maluku	-	-	Yes	Indonesia pushes the development of HPAL smelters to produce cobalt sulfate alongside nickel sulfate.
Manganese	West Timor	4,912.5*)[44]	131,311,041	Yes	Indonesia has 3 operating smelters in Java. Smelting in NTT is being pushed yet development is facing difficulty[45,46].
Graphite	Sulawesi, Sumatra, Kalimantan	-	-	-	Indonesia's graphite production is insufficient to supply battery production. There is possibility of graphite import[47].
Copper	Papua, Sulawesi, Sumatra, Java	132,873,289	3,036,676,590	Yes	Indonesia has 2 smelters owned by Freeport and Amman Mineral. Both are due for operation in 2024[48,49].
Bauxite	Kalimantan, Sumatra, Bangka Belitung	7,473,626	3,135,777,682	Yes	MEMR announced in 2024 that domestic bauxite smelting is expected to operate starting in 2027[50].
Iron ore	Sulawesi, Maluku	530,183**)	1,701,105,310	Yes	Indonesia has 2 operating preparation plants and 2 smelters. There is high demand for iron ore from the construction sector, driving imports.

*) 2020 data

**) in concentrates

[43] Kebutuhan Grafit dan Lithium Dipasok dari Luar Negeri - Kompas, 2023

[44] MEMR 2021. Peluang Investasi Mangan di Indonesia

[45] 12 Proyek Smelter Bisa Mangkrak, Kekurangan Modal Rp 64 T! – CNBC Indonesia, 2021

[46] Ayodhia Klarifikasi Lagi Investasi Smelter Mangan di Pulau Timor – KatongNTT.com, 2023

[47] Akhirnya, Indonesia Miliki Pabrik Nikel dan Kolbat Sulfat Pertama Terbesar di Dunia – Nikel.co.id, 2023

[48] Freeport Kirim Perdana Konsentrat Tembaga ke Smelter Gresik, Tony Wenas: Mewujudkan Hilirisasi – Tempo.co, 2024

[49] Siaran Pers - Proyek Smelter Amman Telah Masuki Tahap Komisioning – Amman, 2024

[50] Menteri ESDM Sampaikan Indonesia akan Punya Smelter Bauksit pada 2027 - Media Indonesia, 2024

In regard to the battery supply chain, Indonesia aims to produce 2,000,000 four-wheeled (4W) EVs and 13,000,000 two-wheeled (2W) EV units[51]. EV deployment in public transportation and incentivized EV purchases are enforced to create a domestic EV market (see **Table 1-5**). Now, Indonesia is at the stage of initiating battery cell manufacturing. State-owned IBC is created to lead domestic battery cell production[52]. Per this report, IBC has established a joint venture with Hyundai and LG, battery cell manufacturer PT HLI Green Power[53]. Located in Karawang, West Java, the company has a production capacity of 32.6 million battery cells, equal to 10 GWh.

Table 1-5 Summary of Indonesia's EV development roadmap strategy (MOI Regulation 28/2023)

Strategy	Description	2020-2021	2022-2025	2026-2030
Establishing a domestic EV market	Preliminary studies and pilot projects related to EVs, e.g., EV implementation in public transportation.	✓	✓	
	Formulate fiscal and non-fiscal incentives.	✓	✓	
	EV charging station development.	✓	✓	
	Enforce mandatory EV usage on a large scale.		✓	✓
	Enforce EV-exclusive zones in the country.		✓	✓
	Establish FTAs with prospective buyer countries.			✓
Industry development	4W EV production.		✓	✓
	2W EV production.		✓	✓
	Charging station production.		✓	✓
	Industrialization of raw materials and components.		✓	✓
Technology development	Battery cell and pack development through incentivizing battery producers.		✓	✓
	Battery management system development.		✓	✓
	Provision of battery materials.		✓	✓
	Development of battery end-of-life schemes.		✓	✓

However, the adoption rate of electric vehicles in Indonesia is still low. End users are hesitant to transition from ICEVs to EVs due to their high purchase price, lack of spare parts and maintenance facilities, and limited charging infrastructure[54]. The domestic EV industry also faces challenges with production capacity and relies heavily on imported components, making it less competitive than ICEVs[55]. Despite the government's efforts to encourage EV adoption through incentives such as

[51] Ini Target Pemerintah untuk Populasi Kendaraan Listrik di Tahun 2030 -- MEMR Press Release, 2024

[52] Indonesia Battery Corporation corporate website

[53] Jadi Produsen Baterai Kendaraan Listrik, RI Mulai Produksi April 2024 – detikFinance, 2024

[54] Candra, C.S. (2022). Evaluation of Barriers to Electric Vehicle Adoption in Indonesia through Grey Ordinal Priority Approach. International Journal of Grey Systems.

[55] Sasongko, T. W., Ciptomulyono, U., Wirjodirdjo, B., & Prastawa, A. (2024). Identification of electric vehicle adoption and production factors based on an ecosystem perspective in Indonesia. Cogent Business & Management, 11(1).

purchase subsidies and tax holidays for manufacturers, these initiatives have strained the national budget[55]. Hence, significant capital investment is needed to boost EV adoption[56], highlighting the importance of attracting foreign investment[57].

Gender equality and social inclusion issues towards a sustainable battery supply chain

Advancing gender equality is critical to all areas of society. Achieving gender equality and empowering all women and girls is a key priority in the Global Development Agenda, specifically outlined in Sustainable Development Goal 5.

Women and girls face gender-specific constraints related to social and cultural norms anchored in our society, including precarious jobs, unequal remunerations, poverty, sexual violence and exploitation, social insecurity, lower levels of representation in decision making roles, etc; compared to their male peers. Based on the above; to create sustainable supply chains it is essential to close the gaps in empowerment between men and women.

In the battery supply chain scenario, women are involved in raw material extraction directly or indirectly, often serving as small business owners, executives, and workers. They can be both beneficiaries and agents of change. By applying a gender lens to the development of sustainable battery supply chain, we can ensure no harm or negative damage will be infringe to women, and also helps to identify where actions can be taken to unlock opportunities for women fostering an energy transition scenario where no one is left behind.

According to the Bank's Gender Equality for Growth Program, Indonesia´s female labour force participation rate was 53% in 2021, and has remained unchanged for over two decades, this participation is relatively low compared to regional standards, with the East Asia and Pacific regional average at 66 percent[58] . Many women exit the labour market after marriage and childbirth, mainly related of a scarcity of childcare services. Thus, increasing public expenditure in childcare services

[56] AC Ventures and AEML. (2023). Indonesia's Electric Vehicle Outlook.

[57] Indonesia Bets Big on Electric Vehicles – Foreign Policy, 2024

[58] World Bank (2020). Indonesia Country Gender Assessment: Investing in Opportunities for Women. © World Bank, Washington, DC. http://hdl.handle.net/10986/35310 License: CC BY 3.0 IGO

may led to an increasing in female labour force participation, improve employment outcomes, and boost productivity and job creation[59].

While Indonesia has made significant improvements in gender equality, it has been researched that improved policy and regulatory frameworks are needed to support married women or female heads of households in remaining in the labour force. Furthermore, while women have transitioned from the agricultural sector to manufacturing and services, gender occupational segregation still persists. Women continue to be primarily employed in subsectors such as retail trade, food and hospitality, while sectors such as construction; electricity, gas, and water supply; transport; and finance and business services sectors remain male dominated. This is closely linked to the under representation of women in the science, technology, engineering and mathematics (STEM) fields that has been traditionally dominated by male peers[60]. Therefore, increasing the inclusion of women in STEM occupations is essential for achieving gender balance in the workforce and fostering economic growth.

In terms of labour market participation, women are more likely to be employed in the informal sector, with rural women comprising the largest group of non-wage workers. Those in the formal sector tend to be small business owners, facing significant barriers such as limited access to financial opportunities and difficulties in raising capital, accessing credit and, therefore, obtaining technology and market access.

Consequently, men and women in the battery supply chain may face different impacts depending on their roles. For instance:

- Extraction: Men usually encounter issues related to health and safety, human rights, labour rights, while women are more vulnerable to crime and violence when new mining sites are established nearby. However, women in the informal sector may benefit from indirect job creation – hospitality and related services.

[59] World Bank (2023). Economic Gains from Investing in Childcare : The Case of Indonesia (English). Washington, D.C.; World Bank Group. http://documents.worldbank.org/curated/en/099110010032227938/P1721820ecba5d0e90ad6206b56b8a2986e

[60] UNESCO (2015). A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia. Bangkok. Available at https://unesdoc.unesco.org/ark:/48223/pf0000231519 This study indicates that women tend to be concentrated in certain disciplines within STEM (e.g. pharmacy and biology), and underrepresented in others, such as physics and chemical engineering.

- Processing and Manufacturing: In current conditions, men have traditionally dominated the workforce, while professional women and female business owners require additional support for growth, such as flexible work policies, childcare improvements, scholarships, mentoring programs, and access to finance. Studies indicate that women in manufacturing frequently experience sexual harassment, violations of labour rights, and lack of maternity-related benefits[61,62].

In the latest stages of the supply chain - end use and end of life – The impacts on men and women are expected to vary based on market informality. Insights gained during this project´s implementation will inform the development of policy frameworks and recommendations, ensuring that the differentiated challenges and opportunities faced by men and women are addressed in the pursuit of a sustainable supply chain.

[61] World Bank (2020). Addressing gender-based violence and harassment (GBVH) in the manufacturing sector. Available at: https://documents1.worldbank.org/curated/en/099009112022227303/pdf/IDU0965cf2a30a80c049a10a8160b8309f51714e.pdf

[62] ILO (2018). Game changers: Women and the future of work in Asia and The Pacific. ISBN: 978-92-2-030996-4. Available at: https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@asia/@ro-bangkok/@sro-bangkok/documents/publication/wcms_645601.pdf

2 Scope of services

The scope of services for the study covers a comprehensive analysis and development plan for a *sustainable battery supply chain*[63] in Indonesia, safeguarding environmental and social protection. The analysis includes both a policy and a private sector analysis, thereby supporting a comprehensive case to attract investment to the most competitive battery/technology to be developed in Indonesia. This project has three main objectives:

(i) catalyse the development of a sustainable battery supply chain,

(ii) develop an integrated electric vehicle (EV) supply chain and

(iii) leverage the abundance of natural resources in the country, particularly nickel.

The study will have the following outputs:

(i) A comprehensive report on the analysis of the supply chain of batteries,

(ii) A comprehensive guide and roadmap to support key stakeholders in accelerating energy transition through batteries, and

(iii) An analysis of the social and environmental impacts related to the supply chain of batteries and proposed solutions.

Constant stakeholder engagement is integral to this project. Regular consultations with government entities, private industry, and multinational development banks (MDB) will be conducted to ensure comprehensive feedback and open discussion. This engagement will help assess the macroeconomic, sector-specific, and local community impacts of developing Indonesia's battery supply chain. By ensuring all deliverables and communications are clear and accessible, the study aims to maximize policy impact and support informed decision-making for sustainable development.

[63] 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.

3 Methodology and workplan

Four workstreams divide this analysis. Workstream A focuses on the current status of Indonesia´s critical mineral resources, especially the nickel value chain, considering national reserves, and battery production. The analysis will include an assessment of the resources needed and available for different stages of the battery supply chain, from extraction to production of electric vehicle batteries.

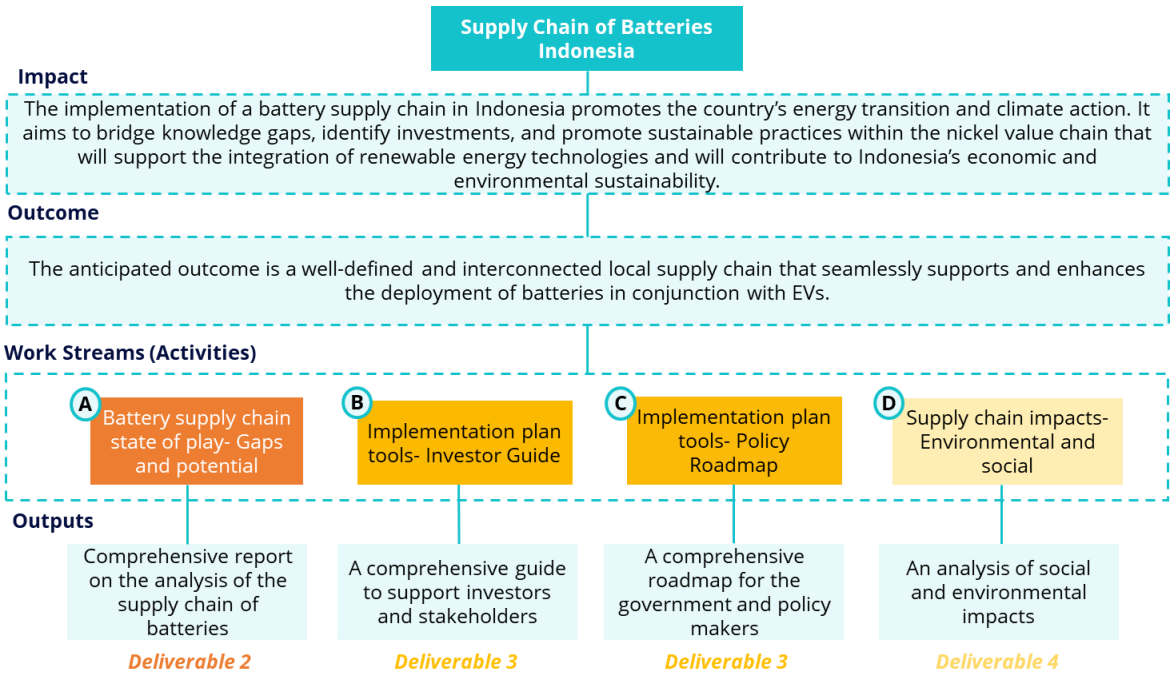
Workstream B addresses investment opportunities in developing stages the battery value chain and targets the private sector and investors. Workstream C is a policy roadmap that outlines the public policy actions and regulations necessary for supply chain development, also targeting the public sector. Finally, Workstream D focuses on measuring the potential social and environmental impacts of supply chain development in Indonesia and how these impacts should be mitigated and targets local communities. The study is aimed at the public sector and decision-makers.

Gender perspective and social inclusion considerations will also be included into the analysis as a cross-cutting approach for project implementation.

3.1 Methodology

As indicated in the accepted Project Proposal, the methodology is organized into four distinct workstreams, each aimed at fulfilling the project's deliverables' requirements and main objectives. **Figure 3-1 Project's Theory of Change diagram** illustrates the methodology in a Theory of Change framework, providing a blueprint for the systemic implementation of the project.

Figure 3-1 Project's Theory of Change diagram



The project consists of six deliverables: One inception report, four reports on key aspects of a battery supply chain and a final report summarizing the entire work. The four workstreams are strategically aligned with the activities required to successfully achieve these deliverables.

Presentation Event 1. After the Inception report, the Presentation Event 1 will be carried out to present the project's work plan, methodology and communication plan, as described in the Inception Report. Presentation Event 1 will consist of a virtual event and attendees include ETP counterparts and the consortium team partners.

Workstream A: Battery supply chain state of play

Workstream A, which focuses on Deliverable 2, aims to outline the current state of play of the battery supply chain for EVs in Indonesia. It will begin by offering a global perspective on battery supply chain before delving into specific details related to Indonesia. This deliverable will encompass two perspectives:

1. **Mineral Resources and Industrial Landscape Perspective:** Detailing the available mineral resources in the country, technologies, and existing industries for battery processing. It will highlight technological and knowledge gaps and identify project and investment opportunities for the sustainable deployment of the supply chain.

2. **Economic Perspective:** Analysing the national economic impacts of battery supply chain activities, including a demand analysis for batteries and an economic analysis.

Mineral Resources and Industrial Landscape Perspective

The global battery value chain will be described by first outlining its organizational structure globally, to then describe and visualize the state of play of the battery industry in Indonesia. The assessment will begin with a preliminary supply chain mapping exercise aimed at identifying key global stakeholders in the battery value chain, including their locations, production volumes, and applications. The mapping will focus on structural parts of the battery value chain representing the input-output flow of batteries, namely extraction, processing, manufacturing, end use and end-of-life.

Methodologically, the initial mapping draws upon literature reviews, industry reports and market analysis (see Section 7 Data collection strategy and data requirements) to provide an overview of the battery industry´s operations within and beyond Indonesia´s borders. International data sources will be utilized (e.g. International Energy Agency, *Global Supply Chains of EV Batteries*, 2023).

The mapping exercise will trace major supply chain steps from mining to end use-end of life, detailing each stage with descriptions of key activities, technologies involved, and their relevance and significance for the Indonesian economy and battery demand.

To comprehensively identify and understand Indonesia's role as a global player and enable quantitative comparisons of its supply chain, the International Standard Industrial Classification of All Economic Activities[64] (ISIC) will be used for classifying data. As well as Harmonized System (HS), specifically, the 6-digit codes to classify each product within the battery supply chain.

Economic activities under the ISIC system are classified as primary, secondary and ancillary activities. An economic activity is considered primary under the ISIC if the primary activity accounts for the majority of output, secondary if the activity accounts for a significant share of output whereas ancillary activities are not accounted separately. Ancillary

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

activities will not be included in our value chain mapping. Table 3-1includes the most relevant sector and activities from the perspective of our study[65].

Table 3-1 Main relevant sectors in a battery value chain, including codes based on ISIC Rev4

Hierarchical structure	Description
B Mining and quarrying	
Division (2-digit)	07 Mining of metal ores
Group (3-digit)	072 Mining of non-ferrous metal ores
Class (Inclusions)	0729 Mining of other non-ferrous metal ores This class includes: - mining and preparation of ores valued chiefly for non-ferrous metal content: * aluminium (bauxite), copper, lead, zinc, tin, manganese, chrome, nickel, cobalt, molybdenum, tantalum, vanadium etc. * precious metals: gold, silver
C Manufacturing	
Division (2-digit)	24 Manufacture of basic metals
Group (3-digit)	242 Manufacture of basic precious and other non-ferrous metals
Class (Inclusions)	2420 This class includes production of basic precious metals: production and refining of unwrought or wrought precious metals: gold, silver, platinum etc. from ore and scrap - production of precious metal alloys - production of precious metal semi-product
Division (2-digit)	27 Manufacture of electrical equipment
Group (3-digit)	272 Manufacture of batteries and accumulators
Class (Inclusions)	2720 Manufacture of batteries and accumulators This class includes the manufacture of non-rechargeable and rechargeable batteries. This class includes manufacture of primary cells and primary batteries; cells containing manganese dioxide, mercuric dioxide, silver oxide etc.; manufacture of electric accumulators, including parts thereof: separators, containers, covers manufacture of lead acid batteries; manufacture of NiCad batteries; manufacture of NiMH batteries; manufacture of lithium batteries; manufacture of dry cell batteries; manufacture of wet cell batteries
Class (Inclusions)	2790 This class includes the manufacture of miscellaneous electrical equipment other than motors, generators and transformers, batteries and accumulators, wires and wiring devices, lighting equipment or domestic appliances. This class includes: Manufacture of battery chargers, solid-state; manufacture of door opening and closing devices, electrical; manufacture of electric bells; manufacture of ultrasonic cleaning machines (except laboratory and dental); manufacture of tanning beds; manufacture of solid state inverters, rectifying apparatus, fuel cells, regulated and unregulated power supplies; manufacture of uninterruptible power supplies (UPS); manufacture of surge suppressors (except for distribution level voltage); manufacture of appliance cords, extension cords, and other electrical cord sets with insulated wire and connectors; manufacture of carbon and graphite electrodes, contacts, and other electrical carbon and graphite products; manufacture of particle accelerators; manufacture of electrical capacitors, resistors, condensers and similar

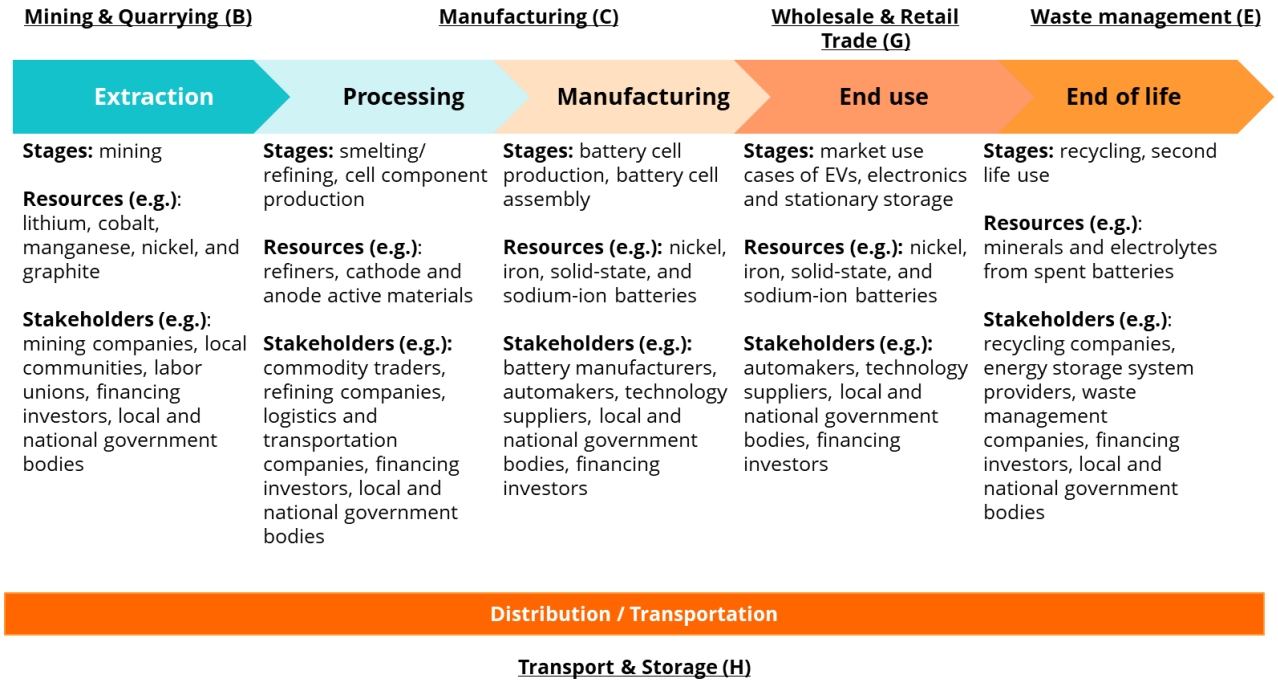
[65] This is a preliminary list subject to adjustments during Workstream A.

Hierarchical structure	Description
	components; manufacture of electromagnets; manufacture of sirens; manufacture of electronic scoreboards; manufacture of electrical signs; manufacture of electrical signalling equipment such as traffic lights and pedestrian signalling equipment; manufacture of electrical insulators (except glass or porcelain); manufacture of electrical welding and soldering equipment, including hand-held soldering irons.
G Wholesale and retail trade; repair of motor vehicles and motorcycles	
Division (2-digit)	45 Wholesale and retail trade and repair of motor vehicles and motorcycles
Group (3-digit)	451 Sale of motor vehicles
Class (Inclusions)	4510 Sale of motor vehicles This class includes: - wholesale and retail sale of new and used vehicles: * passenger motor vehicles, including specialized passenger motor vehicles such as ambulances and minibuses, etc. * lorries, trailers and semi-trailers * camping vehicles
Group (3-digit)	453 Sale of motor vehicle parts and accessories
Class (Inclusions)	4530 Sale of motor vehicle parts and accessories This class includes: - wholesale and retail sale of all kinds of parts, components, supplies, tools and accessories for motor vehicles, such as: * rubber tires and inner tubes for tires * spark plugs, batteries, lighting equipment and electrical parts
Group (3-digit)	454 Sale, maintenance and repair of motorcycles and related parts and accessories
Class (Inclusions)	4540 Sale, maintenance and repair of motorcycles and related parts and accessories This class includes wholesale and retail sale of motorcycles, including mopeds - wholesale and retail sale of parts and accessories for motorcycles (including by commission agents and mail order houses); maintenance and repair of motorcycles
Group (3-digit)	466 Other specialized wholesale
Class (Inclusions)	4662 Wholesale of metals and metal ores This class includes: - wholesale of ferrous and non-ferrous metal ores - wholesale of ferrous and non-ferrous metals in primary forms - wholesale of ferrous and non-ferrous semi-finished metal products not elsewhere classified; wholesale of gold and other precious metals
E Water supply; sewerage, waste management and remediation activities	
Division (2-digit)	38 Waste collection, treatment and disposal activities; materials recovery
Group (3-digit)	383 Materials recovery
Class (Inclusions)	3830 Materials recovery This class includes processing of metal and non-metal waste and scrap and other articles into secondary raw materials, usually involving a mechanical or chemical transformation process; recovery of materials from waste streams: Separating and sorting recoverable materials from non-hazardous waste streams (i.e. garbage); Separating and sorting of commingled recoverable materials, such as paper, plastics, used beverage cans and metals, into distinct categories.

Using ISIC system and HS codes will facilitate the collection of statistics such as the number of companies, employment figures, and geographical distributions relevant to each stage of the battery value chain. While statistical data will outline the value chain mapping, stakeholder insights will complement this approach.

Regarding battery technologies, the supply chain for four battery technology types will be evaluated: nickel batteries, iron batteries, solid-state batteries, and sodium-ion batteries. The preliminary supply chain will be divided into five main stages, as shown in Figure 3-2:

Figure 3-2 Diagram of the supply chain of batteries – Codes based on ISIC4



A brief description of the supply chain stages is as follows:

1. **Mining & Quarrying (B) – Extraction - Mining:** Mines extract raw materials; these typically include lithium, nickel, cobalt, manganese, and graphite. This section will describe the types of mineral ores, known mineral resources, mining methodologies, and their trade flow from mines to processing steps. For example, an examination of lithium will show the volume of lithium resources across brines, spodumene, and clay types of ores. The analysis for lithium will further describe the mining methodologies for all ore types and where do the mined materials flow for processing.

2. **Manufacturing (C) – Processing – Smelting, refining, cell component production:** Processors and refiners purify the raw materials, then use them to create cathode and anode active battery minerals. At this stage, the raw materials are purified and transformed into active materials for battery production through advanced chemical processes to ensure materials meet quality and performance standards. This section will describe the technologies and steps involved for processing. Where available, this section will also include the geographic distribution of processing capacities.

3. **Manufacturing (C) – Manufacturing – Battery cell production, battery cell assembly**: Battery manufacturers take purified and refined materials to assemble battery cells. These cells are then grouped into modules and packs, essential components of EVs and then sold to automakers.

4. **Wholesale and retail trade (G) - End use – Market use cases of EVs, electronics and stationary storage**: Is the stage where batteries are utilized in their intended applications by consumers or industries. This stage encompasses the final deployment and practical usage of batteries in various products and technologies.

5. **Water supply; waste management (E) - End of life – Recycling, second life use**: Addresses what happens to batteries once they no longer serve their original purpose. Instead of being discarded, used batteries can often be repurposed or recycled. Repurposed means finding new applications for batteries that still have some remaining capacity. Recycle, on the other hand, involves breaking down batteries to recover valuable materials which can be used to produce new batteries.

Additionally, the competing end use market and battery alternatives will also be considered throughout the evaluation of the battery supply chain. If the availability and cost of battery resources pose challenges, identifying and adopting alternatives will be essential for the battery markets and supply chain. Therefore, these will also be identified and analysed. For example, iron phosphate lithium batteries use the iron phosphate chemistry as an alternative to cobalt. If Nickel becomes too expensive, there could be a scenario where battery companies need to switch to other minerals to reduce costs.

Economic Perspective

The economic perspective will include a demand analysis to estimate the national demand for batteries and a high-level economic analysis of the benefits for Indonesia in developing the battery supply chain. The demand analysis aims to estimate the national demand for batteries by constructing scenarios that account for variations in electromobility adoption. This analysis will utilize both global and regional data sources to evaluate future demand trends, ensuring alignment with ETP and other government stakeholders by fine-tuning the scenarios accordingly.

The high-level economic analysis will illustrate the broader economic implications of developing the battery supply chain in Indonesia. This analysis will focus on key economic indicators, such as sales revenue, VAT obtained from sales, and resources required for battery production. Specifically, the methodology will include:

- Sales
- VAT

- Price of Added Sale
- Job Creation, including gender considerations, such as participation and potential impacts on women and vulnerable groups.

The analysis of imported materials will include contributions from import duties and transportation-related employment. It will also cover product-specific import and export taxes, tariffs, and duties within the battery supply chain. Additionally, the analysis will feature the latest rates in selected countries involved in the supply chain and provide a high-level overview of global trends.

Presentation Event 2. An in-person presentation event will be prepared to disseminate the outputs delivered during Workstream A and gather input and feedback from stakeholders.

Workstream B: Implementation plan tools for investor guide

Both, **Workstream B: Implementation plan tools- investor guide** and **Workstream C: Implementation plan tools - policy roadmap** will focus on **Deliverable 3**. The aim of Deliverable 3 is to provide a strategic framework for potential investors, stakeholders, and the Indonesian government to establish supply chain for batteries. A similar approach to the PESTEL framework will be followed to conduct Deliverable 3 analysis. PESTEL stands for Political, Economic, Social, Technological, Environmental, and Legal factors. By examining these six factors, insights can be gained into the external and internal influences that could impact the battery supply chain development.

Workstream B focuses on Economic and Technological factors. The aim of Workstream B is to provide a clear understanding of the availability of resources and the cost competitiveness of the technology to be developed to determine which battery technology stands out as being the most competitive, focusing on nickel batteries, iron batteries, solid-state batteries, and sodium-ion batteries. It will inform potential investors about the opportunities within Indonesia's battery supply chain.

The analysis of the Economic factor for Workstream B translates into an evaluation of the financial viability of the development of the battery technologies and their supply chain. Specific projects and technologies will be selected for different supply chain stages. From a resource supply perspective, mining, processing, and smelting activities will be assessed. For the manufacturing stage, the evaluation will include cell manufacturing, packaging of cells into modules, container manufacturing, and assembly. Furthermore, the recycling processes that repurpose end-of-life batteries to produce black mass or other materials for cell manufacturing will also be considered as a similar supply chain can be used for recycled minerals.

The financial analysis will be conducted structured in four steps:

1. **Financial metrics:** A comprehensive analysis of both the capital and operating costs for developing the battery supply chain identified as project and investment opportunities. This includes assessments of investments in mining operations, processing facilities, transportation, and other related expenditures such as environmental compliance costs. Additionally, financial parameters will be established, including tax rates and cost of capital.

2. **Risk and sensitivity analysis:** Testing the sensitivity of the financial model to changes in key variables such as the critical minerals market prices, production costs, and demand within the battery sector. Additionally, the impact of external factors, such as legislative developments in major importing destinations, will be considered.

3. **Metrics for investment decisions:** Setting benchmarks for profitability measures that projects must meet to be considered viable, which will be informed by the industry standards.

4. **Reporting and documentation:** Involves a report that will document the methodologies, assumptions, and outcomes of the financial analysis exercise for each project evaluated, providing a clear and transparent basis for decision-making. An investment data sheet will be developed additionally developed for the financial viability of the project evaluated. This will be included as an annex and will be further complemented with the Technology factor explained below.

The analysis of the Technology factor for Workstream B translates into an evaluation of the operational feasibility of the development of the batteries supply chain for the projects identified. This analysis will review strategies.

The results of Workstream B will be summarized into investment datasheets for each evaluated project. This datasheet will include a summary of all the key aspects evaluated previously. Figure 3-3 illustrates what these investment datasheets might look like for each project.

Figure 3-3 Illustrative example of Investment data sheets for Deliverable 3

Investment project datasheet Technology name	
Description and relation with battery supply chain category	
Technology Readiness Level (TRL), availability in Indonesia, workforce capability and required skills,	
Implementation costs	
CAPEX	• Costs assumptions, consider major replacement technology's CAPEX • Risks
OPEX	
End-use	
Description of the technology's end use	
Non-financial Indicators	
Social and environmental impact indicators	

Workstream C: Implementation plan tools for policy roadmap

Along with the investor's guide, Workstream C focuses on the Political and Legal factors related to the battery supply chain. Workstream C will formulate a comprehensive policy mapping to identify existing gap in the regulatory landscape then provide recommended roadmap, detailing actionable steps to foster a sustainable battery supply chain considering all different stages of battery supply chain: extraction, processing, manufacturing, end use and end of life.

The analysis of the policy factors in Workstream C results in a comprehensive analysis building on the national and international policy and legislative context on the basis of which policy and legislative gaps and barriers are identified, followed by recommendations provided for developing a more sustainable battery supply chain. Context such as ministerial policy synergy and decentralized policy implementation at the local government level will increase pragmatic recommendations to be addressed across all layers and coordinating bodies of the government.

The foundation for this work is established in Workstream A, which outlines the current status of the supply chain. Building on this context, the first step involves mapping Indonesia's current governmental policies and initiatives related to energy transition, with a focus on their impact on the battery supply chain. This will be achieved through in-depth desktop research.

Next, doctrinal legal research will be employed to map the legislative framework governing each stage of the battery supply chain. This will include an analysis of how these regulations are applied specifically to the battery sector.

Recognizing that law operates within a broader context, the analysis will also examine the national policy and legislative framework in relation to the international and transnational context. This will be approached through law-in-context and comparative law methods to understand the international implications of measures and to identify global best practices for developing a sustainable battery value chain.

This analysis will address various factors, including geopolitical issues, EU and US measures to support domestic battery supply chains, and international collaborations that could impact the supply chain. For example, as global competition in batteries intensifies, it is essential to consider the global repercussion of 'local' measures and related upheavals when designing national policies. This includes examining the Indonesia-EU dispute over nickel ore exports before the WTO panel, as well as the global effects of US and EU battery policies and recently adopted legislative frameworks. While these policies offer important lessons for strengthening domestic supply chains, they also have significant impacts on global markets beyond national borders.

Finally, given the inherently global nature of the battery value chain, international collaboration is crucial for creating a sustainable value chain.

Based on the information on the current policy and legislative frameworks that affect battery value chain, gaps and barriers in current policies and legislation will be identified. This allows the assessment of enhanced policy efforts aimed at developing a sustainable battery supply chain, building on the national characteristics and policy priorities. Specific policy instruments to support the development of each stage of the supply chain will be proposed based on the analysis and integrated into policy project datasheets. These instruments relate to the following broad priority categories that align with the different stages of the supply chain: (1) extraction and recovery of materials for the creation of a sustainable and circular battery industry ; (2) creating conditions for the development of a sustainable battery production in Indonesia ; (3) creating the demand for and use of sustainable batteries ; (4) research and innovation across the battery value chain; (5) promoting cooperation, both with local stakeholders but also internationally across the battery value chain.

Additionally, Focus Groups Discussions (FGDs) will be held with the private sector, to align expectations when designing the policy instruments to develop the battery supply chain, discussions will have following objectives:

- Assess economic impact to identify potential negative economic impacts and explore solutions to mitigate them
- Facilitate stakeholder buy in to align expectations and encourage compliance from private sector stakeholders

- Encourage transparency by fostering open discussions between private and public sectors
- Feasibility of policy measures
- Promote knowledge transfer, learn mutually of needs and existing solutions, to inform policy decisions.

The results of Workstream C are summarized in policy project datasheets. These datasheets provide a step-by-step summary of the recommended public policy and legislative actions to be implemented for the development of the battery supply chain in Indonesia. The policy project datasheets will follow the International Energy Agency's (IEA) key elements in designing the successful roadmap. **Table 3-2** lists the main characteristics to be defined for each policy project. **Figure 3-4** illustrates how these policy project datasheets might look like for each action.

Table 3-2 Characteristics of each policy project datasheet

Characteristic	Description
Goals	The goal must be clear and concise, expressing the intended outcome of the policy project implementation. It should be directly related to the overall goals of the project and the areas identified in the gap analysis.
Responsible Party	A direct responsible party must be established, whether it is a ministry, department, or institution.
Description	A description of the policy project should be provided, including an explanation of how it will contribute to the development of the supply chain of batteries.
Gaps and barriers with current policies and regulations	Policy projects could face barriers or address gaps in the existing laws, regulations, and programs at the national, subnational, or local levels, which should be mentioned in the datasheets.
Action proposed achievement	The expected results of the policy action should be specified. These should be quantifiable, verifiable and reported.
Activities	A list of the activities needed to implement the policy project recommendation will be outlined, together with timelines for activity.
Progress metrics	These are indicators designed to provide a standard against which the progress of the policy project can be evaluated or demonstrated. These metrics focus on ensuring the timely completion of activities.
Milestones	They represent the achievement of a significant benchmark in the development or implementation of the policy project.

Figure 3-4. Illustrative example of policy projects datasheets for Deliverable 3

Policy project datasheet Policy name				
Goals				
Responsible Ministry or Political Entity				
Description				
Gaps and barriers with current policies and regulations relevant to the implementation of the battery supply chain				
Gaps	Barriers			
Activities to develop the policy				
Activity no.	**Timeframe**	**Participants**	**Responsible party**	**Milestones**
1	Medium-term	Needs collaboration with...	Ministry of Y	Milestone 1
2	Short-term	Needs collaboration with...	Ministry of X	Milestone 2

By combining all the policy project datasheets together, a policy roadmap will be developed. The policy conditions in which the actions will be designed will also be established by describing the relationship between the policy project recommendation with the national context. Each suggested policy project will be identified in the national and state proposals align with local needs and will be justified with Indonesia's current legal framework. Finally, the roadmap will also include the participants that will be involved in the policy project's implementation and a responsible party, which is the regulatory body that will oversee the policy project implementation.

Presentation event 3. An in-person event will be delivered to present and disseminate Workstreams B and C outputs and gather input and feedback from stakeholders. The event will include a presentation for investors to facilitate navigating regulatory and operational complexities.

Workstream D: Supply chain environmental and social impacts

Workstream D: Supply chain impacts - Environmental and social will focus on **Deliverable 4**. The aim of Deliverable 4 is to evaluate current practices across the supply chain, addressing challenges and impacts posed in the current activities of the supply chain and provide recommendations to improve the environmental and social aspects of the battery supply chain, developing clear recommendations at every stage to mitigate them and contributing to more responsible and sustainable supply chain management.

Workstream D synergizes with Workstreams B and C to provide essential information to investors and policymakers about the inherent social and environmental impacts associated with the supply chain. It aims to identify, evaluate, and provide recommendations to

mitigate these impacts, focusing both on potential negative and positive outcomes. Furthermore, Workstream D involves field activities to ensure participatory activities in developing the analysis such as Focus Group Discussion and gathering information from local communities currently related to the battery supply chain or those who could potentially be affected by its activities obtaining first-hand information. Special consideration will be given to gender, equity, and social inclusion concerns, ensuring that the benefits of the supply chain development promote inclusive growth. Concerns on biodiversity conservation within the region of mineral rich battery supply chain focus regions will also be addressed.

The legal framework for Workstream D will refer to applicable Indonesian laws and regulations (see Table 3-3) as well as international standards, such as the IFC Performance Standards[66]. Figure 3-5 illustrates the Environmental and Social Impact Assessment (ESIA) process.

Table 3-3 National level applicable policy and regulations for the ESIA

National regulation	Brief description
Law No. 11 of 2020 on Job Creation (Omnibus Law)	This Law introduces business reforms, particularly related to permitting and licensing, employment welfare and safety, investment, and corporate responsibility. This umbrella law serves as the basis for all regulations related to conducting business in Indonesia.
Government Regulation No. 47/2012 on Corporate Social and Environmental Responsibility	This regulation enforces businesses to practice corporate social and environmental responsibility.
Government Regulation No. 50/2012 on Implementation of Occupational Health and Safety Management System	This regulation is a guideline for businesses and business owners to implement organizational occupational health and safety management systems. It aims to minimize workplace risks, protect employees and contractors, and ensure businesses demonstrate good practices.
Government Regulation No 22/2021 on Implementation of Environmental Protection and Management	This regulation is a general environmental protection and management guideline for the government and businesses. The main topic is the implementation of the Environmental Impact Assessment (EIA), which describes in detail the process and minimum requirements, including community involvement. Other topics addressed include environmental pollution standards and public consultation procedures.
MOEF Regulation No. 4/2021 on the List of Business and/or Activities Required to Have Amdal, UKL-UPL, or SPPL	This regulation addresses business activities subjected to different forms of the EIA[67] based on their risk and amount of foreign investment. Several business activities within the battery supply chain fall within this obligation.
MOEF Regulation No. 6/2021 on Procedures and Requirements for Hazardous Waste Management	This regulation establishes clear standards and guidelines for hazardous waste management, including handling, storage, transportation, and disposal.

[66] International Finance Corporation (2021)

[67] In Indonesia, the different forms of EIA are as categorized as follows, starting from the most level of depth: 1) Amdal (*Analisis Dampak Mengenal Lingkungan*), 2) UKL-UPL (*Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan*), and 3) SPPL (*Surat Pernyataan Pengelolaan Lingkungan*)

National regulation	Brief description
MOEF Regulation No. 9/2021 on Social Forestry Management	This regulation states that forest areas belonging to the State that fall within the boundary of Indigenous communities shall be managed by Indigenous people.
Minister of Agrarian Affairs and Spatial Planning Regulation No. 14/2024 on Implementation of Land Administration and Registration of Customary Land Rights of Indigenous Communities	This regulation serves as a guideline for land administration and registration procedures for customary land rights. This countermeasure prevents customary lands from overlapping with business concessions, usually the primary source of dispute between businesses and local communities.

The scope of the ESIA shall encompass a high-level overview of the battery supply chain in Indonesia, addressing activities as indicated in Workstream A.

Figure 3-5 General overview of ESIA process

The analysis of the **environmental factors in Workstream D** will include the evaluation of both the physical sphere, biological sphere, and waste generation. The environmental aspects for the baseline assessment in supply chain systems will include but not limited to the items listed in **Table 3-4**.

Table 3-4 Environmental aspects to be included in the baseline[68]

Environmental aspects	Sub-aspects
Physical sphere	Regional temperature and rainfall
	Air quality
	Dust
	Noise
	Marine, river, and groundwater quality
	Water supply
	Soil
	Land use change
	Flood and landslide risk
Biological sphere	Biodiversity
	Conservation areas
	Ecosystem services
Waste	Waste generation
Climate change	Energy intensity and consumption
	Greenhouse gas emissions

Potential impacts from each supply chain activity will be identified using the Leopold matrix (an example is shown in **Table 3-5**). Each corresponding impact will be assessed based on receptor sensitivity and impact magnitude. Based on the study scope and findings, an appropriate impact analysis approach will be determined. **Table 3-6** illustrates impact assessment using the risk matrix. Risks will be determined using research publications, reports, and other secondary sources as references. Transboundary and cumulative impacts will also be addressed if identified in the assessment.

[68] (1997). 3.0 Methods for Environmental Impact Assessment.

Table 3-5 Example of Leopold matrix in ESIA[69]

Environmental Components	Project Activities								
	Plant Construction	Farming of Kenaf	Use of Pesticide Fertilizer	Transport of Raw Materials	Water Intake	Solid Waste	Effluent Discharge	Emissions	Employ-ment
Surface Water Quality			x			x	x		x
Surface Water Hydrology					x				
Air Quality				x				x	
Fisheries			x				x		
Terrestrial Wildlife Habitat	x								
Terrestrial Wildlife	x								
Land Use Pattern		x							
Highways/Railways				x					
Water Supply			x				x		
Agriculture		x							
Housing									x
Health						x	x	x	
Socioeconomic									x

Table 3-6 Illustration of risk matrix for impact assessment[70]

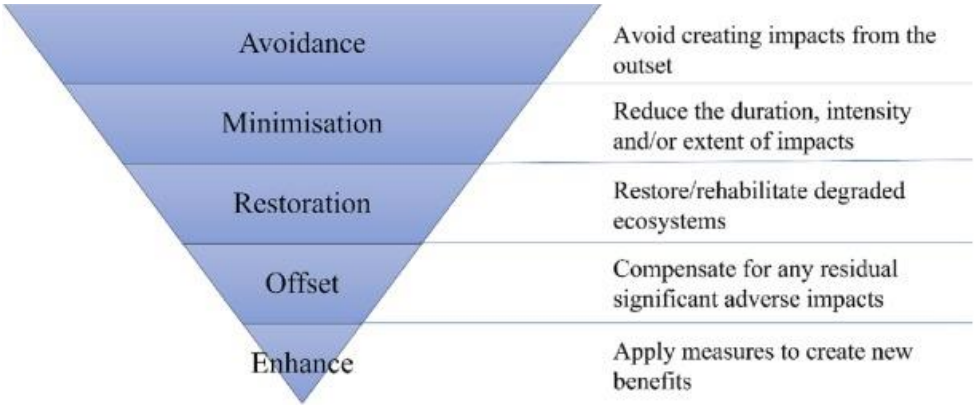
		Likelihood of occurrence				
		Very unlikely to occur (1)	Not expected to occur (2)	Likely – could occur (3)	Known to oc-cur – almost certain (4)	Common oc-currence (5)
Impact	Severe (5)	Moderate	Substantial	High	High	High
	Major (4)	Low	Moderate	Substantial	Substantial	High
	Medium (3)	Low	Moderate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

Based on the impact assessment results, mitigation strategies shall be determined based on residual impacts. The mitigation strategies will be determined using the mitigation hierarchy approach, as shown in **Figure 3-6**.

[69] (1997). 3.0 Methods for Environmental Impact Assessment.

[70] IUCN (2020)

Figure 3-6 Illustration of the mitigation hierarchy[71].



The outcome of the environmental impacts and mitigation strategies will tentatively be presented as shown in Table 3-7. However, the style used can be modified depending on findings during the analysis focusing on their importance for being communicated.

Table 3-7 Illustrative table of how the environmental impacts identified in each supply chain stage will be summarized

Supply chain stage	Activity name	Geographic location	Impact assessment				Mitigation	
			Environmental risk	Potential receptor	Impact	Mitigation hierarchy	Mitigation strategy	Performance indicator
Extraction	Nickel mining	South Sulawesi	Surface water quality degradation	Surface water	High	Minimize	Mining companies should treat wastewater before discharging to water bodies.	Wastewater quality should comply with effluent water discharge standards.

The **social factor in Workstream D** begins with establishing a comprehensive social baseline, capturing key aspects of the supply chain stage at different stages, including demography, education, employment, community health, local organizations, and cultural dynamics. This baseline will be developed from national and regional statistical data and compared with information from the FGD activities.

The information obtained from the social baseline will serve as a foundation for identifying potential social impacts within the battery supply chain. The summary of how the

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

social impact assessment will be presented is shown in **Table 3-8**. Social risks and impacts will include:

- threats to **human safety** through the escalation of personal, communal, or inter-state conflict, crime, or violence;
- risks that project impacts fall disproportionately on disadvantaged or **vulnerable individuals and groups**;
- any prejudice or discrimination, such as the **loss of livelihood**, displacement and cultural disruptions, toward individuals or groups in providing access to development resources and project benefits, particularly for those who may be disadvantaged or vulnerable;
- risks of ensuring **fair labour practices** and providing safe working conditions to avoid exploitative practices, including low wages and child labor;
- negative economic and social impacts relating to the involuntary taking of land or restrictions on **land use**;
- impacts associated with land and natural resource tenure and use, including (as relevant) potential project impacts on local land use patterns and tenurial arrangements, land access and availability, food security and land values, and any corresponding risks related to conflict or contestation over land and natural resources;
- risks that affect the recognition of **human rights** for workers, individuals, communities and indigenous peoples.
- impacts on the **health, safety** and well-being workers and project-affected communities; and
- risks to cultural heritage.

These aspects will also evaluate the involvement of vulnerable groups in the supply chain emphasizing the five domains of GESI, such as access, decision-making, participation, systems, and well-being. How GESI considerations are involved within a specific stage of the supply chain and what are the opportunities and recommendations to promote the inclusion and improvement of the livelihood of women will be incorporated in **Table 3-8**.

Table 3-8. Illustrative table of how the social impacts identified in each supply chain stage will be presented

Supply chain stage	Activity name	Geo-graphic location	Social risks	Impact category (term; medium or high)		Impact mitigation measure	GESI approach
Extraction	Nickel mining	South Sulawesi	Unfair job opening for local people	Short-term	Medium	Fair distribution of working conditions supported by policy emphasizing the importance of local people involvement	Opportunities for female workers, usually focused on indirect jobs created, are considered within social development plans promoted by public policies

Stakeholder engagement

Workstream D includes two site visits to supply chain locations, specifically in Sulawesi or Maluku. The primary objective of site visits is to acquire firsthand data and evaluate on-the-ground conditions. Collection of information will be based on observed on-the-ground conditions, which allow more visibility and confirmation regarding the risks such as logistical challenges and potential limited stakeholder participation, including alternative data collection methods during the site visits will be considered leveraging both physical and virtual platforms for stakeholder engagement. During this phase, a FGD will be facilitated to actively involve regional stakeholders, such as local governments, communities, and environmental organizations.

The FGD methodology will involve a small, diverse, and inclusive group of participants (typically 6-12) guided by the consulting team's environmental or social local experts, as applicable, to explore locals' perceptions and ideas about the social and environmental impacts of the battery supply chain development. It aims to generate in-depth insights through interactive discussion and to gather them into a brief report that will be used to inform the social and environmental risks tables. The purpose of the FGD will be to share the baseline data collection, validate information with regional stakeholders, and invite key individuals to share their valuable perspectives.

An initial assessment results will be shared through a follow-up discussion session to gather feedback and input from the stakeholders. Depending on the complexity of the data gathering and stakeholder engagement process, the follow-up meetings can take place virtually or with international stakeholders attending to observe and participate in the session discussions.

To finalize Workstream D, the in-person **Presentation Event 4** will be conducted. The event aims to present Deliverable 4 results to key stakeholders. The event will encourage open discussion, maintaining confidentiality to foster candid exchanges, where expert insights and feedback will be collected. Key attendees will include representatives from relevant Indonesian ministries and organizations such as the Coordinating Ministry of Maritime and Investment Affairs, Indonesia Battery Cooperation (IBC), and a number of companies with interest in the battery sector described in Section 6.1 e.g. industrial estate compounds, mining companies, EV manufacturing companies. The aim is to validate and generate consensus regarding the implementation of best environmental and social practices throughout the development of the battery supply chain.

Final Report: Deliverable 5

To conclude the project, a final deliverable will be developed to compile all the results obtained from the four workstreams. The aim is to provide stakeholders with a detailed account of the project's objectives, processes, outcomes, and recommendations. This document should be well-structured, evidence-based, and accessible to a broad range of stakeholders to ensure its impact and usefulness.

The Final Report's content follows the requirements set in the Request for Proposal and is further detailed in Section 4 of this document. Additionally, a section of the Final Report will integrate the concise and illustrative summaries of each deliverable as detailed in the workstreams' methodologies. This includes the supply chain map diagram, the project investment and policy project datasheets, and the social and impact assessment tables, all combined into a single, homogenized, and comprehensive result. The goal is to ensure that this report is easy to understand, as it will be targeted at a wide audience of diverse stakeholders.

Finally, a presentation event for Deliverable 5 will be given to disseminate the project's results and to conclude the consultancy services. **Presentation Event 5** will not only present a record of the project's progress but will also outline a roadmap with specific recommendations for future initiatives in the battery supply chain. Key attendees will include representatives from relevant Indonesian ministries and organizations such as the Coordinating Ministry of Maritime and Investment Affairs, Indonesia Battery Cooperation (IBC), and PT. Aneka Tambang Tbk.

3.2 Workplan

The project will be developed over a 15-month period starting from 21/05/2024. Throughout this period, five key deliverables will be submitted to portray the progress of the project, showcase preliminary or partial results, and integrate feedback and comments from

ETP and other relevant stakeholders. The implementation timeline is organized by deliverable, following the methodological approach of each workstream:

- **Inception Report and Communications Plan (1 month):** This initial deliverable will establish the project framework and outline the communication strategy.
- **Deliverable 2 (3 months):** A comprehensive report analyzing the battery supply chain to justify and drive investments.
- **Deliverable 3 (4 months):** A detailed guide and roadmap to support stakeholders in accelerating the energy transition through batteries.
- **Deliverable 4 (4 months):** An analysis of the social and environmental impacts related to the battery supply chain.
- **Deliverable 5 (3 months):** A strategic development report gathering results and outcomes from previous deliverables, providing recommendations.

In addition to the deliverables, a series of meetings, FGDs, and presentations with stakeholders will be conducted. These interactions are crucial for incorporating feedback and ensuring that the project aligns with the needs and expectations of ETP and other stakeholders. The dates for these meetings and the submission of deliverables are detailed in Table 3-9

Table 3-9 Schedule of deliverables and meetings

Milestones and Events	Tentative Date	Description
Contract starts	21/05/2024	
Deliver Inception Report	28/06/2024	Submission of Inception Report to ETP
Presentation Event 1 – Kick-off meeting (online)	August 2024 – Date to be confirmed	Online event to present the Inception Report including work plan, methodology and communication plan. Collective interviews will be conducted during the event to collect relevant data.
Deliverable 2	20/09/2024	Submission (D2) Assessment for government, investors, and relevant stakeholders: providing detailed understanding of Indonesia's aspects of battery supply chain and highlight opportunities
Presentation Event 2	04/10/2024	In-person presentation event to disseminate the outputs delivered during Workstream A and gather input and feedback from stakeholders

Milestones and Events	Tentative Date	Description
Meeting with ETP	05/10/2024	Online presentations of project progress and highlights to the ETP Secretariat. ETP Funders, and/or ETP Stakeholders
Deliverable 3	24/01/2025	Submission (D3) Roadmap Implementation Plan: Detailed step-by-step strategies for government to execute battery supply chain, encompassing timelines, resource allocation, policies, and milestones
Presentation Event 3	31/01/2025	Deliver an in-person event to present and disseminate Workstreams B and C outputs and gather input and feedback from stakeholders. The event will include a presentation for investors to facilitate navigating regulatory and operational complexities
Deliverable 4	23/05/2025	Submission (D4) Analysis of social and environmental impacts related to batteries supply chain and proposed solutions
Presentation Event 4	02/06/2025	In-person presentation event to disseminate the outputs delivered during Workstream D and gather input and feedback from stakeholders.
Deliverable 5 - Final Report	22/08/2025	Submission Final Report summarizing the project's objectives, methodology, findings and recommendations of the whole project
Meeting with ETP	27/08/2025	Online presentations of project progress and highlights to the ETP Secretariat. ETP Funders, and/or ETP Stakeholders
Presentation event 5 - Final project presentation	29/08/2025	In-person presentation to disseminate the project's results and gather input and feedback from stakeholders. Dissemination materials include a presentation to different audiences, including decision makers in relevant ministries and staff members to enhance the acceptance and apprehension of the roadmap.

The dates of all Presentation events are preliminary and will be defined with ETP after the submission of each deliverable. Table 3-10 shows the detailed Gantt chart for the activities that will be developed and included in each of the Deliverables of this project and the dates in which they will be conducted.

All deliverables will be submitted in English for ETP's consideration and review and will be translated to Bahasa until a final approved version of the documents has been agreed.

In addition to the formal meetings described in Table 3-9, regular update meetings will be held with ETP bi-weekly to show and discuss the progress of the project.

Table 3-10 Gantt chart with deliverables and main activities

Gantt Chart	2024							2025							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
D1 -Inception report	x														
Research of project background and documentation needed for	x														
Work plan, schedule, and monitoring and evaluation outline documents	x														
Project management description, risks, mitigations, and	x														
Communication Plan planning and definition	x														
Draft Inception Report		x													
Presentation event 1: Kick-off meeting			x												

Gantt Chart	2024							2025							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
D2 -Deliverable A Comprehensive Report on the Analysis of the supply Chain of batteries for EVs to justify and drive investments	x	x	x	x											
Stakeholder mapping		x													
Assessment of battery technologies: raw materials, chemicals and technologcial advancements		x													
Supply Chain Mapping: from raw material extraction to manufacturing, distribution, and end-use		x													
Resource availability and production capacity assessments within Indonesia		x	x												
Demand Analysis		x	x												
High-level economic analysis of the benefits for Indonesia in developing battery supply chain			x												
Investment Justification: Make compelling case for investments in domestic battery production			x												
(D2) Assessment for government, investors, and relevant stakeholders: providing detailed understanding of Indonesia's aspects of battery supply chain and highlight opportunities			x	x											
Policy brief: for policy makers highlighting recommendations and suggested policy actions				x											
Presentation Event 2				x											

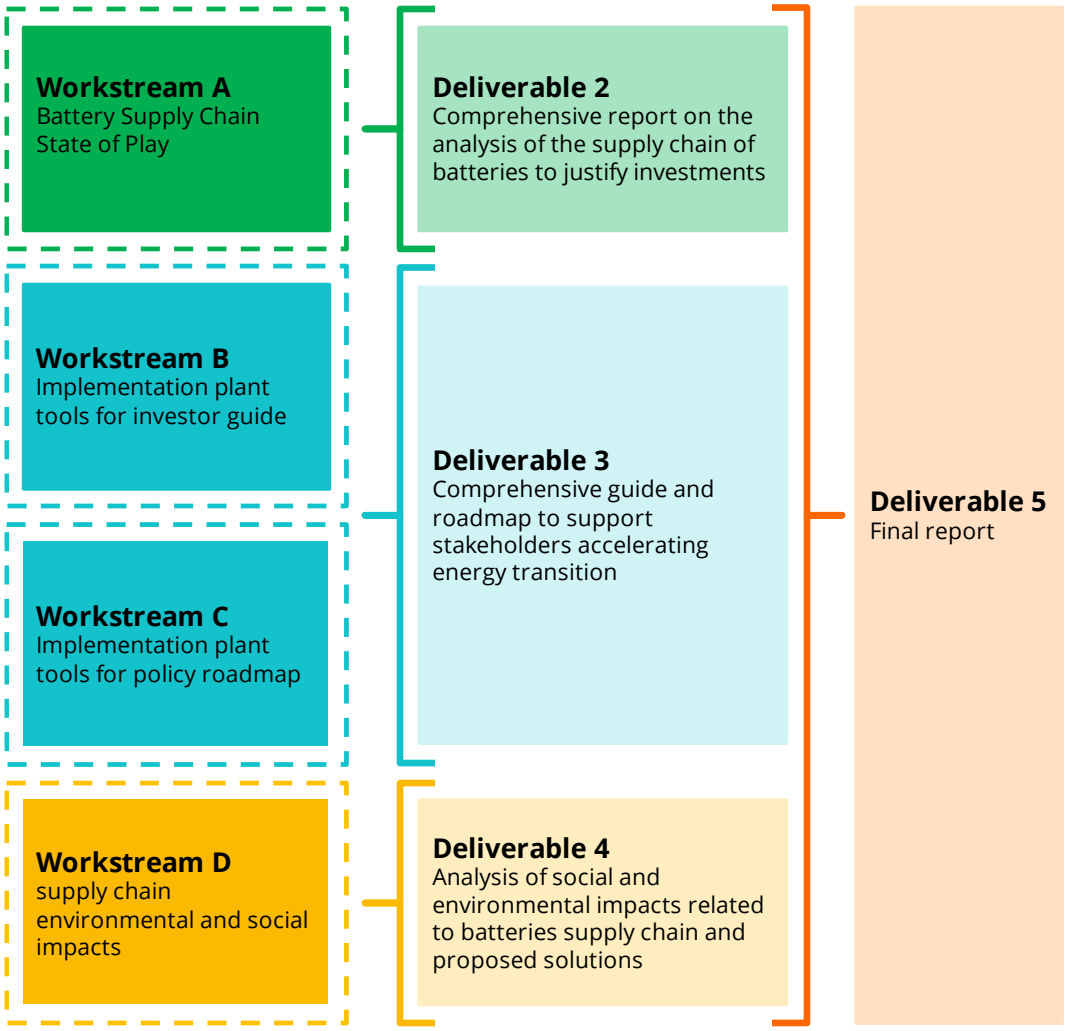
Gantt Chart	2024							2025							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
D3-Comprehensive guide and roadmap to support stakeholders accelerating energy transition					x	x	x	x							
Target Compatibility Assessment: Evaluation of projects alignment with national energy transition goals					x										
Financial viability evaluation					x	x									
Operational feasibility and strategic development analysis					x	x									
Battery supply chain regulatory framework in Indonesia and incentive schemes revision and assessment					x	x									
Strategies for integrating battery supply chain the supply chain of batteries for EVs							x								
Strategic development opportunities							x								
Comprehensive roadmap and recommendation for future policies and regulations to address the impediments and to create an implementation plan to integrate the batteries supply chain							x	x							
strategies for government to execute battery supply chain, encompassing timelines, resource allocation, policies, and milestones							x	x							
Policy brief for policy makers highlighting recommendations and suggested policy actions								x							
Presentation Event 3								x							

Gantt Chart	2024							2025							
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
D4- Analysis of social and environmental impacts related to batteries supply chain and proposed solutions		**x**			**x**			**x**	**x**	**x**	**x**	**x**			
Environmental impact assessment: associated with battery supply chain, exemplified by 1-2 projects								x	x						
Social impact assessment: social consequences of battery supply chain operations								x	x						
Stakeholder engagement: involvement of stakeholders to gather inputs, concerns and insights related to social and environmental impacts								x	x	x					
Site Visits: minimum two times to gather firsthand data and assess on-ground conditions		x			x			x							
Proposed solutions: formulation of strategies to address and mitigate environmnetal and social challenges									x	x					
Impact Mitigation Plans: Development of plans that outline how proposed solutions will be implemented, monitores, and evaluates over time											x				
Sustainability Metrics: Develop measurable sustainability metrics and indicators to quantify impacts of battery supply chain on the environment and society											x				
(D4) Analysis of social and environmental impacts related to batteries supply chain and proposed solutions												x			
Policy brief for policymakers highlighting recommendations and suggested policy actions												x			
Presentation Event 4												x			
D5 - Final Report													**x**	**x**	**x**
Executive summary, project backgorund and rationale													x		
Methodology description and Stakeholder engagement overview													x		
Findings and recommendations													x		
Impact assessment: evaluation of the project's influence on Indonesia's energy transition													x		
Lessons learned, sustainability plan and future steps													x		
(D5) Final version of deliverable														x	x
Presentation event 5: Final project presentation															x
Policy brief for policymakers highlighting recommendations and suggested policy actions															x
D6 - Consultation workshops, meetings, and post-workshop report				**x**				**x**				**x**		**x**	**x**
Post work-shop report				x				x				x		x	x
D 7 - Monthly progress	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Monthly progress Report updated and delivered	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ongoing implementation of Communication Plan			x		x		x		x		x		x		x

4 Deliverables detailed approach

The activities and analysis developed under each Workstream will produce a Deliverable that will provide an executive summary, context, describe the methodology used and show the findings, conclusions and recommendations resulting from the analysis. The project's deliverables will be designed to be concise, straightforward, and accessible to a broad audience, ensuring clarity and widespread use. Deliverables will be accompanied by slide decks to facilitate dissemination of information. Figure 4-1 describes the relationship between the methodology's workstreams and the project's deliverables.

Figure 4-1 Workstreams and deliverables' relationship



The following subsection describes the planned content to be included in each deliverable[72].

[72] Please note that outlines can be modified depending on the findings throughout project implementation.

4.1 Deliverable 2. Comprehensive report on the analysis of the supply chain of batteries

0. Executive summary
1. Battery technologies
   - 1.1. Introduction
   - 1.2. Technology readiness level (TRL) and commercial availability
   - 1.3. End use
   - 1.4. Raw materials required
   - 1.5. Alternative raw materials
2. Resource availability and production capacity In Indonesia
   - 2.1. Resources availability
     - 2.1.1. Current extraction capacity and geographic distribution
     - 2.1.2. Mining
     - 2.1.3. Processing
     - 2.1.4. Current extraction level and geographic distribution
3. Mapping of Indonesia's Battery Supply Chain
   - 3.1. Operating industries by supply chain stages
     - 3.1.1.1. Power supply availability
   - 3.2. Extraction (Lithium, Nickel, Cobalt, Manganese, Graphite)
   - 3.3. Processing (including Purification of raw materials, and Processing for cathode and anode active battery minerals)
   - 3.4. Manufacturing
     - 3.4.1. Nickel batteries
     - 3.4.2. Iron batteries
     - 3.4.3. Solid-state batteries
     - 3.4.4. Sodium-ion batteries
   - 3.5. End-of-life
     - 3.5.1. Reuse
     - 3.5.2. Recycle
   - 3.6. Opportunities and gaps for development to pinpoint the ideal battery technology in Indonesia
     - 3.6.1. Gaps in existing battery supply chain
     - 3.6.2. Opportunities for cross industries cooperation
4. Economic analysis developing battery supply chain in Indonesia
   - 4.1. National demand analysis
     - 4.1.1. Electromobility adoption trends
     - 4.1.2. Future demand trends and scenarios
   - 4.2. Economic implications
     - 4.2.1. Sales
     - 4.2.2. VAT

4.2 Deliverable 3. Comprehensive guide and roadmap to support stakeholders accelerating energy transition

0. Executive summary
1. Introduction
   - 1.1. Target compatibility assessment
     - 1.1.1. National energy transition goals, related to RE and battery applications e.g. EVs.
     - 1.1.2. Evaluation of projects alignment with national energy transition goals
     - 1.1.3. Investor's guide
   - 1.2. Financial viability evaluation
     - 1.2.1. Financial metrics
     - 1.2.2. Risk and sensitivity analysis
     - 1.2.3. Metrics for investments decisions
   - 1.3. Operational feasibility and strategic development analysis
     - 1.3.1. Production capacity
     - 1.3.2. Technology Readiness Levels (TRLs)
2. Policy roadmap
   - 2.1. Regulatory framework assessment
     - 2.1.1. State of play
       - 2.1.1.1. Fiscal and non-fiscal Incentive schemes
     - 2.1.2. Opportunities
     - 2.1.3. Regulatory Gaps
   - 2.2. Roadmap and recommendations for future policies
     - 2.2.1. Strategic development opportunities
     - 2.2.2. Roadmap implementation plan
     - 2.2.3. EV's Supply chain integration

   Annex
   - 0.1. Investment data sheet
   - 0.2. Policy data sheets

4.3 Deliverable 4. Analysis of social and environmental impacts related to batteries supply chain and proposed solutions

0. Executive summary
1. Introduction
   1.1. Scope of Study
   1.2. Policy, Legislative, and Regulatory Framework
2. Environmental and social baselines
   2.1. Definition of environmental baseline and scope
   2.2. Definition of social parameters and scope
3. Environmental and social impact assessment (ESIA)
   3.1. Environmental and Social Receptors
   3.2. Impact Identification Method
   3.3. Identified Environmental and Social Impacts
   3.4. Cumulative Impacts
   3.5. Environmental and social mitigation strategies
   3.6. Mitigation strategies
   3.7. Mainstreaming social and gender considerations into the development of the supply chains

Annex

0. Stakeholder Engagement and Consultation
   0.1. Stakeholder Analysis and Engagement
   0.2. Disclosure of Information
   0.3. Consultation and Participation

4.4 Deliverable 5. Final report

The final report will present revised and approved deliverables' results, along with the summary of information disseminated and published. Final RBMF results will be presented, with final advisory from the GESI expert. Upon approval, the final report will be submitted to ETP.

The final report will have the following content:

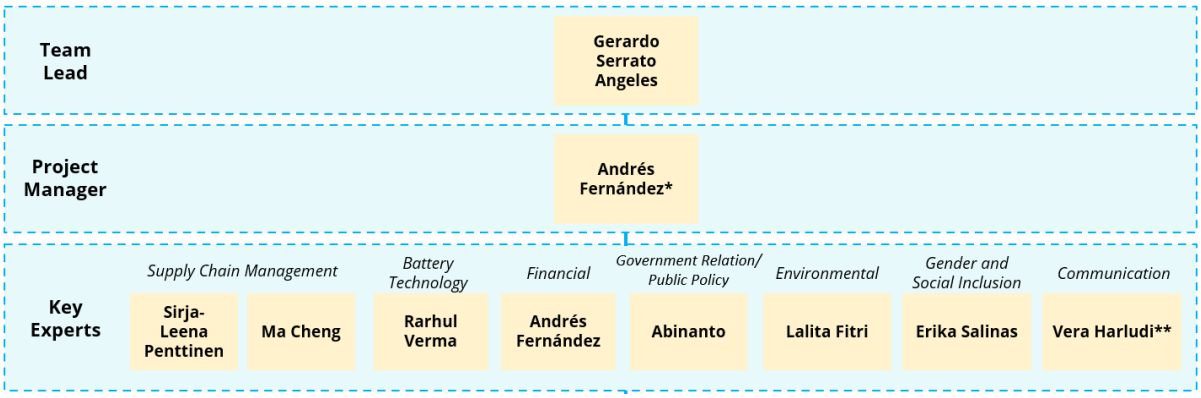
1. Executive summary, project background and rationale
2. Methodology description
3. Stakeholder engagement overview
4. Findings and recommendations
5. Projects' Impact assessment on Indonesia's energy transition
6. Lessons learned, sustainability plan and future steps

5 Project management

5.1 Project organization and personnel

The project will be conducted by the consortium formed by Hartree Consulting, Kolibri and Fractal bringing together different strengths of each entity to deliver the objectives of this project. The consulting team is composed by highly experienced experts from each of the members of the consortium Figure 5-1.

Figure 5-1 Organizational chart



*Point of contact between UNOPS and the consortium
**Point of contact between local stakeholders and the consortium

The relevant points of contact are described in Table 5-1

Table 5-1 Points of contact

Team Leader & Project Manager	Gerardo Serrato gerardo.serrato@hartreepartners.com cc: Andrés Fernández, andres.fernandez@hartreepartners.com; in-foconsulting@hartreepartners.com Technical manager, point of contact to the subcontractors and UNOPS, and in charge of the day-to-day project management and to deliver the final version of the deliverables
Other Point of Contacts	Kolibri Vera Harludi, vera@kolibriforimpact.com cc: Dhia Fani, dhia@kolibriforimpact.com Fractal Rahul Verma, rahul@fractalba.com
Local Point of Contact / Stakeholder Engagement	Vera Harludi **vera@kolibriforimpact.com** Local expert will oversee quality output and communication efforts, serve as local point of contact and manage local translations. This local point of contact will coordinate stakeholder engagement in Indonesia

5.2 Deliverables management plan

To ensure effective management of project deliverables and maintain high standards of quality, the following structured approach will be adopted:

Biweekly Checkpoints with ETP

Every two weeks, the project manager will conduct a checkpoint meeting with the ETP project manager to maintain continuous alignment and addressing any changes promptly. During these meetings, the status of deliverables will be reviewed, emerging issues or changes will be discussed, and expectations will be aligned. To facilitate informed discussions, interim progress reports will be shared with the ETP project manager prior to each meeting, providing a detailed overview of the project's current state and any significant developments.

Weekly Team Meetings

Weekly meetings with the entire project team will be held to ensure everyone is up to date on deliverable progress and can address any issues immediately. These meetings will follow a preset agenda that includes status updates, risk identification, and action items. By discussing upcoming milestones and identifying potential risks, the team can proactively manage any challenges that arise. Comprehensive meeting minutes will be recorded to document key points, decisions, and assigned tasks, ensuring transparency and accountability within the team.

Documentation and Communication

Minutes will be documented for every meeting, capturing key discussions, decisions, and action items to keep a record of progress and accountability, facilitating communication even if team members are absent. The Results-Based Monitoring Framework (RBMF) will be updated monthly to support detailed tracking and reporting of project progress.

5.3 Deliverables' quality assurance

Each deliverable is assigned to a responsible expert from the consulting team, who oversees its development and ensures compliance with technical specifications. The deliverable undergoes peer-to-peer reviews by other team members, providing comprehensive and holistic feedback from multiple perspectives.

The quality review process consists of two stages. First, the deliverable is checked for compliance with all methodological requirements. Any identified errors or issues are addressed to enhance the quality of the deliverable. In the second stage, the Project Manager reviews the deliverable to ensure it is complete and coherent. The Project Manager

then collaborates with the Team Lead to maximize quality. Only after this thorough review process is the deliverable sent to ETP for final approval.

5.4 Donor coordination strategy

Donor coordination requires significant effort and time and will be conducted to enhance the efficiency of donor funding, avoid duplication of studies, and ensure impartial, informed guidance to the Government of Indonesia. The main outcome of this coordination is to identify, leverage, and inform concurrent studies related to the current state of the battery supply chain, potential roadmaps, operational implementation, and environmental and social safeguards (ESS).

Three types of partners that can support Indonesia's energy transition have been identified:

1. **Multilateral development banks**
2. **Government agencies**
3. **Philanthropies**

The consultants will actively engage with these donor partners, including the French Development Agency (AFD), Children's Investment Fund Foundation (CIFF), the Foreign, Commonwealth and Development Office of the United Kingdom (UK - FCDO), the Global Green Growth Institute (GGGI), the Asian Development Bank (ADB), private industries such as mining companies or associations, and other non-state donors. By participating in events and meetings hosted by these entities, the consultants will create opportunities to communicate project progress and explore further alignment opportunities. A mapping of past and ongoing financial support and technical assistance from several of Indonesia's largest donors and development partners will be conducted. This mapping will provide the Indonesian government with an understanding of which development partners and donors could be the most promising for future interventions based on their past engagements in similar projects. It will include information on each project, such as the project descriptions, and activities carried out. The results of the mapping will be presented following the structure showed in Table 5-2.

Table 5-2 Template for mapping of past and ongoing financial support and technical assistance

Name of the project	Objective	Start date	End date	Organization funding the project

Currently, the following projects with potential overlap have been identified:

- **A Project from US Net Zero World Initiative,** where the general objective is to develop tailored strategies addressing technical clean energy pathways and deployment and investment opportunities to reach net-zero[73].

- **The Development of a Battery Manufacturing Industry Roadmap for Indonesia from the World Bank,** whose objective is to develop a policy and roadmap for the Government of Indonesia to implement, to boost investment in battery manufacturing, by assessing the potential development of the sector/value chain, the associated job creation, and the ensuing growth together with a series of actions that would need to sequentially take place for the creation of a competitive battery manufacturing industry[74].

- **The Energy Sector Roadmap to Net Zero Emissions in Indonesia from the International Energy Agency (IEA)**, which aims to provide comprehensive roadmap to net zero by 2060 for the country. The analysis spans key areas such as people-centred transitions, the phasing down of coal use, investment and financing needs, and critical minerals needed for battery manufacturing and as electronic components for clean energy technologies[75].

- **Renewable Energy Manufacturing: Opportunities for Southeast Asia from the Asian Development Bank (ADB)**. The report includes a comprehensive section for battery manufacturing in the region and uses Indonesia as an example to showcase the overall battery supply chain state of play and potential development, including current nickel manganese cobalt (NBC) battery cell manufacturing players in the country, a simulation of the country's cost competitiveness for battery production, the investment needed for the Indonesian government to achieve 140 GWh of battery production by 2030, among other relevant analyses[76].

To ensure effective donor coordination, the project will establish a clear point of contact within relevant agencies, organizations, and development banks. After each engagement, online satisfaction surveys will be distributed to gather feedback and maintain a contact list of relevant stakeholders. The project's point of contact will be included in all project materials, enabling ETP funders and development partners to directly contact the

[73] For more information, please visit: https://www.nrel.gov/international/net-zero-world.html

[74] This potential project is currently on bidding by the World Bank Group.

[75] The following report is the outcome of the mentioned analysis: IEA (2022), An Energy Sector Roadmap to Net Zero Emissions in Indonesia, IEA, Paris https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia, Licence: CC BY 4.0

[76] The following report is the outcome of the mentioned analysis: ADB (2023), Renewable energy manufacturing. https://doi.org/10.22617/tcs230310-2

Consultants with suggestions, questions, or to align interests and efforts. The project manager will ensure these contacts are well-informed and actively involved throughout the project. ETP will be kept informed of any additional conversations resulting from these direct outreaches.

6 Stakeholder mapping and communication plan

6.1 Preliminary stakeholder mapping

A preliminary stakeholder mapping exercise, as shown in Table 6-1, has been conducted to identify key players directly or indirectly engaged in the battery supply chain. This initial effort provides a foundation for further detailed analysis. Under Deliverable 2, a more comprehensive stakeholder exercise will be carried out to identify additional key player and mark its relationship with the supply chain. This will result in the creation of a database that compiles and categorizes stakeholders according to their relevance and contribution to each Workstream and supply chain category.

Table 6-1 Preliminary list of key stakeholders

Key Stakeholders	Relevance to this project	Related supply chain stage based on ISIC4
Ministry of Investment	The Ministry could attract international and national investors to develop the batteries' supply chain and promote the country as an attractive destination for investments, stimulating economic growth.	Overall Section B, Div 07, Group 072 Section C, Div 27, Group 272 Section G, Div 45-46, Group 451, 452, 466 Section E, Div 38, Group 383
Ministry of Industry	Besides strengthening industrial growth and competitiveness, this Ministry can support the project's financial and operational feasibility results to key industry members that may join the supply chain of batteries.	Manufacturing Section C, Div 27, Group 272
Ministry of Energy and Mineral Resources (MEMR)	MEMR's efforts to accelerate energy transitions in Indonesia will be useful for the project ensuring alignment with national goals. Likewise, the project will provide the Ministry with relevant knowledge and strategies to facilitate and enable decision making.	Mining & Quarrying Section B, Div 07, Group 072
Ministry of Environment and Forestry	Ensuring that battery value chain activities comply with environmental protection laws and guidelines, and promoting the sustainable management of Indonesia's natural resources, including forests and ecosystems, which may be affected by battery-related activities.	Overall Section B, Div 07, Group 072 Section C, Div 27, Group 272 Section G, Div 45-46, Group 451, 452, 466 Section E, Div 38, Group 383
Coordinating Ministry of Maritime and Investment Affairs (CMMIA)	CMMIA could both support and benefit from the roadmap for battery-related investments by providing insights to the Consulting Teams and the roadmap is being built and leveraging from having clear guidelines once the roadmap is finalized.	Overall Section B, Div 07, Group 072 Section C, Div 27, Group 272 Section G, Div 45-46, Group 451, 452, 466 Section E, Div 38, Group 383

Key Stakeholders	Relevance to this project	Related supply chain stage based on ISIC4
Ministry of National Development Planning (Bappenas)	BAPPENAS could benefit from the project to develop and implement new effective policies that align with the national development plans and with sustainable practices.	Overall Section B, Div 07, Group 072 Section C, Div 27, Group 272 Section G, Div 45-46, Group 451, 452, 466 Section E, Div 38, Group 383
Mining Industry Indonesia (MIND ID)	Engagement with Indonesia's mining industry holding company comprised PT ANTAM Tbk, PT Bukit Asam, PT Freeport Indonesia, PT Indonesia Asahan Aluminium (Persero), and PT Timah Tbk., will be crucial during the development of this project. MIND ID will feedback will be highly relevant for the assessment of Indonesia's mineral resources and its processing potential	Mining & Quarrying / Water supply, waste management Section B, Div 07, Group 072 Section E, Div 38, Group 383
PT. Aneka Tambang Tbk.	Antam being the largest nickel producer in Indonesia will be a key player in the development of the supply chain of EVs' batteries in the country.	Mining & Quarrying Section B, Div 07, Group 072
Indonesia Battery Corporation (IBC)	IBC will benefit from the project's findings to ensure joint efforts are targeted towards developing the supply chain of batteries. The collaboration of IBC with this project can ensure a more efficient collaboration with other stakeholders and foster industry growth.	Overall Section B, Div 07, Group 072 Section C, Div 27, Group 272 Section G, Div 45-46, Group 451, 452, 466 Section E, Div 38, Group 383
Indonesian Nickel Miners' Association (APNI)	The APNI's efforts are focused on synergizing all Indonesian nickel mining business communities. The APNI's experience allows it to have a complete view of Indonesia's nickel industry's state of play, which is crucial to understand how the entire supply chain of EV batteries can be integrated	Mining & Quarrying Section B, Div 07, Group 072
AEML - Electric Mobility Ecosystem Association	AEML is a non-profit organization dedicated to catalyzing the development of a world-class electric mobility ecosystem in Indonesia. Their vision is to support the adoption of electric vehicles (EVs) and foster a globally competitive EV ecosystem.	Manufacturing / Water supply, waste management Section C, Div 27, Group 272 Section E, Div 38, Group 383
INA - Indonesia Investment Authority	INA plays a pivotal role in Indonesia's energy transition mechanism (ETM). They collaborate with various stakeholders to support the transition toward cleaner energy sources.	Overall Section B, Div 07, Group 072 Section C, Div 27, Group 272 Section G, Div 45-46, Group 451, 452, 466 Section E, Div 38, Group 383

In addition, a preliminary list of other potential stakeholders that will be engaged throughout the project and invited to the Presentation events is described in the following table:

Table 6-2 Indicative list of additional potentials stakeholders

Category	Organization
Government	Coordinating Ministry of Maritime and Investment Affairs
Government	Min. of Energy and Mineral Resources
Government	Min. of Industry
Government	Min. of Environment and Forestry
Government	PT PLN (Persero)
Industry	IBC
Industry	Electric Vehicle Manufacturer Assc
Non-Governmental	Indonesian Renewable Energy Society (METI)
International	International Energy Agency (IEA)
Industrial Est.	PT Indonesia Morowali Industrial Park
Industrial Est.	PT Indonesia Weda Bay Industrial Park
Industrial Association	Asosiasi Industri Sepeda Motor Indonesia
Industrial Association	GAIKINDO
Mining and Smelting	MIND ID
Mining and Smelting	PT Aneka Tambang Tbk
Mining and Smelting	PT Vale Indonesia
Mining and Smelting	PT Halmahera Persada Lygend
Mining and Smelting	PT Merdeka Battery Materials
EV producers	PT Hyundai Motor Manufacturing Indonesia
EV producers	PT SGMW Motor Indonesia
Battery producers	PT HLI Green Power

Support from ETP will be required to facilitate initial outreach efforts and foster collaboration with key stakeholders, such as governmental agencies and officials and other donor community efforts. Endorsement and support letters from ETP would enhance the project's credibility and significance.

6.2 Audience mapping & outreach plan

Engagement activities in the four Workstreams include Presentation Events per deliverable. The events will present each deliverable's results to key stakeholders as a strategy for engaging and involving potential investors, decision makers, and government agencies in the development and implementation of these projects. Adhering to Chatham House rules, the events will encourage open discussion, maintaining confidentiality to foster exchanges of expert insights and feedback.

Overview of Event Activities

As an integral component of external stakeholder outreach and engagement, Table 6-3 below serves as an engagement tracker tool for the Presentation Events, outlining their objectives, key stakeholders, and the collaborative development of invitation lists with the project team and ETP.

Table 6-3 List of Event Activities engagement tracker tool

Event name	Event Description	Event Objective	Tentative Date	Key Stakeholders
PE 1: Kick-off meeting (online)	Online event to present the Inception Report including work plan, methodology and communication plan. Collective interviews will be conducted during the event to collect relevant data.	External project kick-off meeting to introduce project goal and objective, foster collaborative efforts and gauge initial insights from key stakeholders.	August2024 – Date to be confirmed	Relevant key stakeholder as identified in a collaborative effort with ETP
PE 2: Battery supply chain state of play – Gaps and potential	In-person presentation event to disseminate the outputs delivered during Workstream A and gather input and feedback from stakeholders	Initiate discussions with key stakeholders regarding supply chain gaps and potential solutions, confirming efforts and data to foster collaborative ownership across stakeholders.	4-Oct-24	GOI incl. relevant ministries, IBC, companies with interest in the battery sector (e.g., industrial estate compounds, mining companies, EV manufacturing companies.)
PE 3: Implementation plan tools – Investor Guide / Policy Roadmap	Deliver an in-person event to present and disseminate Workstreams B and C outputs and gather input and feedback from stakeholders. The event will include a presentation for investors to facilitate navigating regulatory and operational complexities	Catalyzing dialogue on policy and financing gaps to gain valuable insights and recommendations from stakeholders.	31-Jan-25	GOI incl. relevant ministries, IBC, companies with interest in the battery sector (e.g., industrial estate compounds, mining companies, EV manufacturing companies.)
PE 4: Supply chain impacts – Environmental and Social	In-person presentation event to disseminate the outputs	Initiating discussion with key stakeholders to assess their	23-May-25	GOI incl. relevant ministries, IBC, companies with interest in the

Event name	Event Description	Event Objective	Tentative Date	Key Stakeholders
	delivered during Workstream D and gather input and feedback from stakeholders.	perspectives on environmental and social impacts within the supply chain.		battery sector (e.g., industrial estate compounds, mining companies, EV manufacturing companies.)
PE 5: Final Report Deliverable	Submission Final Report summarizing the project's objectives, methodology, findings and recommendations of the whole project	Share a comprehensive roadmap and strategic recommendations for future initiatives within the battery supply chain, facilitating actionable outcomes and informed decision-making.	22-Aug-25	GOI incl. relevant ministries, IBC, companies with interest in the battery sector (e.g., industrial estate compounds, mining companies, EV manufacturing companies.)

6.3 Communications material

A variety of communication materials will be developed throughout the study. The progress of these efforts will be monitored using the tracker provided below in Table 6-4:

Table 6-4 Communication Progress Tracker

No	Category	Communication Materials	Description	Target	Progress	Status
1	Soc-Med	Social Media Post (liasing with ETP)	Spread throughout the duration of the project linked to various key milestone events	5	0	Not Done
2	Press	Press Releases	For each public workshop/ event published in at least 5 publications	5	0	Not Done
3	Newspaper	Newspaper Articles (Online)	For each public workshop/ event in 5 publications	5	0	Not Done
4	Policy Brief	Policy briefs	One for each deliverable 2-5	4	0	Not Done
5	Op-Ed	Opinion Editorial (Op-Ed)	At least 2 publications	2	0	Not Done

No	Category	Communication Materials	Description	Target	Progress	Status
6	Presenta-tion	Online presentations of project progress and highlights to the ETP Sec-retariat. ETP Funders, and/or ETP Stakeholders	1 hour max/ each	2	0	Not Done
7	Assets	Maintain/develop a data-base of photographs/ vid-eos/ vox pops from events/ activities	High-quality images per workshop/event	4	0	Not Done
			High-quality short raw video footage (2-3 mins) per work-shop/event (ideally, key speeches and/or highlights reel)	2	0	Not Done

In order to follow language that does not demean or stereotype men or women, using non-sexist language will be applied in writing communication material.

Each communication item will be further detailed using the tool structured below. The document will be accessible to the project team and ETP for collaborative efforts. Currently, the content within the tool are placeholders.

Table 6-5 Example of Communication Tool Table Structure

No	Category	Comm Materials	Audience	Date		Status	Link
				Planned	Published		
1	Soc. Media	Social media post to on ETP re-lated content	ETP social media fol-lowers	28 Jun-24	28 Jun-24	Done	Link
2	Press	Press release on the study find-ings A	Media outlet A, MO B, MO C	8 Jul-24	10 Jul-24	Hold	Link

7 Data collection strategy and data requirements

7.1 Data collection strategy

A variety of methods will be applied to collect data and information needed to conduct the study. The consulting team will conduct one-on-one interviews and correspondence with relevant stakeholders. Data based on documents published by the government will also be collected first and verified afterwards. Meanwhile, for the secondary data collection strategy, the consultants will use public literature and/or internal study. Both primary and secondary data will be confirmed with relevant stakeholders through Focus Group Discussions (FGD). It is to be noted that all engagement with stakeholders will require ETP's support.

7.2 Data requirements

This section outlines a preliminary and comprehensive list of data required for the activities of the various Workstreams. The data requirements may evolve as the project progresses. The consulting team will ensure all data used for analysis are current and of high quality.

To maintain the highest quality standards, data inputs for each deliverable will be reviewed for origin, completeness, and relevance to Indonesia's context by the assigned consulting team member. Once verified, the data will be processed and stored for use. If specific data is unavailable or delayed, proxy datasets will be considered. The consulting team will also seek validation from ETP to ensure the data meets project expectations.

Table 7-1 Data requirements for Workstream A: Battery Supply Chain State of Play – Gaps and potential

Mineral Resources and Industrial Landscape Perspective	
Raw Material and Resource Availability • Critical minerals' national reserves in metric tons • Geographical distribution of these reserves within Indonesia • Annual production volume of critical minerals disaggregated by region • Current and planned exploration projects for critical minerals • Annual export volumes of critical minerals • Main destination countries • Annual import volumes of critical minerals • Main countries of origin for these imports • Trends in import volumes over the past 5-10 years **Production capacity**	**Preliminary sources:** • Industry reports- sector specific reports and public databases • Market research- reports on market size, consumer trends, and growth forecast • World Bank database • IEA- World Energy Outlook 2023 & 2024, Batteries and Secure Energy Transitions • IEA- Global EV Outlook 2024 • Trademap- Index • Indonesia Battery Corporation Reports

• Total production capacity of battery manufacturing plants in Indonesia • Capacity factor of the plants • Facility locations and details of plants size and production lines • Information on new battery production facilities planned or under construction • Name of major battery manufacturers in Indonesia, locations of their production facilities, and their national market share • Location of production facilities and operational status of facilities identified **Supply Chain Mapping in Indonesia** • List of companies involved in each stage – mining, refining, manufacturing, distribution, and end use- including their roles and contributions • Partnerships and JVs between local and international companies **Battery types and composition** • Types and quantities of raw materials required for battery production	• Indonesian Energy Outlook from the Ministry of Energy and Mineral Resources • Handbook of Energy & Economics Statistics of Indonesia from the Ministry of Energy and Mineral Resources • Ministry of Energy and Mineral Resources DG Mineral and Coal • Academic publications
Economic Perspective	
Demand analysis • Current and projected adoption rates of EV in Indonesia • Current and projected adoption rates of EV globally and in AEAN region, disaggregated by market segment (vehicle type) • Current global demand batteries driven by the growth of the EV market • Government Policies and Incentives that promote electric vehicle adoption, at national and ASEAN levels • National electric vehicle adoption projection and goals **High-level economic analysis** • Historical sales data of batteries • Projected growth rates for battery sales • Avg selling prices of different types of batteries • Current VAT rate • Estimated sales revenue from battery production. • VAT exemptions or reductions applicable to battery sale • Current availability and cost of raw materials required for battery production • Labor requirements and costs for battery production • Incremental costs associated with the production and sale of batteries. • Comparative pricing data from other countries • Multiplier effects of the supply chain on other industries	**Preliminary sources**: • IEA- Global EV Outlook 2024 • Trademap- Index • World Bank database • IMF database • National statistics databases for GDP and other macroeconomic indicators • Academic publications

• Number of jobs directly created in the battery production sector • Gender distribution of the workforce in the battery production sector • Social benefits and challenges related to battery production	

Table 7-2 Data requirements for Workstream B: Implementation plan tools – Investors guide

Economic model development	
• Mineral historical and projected prices • Market demand forecast for batteries • Cost estimation • Environmental impact assessment costs • Applicable tax rates by region and by sector/supply chain stage • Data on interest rates by supply chain stage	**Preliminary sources**: • Trademap- Index • National statistics databases from the Ministry of Energy and Mineral Resources and the Ministry of Investment • Mining and battery manufacturers corporations • US Geological Survey • Academic research
Risk and sensitivity analysis	
Risk from external factors • International prices established on products manufactured in each stage of the battery supply chain, e.g. CBAM	**Preliminary sources**: • Published international policy and regulations
Technology factors analysis for investment projects	
• List of technologies and investment projects present in the battery supply chain • Production capacity • Technology Readiness Level (TRL) • Suppliers required for the technology or investment project implementation • Distributors benefitted for the technology or investment project implementation • Batteries end-use cases	Preliminary sources: • Academic publications

Table 7-3 Data requirements for Workstream C: Implementation plan tools – Policy roadmap

Policy factors mapping	
Government policies and incentives • Current policies and initiatives related to the energy transition in Indonesia	**Preliminary sources:** • Existing EV demand incentives such as Law No. 1/2022, Reg. No. 1/2021, and the MoF Reg. 138/PMK.02/2021

• Specific government plans and roadmaps for the battery supply chain • International and transnational standards in the battery supply chain for operational, environmental, and social parameters Geopolitical issues and collaborations related with the battery supply chain and their implications • Map of historical cases of geopolitical issues • Positive regional collaborations and agreements Government Agencies Influence • List of government agencies and regulatory bodies and their roles in supporting the battery supply chain	• IESR- Indonesian Government's Capacity for Just Energy Transition Planning • Public announcements of international collaboration (MOU) for EV and batteries development
Legal factors mapping	
Regulations • List of current Indonesian regulations pertinent to the battery supply chain • Indonesia's energy transition, and climate action goals • International agreements • Existing incentive schemes to promote supply chain sector investments	**Preliminary sources:** • Indonesia's decarbonization plans included in national plans such as National Energy Policy and the National Energy Plan • Indonesia's NDC • IESR- Indonesia Energy Transition Outlook (2024)

For Workstream D, a first iteration of the data will be collected prior to site visits for the mapped regions. During the site visits, these data will be discussed and validated with the local groups interviewed.

Table 7-4 Data requirements for Workstream D: Impact assessment– Environmental and social

Social impact analysis	
Demographic data • Population size, density and distribution • Age, gender, and ethnicity • Urbanization trends • Literacy and educational trends • Employment rates and type of employment (informal vs. formal) **Labor data** • Labor conditions and wages • Access to healthcare offered by employer • Data on incidents and health risks at the workplace • Land ownership • Information on conflicts related to land and natural resources	**Preliminary sources:** • National statistics databases for GDP and other macroeconomic indicators • Academic publications • Primary information collected from site visits • Case studies • Atlas of environmental justice

Environmental impact analysis	
Energy and power consumption • Current energy consumption, including fossil fuel and power, for the supply chain (annual volumes) • Shares of renewable energy sources vs. non-renewable energy in the supply chain • Emission levels of CO2, CH4 and N2O across the supply chain stages **Waste generation and management** • Data on waste management practices, particularly for hazardous materials for each stage of the supply chain • Available recycling facilities • Safe waste disposal facilities available in Indonesia **Land use** • Data on land cover change in relevant supply chain areas, most particularly in Sulawesi and Halmahera **Air quality** • Data on air quality rates among the supply chain operating locations • Historic concentrations of O3, PM2.5, PM10, CO, SO2 and NOx, previous operations related with the battery supply chain development and after its implementation **Surface water, groundwater, and marine water quality** • Contaminant levels in surface water, groundwater, and marine water for both upstream and downstream activities • Wastewater treatment practices **Terrestrial and marine biodiversity** • Inventory of species with significant international and national conservation status • Important species distribution, protected areas, and notable ecosystems that intersect with supply chain routes	Preliminary sources: • WRI database • FAO database (Aquastat) • Historic land cover data from publicly available GIS-based data • Air quality data from the Meteorology, Climatology, and Geophysics Council BMKG and • Corporate environmental monitoring reports obtained from the Ministry of Environment and Forestry and its regional agencies (i.e. DLH) • Biodiversity, protected areas, and notable ecosystems data from IUCN Red List data, World Database of Protected Areas, and other publicly available data • Academic publication • Primary information collected from site visits • Case studies

8 Risks, mitigations, and assumptions

A comprehensive risk mapping was conducted for each workstream and the overall project. This exercise aimed to disaggregate and assess the specific risks associated with the project as a whole and differentiated per each workstream, determining their impact and likelihood, and establishing appropriate mitigation actions.

The preliminary risks identified include data quality, access to data, acceptance of proposals and recommendations by stakeholders, and changes in government. Table 8-1 outlines these risks and the proposed mitigation actions.

Table 8-1. Risks and mitigation actions

Risk type	Workstream				Risk source	Consequence	Likelihood	Level of Impact	Mitigation action
	A	B	C	D					
Data quality	✓	✓	✓	✓	Error in analysing data input	Inconsistency of output with the deliverable's expectations	Low	Moderate	Enforce and implement the data quality assurance plan. Validate data used with ETP and between team's experts and the Project Manager
Data availability	✓	✓	✓	✓	Missing or inadequate data mapped and required to develop the tasks	Data with poor quality used Delayed submission of the deliverable	Medium	Moderate	Secondary data sources will be identified and validated with the Project Manager
				✓	Unable to contact local stakeholders Missing collaboration with local stakeholders	Not being able to collect data from site visits	Medium	Moderate	
				✓	Difficulty in obtaining hard copy reports from	Not being able to collect data from local/regional government agencies	Medium	Low	

Risk type	Workstream				Risk source	Consequence	Likelihood	Level of Impact	Mitigation action
	A	B	C	D					
					local/regional government agencies				
Recommendations acceptance			✓		Missing collaboration and dialogue with stakeholders to gain inputs to draft recommendations	Missing ownership of the policy roadmap from stakeholders who would implement policy actions	Low	Moderate	Promote acceptance through communications plan Appropriate stakeholder engagement activities, considering actors' inputs for the implementation of projects and coordination activities from stakeholders from different sectors
Change of government	✓	✓	✓	✓	Challenges identifying relevant stakeholders	Engaging with different government officials before and after government change	High	Moderate	Conduct two stakeholder mapping exercises for government officials: prior and post-government change. Adjust engagement activities to collaborate with stakeholders involved in the project's sustainability and implementation.
					Changes in government priorities	New legislation proposed that could hinder the project's implementation and long-term sustainability	Medium	Moderate	Advocacy through the communication plan to promote liaise and cooperation with the new government's commitment with a comprehensive energy transition plan
Poor accessibility during field visits				✓	Poor mobile reception due to poor infrastructure	Difficulty in coordinating with remote project team members and emergency contacts.	Medium	Low	Establish daily check-in times with the project manager/off-field project team member.
					Inadequate public facilities, e.g., roads, hospitals	Difficulty in project navigation, getting to certain areas, and emergency evacuation.	Medium	Low	Opt to use 4WD vehicles during field visits to anticipate poor roadworks. Identify on-site emergency contacts (e.g., hospital, police) before the field visit is conducted.

Risk type	Workstream				Risk source	Consequence	Likelihood	Level of Impact	Mitigation action
	A	B	C	D					
Difficulty in field verification				✓	Restricted access in certain areas, e.g., industrial estates, mining concessions, factory compounds	Inadequate data for field verification.	High	Low	Secondary data sources will be identified and validated with the Project Manager.
Safety and security threat during field visit				✓	Civil unrest, unstable, chaotic environment	Physical harm, death	Low	High	Conduct thorough risk assessments before the visit Coordinate with local authorities and security agencies Provide consultants with detailed safety briefings and emergency contact information
Limited stakeholder engagement				✓	Stakeholders may be hesitant to connect with external parties due to the high presence of outsiders in the area.	Challenges in engaging stakeholders and conducting focus group discussions (FGDs).	Medium	Low	Engage the local representative of the consortium to conduct field visits to mitigate pushback. Leverage UNOPS ETP connections to establish a direct link between the project team and stakeholders.
Protest and civil unrest from the industry	✓	✓	✓	✓	High accident risk associated with nickel smelters Potential accidents triggering riots Escalation during industry events	Significant reputational damage to the organization Physical harm to consultants, employees, and attendees Potential legal and financial liabilities	Medium	High	Engage with local communities and industry stakeholders to address safety concerns Develop a crisis communication plan to manage reputational damage Monitor social and industrial environments for early signs of unrest

Given the diverse range of stakeholders involved in this project, frequent communication will be encouraged to align assumptions. At the start of each workstream, scheduling dates with key stakeholders will ensure their availability to voice opinions and achieve consensus. Continuous communication among the consulting team members and ETP will facilitate the prompt identification and communication of any additional risks arising during the project's development, allowing for swift mitigation actions.

9 Monitoring and evaluation framework

The consultants will utilize ETP's Results-Based Monitoring Framework (RBMF), developed by Accenture, to monitor and evaluate the project's progress, ensuring inclusion and transparency throughout its development. The RBMF will track the general terms of the project, including implementation partners, stakeholders, and beneficiaries, and assess the project's impact on the energy transition agenda and the community.

For more detailed monitoring, the RBMF will register the project's progress in primary outcome areas by collecting data on specific indicators to track outputs. Table 9-1 outlines the outcomes and indicators to be monitored throughout the project. Additionally, the framework will document all project-related events, including lists of attendees and photographs.

Table 9-1 RBMF's outcomes, indicators and outputs

Primary Outcome Area	Indicators	Project Output
SO1 - Policy alignment with climate commitments	IN 1.1-02.1 - No. of RE and EE policies, laws, regulations, and/or technical standards developed and presented to the government entities	Policy recommendations to accelerate energy transition through batteries for EV, solar PV ecosystem development and other power plants
SO2 - De-risking EE and RE investments	IN 2.2-01 - No. of new and existing, national and international, financing options / instruments de-risked and opened for private and blended financing	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
SO4 - Knowledge and Awareness Building	IN 4.1-01 - No. of studies, research, new evidence gathered and published, for raising awareness, improving the knowledge base, driving decisions, and dissemination	A comprehensive report on the analysis of the supply chain of batteries for EVs, and solar PVs, and other RE power plants to justify and drive investments
	IN 4.1-01 - No. of studies, research, new evidence gathered and published, for raising awareness, improving the knowledge base, driving decisions, and dissemination	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
	IN 4.1-01 - No. of studies, research, new evidence gathered and published, for raising awareness, improving the knowledge base, driving decisions, and dissemination	An analysis of social and environmental impacts related to the supply chain of batteries, and proposed solutions for social and environmental challenges encountered along the supply chain

Primary Outcome Area	Indicators	Project Output
	IN 4.1-02 - No. of trainings, knowledge sharing events, and/or awareness workshops organised at national and regional levels building institutional capacity and knowledge networks	Workshops to disseminate project outputs and gather input and feedback from relevant stakeholders
	IN 4.1-02 A - Total no. of attendees	Minimum 50 attendees per workshop
	IN 4.1-02 B - Total no. of female attendees	At least 30% female attendees[77]
	IN 4.1-03 - No. of articles, press-releases on social media, and mass media, for outreach	Social media posts
	IN 4.1-03 - No. of articles, press-releases on social media, and mass media, for outreach	Press releases (1 per public workshop/event published in at least 5 publications)
	IN 4.1-03 - No. of articles, press-releases on social media, and mass media, for outreach	Online newspaper articles (1 per public workshop/event in 5 publications)
	IN 4.1-03 - No. of articles, press-releases on social media, and mass media, for outreach	Policy briefs on recommendations and suggested policy actions to accelerate energy transition through batteries for EV, solar PV and other RE power plants
	IN 4.1-03 - No. of articles, press-releases on social media, and mass media, for outreach	Opinion Editorial (Op-Ed)
	IN 4.1-04 - Total no. of entities supported through Technical Assistance	1. Coordinating Ministry of Maritime and Investment Affairs 2. Ministry of Investment 3. Ministry of Industry 4. Ministry of Energy and Mineral Resources 5. Ministry of National Development Planning (BAPPENAS) 6. Indonesia Battery Cooperation (IBC) 7. PT. Antam Tbk

[77] There is no information available regarding baseline participation of women in technical events. As a first attempt, 30% female attendees are the target proposed.