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IMPACT OF ELECTRIC VEHICLES ADOPTION AND DEVELOPMENT ON INDONESIA'S GREEN ECONOMY PROGRESS

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Introduction

I.1 Background

The Indonesian government is currently developing the next long-term national development plan, called RPJPN, for the period 2025-2045. This will be the first RPJPN, which accommodates a low-carbon development approach and contributes to achieving a net zero emission target by 2060 or earlier. This new development approach is also in line with the commitment of the G20 countries to promote low-carbon green and blue economic development stated in its 17th summit in Bali in November 2022.

During the G20 Side Event, The Ministry of National Development Planning (Bappenas) launched an Indonesia Green Economy Framework (IGEF), as a comprehensive and primary reference document for policymakers and stakeholders engaged in the implementation of green economy initiatives within Indonesia. To measure the progress of the low carbon and green economy in Indonesia, the IGEF will be developed by utilising the Indonesia Green Economy Index (IGEI).

By adopting the green economy principles, the proposed RPJPN targets an accelerated economic growth of at least 6% per annum during the period while also improving the productivity in the manufacturing industry, increasing the employment rate, and reducing greenhouse gas emissions. Therefore, to achieve higher economic growth, the government should boost industrialization and adopt low-carbon development.

Electrifying the mobility sector and transitioning from fossil-fuel-based electricity production to renewable energy sources are pivotal steps toward this objective. Notably, the transportation sector accounts for 40% of the total energy consumption and 27% of national greenhouse gas emissions.

The acceleration of electric vehicle (EV) production in Indonesia is expected to diminish reliance on oil imports and subsidies, increase the employment rate by providing green job opportunities, and reduce greenhouse gas emissions. Besides appearing in the recent draft of RPJPN 2025-2045, the transition to EVs has been incorporated into the National Industrial Development Master Plan (RIPIN) 2015-2035. Through Presidential Decree No. 55 in 2019, the Indonesian government has also committed to delineating a clear path and guidance for the nation's EV development and adoption.

Therefore, it will not only contribute to increased economic growth and employment but also to a reduced greenhouse gas emission intensity, as proposed in the RPJPN. The progress of the low-carbon green economic development targets is expected to be traced by the Indonesian Green Economic Index (IGEI).

I.2 Objective

This study aims to identify the impact of green economy principles in the EV sectors on Indonesia's Green Economy Index. This adoption of EV is expected to accelerate economic growth, reduce unemployment, and reduce greenhouse gas emissions.

The study result will also serve as a strategic background paper for the upcoming medium-term national development plan (RPJMN) for 2025-2029. Furthermore, the research findings will contribute to the update of the LCDI Phase 2 Framework, which will be used by the Government, development partners, and key stakeholders to reinforce and implement national green economy policies and priorities moving forward. This study will focus on the following core objectives:

1. Collecting relevant data related to the EV sector, including market trends, emissions data, potential adoption and challenges, and policy documents;
2. Identification of the potential impact of the EV sector adoption on Indonesia's Green Economy Index (IGEI);
3. Developing policy options and action points to be integrated into a comprehensive Mid-Term national development plan, especially focusing on the EV sector development.

I.3 Scope of Study

To achieve this objective, the study will explore how green economy principles can be applied in the Electric Vehicles (EV) sector, specifically focusing on the downstream aspect. This study only addresses the downstream sectors, which are EV usage, to midstream sectors, specifically the battery industry. Therefore, the examination of upstream sectors, such as mining, metal processing, metal refining, as well as the battery component industry, are outside the scope of the study. This limitation arises from the lack of regulations or roadmaps mandating that all components of EVs should be domestically produced and utilise domestic mineral resources. Each ministry or institution involved is currently striving to meet their targets, leading to an absence of clear linkage and synergy among institutions towards the objective of fostering the EV ecosystem in Indonesia.

Therefore, our analysis will encompass an exploration of the following aspects:

1. Identifying existing policy and roadmap for EV development in Indonesia and other countries;
2. Assessment of the current state of the EV sector utilising the Indonesia Green Economy Index;
3. Integration of analysis into LCDI model and impact of EV adoption on IGEI improvement;
4. Developing policy recommendations for EV sector development in Indonesia.

I.4 Methodology

This study uses both quantitative methods and qualitative methods or mixed methods research. Mixed methods research is an approach to inquiries descriptively both quantitative and qualitative data. The two forms of data approaches use distinct designs that may involve different philosophical assumptions and theoretical frameworks. The core assumption of this form of inquiry is that the integration of qualitative and quantitative data yields additional insight beyond the information provided by either the quantitative or qualitative data alone (Creswell & Creswell, 2018).

In this study, the qualitative and quantitative data are carried out simultaneously. The sources of data are obtained from several publications and other relevant databases. Several data collection methods used in this study include:

- **Literature review**. The literature review is a qualitative data collection method that reviews existing literature such as reports, scientific articles, publications, policies, and other documents to get an overview of the current state of EV development in Indonesia and other countries. The review process uses several keywords including "electric vehicle" or "EV", "EV policy", "EV roadmap", "EV incentive", "fiscal incentive", "non-fiscal incentive", "Thailand", "United States", "European Union", and "China" in Google Scholar, Elsevier, and Scopus as the main databases, limiting the publication data in the last ten years to capture the latest trend on the issue.
- **Secondary data analysis.** The secondary data analysis is a quantitative data collection method analysing existing data sets that were collected for another purpose to assess the impact of EV adoption and development on green economy index improvement in Indonesia. The secondary data originates from BPS, Gaikindo, AISI, and relevant government databases such as Bappenas, Kemenko Marves, KLHK, KESDM, and others.
- **Focus Group Discussion.** The focus group discussion is a qualitative data collection method involving small group discussions led by a moderator to gather opinions, perceptions, and insights on the policy recommendations for EV sector development in Indonesia. Participants are selected based on several criteria, namely having an interest in EV issues and/or having expertise relevant to the development of the EV sector in Indonesia. Some of the participants involved include central government entities such as responsible ministries, local governments, the automotive industry, academics, and others.

Meanwhile, for the analysis, this study will integrate some methods, including:

- **Descriptive Analysis.** The descriptive method is used for describing both quantitative and qualitative approaches, formulated with a problem statement that integrates research to thoroughly, extensively, and profoundly explore or capture a social scenario. In the quantitative approach, the descriptive method aims to provide a clear and concise representation of the data's central tendencies and variations. Meanwhile, in the qualitative approach, the focus of this method is to systematically depict the facts or characteristics of a particular population or field in a precise and factual manner.

- **System Dynamic Model.** The system dynamic model is a quantitative modelling approach that is particularly useful for analysing complex systems and understanding the dynamic behaviour of variables over time to simulate, analyse, and optimise the behaviour of complex systems. This method uses causal loop diagrams that have been developed by Bappenas, namely the Green Economy Model to evaluate the EV sector's impact on the system's performance and identify the most effective strategies for achieving desired outcomes.

CHAPTER II
Overview of Indonesia's Green Economy Index (IGEI)

II.1 Concept

Indonesia's Green Economy Index is an evaluation tool to measure green economic progress in the country by assessing economic, environmental, and social nexus. Although the concept of green economy has yet to build a consensus internationally, some organisations and governments generally shared the same core idea for the green economy. In the context of Indonesia, Bappenas defines green economy as referring to UNEP's definition of an economic development model to support sustainable development with a focus on investment, capital, infrastructure, employment, and skill to achieve social welfare and environmental sustainability (UNEP (2012) in Bappenas (2022)).

As part of Indonesia's economic transformation strategy, the green economy aims to achieve high and inclusive economic growth while achieving social well-being and maintaining environmental quality. Therefore, the practices of the green economy in Indonesia are focused on the core instruments or "backbone" of the green economy itself, namely carbon development and climate resilience policies. These policies are incorporated within the national medium-term development plan (RPJMN 2020-2024), which also adheres to the mandate of the United Nations Framework Convention on Climate Change (UNFCCC) Article 3.4 to incorporate climate action into the development plan.

The Indonesia Green Economy Index (IGEI) is being developed as a tool for tracking the advancement of the green economy as part of economic reform. IGEI also offers an important step forward for Indonesia's transition to a low-carbon, green economy by offering a comprehensive and objective analysis of the economic, environmental, and social nexus. As a result, it would give evaluation and strategic development services to the government in order to assist it in designing future planning documents and policies.

There are several types of GEI developed for example by UNEP, OECD, and Green Growth and Dual Citizen. The distinction among these indices lies in the types and number of indicators utilised to construct the respective indices. For example, UNEP Green Economy Index consists of 40 indicators under environmental, policy interventions, and well-being and equity categorizations (UNEP (2012) in Bappenas (2022). PAGE utilised 13 indicators that are classified into three groups: economy, social, and environment conditions (PAGE (2017) in Bappenas (2022)). In OECD, 26 green growth indicators are incorporated and specified into productivity, natural asset base, quality of life, and policies (OECD (2017) in Bappenas (2022)). Whereas Green Economy Index developed by Green Growth and Dual Citizen utilised 18 quantitative and qualitative indicators under four key dimensions: climate change and social security are incorporated. Although some Green Economy Index has existed, Indonesia built Green Economy Index (GEI) as a framework that is able to represent green economy conditions in the context of Indonesia economy.

Besides using references from existing global indexes and studies, Indonesia Green Economy Index chooses indicators based on two criteria. First, the availability and accessibility of technical data, including the historical data and its ability for projection. Second, the indicators are Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) characteristics for its target. The interrelationships of selected indicators for the IGEI have been drawn by Bappenas using a system dynamic model.

II.2 Components

The GEI has 15 indicators that can be divided into three sustainability pillars, namely environmental, economic, and social pillars (see Table 1). The environmental pillar consists of five indicators, including the percentage of forest cover, the share of renewable energy, GHG emission reduction, managed waste and degraded peatland. The economic pillar has six indicators, namely emission intensity, final energy intensity, gross national income per capita, agricultural productivity, industrial sector labour productivity, and service sector labour productivity. Then, the social pillar has four indicators, including mean years of schooling, life expectancy, poverty rate, and unemployment rate. Each indicator in the GEI has different maximum and minimum thresholds based on the target goals from documents such as the 2060 Net Zero Emission, the Executive Summary of Indonesia's Vision 2045, the World Bank, and others.

Table 1 GEI's Pillars and Indicators

No.	Indicators	Description	Minimum Thresholds	Maximum Thresholds
		Environmental Pillar		
1	Forest cover (%)	Comparison between forest cover with Indonesia's total land area (excluding water).	30%	54%
2	Share of renewable energy (%)	The share of energy from renewable sources against the total national primary energy mix.	0%	42%
3	Managed waste (%)	Level of household waste generation managed by the government compared to the total waste generated.	0%	82%
4	GHG emission reduction (%)	Level of cumulative emissions reduced from all sectors, started from 2010 as the base year compared to baseline of cumulative emission within the same period.	0%	70%
5	Degraded peatland (%)	Comparison between forest cover on peatland area out of the total peatland area in Indonesia.	30%	0%
		Economy Pillar		

No.	Indicators	Description	Minimum Thresholds	Maximum Thresholds
6	Emission intensity (TCO_2eq/BnRp)	Ratio of GHG emissions per unit of economic activity, represented at the national level by GDP.	270 TCO_2eq/BnRp	26 TCO_2eq/BnRp
7	Final energy intensity (BOE/BnRp)	Amount of energy consumed per level of economic activity, represented at the national level by GDP.	125 BOE/BnRp	63 BOE/BnRp
8	Gross National Income (GNI) per capita (USD/capita)	Sum of value added by all resident producers plus any product taxes not included in the valuation of output plus net receipts of primary income, measured in IDR and converted to USD.	500 USD	12,695 USD
9	Agricultural productivity (ton/ha/year)	Level of agriculture production output, specific on food crops (paddy), plantations (palm oil), and fisheries (aquaculture) per total area used in a year.	5 ton paddy/ha/year 2 ton CPO/ha/year 3 ton aquaculture/ha/year	12 ton paddy/ha/year 5 ton CPO/ha/year 19 ton aquaculture/ha/year
10	Industrial sector labour productivity (MnRp/person)	Value that shows the ability of labour to produce production goods in the industrial sector is measured by dividing the added value of production by the amount of paid labour.	20 MnRp/person	200 MnRp/person
11	Service sector labour productivity (MnRp/person)	Value that demonstrates the labour's ability to generate goods in service sector, calculated by dividing the added value of production by the amount of paid labour.	20 MnRp/person	200 MnRp/person
		Social Pillar		
12	Mean year of schooling (years)	Total years of education for adult age (25 and above) divided by total adult population age (25 and above).	2 years	12 years
13	Life expectancy (years)	The average period of people may expect to live.	55 years	75.5 years
14	Poverty rate (%)	Percentage of total population with total expenditure below the national poverty line.	13%	0%
15	Unemployment rate (%)	Percentage of unemployed people in the labour force.	15%	3%

Source: Bappenas (2022)

To calculate the GEI, the first thing to do is to calculate the scores for each indicator. The score for each indicator is the result of comparing the existing year's score (denoted as yi) with their respective maximum thresholds (ymax) and minimum thresholds (ymin) (see Equation 1).

$$Indicator\ score\ (i) = \frac{(yi - ymin)}{(ymax - ymin)} x\ 100 \quad (1)$$

After obtaining the scores for each indicator, the second step is to calculate the scores for each GEI pillar. The score for each pillar is the arithmetic average from the sum of the respective indicators within it. The formula for the score of each pillar can be seen in the following equation.

$$Environment\ score\ (i) = \frac{\sum \quad Indicator\ score\ (i)}{5} \qquad (2)$$

$$Economy\ score\ (i) = \frac{\sum \quad Indicator\ score\ (i)}{6} \qquad (3)$$

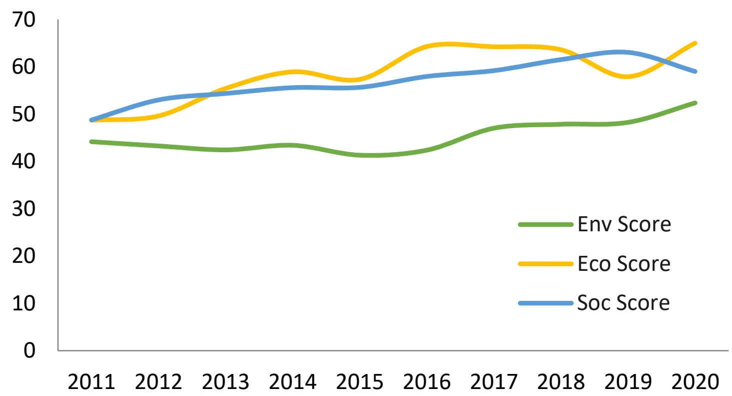
$$Social\ score\ (i) = \frac{\sum \quad Indicator\ score\ (i)}{4} \qquad (4)$$

Furthermore, the scores of each pillar are aggregated with weights based on the number of their respective indicators. Therefore, the GEI can be obtained through Equation 5 below.

$$GE\ Index\ (i) = \frac{(Env.score\ (i)x5) + (Eco.score\ (i)x6) + (Soc.score\ (i)x4)}{15} \qquad (5)$$

Based on the results of the Green Economy Index (GEI) over the period 2011-2020, the green economy conditions in Indonesia showed an increasing trend compared to previous years (see Figure 1) (Bappenas, 2022). However, the environmental pillar consistently had the lowest scores compared to the economic and social pillars. Therefore, various government efforts are essential to support the implementation of the green economy, particularly in the environmental pillar.

Figure 1 GEI's Annual Score



Source: Bappenas (2022)

Furthermore, when examined closely, the indicators within the environmental pillar with the lowest share are the renewable energy indicator and the emission reduction indicator (Bappenas, 2022). The renewable energy indicator has shown significant improvement after the formulation of Presidential Regulation No. 22/2017 on the National Energy General Plan (RUEN), which has promoted the use of renewable energy sources such as hydro, geothermal, and biomass. In addition, the emission reduction indicator also contributes minimally to the GEI due to high emissions from the energy sector, particularly from power generation, and the Forestry and Other Land Use (FOLU) sector due to forest and land fires.

CHAPTER III
Existing Policy and Roadmap for Electric Vehicles Development in Indonesia and Other Countries

III.1 Electric Vehicles Regulatory Review in Indonesia

The policy to expedite the Battery Electric Vehicle program in Indonesia is grounded in Presidential Regulation Number 55 of 2019. Under this regulation, the Battery Electric Vehicles program for road transportation is implemented by accelerating the development of the domestic electric vehicle (EV) industry, providing incentives, establishing electric charging infrastructure, and regulating electric power tariffs for Battery Electric Vehicles. Additionally, the regulation focuses on meeting EV technical specifications and ensuring environmental protection. In 2023, this regulation underwent an update through Presidential Regulation Number 79 of 2023, introducing several additional provisions. These include converting conventional vehicles to EVs, regulations for EV charging stations involving battery exchange, adjustments to domestic content level regulations, provisions related to the import of battery electric vehicles, regulations and incentives for recipients, and specifications for electric charging infrastructure.

To support the acceleration plan for the development of the EV industry, the government also issued Presidential Instruction No. 7 of 2022. This regulation mandates the use of Battery Electric Vehicles as operational government vehicles and/or personal vehicles for officials in both Central and Regional Government Agencies. To implement this directive, the central and regional governments can formulate and establish regulations and/or policies, allocate budgets in support, and procure Battery Electric Vehicles or engage in programs to convert combustion engine vehicles into battery electric vehicles. The regulation also provides specific instructions to the Ministers of 14 ministries, the Chief of Presidential Staff, the Chief of the Indonesian National Police, as well as governors, regents, and mayors, outlining their respective responsibilities in supporting the acceleration plan for the development of the EV industry in the country.

Apart from presidential regulations, various policies and laws are enacted at the ministerial level, such as in the Ministry of Energy and Mineral Resources (KESDM). As the authority responsible for developing charging infrastructure, regulating electricity prices, and overall energy management, including ensuring the attainment of renewable energy targets, KESDM has introduced regulations addressing these aspects. The first among them is Ministerial Regulation No. 1 of 2023 concerning the provision of Charging Infrastructure for Battery Electric Motor Vehicles, which repeals the previous Regulation No. 13 of 2020 issued by the Ministry of Energy and Mineral Resources.

The Ministry of Energy and Mineral Resources (KESDM) also regulates government assistance in the program for converting motorcycles with internal combustion engines into battery-based electric motorcycles, as outlined in Ministerial Regulation Number 13 of 2023, amending

Ministerial Regulation Number 3 of 2023. This ministerial regulation addresses general provisions, aid recipients, conversion costs, evaluation, obligations of aid recipients, verification, as well as funding and governance of the assistance. Furthermore, the technical guidelines for implementing government assistance in the program for converting motorcycles with internal combustion engines into battery-based electric motorcycles are detailed in Ministerial Decision Number 39.K/EK.07/DJE/2023.

Other supportive policies for Battery Electric Vehicles (KBLBB) have also been issued by ministries such as the Ministry of Home Affairs, Ministry of Finance, Ministry of Transportation, and Ministry of Industry. In 2023, the Ministry of Home Affairs released Ministerial Regulation Number 6 of 2023 concerning the basis for motor vehicle tax, BBN (Motor Vehicle Inspection Fee), and Heavy Equipment Tax. Subsequently, the Ministry of Finance regulates the VAT borne by the government (PPN DTP) for Electric Cars and Buses in the Fiscal Year 2023 through Ministerial Regulation Number 38 of 2023. The Ministry of Transportation oversees the conversion of motorcycles with internal combustion engines into battery-based electric motorcycles through Ministerial Regulation PM 39 of 2023. The Ministry of Industry also amends the guidelines for government assistance in purchasing two-wheeled battery-based electric motor vehicles through Ministerial Regulation Number 21 of 2023 as an amendment to Ministerial Regulation Number 6 of 2023.

III.2 Roadmap of Electric Vehicles Development in Indonesia 2030

As the world's largest nickel producer, Indonesia aspires to become a key player in the electric vehicle industry. With its substantial nickel ore reserves, Indonesia has the potential to establish an indigenous battery and electric vehicle sector. To support the development of Indonesia's battery and electric vehicle industries, the government has developed a roadmap and targets to be achieved in the coming years to achieve its goal of developing the nation's electric vehicle sector.

The Indonesian government set a strategy for Indonesia's electric vehicle sector through Regulation Number 6 of 2022 that regulates the specification, the development roadmap, and provisions regarding the calculation of the local component value of electric battery vehicles. According to this rule, the Indonesian government has created a roadmap for the entire value chain of the electric vehicle industry (Ministry of Industry of the Republic of Indonesia, 2022). Under this roadmap, the government has set targets to be achieved over the next 11 years in each sub sector relevant to the development of the electric vehicle industry, from raw materials to the production of electric vehicles themselves. Table 2 shows the specifics of this industry plan.

Table 2 Roadmap for the Electric Vehicles Industry Based on Minister of Industry Regulation No. 6 of 2022

Component	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Battery												
Battery Pack Assembly	Battery Pack Assembly Pack											
Battery Cell Production		LiB and NiMH Cylinder Type Cell					>95% Inverter Efficiency (High Frequency HFET					
Battery Management System (BMS)	BMS (Assembly)			Passive BMS >90% BMS Efficiency & Integration System Can Bus				Active BMS >90% BMS Efficiency & Integration System Can Bus/OBD 2				
Battery Material	HPAL Smelter											
			Nickel Sulfate & Cobalt Sulfate				Cathode & Anode Materials					
End of Life Recycling (EOL)		Recycling of Secondary Battery (NiMH & LiB)										
Electric Motor			Non-Permanent Magnet Base 85% Efficiency						94% Efficiency Motor			
				Permanent Magnet Base 85% Efficiency								
Converter/Inverter			95% Inverter Efficiency (Ultra low Ron Sic, Low Parasitic Impedance, High Power Density)						95% Inverter Efficiency (High Frequency HFET)			
Charging System		AC Level I & Level II Charger & DC Fast Charger			Ultra Fast Charger							
Minimum Local Content Requirements (TKDN) Targets for 4-Wheeled or More	Minimal 35%		Minimal 40%		Minimal 60%						Minimal 80%	
Public Passenger Vehicles[1]	CBU	CKD				IKD		Part by Part				
Buses and Trucks	CKD					IKD		Part by Part				
Private Passenger Vehicles	CBU	CKD				IKD		Part by Part				
Minimum Local Content Requirements (TKDN) Targets for 2-Wheeled or 3-Wheeled	Minimal 40%				Minimal 60%		Minimal 80%					
Motorcycles	CBU	CKD				IKD		Part by Part				

Source: Ministry of Industry, 2022

The regulation addresses not only the roadmap for the electric vehicle industry but also the determination of the minimum domestic component requirements for electric vehicles manufactured in Indonesia (Ministry of Industry of the Republic of Indonesia, 2022). The regulation requires that any electric vehicle made in Indonesia, whether four-wheeled or two-wheeled, contain a certain percentage of domestic components. The requirements for the mandatory use of domestic components will be implemented gradually over 11 years. Initially, the minimum proportion of domestic component consumption for four-wheeled and two-wheeled vehicles in 2023 is set at 35% and 40%, respectively. This minimum level is steadily increasing, and we intend to reach 80% domestic component usage by 2031.

[1] CBU: Completely Build Up
CKD: Completely Knock Down
IKD: Incompletely Knock Down

The government targets the development and production of the battery-based electric vehicle sector from 2020 to 2035 in the same rule. The goal for the two- and three-wheeled electric vehicle manufacturing target is to produce 12 million units by 2035. The production target for four-wheeled and bigger vehicles is anticipated to exceed 1 million units (Table 3).

Table 3 Quantitative Target for Development of the Battery-Based Electric Motor Vehicle Industry

Variable		2020	2025	2030	2035
Battery-based electric motorised vehicles with four-wheeled batteries and more	Production (Unit)	0	400,000	600,000	1,000,000
Battery-based electric motorised vehicles with two and three wheels	Production (Unit)	5,000	6,000,000	9,000,000	12,000,000

Source: Ministry of Industry Regulation No 6 of 2022

The government is also aiming for the primary goal points in supporting the development of the electric vehicle ecosystem by 2030, including:

1. Self-sufficient local production of raw materials and key components
2. Optimised sectoral productivity along the value chain
3. Leading automotive export hub
4. Regional leader in EV production

Table 4 Energy Source and Infrastructure Requirement for Electric Vehicle

	EXISTING	NEXT: ELECTRIC VEHICLES		
	LCGC (Low-Cost Green Car)	**HEV (Hybrid Electric Vehicle)**	**PHEV (Plug-in Hybrid Electric Vehicle)**	**BEV/FCEV (Battery Electric Vehicle/Fuel Cell Electric Vehicles)**
Overview	Low carbon emission vehicle	Mostly fuel-powered, but uses small battery packs to improve fuel efficiency	Optimise battery powered, but uses a fuel-powered generator (range extender)	Full-electric vehicle that are completely battery/fuel cell powered
Energy Source	Gasoline/ diesel	Gasoline/ diesel	• Gasoline/diesel • Electricity	Electricity/hydrogen
Infrastructure Requirements	Pump station (available)	Pump station (available)	Pump station, Charging station (alternative)	Charging station/hydrogen station (required)

Source: Ministry of Industry, Stimulating Clean Energy Investment to Support Transformation Towards a Low Carbon Energy System in Indonesia

The government intends to develop an end-to-end domestic electric vehicle battery supply chain to support the development of domestic electric vehicles. Given that Indonesia has huge nickel reserves, which are used to produce lithium-ion batteries. Several State-Owned

Enterprises (BUMN) are also expected to be involved in this industrial supply chain, such as MIND ID (Antam and Pertamina) and Indonesia State Electricity Corporation (PLN).

The government has started its attempts to encourage the development of a battery-based electric vehicle industry, particularly in fulfilling the demand for nickel-based batteries, by prohibiting the export of nickel ore with a Ni content of 1.7%. This is stated in the Ministry of Energy and Mineral Resources Regulation No. 11 of 2019. With this regulation, this industry is expected to invest in domestic hydrometallurgical nickel refining facilities.

In Indonesia, approximately fifty nickel manufacturing facilities are presently operational, with another 86 under development or in construction phases. Pyrometallurgy plants (processing saprolite nickel) operate the majority of smelters, with 50 in operation by 2023. Meanwhile, there are only four operational hydrometallurgy units (processing limonite nickel) in 2023, with six more under construction or planned. In addition, Indonesia already has four battery precursor processing plants and five raw material battery management units.

III.3 Electric Vehicles Development Target in Indonesia 2030

In 2030, Indonesia targets the adoption of approximately 15 million electric vehicles (EVs), comprising 1.97 million electric cars and 12.90 million electric motorcycles, to support efforts in industrial transformation, energy resilience, and decarbonization (Coordinating Ministry for Maritime and Investment Affairs, 2023). In industrial transformation, the adoption of EVs is expected to provide added value through investments in the development of EV components or models (Coordinating Ministry for Maritime and Investment Affairs, 2023). This aligns with the National Industrial Development Master Plan (RIPIN) 2015-2035, which aims to develop 10 Priority Industries, including basic metal industries (with nickel as a raw material for EV batteries), energy generation industries (with batteries as EV main components), and transportation equipment industries (with electric vehicles as EV models) (Ministry of Industry, 2015).

The adoption of EVs is anticipated to contribute to the target of processing natural resources, particularly nickel commodities, up to 17 million tons per year by 2035. Furthermore, the achievement of this EV adoption target can also be quantified and calculated for its magnitude of contribution to the increase in GEI through various indicators, such as the rise in GNI per capita, the improvement of labour productivity in the industrial sector, and the reduction in the unemployment rate (National Development Planning Agency, 2022).

In terms of energy resilience, the adoption of EVs can reduce the use of fossil fuels, leading to savings in expenditures for imported oil petroleum (Coordinating Ministry for Maritime and Investment Affairs, 2023). This aligns with the Enhanced Nationally Determined Contribution (Enhanced NDC) 2030, which aims to enhance energy efficiency by saving 71 million barrels of oil equivalent (BOE) in consumption (Ministry of Environment and Forestry, 2022). Furthermore, the achievement of this EV adoption target can also be quantified and calculated for its magnitude of contribution to the increase in GEI's indicator, such as the reduction in final energy intensity (National Development Planning Agency, 2022).

In the aspect of decarbonization, the adoption of EVs can support decarbonization by avoiding emissions produced from fossil fuels in Internal Combustion Engine (ICE) vehicles

(Coordinating Ministry for Maritime and Investment Affairs, 2023). This is in line with the Enhanced NDC 2030, aiming to reduce greenhouse gas emissions from the energy sector, including the transportation sector, by 358 million tons of oil equivalent (MTOE) per year or achieving a maximum emission of 1,311 MTOE by 2030 (Ministry of Environment and Forestry, 2022). Additionally, the achievement of this EV adoption target can be quantified and calculated for its contribution to the increase in GEI through indicators such as the increase in greenhouse gas emission reduction and the reduction in emission intensity (National Development Planning Agency, 2022).

Nevertheless, the adoption of EVs can contradict decarbonization goals if the primary energy mix continues to be dominated by fossil fuels. Increased electricity consumption for EVs sourced from on-grid power plants, or captive power plants to support nickel ore mining, nickel refining industries, and battery industries, can significantly escalate carbon emissions. Therefore, EVs development policies should align with the decarbonization of electricity production.

III.4 EV Incentive Policy Comparison across Various Countries

III.4.1 United States of America

To combat climate change, the United States of America (US) government provides incentives for its citizens to transition to electric vehicles. Various initiatives have been undertaken by both the Federal and State Governments. These incentives extend beyond mere financial benefits to encompass non-monetary incentives as well.

A. Financial Incentive

The incentives provided by the government in the United States for electric vehicles include tax credits, rebates, and electricity credits, among others. These policies are not only established by the Federal Government but also by State Governments. Here are some examples of incentives offered by both levels of government.

1. The Federal Government

   Legislation has been enacted by the Federal Government to grant tax credits for EV purchasers. Furthermore, incentives may include rebates and support for EV manufacturing industries.

   a. Federal Tax Credit for EV Shoppers

      For New Vehicles, up to $7,500 tax credit. The Inflation Reduction Act extended the previous $7,500 tax credit, but newer rules restrict the specific vehicles that qualify — for example, to qualify for the tax credit, the EV must have had its final assembly in North America.

      For Used Vehicles, up to $4,000 tax credit. Beginning January 1, 2024, if you buy a qualified used electric vehicle (EV) or fuel cell vehicle (FCEV) from a licensed dealer, you may be eligible for a used clean vehicle tax credit or discount. The credit or discount equals 30% of the sale price up to a maximum credit of $4,000.

b. Incentives for EV manufacturers. EV manufacturers will no longer face a cap on incentives restricted to the first 200,000 EVs sold. Consequently, every qualifying EV purchased in 2023 should qualify for a tax credit.

Rebates for used EVs. If you purchase a pre-owned EV for under $25,000, you might qualify for a $4,000 tax credit. However, you have to fulfil certain criteria before you can avail yourself of this tax incentive.

2. The State Government

Many states offer additional incentives such as a tax credit, rebate, or other financial incentives for buying an electric vehicle. However, the only states not currently offering any specific benefit are Kentucky, Montana, North Dakota, and Wyoming.

Table 5 Type of Electric Car Incentives in United States

Type of Electric Car Incentives	Incentives
Tax Credit	Providing a tax credit for either new or used EVs and PHEVs. It means that you will be able to subtract a certain amount from the total you owe in taxes.
Rebates	Getting rebates for multiple purchases can result in saving an extra $1,000 or more on the purchase and set up of a new or used EV.
Electricity Credits	Numerous electric companies extend credits towards your electricity bill or reduced rates for individuals who consent to charge their EVs during off-peak periods.
Exemption	Certain states might opt to grant exemptions from particular taxes or procedures, such as annual vehicle inspections, instead of providing a tax credit or rebate.

Source: Derived from various sources

Some examples of incentives provided by the states include:

a. California: California has a dozen or more EV incentives, including Plug-In Hybrid and Zero Emission Light-Duty Vehicle rebates, an All-Electric Vehicle (EV) Rebate - MCE, and a Used Electric Vehicle (EV) Rebate Program - LADWP.

b. Colorado: Colorado offers an EV tax credit for light-duty EVs purchased or leased before January 1, 2026, and an EV rebate through Xcel Energy.

c. Washington D.C: Washington, D.C. offers an electric vehicle title excise tax exemption.

d. New York: New York offers an EV rebate of up to $2,000 when you buy an eligible electric vehicle.

e. Massachusetts: Massachusetts offers an EV rebate between $1,500 to $2,500, depending on which type of car you buy.

B. Non-Financial Incentives

In addition to providing financial incentives, the United States government also offers non-financial incentives to aid in the implementation of electric vehicle usage. Some of these include:

1. Charging Infrastructure Incentives

The purpose of these incentives is to simplify and reduce the cost for businesses, institutions, and individuals to set up EV charging stations, thereby fostering the expansion of the EV market. More than 40 states offer local incentives for the procurement and installation of EV chargers.

a. Commercial and Fleet Station

According to the U.S. Department of Energy's Alternative Fuels Data Center, there are approximately 50,000 public EV charging stations in the U.S., providing nearly 130,000 individual charging ports. ChargePoint leads the market with over 27,000 stations and almost 50,000 ports, mainly offering Level 2 charging. Tesla follows closely with about 6,000 stations and 28,000 ports, focusing on Superchargers. Additionally, there are nearly 8,500 non-networked EV charging stations, primarily providing Level 2 ports. Other companies in the public charging infrastructure sector have fewer locations and charging points compared to ChargePoint and Tesla. In 2022, the California government provides USD 1 billion funding for transportation electrification programmes with 70% for M/HDV charging infrastructure and 30% for LDV charging in Municipal Utility Districts. In 2018 the state also has targeted 250,000 electric vehicle charging stations by 2025 (IEA, 2023).

b. Home EV Charging Incentives in States

Many states, cities and utilities offer attractive incentives for EVs and charging. Electricity companies that provide home charging EV installation services provide incentives for customers who use EVs, such as discounts on Home Charging installation services. Some examples of incentives for Home EV Sharing Incentive in several States;

- In Colorado, Gunnison County Electric Association (GCEA) provides rebates to residential customers toward the purchase of Level 2 EVSE. 70%, up to $500, of the cost of a Level 2 Home Charger. 5% Discount on chargers purchased from GCEA.

- In California, Alameda Municipal Power (AMP) is offering rebates for electric vehicle charging stations for residents who are AMP customers. Get up to an $800 AMP rebate on the purchase and/or installation of a new electric vehicle charger. Also, Imperial Irrigation District is offering a rebate of up to $500 to customers who purchase and install a qualified Level 2 (240V) home charger.
- In Illinois, Clearview Energy is offering free EV charging daily from 11 PM to 6 AM (Sunday – Saturday) and a $50 rebate for ChargePoint Home charger when you sign up for a CLEARCHARGE Clearview Energy Plan.

2. Other Non-Financial Incentives
   a. EVs are allowed to use High Occupancy Vehicle (HOV) lanes. These lanes, commonly known as "carpool lanes," are designated for vehicles with multiple occupants, buses, and motorcyclists in many regions. Certain HOV lanes also permit inherently low-emission vehicles (ILEVs), such as hybrid electric vehicles (HEVs) and alternative fuel vehicles (AFVs), irrespective of passenger count.
   b. Emission Testing Exemption. Several states in the United States offer incentives for EV users by exempting them from emission testing. Some of these states include California, Colorado, New York, Massachusetts, New Jersey, Oregon, and Washington, among others.

III.4.2 China

China's dominance in the automotive market remained unchallenged, representing nearly 60% of all new electric car registrations worldwide in 2022 (IEA, 2023). In 2023, the country experienced significant growth in vehicle sales, with a 12% increase to 30.09 million units sold, encompassing both domestic and international transactions. Notably, international shipments surged by 58%, totalling 4.91 million units. The electric vehicle (EV) market expanded significantly, with sales reaching 9.49 million units, capturing a substantial 31% share of the overall market. Within the EV segment, plug-in hybrid sales soared by 85% to 2.80 million units, while pure battery-powered vehicle sales grew by 25% to 6.68 million units. In 2022, electric vehicles accounted for 29% of total domestic car sales in China, a significant increase from 16% the previous year and a mere 6% between 2018 and 2020. This upswing can be attributed to several key factors: a heightened global demand, particularly notable for Chinese electric vehicles, intensified competition among automotive manufacturers leveraging discounts and introducing novel models, and a resurgence in the commercial vehicle sector.[2]

This robust growth trajectory of EVs in China is underpinned by more than a decade of consistent policy support to incentivize early adopters. Policies such as the extension of purchase incentives, initially slated for phase-out in 2020 but extended to 2022 due to the disruptive impact of the COVID-19 pandemic, have played a pivotal role. Moreover, non-financial measures, including the rapid deployment of charging infrastructure and stringent registration protocols for non-electric vehicles, have further bolstered the transition towards

[2] China's 2023 auto sales grow 12% on overseas demand for EVs. *Nikkei Asia* (January 11, 2024). https://asia.nikkei.com/Business/Automobiles/China-s-2023-auto-sales-grow-12-on-overseas-demand-for-EVs

electric mobility (IEA, 2023). Since 2009, the government has subsidised EV producers catering to public transport, taxi services, and the consumer market. Additionally, Chinese EV consumers have benefited from government purchase incentives for several years. China has allocated over 200 billion yuan (US$28 billion) towards EV subsidies and tax incentives between 2009 and 2022 (Yu, 2023).

China employs consumption tax exemptions to reduce production expenses for electric vehicles (EVs) and fuel cell vehicles, alongside providing purchase subsidies and tax relief for consumers, while also exempting car owners from vehicle and vessel taxes and enhancing infrastructure to support EV utilisation (Yu, 2023). Various government policies are expected to continue supporting the widespread adoption of EVs. In 2023, the Chinese government extended the purchase tax exemption for EVs until the end of 2027, with purchases in 2024 and 2025 enjoying total exemption, while those in 2026 and 2027 receive a half-tax reduction.[3]

Table 6 China Government Policies Supporting Electric Vehicles (EVs)

Policy	End Date	Specifics
Exemption from consumption tax and vehicle & vessel tax	Not specified	Carmakers are exempted from consumption tax and vehicle & vessel tax for producing, subcontracting processing, and importing EVs.
Purchase subsidy	End of 2022	- A maximum subsidy of 12,600 yuan per vehicle for battery electric vehicle (BEV) passenger cars, and 4,800 yuan for plug-in hybrid (PHEV) passenger cars, including extended-range PHEVs.
		- For non-fast-charging BEV buses, there's a maximum subsidy of 50,400 yuan per vehicle; for fast-charging BEV buses, it's 36,400 yuan; and for PHEV (including extended-range) buses, it's 21,300 yuan.
		- BEV trucks receive a maximum subsidy of 28,000 yuan per vehicle, while PHEV (including extended-range) trucks get 17,600 yuan.
Purchase tax exemption	End of 2027	- New EVs purchased by December 31, 2025, are exempt from vehicle purchase tax. Those bought between January 1, 2026, and December 31, 2027, have the purchase tax reduced by half.

[3] Tax Break Extension for NEVs Expected to Boost Consumer Demand" *China Daily* (June 22, 2023). https://english.www.gov.cn/news/202306/22/content_WS6493ab47c6d0868f4e8dd1d0.html#:~:text=China%27s%20latest%20policy%20measures%20to,auto%20market%2C%20industry%20experts%20said.

Policy	End Date	Specifics
Infrastructure support	Not specified	- EV charging and battery-switching facilities offer discounted electricity tariffs.
		- Service fees for EV charging and switching are regulated by the government.
		- Grid-conversion costs for EV charging and switching facilities are included in generator tariffs for power transmission and distribution.

Source: Yu (2023)

According to Liu et al. (2023), China implemented monetary subsidy policies for electric vehicles (EVs) in 2009, undergoing iterative adjustments across four significant dimensions. First, the subsidy coverage saw a gradual expansion from limited trials conducted in a handful of cities in 2009 to the selection of numerous points by 2013, eventually culminating in nationwide implementation in 2015. Second, the scope of subsidy targets witnessed a noteworthy broadening. It was initially confined to public sectors such as public transportation, rentals, sanitation, and postal services; subsidies were later extended to encompass private sectors, a move initiated in 2010 and further popularised among consumers nationwide by 2015. Third, there has been a consistent trend towards tightening technical standards governing subsidy policies, emphasising enhancing the quality and performance of EVs. The evolution of subsidy standards transitioned from an initial focus on maximum power ratio to a more nuanced emphasis on factors like range capability, battery system quality, energy density, and power consumption per hundred kilometres. Fourth, the maximum subsidy amounts allocated for individual EV purchases have exhibited a consistent downward trajectory over the years. For instance, taking battery electric vehicles (BEVs) with a range exceeding 250 km as an illustration, the highest central government subsidy standard stood at 60,000 yuan in 2009, gradually declining to 16,200 yuan by 2020, indicative of a deliberate strategy to phase out subsidies while fostering sustainable growth in the EV market.

Furthermore, since the presence of charging stations is vital for the advancement of EVs, the Chinese government has extended its support through subsidies and the establishment of Public Charging Stations as required. The key details of government support are outlined below (Liu, et al. 2023).

- April 2012: "Energy-saving and New Energy Automobile Industry Development Regulations (2012–2020)" set the groundwork for strengthening technological development and promoting the construction of charging facilities to support the industrialization of EVs.
- July 2014: "Guiding Opinions on Accelerating the Promotion and Application of New Energy Vehicles" emphasised the formulation of development plans and technical standards for charging facilities, along with improvements in urban planning and land use policies.

- March 2015: "Implementation Opinions on Accelerating the Promotion and Application of New Energy Vehicles in the Transportation Industry" aimed to improve charging and replacement facilities in the transportation sector, encouraging private investment in charging infrastructure.
- October 2015: "Electric Vehicle Charging Infrastructure Development Guide (2015–2020)" focused on promoting the construction of a comprehensive charging infrastructure system, enhancing power grid capabilities, and exploring sustainable business models.
- December 2016: "Notice on Coordinating and Accelerating the Integrated Construction of Parking Lots and Charging Infrastructure" mandated the inclusion of charging facilities in new residential buildings and initiated collective approaches for charging infrastructure development in existing residential areas.
- March 2019: "Notice on Further Improving the Financial Subsidy Policy for the Promotion and Application of New Energy Vehicles" shifted subsidies from vehicle purchases to support charging infrastructure construction and operational services.
- March 2020: "Government Work Report 2020" emphasised the importance of infrastructure development, including charging piles, to promote EV adoption and stimulate new consumer demand.

III.4.3 European Union

Within the European Union (EU), all 27 member states have established policies aimed at stimulating the market penetration of electric vehicles. These policies encompass a variety of tax breaks and purchase incentives, but their specific characteristics and values exhibit substantial variation across the region. These fiscally-supported incentives generally fall into three categories: tax benefits, purchase subsidies, and infrastructure support.

A. Tax Benefits

Fiscal incentives given through tax benefits in EU countries are delivered in multiple layers. These are not exclusively for the ownership of electric vehicles, but also encompass benefits for the acquisition of electric vehicles and their utilisation as company cars.

1. Acquisition

   The policies include VAT deduction, VAT exemption, excise duties exemption, registration charges exemptions, and discounts of various other administrative taxes. The level for deductions and exemptions varies among member states, with nations like the Netherlands giving total exemption for zero emission cars while Austria layers the deductions depending on the price of the EVs. Nations like Spain and Czech Republic also specify the requirements to different degrees of CO_2 emission per kilometre to layer the tax benefits for a wide range of EV types. EV acquisitions are also exempt from existing environmental tax like the nitrogen oxides (NO_x) tax in Ireland and the pollution tax in Austria.

2. Ownership

   On top of benefits from acquisition of EVs, the tax exemptions and deductions are also implemented in the terms of ownership of EVs. These are not only limited towards the ownership of zero-emission of battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV), but also other hybrids like hybrid electric vehicles (HEV) plug-in hybrid electric vehicles (PHEV), and extended-range electric vehicles (EREV). In most states, the tax exemption period is not defined with a specified date, while states like Germany, the tax exemption is given with a guarantee of a 10-year long period.

3. Company Cars

   Beside the exemptions from the individual EV ownership, many states offer additional tax investment incentive for EVs used in business purposes. Austria, for example, offers a 10% tax investment incentive for the purchase of a zero-emission car and they have the privilege to be treated with special depreciation. There are even purchase bonuses like in Lithuania that give a maximum subsidy €400,000 per company. The use of a company car by the employees for private purposes, and the electricity to charge it, are usually regarded as a payment in kind and in many states are exempted from the calculation of personal income tax. In Luxembourg, the benefit in kind is even given a monthly benefit from 0.5-1.8% depending on CO_2 emissions. There are also special maximum deductibility of business expenses relating to purchase and usage of EV and its batteries, which is applied in countries like Belgium and Greece. In states like France, the vehicles are also exempt from the CO_2-based tax component that normally applies in all businesses.

B. Purchase Incentive

These purchase incentives are generally in the form of cashbacks or direct price subsidies. The amount varies from €1,500 in Hungary to up to €20,000 in Malta. There are various schemes to apply these bonuses. Most states differ the amount between BEV, PHEV, and the hybrids, and use CO_2 per km emission parameter to limit the incentives. For example, Italy offers €3,000 for a BEV/PHEV emitting ≤ 20g CO_2/km and with a selling price of ≤ €35,000 + VAT, and €2,000 for a BEV/PHEV emitting 21-60g CO_2/km and with a selling price of ≤ €45,000 + VAT.

Most EU member states incorporate scrappage schemes to replace old cars, which further increase the purchase bonus. For example, Cyprus offers up to €12,000 to scrap and replace with a vehicle emitting < 50g CO_2/km and costing ≤ €80,000, and up to €19,000 to buy a BEV with additional €1,000 to scrap an old car. Italy offers an additional €2000 in each of their bonus schemes with scrappage. In Greece, they give extra €1,000 on top of their 30% cashback of maximum €8,000 if a car of more than 10 years is scrapped, or if the buyer is less than 29 years old. Greece's scrappage scheme is also mandatory for old taxis, with extra €5,000 on top of their 40% cashback for BEV taxis, with a max cashback of €17,500.

Furthermore, many nations implemented a wide range of diverse schemes to formulate the purchase incentives. In France, the amount of the bonus received is also determined by income level, which they offer up to €6,000 additional bonus in their scrappage scheme depending on the individual’s income. Spain also gives different incentives for SMEs and large companies. In Germany, one-third of the funding is provided by the industry while the government funds the two-third.

C. Infrastructure Support

Incentives through infrastructure support vary from financial support in development of charging and hydrogen stations to bonuses for purchasing EV-supporting loading infrastructures. These incentives schemes are not as widely implemented across EU member states compared to tax benefits and EV purchase incentives, but in many states, it is already essential to accelerate the development of the EV ecosystem.

In the Czech Republic, the development of charging infrastructure gets direct support from the Ministry of Transport. Italy offers 80% funding contribution for the purchasing standard power infrastructures for recharging electric vehicles, within the maximum limit of €1,500 per applicant. The Polish government offers up to 50% of the eligible costs for hydrogen stations. Spain has the comprehensive time-measured incentives scheme which diversifies the financial support for infrastructure development ranging from individual and community level to companies and public charging points with higher than 50 kW of power. In Denmark, the value of a charging stand/charging outlet provided together with a company car is exempt from tax.

At the residential level, Sweden gives a 50% tax deduction of maximum SEK 15,000 for households installing a charging box at home, on top of grants for the installation of AC charging for residents in apartment buildings. On the other hand, Austria offers bonuses for the purchase of intelligent loading cables and wall boxes for private uses in residential homes.

III.4.4 Thailand

Many countries worldwide, especially in Southeast Asia, have previously implemented electric vehicle incentive policies. Thailand is one of the pioneering nations in establishing electric vehicle incentive policies in Southeast Asia.

The incentives the Thai Government provides for the electric vehicle industry differ slightly from those given by the Indonesian Government. One of the most notable distinctions in Thailand's electric vehicle incentives compared to Indonesia's is the absence of incentives in the upstream sector. Thailand's incentive policies focus more on controlling the country's selling prices of electric vehicles. The Thai Government's incentive policies include cash incentives, tax deductions, and exemptions or reductions in import duties for electric vehicles.

Unlike the cash incentives provided by the Indonesian Government, Thailand provides cash incentives not only for purchasing electric two-wheelers but also for electric four-wheelers. The Thai Government offers a cash incentive of 18,000 Baht or approximately IDR 9 million per unit for each purchase of electric two-wheelers and incentives for four-wheelers ranging from 70,000 Baht to 150,000 Baht or equivalent to IDR 31.2 million to IDR 66.8 million. The cash incentives are determined based on the electric vehicle's battery capacity, whether it is domestically produced (CKD) or imported (CBU). The tax incentives provided by the Thai Government also differ from those given by the Indonesian Government. Thailand's incentives come in the form of a reduction in excise tax for electric four-wheelers and two-wheelers without considering the domestic component level (TKDN). The Thai Government has reduced the excise tax on electric four-wheelers from 8% to 2% and on electric two-wheelers to 1%.

Moreover, the most significant difference lies in the import duty policies set by the Thai and Indonesian Governments. Thailand has implemented numerous import duty reduction and elimination policies compared to Indonesia. Thailand provides a 40% reduction in import duties for electric four-wheelers with a selling price below 2 million Baht or approximately IDR 850 million and a 20% reduction in import duties for electric vehicles with a selling price between 2 million and 7 million Baht or equivalent to IDR 850 million to IDR 3 billion. In addition to reducing import duties, the Thai Government also exempts import duties for crucial electric components used in electric vehicles.

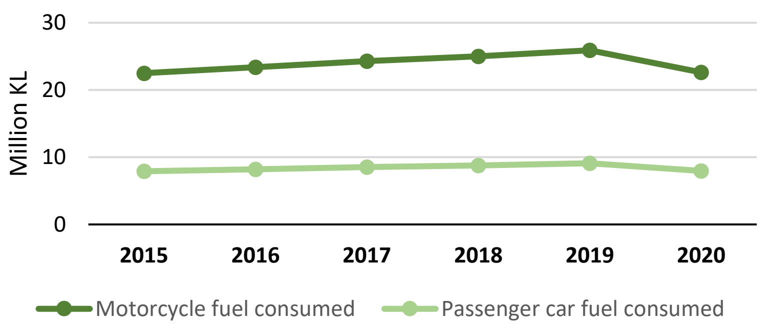
CHAPTER IV
Assessment of the Current State of the Electric Vehicles Sector Utilising the Indonesia Green Economy Index

IV.1 Transportation Sector

IV.1.1 Emissions in the Transportation Sector

Indonesia's energy sector emitted nearly 600 million metric tons of CO2-eq in 2021, with the transportation sector serving as the second-largest contributor to emissions after energy industries (power generation). These two largest sources of emissions accounted for 50% and 23% of the total, respectively. Road transportation emerged as the predominant contributor within the transportation sector, contributing to over 90% of emissions. The increase in greenhouse gas emissions from the transportation sector is primarily attributed to the rising consumption of fossil fuels, with fuel consumption experiencing a notable surge of 1.2 million kilolitres per year from 2015 to 2020, except for the year 2020, when the pandemic led to a downturn in fossil fuel consumption (IESR, 2022). Meanwhile, Indonesia's national energy mix is still dominated by non-renewable energy, especially coal. Based on data from the National Energy Council (DEN), the highest percentage of the energy mix in 2023 was still dominated by Coal (40.46%), Petroleum (30.18%), Natural Gas (16.28%), and Renewable Energy (13.09%). The percentage of renewable energy increased by 0.79% to 13.09% in 2023. However, this realisation is still below the set target of 17.87%.[4]

Figure 2 Fuel Consumption in the Road Transportation (2015-2020)



Source: IESR (2023)

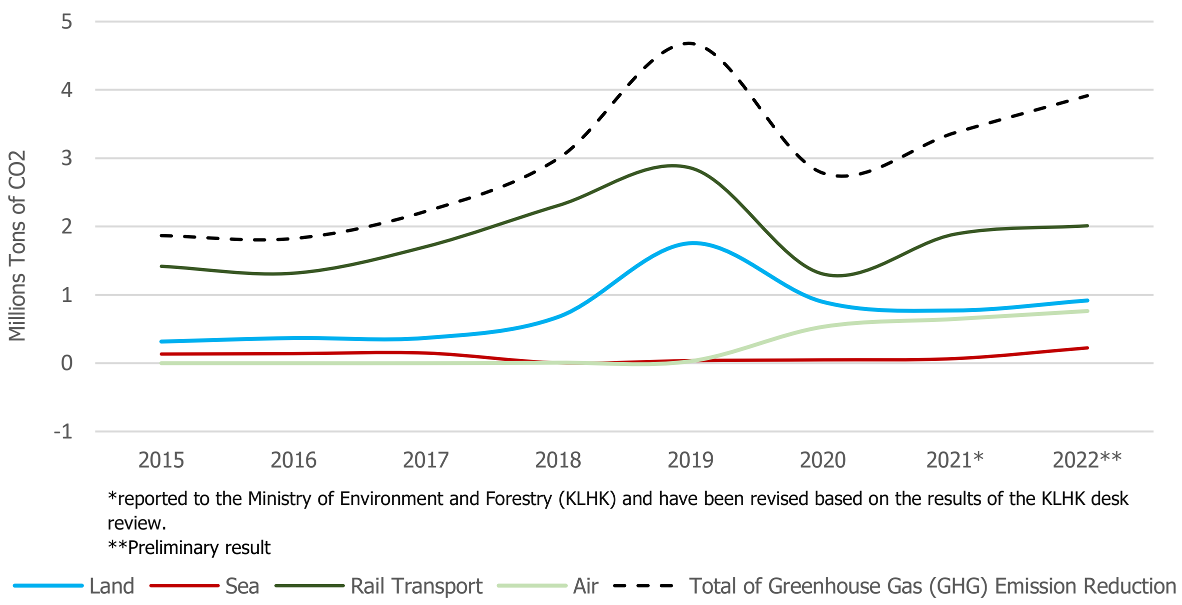
[4] Ministry of Energy and Mineral Resources of the Republic of Indonesia, "Press Release, Number: 55.Pers/04/SJI/2024," dated January 18, 2024, Government Pursues Target to Increase the Share of Renewable Energy Mix, https://www.esdm.go.id/id/media-center/arsip-berita/pemerintah-kejar-tingkatkan-bauran-ebt#:~:text=Berdasarkan%20data%20DEN%2C%20persentase%20bauran,EBT%20(13%2C09%25).

To curb emissions within the transportation sector, the Ministry of Transportation has embarked on a comprehensive implementation of climate change mitigation strategies spanning land, sea, air, and rail transport. In the realm of land transportation, the government is actively advancing initiatives such as the development of a cutting-edge Bus Rapid Transit (BRT) system, leveraging the Area Traffic Control System (ATCS), harnessing solar energy for Public Street Lighting (PJU), introducing long-distance ferry services, and integrating solar-powered New Renewable Energy (SBNP).

In the maritime domain, mitigation efforts encompass the adoption of solar-powered SBNP, the modernization of vessels, and the rollout of shore connection/on-power supply systems at ports. Simultaneously, in the aviation sector, climate change mitigation unfolds through environmental landscaping at airports, the deployment of Photovoltaic Solar Power Systems (PLTS), solar-powered PJU, and the incorporation of LED lighting solutions. On the railway front, the strategic utilisation of double-track trains across northern Java, southern Java, and Sumatra, alongside deploying urban trains, stands out as a chosen avenue for climate change mitigation (Ministry of Transportation, 2023). Notably, the outlined mitigation measures encapsulated in the Greenhouse Gas Reduction Action Plan (GRK) find formal validation in Minister of Transportation Decree No. 8 of 2023.

Based on data from 2015 to 2022, the emission reduction achievements resulting from implementing mitigation actions in the transportation sector exhibit a positive trend despite experiencing a decline in 2020. The most substantial reduction in emissions is observed in the railway transportation sector, followed by the land transportation sector. Conversely, in terms of upward trends, the aviation transportation sector has witnessed the steepest increase since 2019.

Figure 3 Emission Reduction Achievements from the Implementation of Mitigation Actions in the Transportation Sector 2015-2022



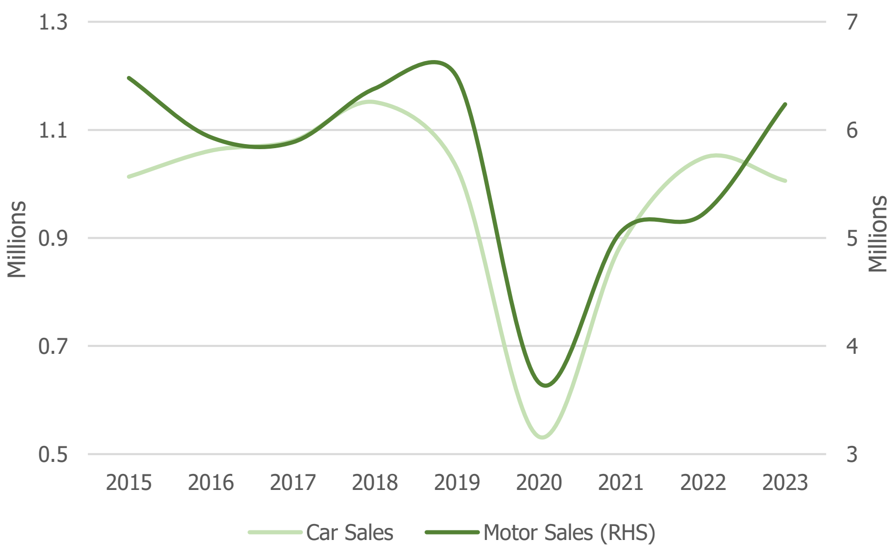
Source: Ministry of Transport (2023)

IV.1.2 Number of Vehicles and Their Growth

The use of public transportation has yet to dominate in Indonesia. The share of public transport in 2022 only reached 16% (IESR, 2023). The dominance of private vehicles is also evident in the transportation choices for commuting workers in Indonesia. In 2020, the proportion of Indonesian commuter workers using private or official vehicles reached 51.24%, surpassing public transportation at 41.93% (Databoks, 2022).

The substantial sales figures for motorcycles and cars show the high utilisation of private vehicles. From January to November 2023, motorcycle sales reached 5.8 million units, while car sales amounted to 920 thousand. The annual growth rates of sales over the past three years have also shown positive trends post-pandemic, except for the negative growth of cars in 2023, which recorded a decline of -12%.

Figure 4 Sales of Car and Motorcycles



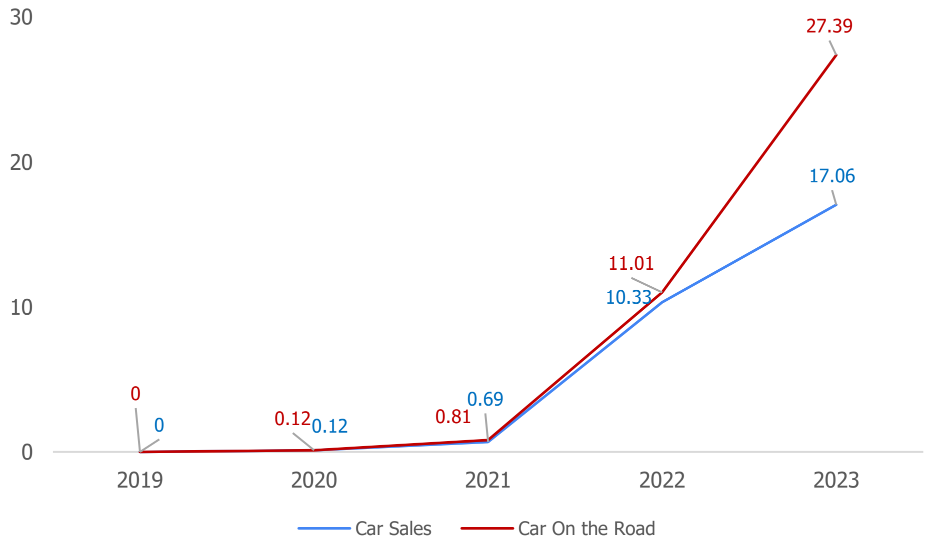
Source: GAIKINDO and AISI (2023)

IV.2 Progress of Electric Vehicles Development and Adoption

IV.2.1 Electric Vehicles Sales

According to Government Regulation Number 55 of 2019 on the Acceleration of Battery Electric Vehicle Programs for Road Transportation, Indonesia aims to reach electric car sales of 1.97 million units, holding a 44% market share of passenger car sales in 2030. According to the government's target, sales must at least surpass the 5% tipping point or reach 0.1 million units on the road by 2023 (Kemenko Marves, 2023). However, in reality, the actual sales of EVs fall below the set target. In 2023, electric car sales only reached 0.02 million units, or a mere 2% of total passenger car sales (Gaikindo, 2023).

Figure 5 Number of EV Sales and EVs on the Road

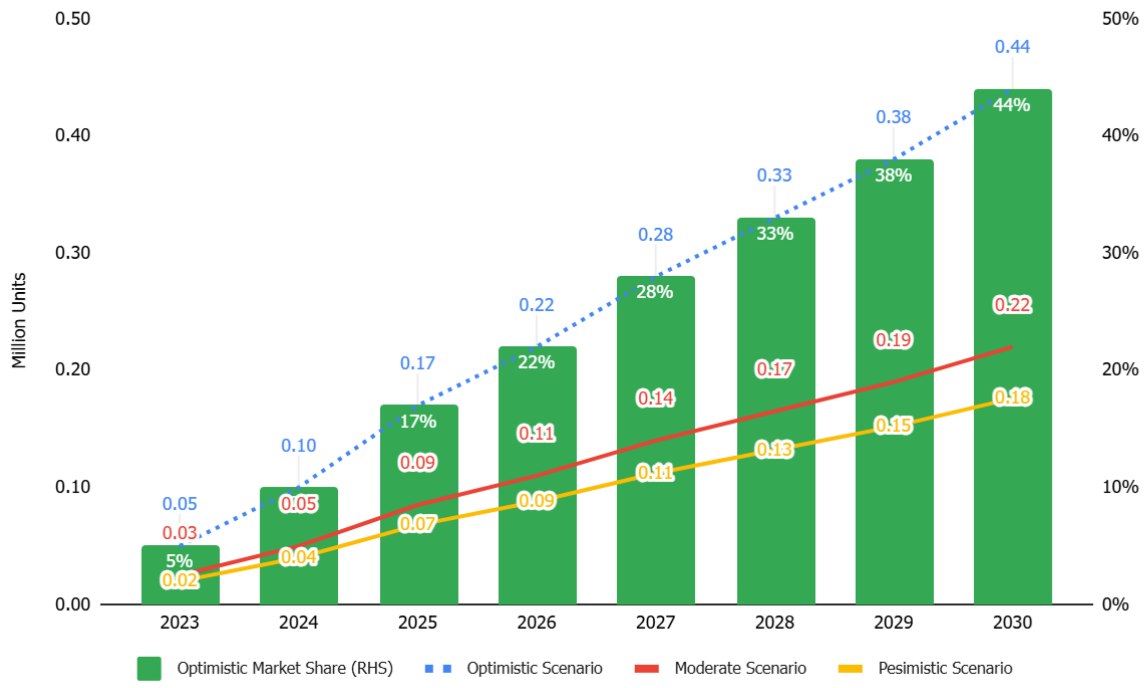


Source: GAIKINDO (2023)

Therefore, various scenarios are needed to assess the impact of EV adoption on the improvement of IGEI scores. The government-released targets, as explained earlier, can be categorised into optimistic scenarios, with a 100% achievement of the 2 million units electric car sales target by 2030 and the 5% tipping point reached by 2023. In a moderate scenario, assumptions are built that only 50% of the sales target will be achieved by 2030. In this scenario, car on-the-road will only reach 1 million units by 2030, and the 5% tipping point will be achieved by 2024. In the pessimistic scenario, assumptions are made that only 40% of electric car sales will be achieved by 2030. This 40% figure is derived from the actual EV car sales from 2022 to 2023 and is assumed to remain constant until 2030. In the pessimistic scenario, car on-the-road will only reach 0.8 million units by 2030, and the 5% tipping point will be achieved by 2025. However, these scenarios have not yet provided detailed information on the supply of cars, including the composition of imports for each target market. As a point of reference, according to the Association of Indonesia Automotive Industries, the electric vehicles (EVs) in Indonesia, specifically in Completely Built-Up (CBU) products, are predominantly sourced from China (47.8%), South Korea (47.7%), and Germany (3.25%).[5]

[5] Bisnis Indonesia. Bebas Bea Masuk Impor Mobil Listrik Berlaku, Impor Korea Selatan dan China Melesat. https://otomotif.bisnis.com/read/20240307/46/1747458/bebas-bea-masuk-impor-mobil-listrik-berlaku-impor-korea-selatan-dan-china-melesat. Accessed 27 March 2024.

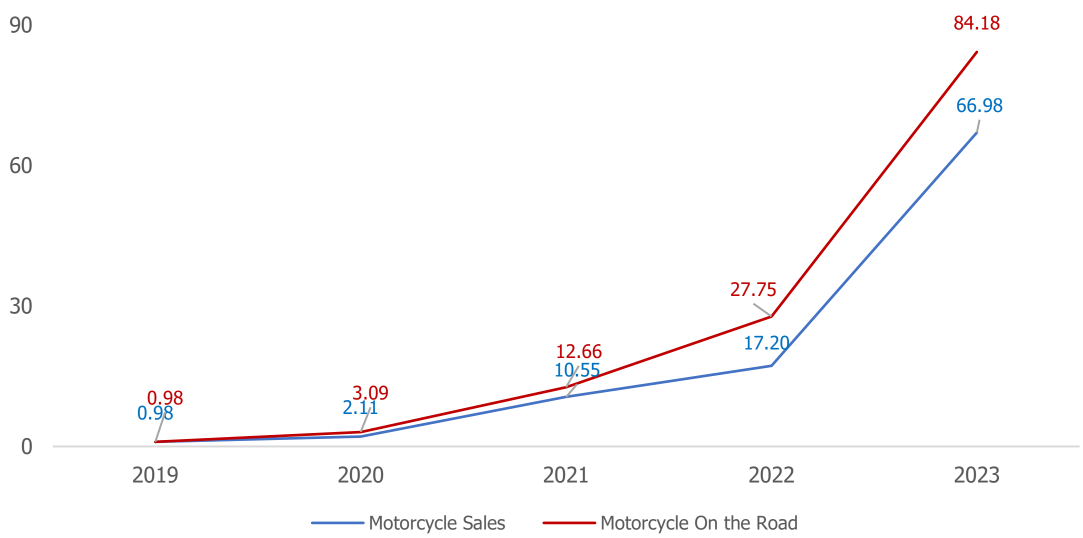
Figure 6 Electric Car Sales and Market Share Scenarios Roadmap



Source: Derived from Gaikindo (2023); Kemenko Marves (2023)

For electric motorcycles, Indonesia targets sales to reach 12.9 million units by 2030, commanding a 44% market share of passenger motorcycle sales in that year. According to the government's target, sales must at least surpass the 5% tipping point or reach 0.3 million units of motorcycle on-the-road by 2023. However, in reality, the actual sales of EVs fall below the set target. In 2023, electric motorcycle sales only reached 0.07 million units, or a mere 0.01% of total motorcycle sales (AISI, 2023; Aismoli, 2023).

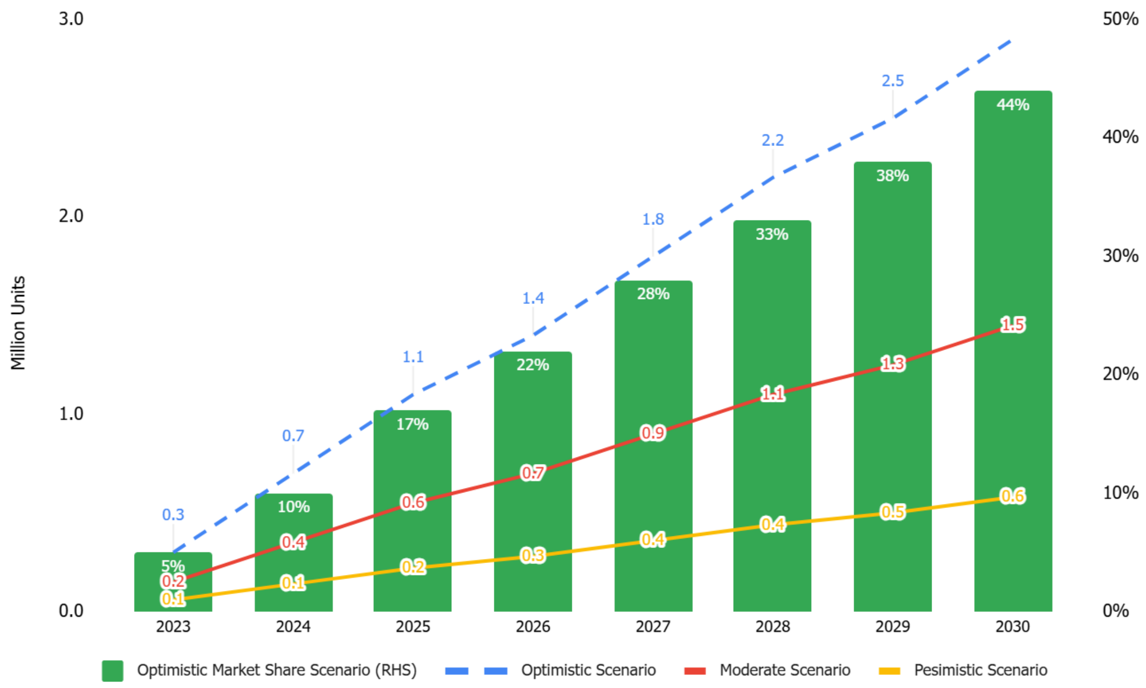
Figure 7 Electric Motorcycles Realisation



Source: Derived from AISI (2023); Aismoli (2023); Kemenhub (2023)

Various scenarios are necessary to calculate the impact of EV adoption on the enhancement of IGEI scores. The government-released targets can be categorised into optimistic scenarios, with a 100% achievement of the 12.9 million units electric motorcycle sales target by 2030 and the 5% tipping point reached by 2023. In a moderate scenario, assumptions are built, envisioning a 50% attainment of the sales target by 2030. In this scheme, motorcycles on-the-road would only reach 6.45 million units by 2030, with the 5% tipping point achieved by 2024. Conversely, in the pessimistic scenario, assumptions posit that only 20% of EV motorcycle sales will be achieved by 2030. This 20% figure is derived from the actual electric car sales data from 2022 to 2023 and is assumed to persist consistently until 2030. In the pessimistic scenario, motorcycle on-the-road would only amount to 2.58 million units by 2030, with the 5% tipping point achieved as late as 2027.

Figure 8 Electric Motorcycles Sales and Market Share Scenarios Roadmap

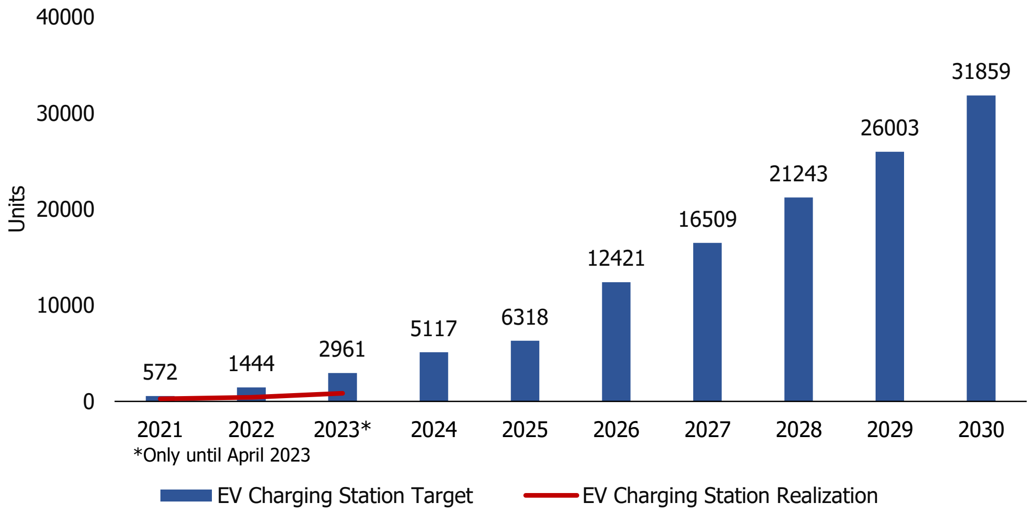


Source: Derived from Gaikindo (2023); Kemenko Marves (2023)

IV.2.2 Electric Vehicles Ecosystems

Based on the Minister of Energy and Mineral Resources Regulation Number 13 of 2020 on the Provision of Electric Charging Infrastructure for Battery-Based Electric Motor Vehicles, Indonesia is promoting the establishment of supportive infrastructure to accelerate EV adoption, including EV charging stations (Stasiun Pengisian Kendaraan Listrik Umum or SPKLU) owned by the government, private entities, or individuals. By 2030, the EV charging station deployment target is 31,859 units (Kemenko Marves, 2021). However, as of April 2023, the actual development of EV charging stations has only reached 842 units, approximately 47% of the annual target (Dirjen EBTKE, 2023; Dirjen Gatrik, 2023). Additionally, the availability of these charging stations is still concentrated in areas like Bali and Java, including West Java and DKI Jakarta provinces (Dirjen Gatrik, 2023).

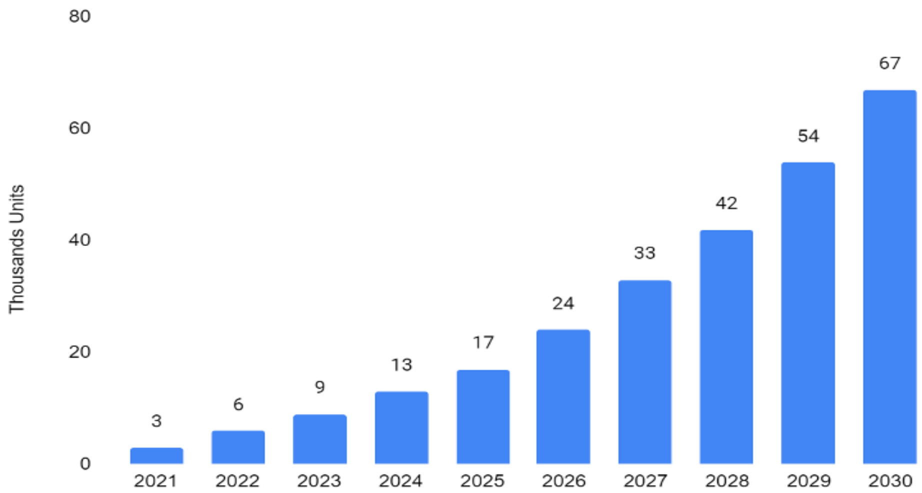
Figure 9 EV Charging Stations Development



Source: Dirjen EBTKE (2023)

Furthermore, Indonesia is encouraging the establishment of supportive infrastructure through government-owned battery swapping stations (Stasiun Penukaran Baterai Kendaraan Listrik Umum or SPBKLU) to expedite EV adoption. By 2030, the target for deploying battery swapping stations is set at 67,000 units (Kemenko Marves, 2021). However, as of April 2023, the actual development of battery swapping stations has only reached 1,401 units, approximately 16% of the annual target (Dirjen EBTKE, 2023; Dirjen Gatrik, 2023). Moreover, the availability of these stations is currently concentrated in the DKI Jakarta and West Java areas, with no infrastructure available in regions such as Kalimantan, Nusa Tenggara, Maluku, and Papua (Dirjen Gatrik, 2023).

Figure 10 Battery Swapping Stations Development



Source: Dirjen EBTKE (2023)

IV.2.3 Supply Chain

Possessing the world's largest nickel ore reserves, Indonesia does not automatically ensure the nation's substantial capability to advance its domestic electric vehicle industry. Because the development of electric vehicle batteries needs raw materials beyond nickel, encompassing graphite, cobalt, manganese, lithium, aluminium, and iron. Moreover, within the nickel production process, additional stages are required to yield derivative products like steel, nickel sulphate, and battery precursors. These derivative products serve as integral components for electric vehicles, extending beyond the utilisation of nickel ore alone. Even though certain materials essential for electric vehicle production may not originate in Indonesia, their inclusion in the EV supply chain contributes to the nation's environmental footprint as their extraction and processing are associated with environmental concerns such as habitat destruction, water pollution, and carbon emissions. The complexity and diversity of Indonesia's electric vehicle supply chain are evident, as depicted in the illustration below (Figure 11), highlighting the fact that not all requisite raw materials are readily available.

Examining the supply chain requirements for electric vehicles, Indonesia possesses distinct advantages due to substantial reserves of various raw mineral materials essential for electric vehicle battery production. Notably, the country boasts a sizable reserve of nickel and cobalt[6], serving as key raw materials. Indonesia holds the world's second-largest cobalt reserves and has 24 thousand metric tons of copper reserves. In addition to nickel and cobalt, Indonesia has essential mineral resources crucial for electric vehicle battery manufacturing, including lithium, graphite, tantalum, neodymium (a rare earth metal), and mica[7].

Concerning the electric vehicle raw material sector, Indonesia presently hosts multiple industries involved in the production of raw materials and supporting components for electric vehicles, with a particular focus on the nickel derivative industry. Various enterprises have been established to facilitate the supply of raw materials essential for electric vehicles, such as the High-Pressure Acid Leaching (HPAL) smelter that manufactures nickel sulphate—an integral component in electric vehicle batteries. Additionally, several corporations are strategically establishing electric car battery manufacturing facilities across different regions of Indonesia, including notable entities like LG and Hyundai, which have undertaken initiatives in Central Java and West Java.

Moreover, in addition to its pyrometallurgical smelters, Indonesia possesses several facilities dedicated to the production of diverse steel goods, including stainless steel welded pipes and stainless cold-rolled coils, which are integral for satisfying the manufacturing demands of electric vehicles. Nevertheless, Indonesia currently lacks a comprehensive industry focused on the production of nickel derivatives that process materials derived from ferronickel or nickel to produce EV batteries.

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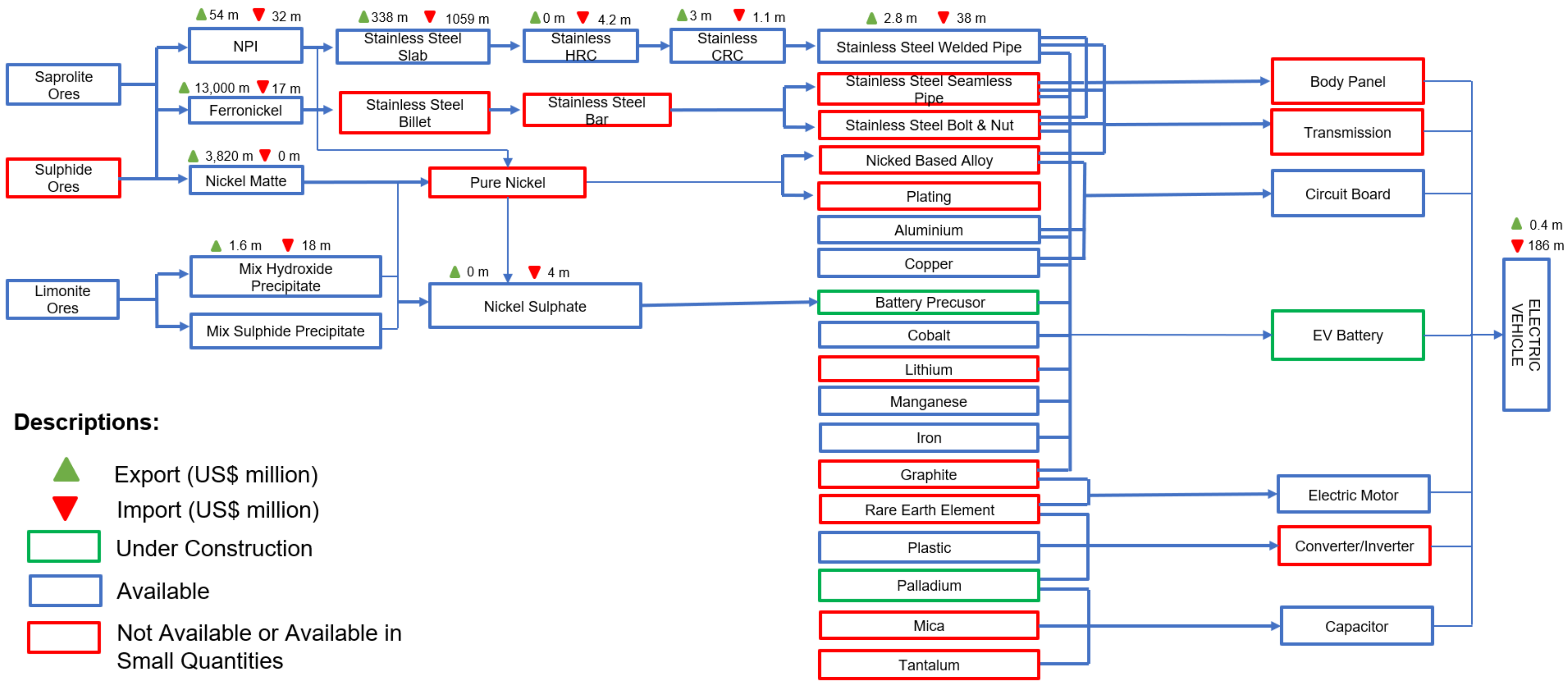
[6] USGS. 2023. Mineral Commodity Summaries. Retrieved from: https://www.usgs.gov/centers/national-minerals-information-center/mineral-commodity-summaries

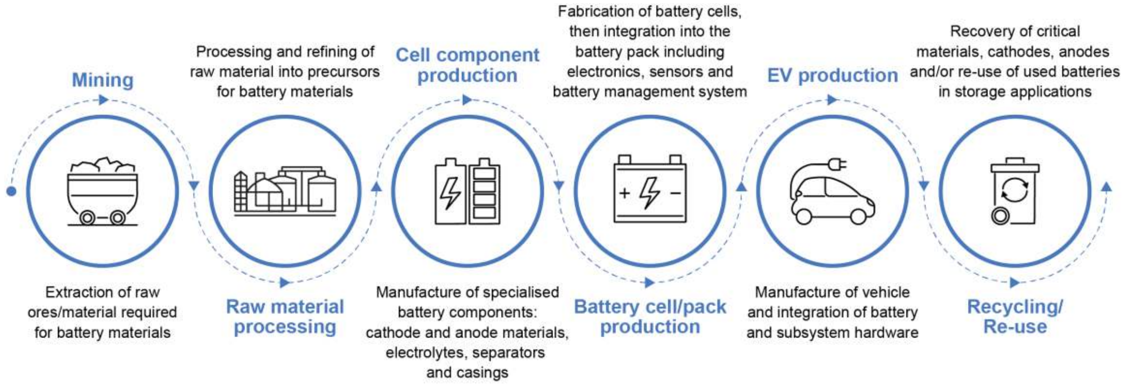
[7] Dinsight Editorial Team.2022. *Indonesia Secures Supply of Lithium and Graphite for EV Batteries*. Retrieved from: https://dinsights.katadata.co.id/read/2022/11/22/indonesia-secures-supply-of-lithium-and-graphite-for-ev-batteries

Figure 11 Indonesia Electric Vehicle Supply Chain



Source: BRIN, 2022; Drive Sustainability, 2022; International Trade Center, 2022 (processed)

Figure 12 Electric vehicle Battery Supply Chain



Source: International Energy Agency, 2022

The battery supply chain for electric vehicles encompasses various sequential stages. The process initiates with the extraction of raw materials, ultimately yielding cathodes, anodes, electrolytes, and separators—integral constituents of batteries. Subsequently, these components undergo synthesis to culminate in the production of a fully assembled battery employed in electric vehicles.

Although Indonesia has the potential natural resources to support the development of EV batteries, the development is still not in line with good green economy concepts. Indonesia is one of the world's largest nickel producers and reserves, contributing 50% of total global nickel production and accounting for 42.3% of total global nickel reserves. Nickel mining in Indonesia is primarily concentrated on the islands of Sulawesi and Maluku. In 2023, the Indonesian government issued more than 319 mining permits, in addition to numerous instances of illegal mining. However, many companies fail to adhere to proper mining practices, leading to detrimental effects on the environment. Deforestation, resulting in floods and damage to water sources, as well as pollution of rivers and seas, have emerged as significant challenges for communities residing near mining sites. Consequently, fishermen have experienced a decline in their incomes due to this environmental degradation. Furthermore, air pollution has led to an increase in digestive tract diseases among the populace.

At the same time, sustainable nickel mining practices in the upstream sector are still minimally carried out by nickel mining companies in Indonesia. According to the Indonesian Nickel Miners Association (APNI), many nickel miners in Indonesia have not yet implemented the principles of Environment, Social, and Governance (ESG). One example is that nickel miners and processors in Indonesia use electricity from Coal-Fired Power Plants (PLTU Batubara). This is due to the still limited infrastructure for green power plants, their relatively high costs, and government regulations that limit the maximum use of solar power to only 15 percent (Core Indonesia, 2024).

IV.2.4 Relevant Stakeholders

The Indonesian government has ambitions to develop the electric vehicle industry ecosystem within the country. To this end, the government has formulated and enacted policies designed to stimulate the growth of the electric vehicle ecosystem. However, notwithstanding these efforts, integrating the electric vehicle industry in Indonesia remains incomplete.

Under Presidential Regulation (PR) 55/2019, ministries, government agencies, and state-owned enterprises (BUMN) represent the major players charged with supporting the acceleration of BEVs. In this instance, the responsibility for monitoring the coordination of the PR's implementation was mandated to the Coordinating Ministry for Maritime Affairs and Investment (MARVES). Furthermore, the pertinent ministries must create regulations to implement the PR 55/2019.

Table 7 Key Stakeholders for EV Development in Indonesia

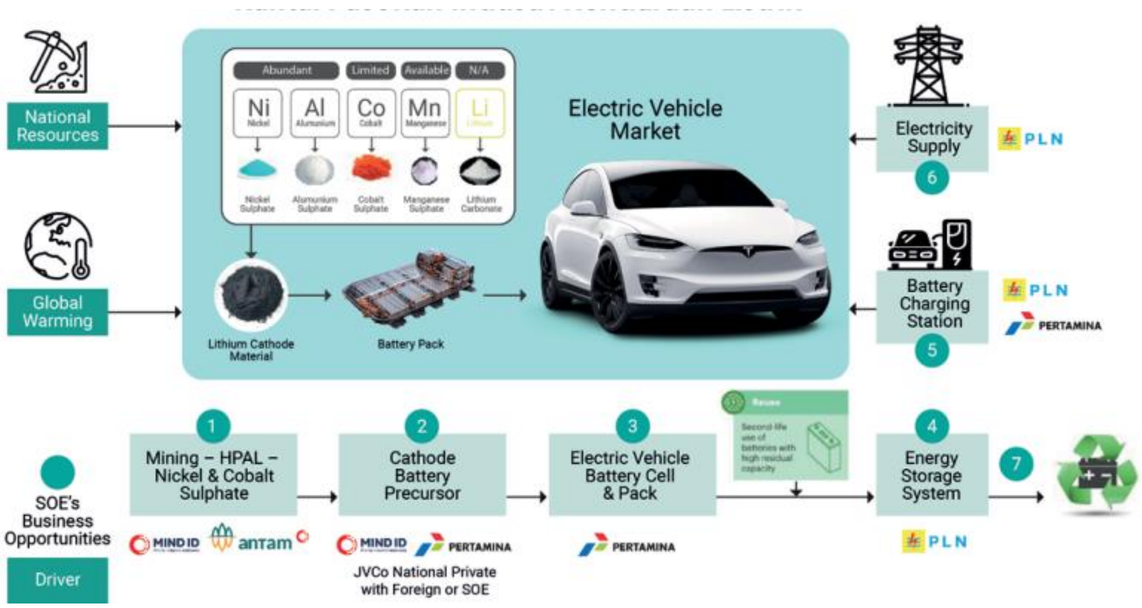
Stakeholders	Role/Function
The President	Issued PR No. 55/2019 and continues to promote EV uptake by providing instruction and direction toward electrification of the transport sector
Coordinating Ministry of Maritime and Investment (Marves)	Takes a leading role in the coordinating committee set up by PR 55/2019
Ministry of Industry (MoI)	Develop technical specifications and roadmap for development and calculation of local content for battery electric vehicles and regulations concerning completely knock down and incompletely knocked down imports MoI will still develop other regulations related to domestic EV production.
Ministry of Finance (MoF)	Formulate and set up carbon tax and fiscal policies, and incorporate EVs into the procurement catalogue for operational vehicles of various government agencies.
Ministry of Energy and Mineral Resource (MEMR)	In charge of charging infrastructure development; regulating electricity prices; and overall energy management, including ensuring that renewable energy targets are achieved.
State-Owned Enterprises	Develop the electric vehicle ecosystem from upstream to downstream. For Example; PLN (State Owned Electric Company) will develop charging infrastructure for EVs and Pertamina will develop the Battery Swapping Station/Charging Station and Hydrogen Fuel Station for Fuel Cell EV, etc.
Agency for Technology Assessment and Application (BPPT)	Lead the assessment of various innovative technologies related to EV-supporting infrastructure.
Ministry of Environment and Forestry	Issue regulations governing vehicle and power plant emission standards; monitor the environmental impact of used battery recycling.
Ministry of Trade	Provide import duty incentives for EVs
Ministry of Transport	Issue vehicle type approval, regulate periodic inspection and maintenance requirements, certify retrofit of conventional engine into electric

Stakeholders	Role/Function
Ministry of Home Affairs	Guide local governments on incentives and privileges for EV users
Police Corps	Provide special identification plate/sign for EVs and manage EV registration data
Automotive industry	Manufacture and distribute EVs to end users
Associations of vehicle industries	Four-wheeler Manufacturer Association (GAIKINDO) and Two-wheeler Manufacturer Association (AISI) advocate for the interests of the auto industry
Local governments	Develop initiatives to promote the uptake of EVs within their jurisdictions
Civil society, university research centres and development partners	Collaborate with the government to support all dimensions relevant to the uptake of EVs.

Source: Indonesia Transport Electrification Strategy, Working Paper, 2021, processed

The figure below delineates the advancement of the electricity development sector through the active involvement of various stakeholders. The depiction highlights the government's strategic role in designating state-owned enterprises (BUMN) as pivotal entities driving progress in the electric vehicle industry, with a specific focus on the electric vehicle battery sector and the establishment of charging stations. The entrusted state-owned enterprises for this undertaking include MIND ID, ANTAM, PERTAMINA, and PLN.

Figure 13 The Projected Supply Chain Involves Several State-owned Enterprises (SOEs)

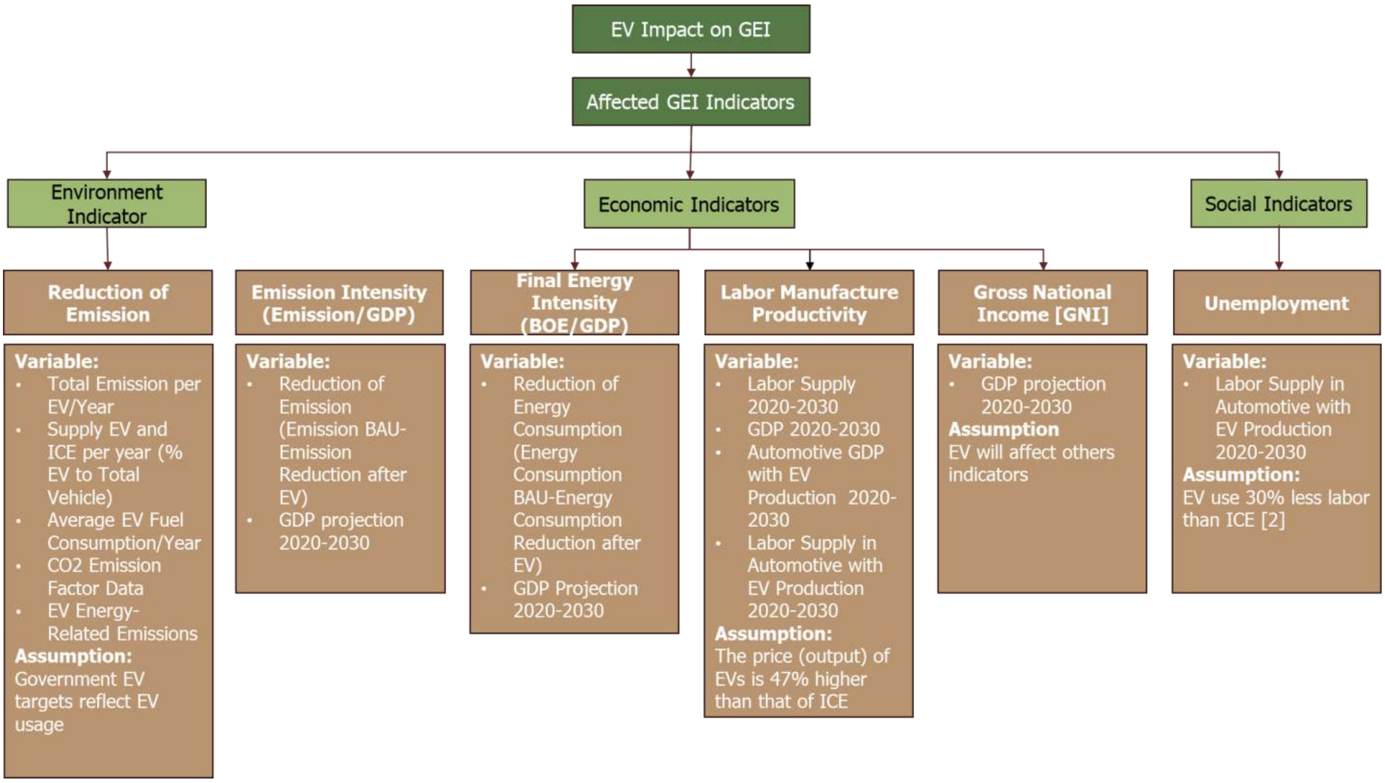


Source: Ministry of Energy and Mineral Resources

CHAPTER V
Integration of Analysis into Green Economy Model and Impact of Electric Vehicles Adoption on Green Economy Index Improvement

V.1 Framework of Analysis and Proposed Indicators

Figure 14 The Framework of Analysis



Source: Analysis of CORE Indonesia (2024)

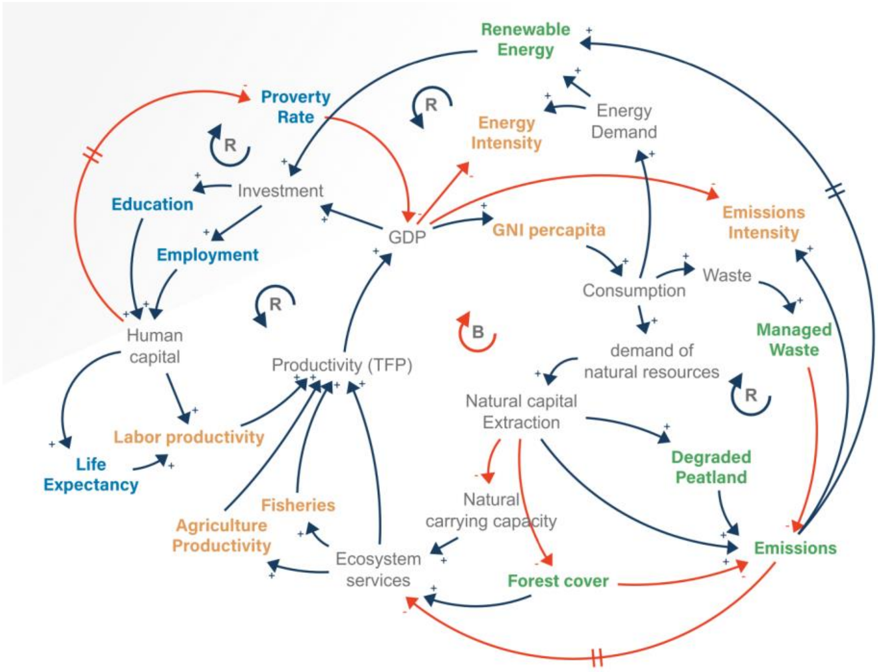
This study utilises 6 out of 15 indicators of the Indonesian Green Economy Index (IGEI) that are pertinent to Electric Vehicle (EV) implementation. Within the Environmental pillar, the selected indicator centres on the percentage of greenhouse gas (GHG) emission reduction. The output of this indicator post-EV implementation is determined using the baseline of GHG emissions and GHG emissions based on mitigation policies outlined in Table 8. Generally, all scenarios employ the same assumptions for variables outside the automotive sector, ensuring comparability. The divergence lies in the existence of EV usage policies and the prioritisation of manufacturing industry deployment to meet EV usage targets. On the Economic dimension, four indicators influenced by EV implementation include emission intensity, final energy intensity, labour manufacturing productivity, and gross national income. Emission intensity is calculated by dividing GHG emissions output from the environmental indicator projection by the GDP figure from the projection. Final energy intensity involves computing the consumption of final energy for EV usage and battery cell plants. EV energy consumption on roads is projected by multiplying the percentage of EVs to the total number of private vehicles by the average EV electricity consumption (KWh/km). The resulting final energy is then divided by GDP to determine final energy intensity. To calculate labour manufacturing productivity, the model considers the number of labour through the structure of Internal Combustion Engine Vehicles (ICEVs) and EVs. Both industries hire new workers as they develop and may reduce the workforce if industry declines due to substitution, for instance. Once the labour figure is obtained, it is divided by the GDP value to ascertain labour manufacturing productivity. As for Gross National Income, this figure is derived by dividing GDP by the population. Finally, within the Social dimension, the unemployment rate is computed by comparing the labour supply not absorbed in the economy.

V.2 Methodology for Assessing the Impact of EV on Green Economy

This study improves upon the Green Economy Model (GEM) developed by Bappenas to calculate Indonesia's Green Economy Index. In the original version of GEM, there was no consideration of the manufacturing structure of EV components and assembly. The model solely focused on policies related to the target number of registered electric cars and motorcycles, thus limiting the scope of analysis to the impacts of EV usage alone. The adoption of EVs influences energy consumption patterns and greenhouse gas (GHG) emissions. The current model emphasises transportation electrification for passenger cars and motorcycles, as they represent the dominant fleets and major emitters. It can assess changes in energy consumption resulting from EV deployment. For instance, there's a decrease in oil fuel consumption while electricity usage rises due to EV battery charging. Additionally, the model includes a power sector sub-model capable of projecting energy mix, which is a crucial factor influencing the impact of EV deployment. Variations in energy conversion efficiency and emission factors between oil fuel and electricity can lead to either a decrease or an increase in final energy consumption and national GHG emissions.

The current Green Economy model integrates key sectors and socio-economic factors for comprehensive planning and policymaking. Illustrated in Figure 15, it shows the interconnectedness among sustainable pillars and indicators. For instance, GDP and per capita GNI growth spur increased consumption and energy demand, driving renewable energy deployment and green investment. This leads to employment and education gains, enhancing human capital and productivity, fostering GDP growth in a reinforcing loop. Conversely, heightened consumption strains natural resources, leading to negative externalities like increased emissions and waste, triggering a balancing loop that hampers ecosystem services and GDP growth. This intricate feedback mechanism underscores the importance of sustainable practices in fostering economic growth.

Figure 15 Interlinkages of Indicators in Green Economy Index

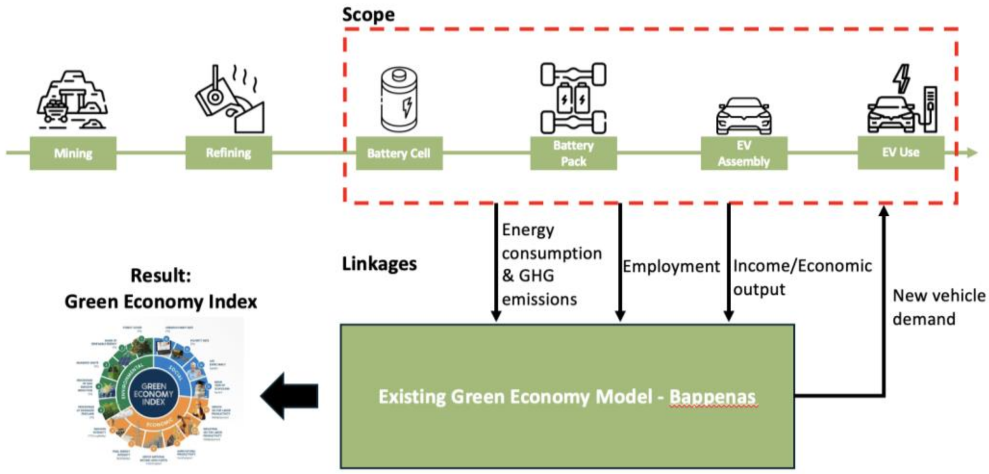


Source: Bappenas (2022)

This study introduces an automotive industry sub-model, enhancing the capabilities of the Green Economy Model (GEM) to evaluate the social and economic impacts of Indonesia's ambitious EV policies. The automotive industry sub-model covers the entire supply chain, starting from upstream activities like battery cell production, followed by battery pack production, and vehicle assembly (see Figure 16). However, it doesn't include the mineral mining industry and its processing into battery precursors due to its focus on exporting semi-finished products. Moreover, the processing of these materials into battery components remains a distant prospect. Despite making significant contributions to the economy, mineral mining and processing in Indonesia are not yet integrated with the EV industry. For example, 90% of nickel derivatives are used for stainless steel material, with only 25% further processed domestically. The remaining 10%, which includes battery materials like mixed hydroxide precipitates (MHP) and nickel sulphate, is entirely exported as the battery cell plant hasn't started operations. Regarding vehicle types, this study concentrates on both four and two-wheelers, with cars assumed to be light-duty vehicles or mid-end passenger cars, and motorcycles equivalent to scooters commonly used in Indonesia.

The new automotive industry sub-model will incorporate several feedback loops into the existing model, focusing on increased energy consumption, greenhouse gas emissions, job creation, and economic output (Refer to Figure 16). The manufacturing of EVs has the potential to generate additional value and create green jobs, thereby contributing to economic expansion. However, it also entails increased environmental pressure due to heightened energy consumption and consequent greenhouse gas emissions. The model is capable of analysing both positive and negative impacts comprehensively. Negative impacts, such as emissions exacerbating climate change and pollution degrading the environment, could impede economic growth by reducing productivity. Additionally, the use of EVs may yield suboptimal results if electricity is sourced from fossil fuel combustion, such as coal-fired power plants (CFPPs). Fortunately, the model includes a power sector sub-model capable of addressing interventions in power plant development, encompassing both renewables and non-renewables.

Figure 16 Incorporation of the New EV Sub-Model into Existing GEM Model



Source: Analysis CORE Indonesia (2024)

The model, enhanced with the EV industry structure (see Figure 16), is simulated across three scenarios: (1) Business as Usual (BaU)/No EV; (2) LCDI Net Zero Emissions (NZE); and (3) EV Impact (See Table 9). The first two scenarios originate from analyses conducted by the Low Carbon Development Initiative (LCDI), which were utilised in establishing greenhouse gas emission reduction targets in the National Long-Term Development Plan (RPJPN) and the National Medium-Term Development Plan (RPJMN) for implementation by 2025. According to Table 8, all scenarios consist of similar climate mitigation policies across sectors, except in the transportation sector. In the transportation sector, the policies are distinguished, particularly in relation to the EV adoption target and development of the EV manufacturing industry.

By aligning assumptions and conditions of other variables, the impacts of EV usage and manufacturing on macro indicators, such as GHG emissions, energy consumption, GDP, and others, can be observed by comparing simulation results across scenarios.

- In the BaU scenario, it is assumed that there is no production or usage of EVs in Indonesia. However, efforts toward energy transition, sustainable agriculture, waste management, and nature conservation continue according to quantitative targets set by the LCDI.
- In the LCDI NZE Scenario, EV adoption is aggressively promoted to achieve the target share of electric vehicles in the total on-road vehicle fleet (See Table 8). However, the scenario does not consider the source of electric vehicle procurement; it is assumed that almost all EVs are imported from abroad. This scenario reflects the current condition where Indonesia heavily relies on imported EVs in Completely Built-Up (CBU) form and lacks operational component factories like battery plants.
- In the EV Impact Scenario, the target for EV adoption and other emission reduction policies in remaining sectors are the same as in the LCDI NZE Scenario. However, the EV manufacturing industry is assumed to be rapidly

developed to meet the deployment needs according to the set target share. In this scenario, the development of manufacturing industries is optimised to meet domestic demand trends in line with policy targets and historical export figures.

To accommodate these scenarios in the model simulation, the automotive industry sector sub-model was added to the existing model. This sub-model comprises ICEV and EV structures, each further divided into passenger car and motorcycle models. Consequently, the model is able to account for trade-offs resulting from EV adoption. As EVs replace ICEVs in sales, some affected producers may decrease their production capacity utilization or even shut down their production facilities, resulting in economic and social losses. If the government implements innovative policies to encourage domestic EV production, the closed facilities will be replaced with new ones.

To maintain model focus and operability, the model neglects heavy-duty vehicles (HDVs) as they are the most challenging and thus the least prioritized for electrification. Therefore, their portion is assumed to be insignificant. Moreover, many HDVs, especially buses, are primarily concentrated in Jakarta, making them irrelevant for a nation-scale assessment. Another limitation of the model is its exclusion of the socio-economic impact of charging infrastructure, which is an inseparable component of EV adoption. In a situation where EV adoption is massive, the production of chargers and the construction of charging stations will generate benefits such as added value and job creation. By omitting HDVs and charging infrastructure, the model certainly underestimates, though not significantly, the socio-economic benefits and emissions generation.

By incorporating the new EV industry manufacturing sub-model, the impact of EV production and deployment on Indonesia's green economy progress can be evaluated. This is achieved by comparing the projected values of six selected indicators across the three scenarios. The differences in EV-related policies among scenarios will demonstrate the impact of not transitioning to EVs, deploying EVs through exports, and deploying EVs through domestic manufacturing. Utilizing diverse policy scenarios also facilitates the formulation of policy recommendations aimed at maximizing the impact of EV policy implementation on achieving green economic objectives in Indonesia.

It should be noted that scenario-based simulation, as detailed in Table 9, implies an uneven level of investment in the transportation sector. The EV Impact Scenario would likely require the highest investment due to the need to develop domestic EV manufacturing facilities. This condition could affect socio-economic aspects, such as job creation and GDP, differently among scenarios. However, in the context of examining the impact of EV adoption and/or manufacturing, the results of the three distinct scenarios remain comparable since the other policies and assumptions are consistent.

Table 8 Description of Simulation Scenarios

Policy	BaU/No EV	LCDI NZE	EV Impact
Policy related to EV use	Share of EVs is assumed to be zero throughout simulation time frame	E4W (% of total 4W fleets) - 2030: 16% - 2045: 40% - 2060: 58% E2W (% of total 2W fleets) - 2030: 40% - 2045: 100% - 2060: 100%	
Policy related to EV manufacture	No EV production	All electric vehicles (EVs) are imported in completely built-up (CBU) form, given that domestic production is presumed to stay at current level, hence negligible.	- Indonesia builds its own manufacturing plants for battery cell, battery pack, and EV production. - Domestic production is pushed to meet the demand caused by EV on the road targets.
Other policy	**AFOLU:** - Deforestation are gradually declining to reach zero in 2060 - Massive ecosystem restorations, including in peatland - Sustainable rice and palm oil intensification **Waste:** - Implementation of 3R, waste-to-energy, and expansion of sanitary landfill and municipal WWTP **Energy:** - Ambitious energy efficiency, electrification, and fuel switching both in commercial and domestic sectors - Rapid energy transitions, including coal phase out and development of renewables		

Source: Derived from various sources

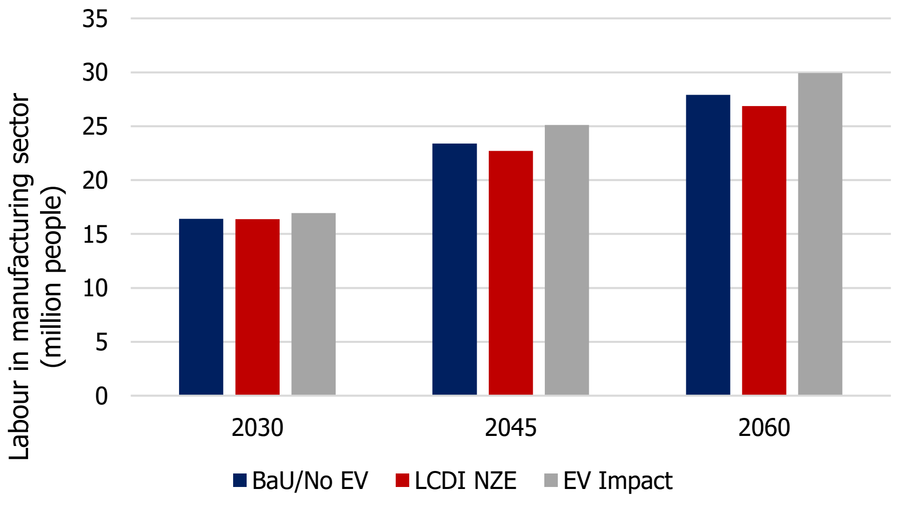
V.3 Social Impact of Electric Vehicle Adoption

V.3.1 Unemployment Rate

In the context of transportation electrification, considerable attention is placed on the social aspect of job creation. This is primarily due to the potential impact on existing industries that produce conventional vehicles when the public adopts electric vehicles. Electric vehicles, characterised by a significant portion (35-50%) of their cost structure being attributed to battery components, experience price reductions as technology progresses, thereby posing a challenge to industries reliant on traditional vehicle manufacturing. The transition to electric vehicles not only affects automotive assembly but also spare part manufacturing industries. Certain components such as engines, oil supply systems, and fuel tanks, which are essential in conventional vehicles, become redundant in electric vehicles. This shift in technology and consumer preference raises concerns among both government authorities and industry stakeholders as it threatens the stability of the automotive sector, which sustains employment for millions of individuals.

On the contrary, this study highlights that widespread EV deployment, if met through domestic production, could lead to job creation. As illustrated in Figure 17, the EV Impact Scenario demonstrates the highest labour output in the manufacturing sector. Additionally, this scenario exhibits the highest growth rate in the number of workers, implying that efforts to achieve a share of operating EV fleets up to 58% for cars and 100% for motorcycles by 2060 could absorb labour forces contributing to the advancement of societal standards and national economy. However, if the target EV adoption is not accompanied by domestic production capacity or relies on imports (LCDI NZE), there might be a reduction in employment compared to the Business as Usual (BaU) scenario, where no electric vehicles are present. This is attributed to the existing conditions of Indonesia's automotive industry as a net exporter of vehicles. Without alternative manufacturing industries, the phase-down of Internal Combustion Engine Vehicles (ICEVs) could lead to a significant number of workers being laid off.

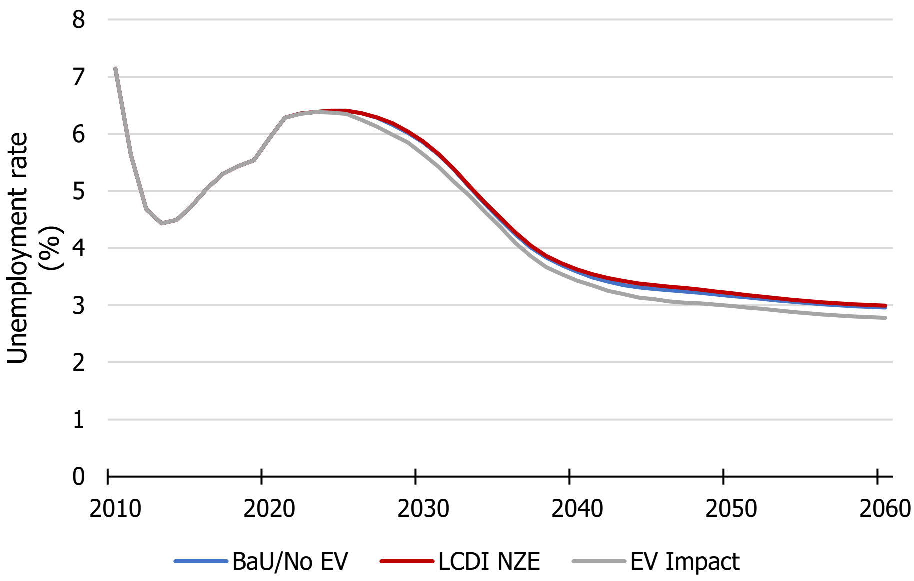
Figure 17 Industrial labour Projection Based on Three Scenarios



Source: Analysis of CORE Indonesia (2024)

When considering the components of the Green Economy Index, particularly the unemployment rate, the EV impact scenarios demonstrate the lowest values compared to the other scenarios. According to the model projections (see figure 18), the unemployment rate by the year 2060 could potentially decrease to as low as 2.78% in the EV Impact Scenario. In contrast, the LCDI NZE and BaU Scenarios show higher figures at 2.99% and 2.96%, respectively, indicating a higher level of unemployment. The notable disparity between the EV Impact Scenario and the other scenarios emphasises the importance of establishing an EV manufacturing industry in Indonesia.

Figure 18 Impact of EV Adoption on Unemployment Rate



Source: Analysis of CORE Indonesia (2024)

Conversely, the marginal difference between the BaU and Ambitious Scenarios suggests that simply setting targets for EV adoption does not lead to significant social benefits. These findings challenge the prevalent belief that transitioning from Internal Combustion Engine Vehicles (ICEVs) to Electric Vehicles (EVs) may increase unemployment due to reduced labour demands in electric car manufacturing. As the production of EVs increases within Indonesia, it creates opportunities for the development of various new component manufacturing sectors. Battery production, for instance, involves battery cell and battery management system (BMS) industries. Additionally, components such as inverters, motors, converters, and chargers have the potential to generate new job opportunities.

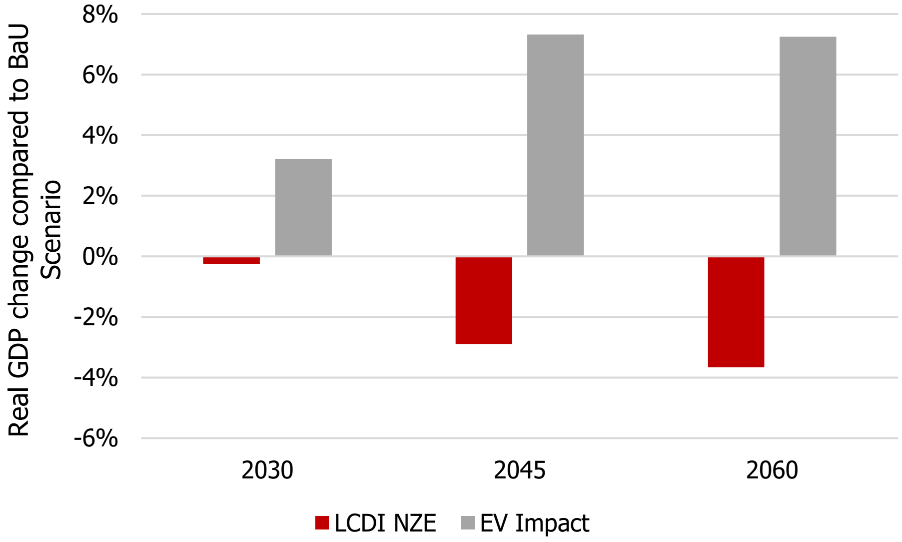
V.4 Economic Impact of Electric Vehicle Adoption

V.4.1 GNI per Capita

The Economic aspect of the Green Economy Index encompasses four of the six selected indicators in this study. GNI per capita is anticipated to reflect the value-added creation resulting from the electrification of Indonesia's transportation sector. Presently, the Indonesian government aims to position the country as a global battery hub, leading global EV battery production. However, concrete plans to realise this ambitious vision are still lacking. Furthermore, to meet the demand and domestic EV fleet targets in pursuit of NZE, progress in manufacturing industry development remains significantly inadequate. In 2023, BEV car sales amounted to only 17,062 units, representing merely 2% of overall passenger car sales and falling far short of the target of producing one million EVs by 2035.

Through model simulation, this study delves deeper into the implications of inadequate development of the domestic EV manufacturing industry in meeting EV adoption targets. As illustrated in Figure 19, a significant transition from ICEVs to EVs, as depicted in the LCDI NZE Scenario, would entail an economic cost, potentially reducing GDP by up to 3.7% in 2060 compared to the Business as Usual (BaU) projection. Conversely, prioritising domestic production for EV components (such as batteries, drivetrains, chassis, accessories, and charging ports) and vehicle assemblies to meet the share of EV fleets could result in a substantial increase in GDP, reaching approximately 7% by 2060.

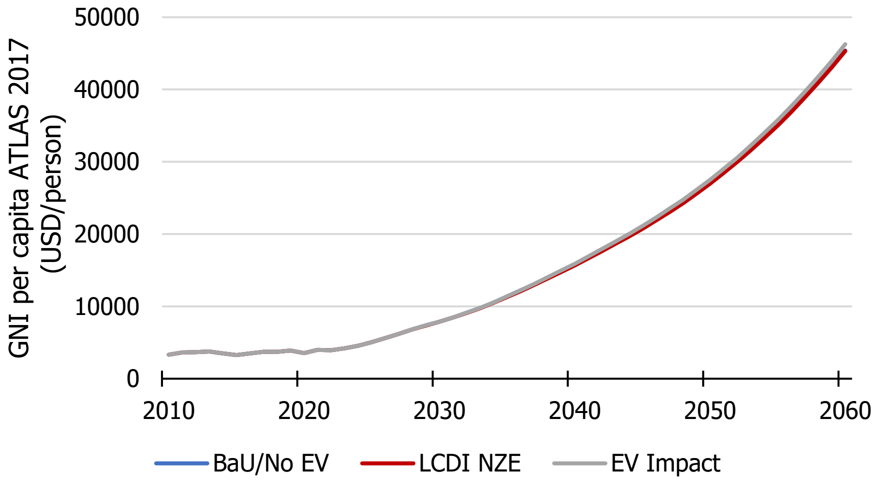
Figure 19 Projected Change in GDP within LCDI NZE and EV Impact Scenarios Compared to BaU



Source: Analysis of CORE Indonesia (2024)

The rise in economic output within the automotive industry contributes positively to Gross National Income (GNI) per capita. By 2060, projections indicate that in the EV Impact Scenario, GNI per capita could reach $46,275 per person, representing a 1.95% increase compared to the Business as Usual (BaU) scenario. Conversely, the LCDI NZE Scenario only shows a modest addition of 0.14% to the BaU scenario. The substantial difference in the EV Impact Scenario is primarily attributed to the presence of domestic industries supplying various components, from battery cells to the assembly of electric cars and motorcycles. According to the EV Impact Scenario, the economic output of the automotive industry in 2060 is projected to quadruple its current value. Achieving this necessitates fulfilling on-road EV usage through domestic production, encompassing powertrain components to vehicle assemblies.

Figure 20 Impact of EV Adoption on GNI per Capita



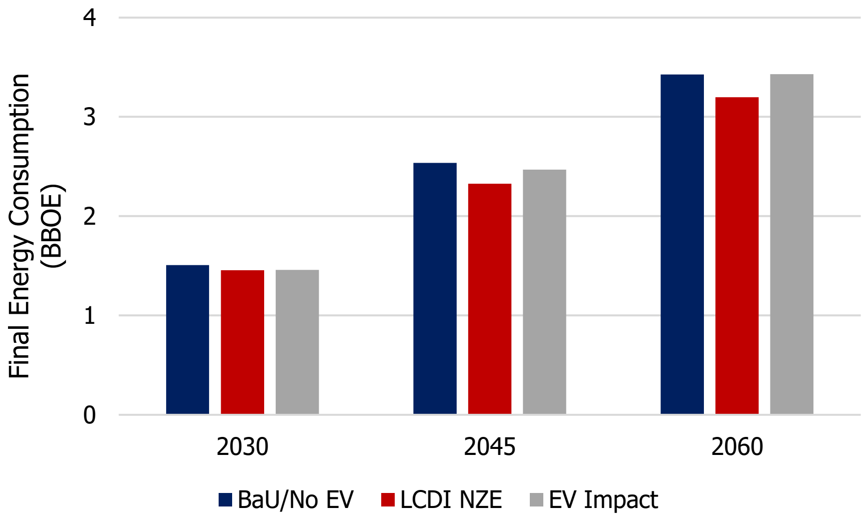
Source: Analysis of CORE Indonesia (2024)

While yielding the largest economic benefits, the outcomes of the EV Impact scenario only exhibit marginal differences from the other scenarios. These similarities stem from the policy and assumption settings outlined in Table 8. The sole distinction among scenarios lies in the deployment of EVs, rendering differences in macro or aggregate sector levels insignificant. Thus, even in the worst-case scenario (BaU), a trajectory of robust economic growth is still generated because green economy policies in sectors such as agriculture, energy, land, etc., are assumed to be implemented as in the LCDI NZE and EV Impact scenarios. By solely differentiating the EV aspect, the effects of EV usage and manufacturing can be discerned.

V.4.2 Final Energy Intensity

Scenarios involving EV usage also result in lower final energy consumption compared to the BaU/No EV scenario (See Figure 21). This indicates that vehicle electrification can create energy efficiency on a broad scale. In terms of usage, EVs require significantly less energy to travel the same distance compared to ICEVs. A study by the International Council on Clean Transportation (ICCT) shows that the Wuling Air EV consumes only 0.5 MJ/km, whereas the Honda Brio consumes 2.4 MJ/km. The same pattern is observed in the SUV and MPV segments, where EVs consume only about 20% of the energy used by ICEVs. The significant difference in usage compensates for the disparity in manufacturing, where EVs consume slightly more energy due to the complex and energy-intensive battery production process. Additionally, Figure 21 demonstrates that the EV Impact scenario outperforms the LCDI NZE scenario due to the rapid development of domestic EV manufacturing, which utilises energy from within the country.

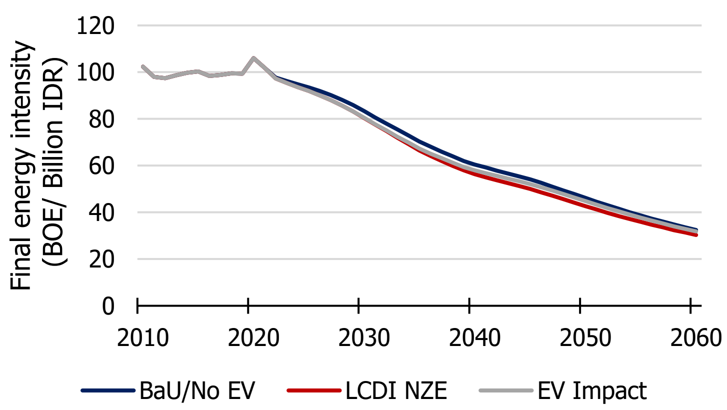
Figure 21 Projected Final Energy Consumption Across Scenarios



Source: Analysis of CORE Indonesia (2024)

The implication is that the BaU/No EV scenario exhibits the highest final energy intensity of 32.44 BOE/Billion IDR in 2060, followed by the EV Impact scenario and the LCDI NZE scenario with 31.84 and 30.29 BOE/Billion IDR, respectively (See Figure 20). The higher result in the EV Impact scenario compared to LCDI NZE also indicates the consequences of prioritising the social and economic impacts of EV deployment by bolstering the domestic manufacturing industry. Since production originates domestically, so does the energy consumption and resulting greenhouse gas (GHG) emissions. Model simulations suggest that battery production and the EV fleet intended to meet on-road EV targets will require 8,084 GWh/year by 2060. However, all scenarios depict significant downward trends resulting from green economy policies in the energy sector, aside from fleet electrification. These policies include the deployment of renewable power plants, phase-out of coal-fired power plants (CFPP), improvements in fuel efficiency and switching, and the adoption of cleaner modes of transportation such as Bus Rapid Transit (BRT) and hydrogen.

Figure 22 Impact of EV Adoption on Final Energy Intensity

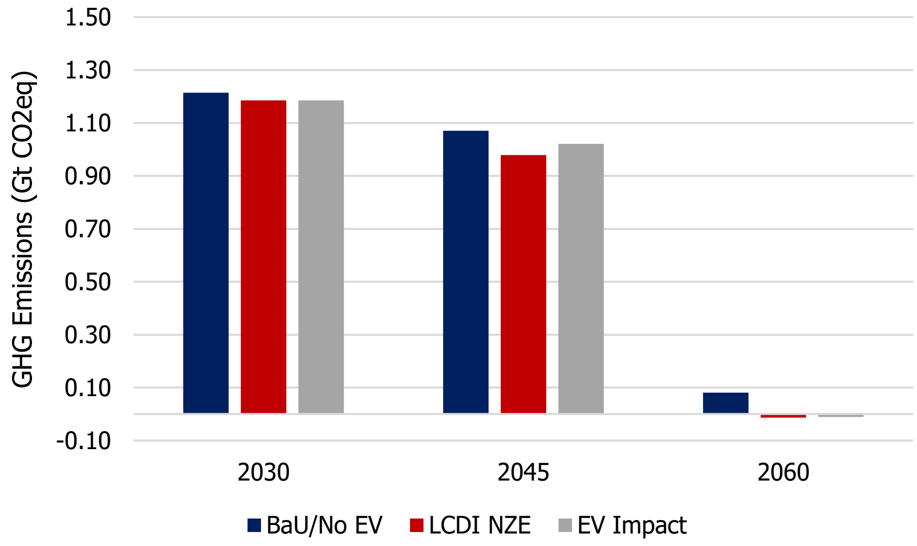


Source: Analysis of CORE Indonesia (2024)

V.4.3 Emission Intensity

Aligned with energy consumption, the greenhouse gas (GHG) emissions pattern across scenarios underscores the necessity of transportation electrification. However, it is crucial to emphasise that all scenarios here employ ambitious energy transition policies. Without concurrent efforts to clean the electricity sources, different outcomes may occur. According to Figure 20, the highest GHG emissions are generated by the BaU/No EV scenario, followed by LCDI NZE and EV Impact. However, over time, the EV Impact scenario experiences a slower reduction in emissions compared to LCDI NZE, resulting in higher emissions. Among these scenarios, only the BaU scenario fails to achieve NZE by 2060, although the emissions produced are already very low, amounting to 0.081 Gt CO2eq. On the other hand, emissions in the LCDI NZE scenario reach -0.13 Gt CO2eq. Thus, EV usage contributes to a reduction of 0.21 Gt CO2eq by 2060. The EV Impact scenario yields emissions of -0.11 Gt CO2eq, or 0.02 Gt CO2eq higher than LCDI NZE due to domestic EV production.

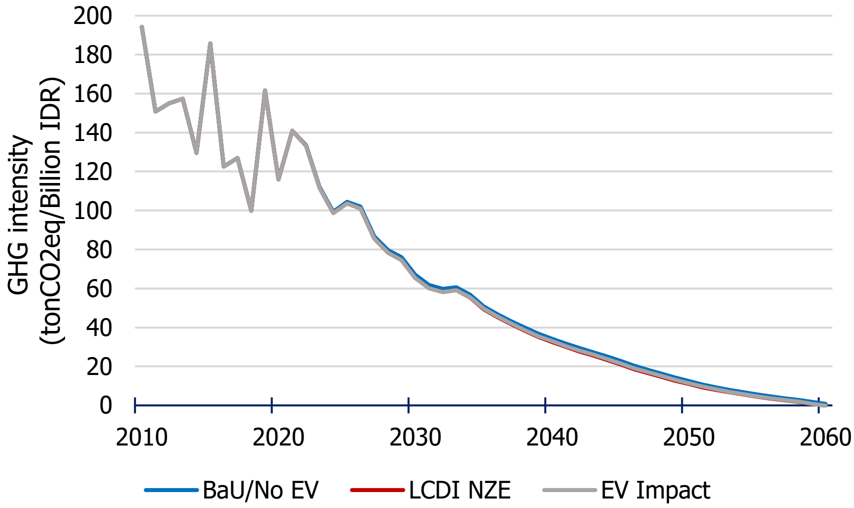
Figure 23 Projected GHG Emission Across Scenarios



Source: Analysis of CORE Indonesia (2024)

In terms of Green Economy Index indicators, the GHG intensity in the EV Impact scenario reaches -0.10 tonCO2eq/Billion IDR in 2060. While still achieving net-zero emissions by 2060, or possibly even sooner, the GHG intensity is higher compared to the LCDI NZE scenario, which stands at -0.13 tonCO2eq/Billion IDR. The low emissions intensity in all three scenarios is the result of cross-sectoral implementation of green economy policies, including energy transition, deforestation reduction and restoration enhancement, sustainable production and consumption, and waste management. These policies not only reduce emissions but also enhance long-term economic growth. Thus, the emissions intensity, which is the ratio of emissions to economic output, significantly decreases.

Figure 24 Impact of EV Adoption on Emission Intensity



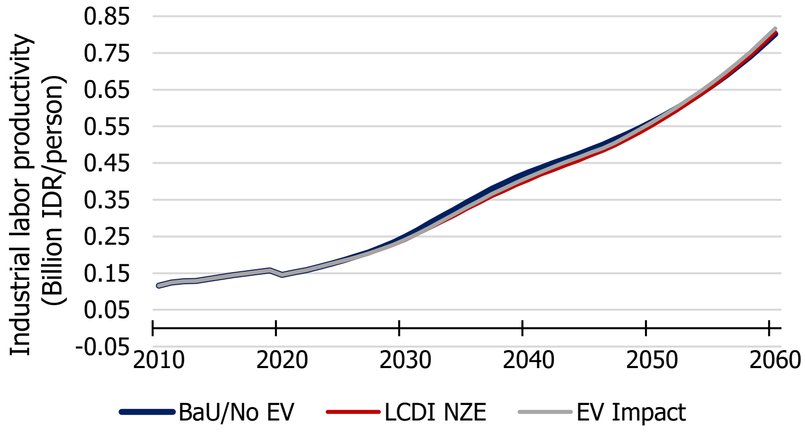
Source: Analysis of CORE Indonesia (2024)

V.4.4 Industrial Sector labour Productivity

Industrial labour productivity refers to the efficiency with which labour inputs are utilised to produce goods or services within the industrial sector. It measures the output generated per unit of labour input, typically expressed as output per worker. Higher industrial labour productivity indicates that workers are producing more goods or services in a given period of time, which can lead to increased economic output and competitiveness. In the context of the study, it assesses how efficiently labour is utilised within the automotive industry, particularly in the production of EV and their components.

The EV Impact scenario yields the highest industrial labour productivity compared to other scenarios. The ambitious target for EV usage, coupled with the development of domestic EV manufacturing covering powertrain components and assembly, can generate greater value-added compared to conventional automotive industries. This leads to an increase in labour productivity. By 2060, it is projected that each labour will produce an average of 0.817 Billion IDR based on the EV Impact scenario. In comparison, the LCDI NZE scenario achieves the highest productivity of 0.806 Billion IDR/person, while the BaU scenario shows the lowest productivity at 0.801 Billion IDR/person. However, it's worth noting that this could also be influenced by the model's assumption on EV prices, as it employs mid-end level pricing which is higher than the average price of ICEVs. In the future, the technological learning curve could drive down EV prices and its components, consequently reducing its value-added contribution.

Figure 25 Impact of EV Adoption on Industrial Sector labour Productivity



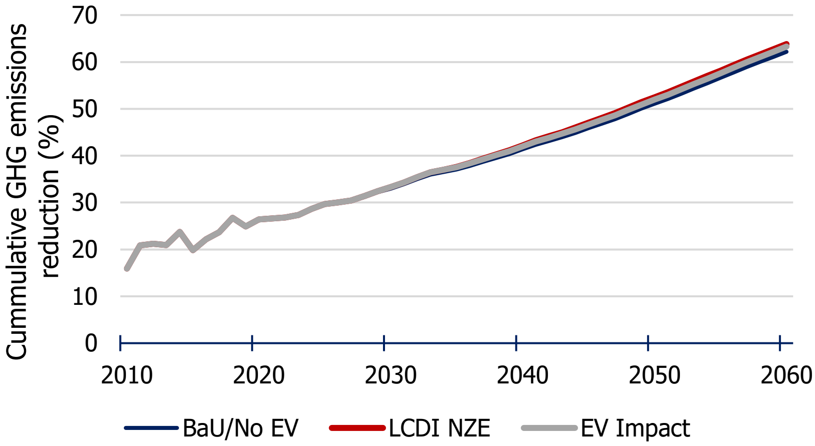
Source: Analysis of CORE Indonesia (2024)

V.5 Environmental Impact of Electric Vehicle Adoption

V.5.1 GHG Emission Reduction

The BaU/No EV Scenario exhibits higher energy consumption and consequently higher greenhouse gas (GHG) emissions, leading to a lower cumulative GHG emissions reduction of 62.17% compared to the EV Impact (63.29%) and LCDI NZE scenarios (63.81%). In the EV Impact scenario, the cumulative emissions reduction is slightly lower than in the LCDI NZE scenario due to higher annual emissions resulting from production activity. Since this model utilises an average energy mix, there is an opportunity to disproportionately increase efforts in the automotive industry beyond the country's average. A more ambitious energy transition, particularly within the automotive industry, is warranted to equip production facilities with clean energy sources, such as solar photovoltaic (PV) and wind power, which are readily available in Java, where most automotive plants are located. Moreover, the industry could adopt more energy-efficient equipment in the production of battery cells, which account for over 90% of energy consumption during EV production. By taking these measures, Indonesia could reap the social and economic benefits of EV deployment without compromising environmental considerations.

Figure 26 Impact of EV Adoption on GHG Emission Reduction



Source: Analysis of CORE Indonesia (2024)

CHAPTER VI
Policy Recommendations and Conclusions

VI.1 Impact of Electric Vehicle Adoption on Green Economy Index

Overall, the gradual increase in EV mode share to 58% for four-wheelers (4W) and 100% for two-wheelers (2W) by 2060, along with other green economy measures (see Table 9), positively impacts the green economy. This is evidenced by the GEI score generated by the Ambitious Scenario, which reaches 95.47 by 2060. This score could be further maximized by developing a domestic industry capable of supplying the E2W and E4W fleets needed to meet the mode share targets, including the upstream EV supply chain. In the EV Impact scenario, the GEI score can reach 95.506, the highest among the three scenarios.

However, this study also shows that the impact of EV-related policies alone is not particularly significant on the Green Economy Index (GEI). Comparing the Ambitious and EV Impact scenarios, which involve EV deployment, to the BaU/No EV scenario, the difference is quite small. Hence, the effects of diverse sectoral policies, ranging from forestry and land use to energy and waste sectors, rather than EV production and adoption, are the main contributors to achieving a green economy in Indonesia.

As depicted in Figure 14, the environment pillar (ENV) includes the indicator of cumulative GHG emissions reduction, which is a selected parameter in this study. Based on model simulation, the Ambitious Scenario yields the highest score because EV production, as in the EV Impact scenario, has unintended consequences, such as increasing energy consumption and GHG emissions by producers. Meanwhile, EV adoption through import has the maximum effect on emissions reduction, as the emissions saved by replacing fossil fuel burning in ICEVs with clean electricity consumption in EVs are not offset by emissions generated from manufacturing.

For the same reason, the Ambitious Scenario also results in the highest score for the economy pillar (ECO) in the GEI. Meeting EV adoption targets through imports can reduce energy intensity and emissions intensity, given that EVs are more energy efficient compared to ICEVs, and the energy consumption and resulting emissions are not accounted for in Indonesia. However, the differences among the three scenarios are too small to be significant. This is because the values from all scenarios exceed the maximum threshold used for converting absolute values into scores. Hence, in most indicators in the economy pillar, the values are the same for all scenarios.

For the social pillar (SOC), the EV Impact scenario results in the highest score due to extensive labor recruitment driven by new industrial development for cell and battery pack production and EV assembly. Without developing a domestic manufacturing industry for EV powertrains and spare parts, the impact of EV deployment on the social pillar of GEI will be less significant, as depicted by the Ambitious Scenario. Worse, no vehicle electrification efforts would lead to the lowest positive effect on the social pillar of GEI, as the ICEV industry absorbs less labor than the EV industry, and there will be indirect effects from emissions on the social sector.

Table 9 Impact of EV Adoption on Green Economy Index

Year	GEI			ECO			ENV			SOC		
	BaU/ No EV	Ambitious	EV Impact	BaU/ No EV	Ambitious	EV Impact	BaU/ No EV	Ambitious	EV Impact	BaU/ No EV	Ambitious	EV Impact
2020	56.067	56.067	56.067	58.385	58.385	58.385	47.988	47.988	47.988	60.669	60.669	60.669
2025	68.282	68.486	68.487	72.877	73.247	73.139	54.102	54.221	54.221	75.570	75.610	75.775
2030	77.624	78.058	78.325	86.642	87.344	87.336	60.009	60.345	60.336	81.713	81.843	82.797
2035	86.145	86.707	86.738	93.981	94.682	94.556	70.949	71.683	71.607	89.585	89.770	90.143
2040	90.071	90.178	90.267	96.799	96.895	96.871	74.406	74.592	74.535	95.646	95.689	96.093
2045	91.672	91.766	91.869	97.566	97.566	97.566	76.600	76.836	76.739	97.904	97.996	98.454
2050	92.911	93.032	93.109	97.926	97.926	97.926	79.209	79.489	79.365	99.091	99.233	99.629
2055	94.110	94.248	94.318	98.345	98.345	98.345	82.484	82.802	82.671	99.384	99.549	99.924
2060	95.324	95.473	95.506	98.446	98.448	98.444	86.413	86.766	86.645	99.552	99.720	99.962

Source: Analysis of CORE Indonesia (2024)

VI.2 Policy Recommendations for Electric Vehicle Adoption and Development in Indonesia

The development of electric vehicles (EVs) can contribute to enhancing Indonesia's Green Economy Index. In the simulation results above, the impact is still relatively small on the overall change in the Green Economy Index. This may be due to the scenario of changes in other indicators being much larger than those resulting from EV adoption on the overall Index. In addition, this scenario has not yet comprehensively incorporated the upstream to downstream supply chain of the EV industry, such as in the nickel mining and smelter for EV battery production that significantly contribute to GHG emission in Indonesia. Furthermore, it is important to consider the lifecycle emissions associated with EV production and disposal, as well as the emissions from the manufacturing of batteries and other components.

Despite these considerations, the contribution of EVs remains important for improving Indonesia's Green Economy Index. A heightened uptake of EVs is poised to drive down emissions within Indonesia's transportation sector, given that the cumulative emissions from production to operation are notably lower compared to vehicles powered by internal combustion engines (ICE). As reported by the US Department of Energy in 2022, annual emissions per electric vehicle amount to 2,727 pounds of CO2, while Plug-in Hybrids yield 4,763 pounds, Hybrids produce 6,898 pounds, and gasoline vehicles emit 12,594 pounds. Furthermore, the domestic production of EVs holds the potential to bolster national economic growth and catalyse employment opportunities.

Consequently, akin to several other nations, the Indonesian government has recently embarked on initiatives to stimulate EV adoption, offering an array of incentives targeting producers, consumers, and ecosystem development. Nevertheless, despite these efforts, EV adoption in Indonesia remains considerably behind that of several other countries, which boast comparatively higher EV sales ratios. For instance, in 2022, EV sales constituted 29 percent of total vehicle sales in China, 21 percent in the European Union (EU 27), 9.4 percent in South Korea, and 7.7 percent in the United States (IEA, 2023).

The lower adoption of EVs in Indonesia, despite the aforementioned government incentives, can be attributed to several reasons. According to a survey by PwC (2023), the top five reasons hindering respondents from purchasing EVs are as follows: i) difficulty in finding or accessing charging stations (64%), ii) lack of charging stations in remote areas (54%), iii) long battery charging times (39%), iv) limitations on maximum mileage before battery recharging (36%), expensive or perceived non-worthiness of service/maintenance costs (29%), and v) high initial costs (29%). Hence, it can be concluded that the main obstacles to adopting EVs are the challenges in the availability of charging infrastructure in sufficient numbers, capable of rapid charging, and able to support long-distance travel. Additionally, there are perceived high costs associated with purchasing and servicing EVs. Some participants in the CORE Indonesia's FGD highlighted the current state of charging stations as a significant challenge for EV adoption. Therefore, addressing these primary issues should be prioritised, alongside other challenges such as the inefficient administration of EV subsidy provision (the process is long and difficult), the inadequate testing system for EVs, and the need for national standardisation of EV voltage.

VI.1.1 Incentives for National Zero Emission Scenario

In this scenario, the current government incentives are augmented with additional measures aimed at further accelerating EV adoption, based on the following assumptions:

- Electric four-wheelers (E4W) are projected to constitute 16% of the total four-wheeled vehicle by 2030, increasing to 40% by 2040, and reaching 58% by 2060.
- Electric two-wheelers (E2W) are anticipated to represent 40% of the total two-wheeled vehicle fleets by 2030, reaching 100% by 2045, and beyond.
- The policy related to EV manufacturing assumes that all electric vehicles (EVs) are imported in completely built-up (CBU) form, as domestic production is expected to remain at current levels, thus deemed negligible.

1. Existing Incentives

The existing incentives provided by the Indonesian government to promote EV adoption include:

1. Cash subsidies of Rp 7 million will be provided for the purchase of 200,000 electric two-wheelers, along with an additional 50,000 subsidies for the conversion of conventional two-wheelers to electric.
2. The government will bear the tax burden by offering an 11% reduction in Value Added Tax (VAT) for the acquisition of four-wheeled electric vehicles with a minimum Domestic Component Level (TKDN) of 40%. Furthermore, VAT reductions of 10% will be granted

for electric buses meeting TKDN thresholds of 40% or higher, and 5% for those with TKDN levels ranging between 20% to 40%.[8]

3. Import tax exemptions include a 0% Luxury Goods Sales Tax (PPnBM) for four-wheeled electric vehicles, as well as a waiver of import duties for electric vehicles arriving in Indonesia in both Incomplete Knocked Down (IKD) and Completely Knocked Down (CKD) states through collaborations under Foreign Portfolio Investment (FPI) and the Comprehensive Economic Partnership Agreement (CEPA) during 2024.[9] The government also exempts import duties on electric cars until December 2025.[10]
4. Provision of super tax deduction for electric battery research activities and exemption of import VAT for motor vehicle capital goods.
5. For non-fiscal assistance, the government provides talent enhancement programs in the form of education and training for practitioners in the electric vehicle industry.

2. Additional Incentives

Several incentives can be proposed to enhance EV adoption in line with the above targets, including incentives for manufacturers, consumers, and ecosystem development (including infrastructure and the use of EV-based public transportation). Moreover, it's important to note that incentives for increasing the share of renewable energy sources in the electricity generation mix are also crucial, since the overall greenhouse gas (GHG) emissions associated with electric vehicles heavily depend on the GHG intensity of the electricity supply. A cleaner and more sustainable energy mix, with a higher proportion of renewable sources such as solar, wind, and hydroelectric power, will maximise the environmental benefits of EV adoption by reducing the emissions associated with electricity generation.

- **Incentives for importers or manufacturers.** Incentives for importers or manufacturers of electric vehicles encompass the removal or reduction of all taxes and duties on imports. For instance, zero-emission vehicles (ZEVs) are subject to a 0% import tax (IEA, 2023). The Indonesian government has generally provided tax exemptions, including luxury goods sales tax (PPnBM) and import duties for Completely Knocked Down (CKD) and Completely Built-Up (CBU) vehicles. However, the duration of these exemptions

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[8] Ministry of Finance (2024). Minister of Finance Regulation No. 8/2024, Value Added Tax (VAT) payable on the delivery of Certain Battery-Based Electric Motor Vehicles (EVs) and/or Certain Battery-Based Electric Bus Vehicles to buyers is covered by the Government for the fiscal year 2024. https://jdih.kemenkeu.go.id/download/7178d808-6b33-415c-ba1c-087952552b0c/2024pmkeuangan008.pdf

[9] Minister of Finance Regulation (PMK) Number 9 of 2024 concerning the Luxury Goods Sales Tax on the Import and/or Delivery of Luxury Taxable Goods in the Form of Specific Four-Wheeled Battery-Based Electric Motor Vehicles Covered by the Government for the Fiscal Year 2024. https://jdih.kemenkeu.go.id/download/125f80d5-de96-4155-8955-f40bb5a93cbf/2024pmkeuangan009.pdf

[10] Minister Of Finance Of The Republic Of Indonesia Number 10 Of 2024 On Amendments To The Minister Of Finance Regulation Number 26/Pmk.010/2022 Concerning The Determination Of The Classification System Of Goods And The Imposition Of Import Duty Tariffs On Imported Goods https://jdih.kemenkeu.go.id/download/f81eaacb-b3f2-478f-945f-40b3a640b0bc/2024pmkeuangan010.pdf

lacks clear limitations, necessitating consideration for extending tax and duty alleviations for a longer period to provide certainty for importers and consumers.[11]

- **Policy on emission reduction for vehicle manufacturers.** Governments can encourage automotive manufacturers to transition from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs) by establishing a roadmap that limits the production and import of vehicles with specific emission levels. For example, in Greece, by 2023, 25% of new company cars are required to have emissions less than 50gCO2/km. Additionally, by 2025, 33% of taxis and leased vehicles are mandated to be zero-emissions.
- **Financial Incentives for consumers, both individual and corporate**. As mentioned above, the Indonesian government currently offers a reduced Value Added Tax (VAT) rate for vehicles with a Domestic Component Level (TKDN) throughout 2024, exemption from Luxury Goods Sales Tax for the duration of 2024, and excise duties exemption granted until early 2025. However, these incentives are limited to a one-year duration, lacking certainty for subsequent years. Therefore, extending these incentives beyond the current one-year duration should be considered to provide more certainty and align with practices in countries like China.
- Other potential incentives include exemption from registration charges (ACEA, 2023), purchasing benefits such as a 25% rebate for Battery Electric Vehicle (BEV) motorcycles as in Canada (IEA, 2023), exemption from Benefit-in-Kind taxes, and accelerated Capital Allowance. This latter incentive allows businesses or individuals purchasing EVs to deduct a larger portion of the car's cost from their taxable income, thereby facilitating quicker tax savings. Moreover, the government may consider offering discounts or exemptions on toll fees for Zero-Emission Vehicles (ZEVs), a practice implemented in several countries such as Norway, the Czech Republic, Ireland, and Russia.[12] In New Jersey, for instance, a 10% discount is applied during peak sessions.[13]

However, it is important to note that such measures may lead to increased inequalities since non-taxable individuals or those with lower incomes who do not significantly benefit from tax deductions are effectively excluded from these types of incentives. Therefore, policymakers should consider implementing a balanced mix of incentives, including non-tax-based measures, to ensure that the benefits of EV adoption are accessible to a broader segment of the population, regardless of their tax liability or income level.

- **Non-financial incentives for consumers.** The government can also provide several non-financial incentives for EV owners or users, differentiating them from owners or users of ICE vehicles. These may include free or discounted parking for EVs in public areas (IEA, 2021). Additionally, the government can implement lane arrangements based on car plate restrictions and EV direct access (IEA, 2021). These policies grant special privileges to EVs, exempting them from the restrictions imposed on conventional vehicles. Furthermore,

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[11] 2024 According to Minister of Finance Regulation (PMK) No. 9/2024 regarding the Luxury Goods Sales Tax on Imports and/or Delivery of Certain Electric Motor Vehicles Based on Battery Four-Wheeler that is Covered by the Government in Fiscal Year 2024, the Luxury Goods Sales Tax (PPnBM) covered by the Government is provided for the Tax Period of January 2024 until the Tax Period of December. https://jdih.kemenkeu.go.id/download/125f80d5-de96-4155-8955-f40bb5a93cbf/2024pmkeuangan009.pdf

[12] Tool EU. Overview of discounts on toll for zero-emission vehicles. https://www.tolls.eu/zero-emission-vehicles

[13] U.S. Energy Department. Electric Vehicle (EV) Toll Discount Program. https://afdc.energy.gov/laws/11621

despite incentives like scrappage schemes to increase purchase bonuses by replacing old cars, these should be designed carefully. It might be more beneficial to use old combustion vehicles until the end of their life before replacing them with electric ones. This approach would maximise the environmental benefits by avoiding the emissions from manufacturing new vehicles prematurely.

- **Accelerating Electric Vehicle Adoption in Public Transportation**. Policy measures aimed at promoting the adoption of electric buses are diverse and encompass various strategies. These may include implementing competitive tenders, instituting green public procurement programs, offering purchase subsidies, providing direct support for the deployment of charging infrastructure, and enforcing effective pollutant emissions standards (IEA, 2021).
- Governments can implement several policies to encourage the electrification of public bus fleets (IEA, 2021) as the battery size of a bus is approximately equal to the sizes of 150 motorcycles (Muhammad Nizam, academician from UNS, in CORE's FGD). In other words, buses are more effective in decreasing the negative impact of ICE on the environment. And among the policies that can be pursued are mandating that all new city buses transition to zero-emission vehicles (ZEVs) or biogas by 2030 and gradually promoting similar policies for intercity buses to transition to ZEVs (IEA, 2023).[14]
- In addition to buses, all other vehicles used for public transportation services, such as official taxis and ride-sharing company cars, should also come under mandates to electrify a portion of their fleets every year. Moreover, government bodies can be mandated to adopt ZEVs for their public sector fleet vehicles, including those used by officials and employees, with specific targets such as transitioning 10% of their fleet to electric by 2025, 30% by 2030, and 100 by 2045. It's worth noting that the government has actually issued Presidential Instruction or Presidential Instruction Number 7 of 2022 regarding the Use of Battery-Based Electric Motor Vehicles as Operational Official Vehicles and/or Personal Official Vehicles of Central Government Agencies and Local Governments. However, this instruction lacks specific targets and implementation details.
- **Incentives for the development of supporting electric vehicle supply equipment** include (ZEV, 2023):
  - **Tax credits for charging station installation**: This policy entails offering financial incentives, in the form of tax credits, to individuals or businesses that install charging stations for electric vehicles (EVs). For instance, in the United States, under the Inflation Reduction Act, $1.7 billion is allocated for tax credits for installing charging and refuelling stations until 2031. This covers up to 30% of the purchase and installation costs of commercial and residential EV chargers.
  - **Funding for charging station infrastructure**: This policy involves earmarking government funds specifically for the development and expansion of charging station infrastructure for electric vehicles. This includes fast-charging stations along highways, as well as in residential areas, workplaces, public parking facilities, commercial areas,

[14] For example, in China, targeting 50% ZEV share of public transit bus stock by 2022, and in India, aiming for 30% of bus stock to be electric by 2030. In Quebec, Canada, targeting 40% of taxis to be electric by 2030.

recreational areas, transit hubs, and even gas stations or pump stations. Initially, central governments can collaborate with local governments to target major cities for funding charging station infrastructure.[15][16]

- **Enhancing electric vehicle infrastructure and operator standards.** As adopted in South Korea, all available charging information, such as charging station status and usage fees, is linked to a Ministry-integrated low-emission vehicle website. Moreover, public disclosure of private charging station information is proposed to further enhance public charging convenience. Furthermore, to bolster charging station operator capabilities, the government can significantly strengthen standards such as qualifications, workforce, and operational capacity (Korea Ministry of Environment, 2021). Currently, the PLN mobile application provides information about charging station locations (Achmad Rofiqi, discussant from Periklindo, on CORE Indonesia's FGD). However, public awareness of this service needs to be promoted.
- **Discounted electricity tariffs for private charging stations:** This policy grants discounted electricity tariffs to households or companies that install EV charging stations, making it more convenient for consumers to own and charge EVs. In 2023, PLN (State Electricity Company of Indonesia) actually offered convenience such as increasing power capacity, providing EV home chargers with installation, integrating them into their system, and granting a 30% tariff discount for home charging from 22:00 to 05:00 WIB.[17] However, limited customer uptake persists due to low EV adoption and public unawareness of their economic benefits, including energy cost savings, as well as the absence of certainty regarding the duration of the policy.
- **Partnerships and collaborations**: This policy emphasises fostering partnerships and collaborations among government agencies, private sector stakeholders, non-profit organisations, and other relevant entities to advance the development of charging infrastructure for electric vehicles. Currently, such collaborations are primarily conducted through business-to-business partnerships between electric vehicle manufacturers and franchised companies e.g. Wulling and PLN. However, its coverage remains very limited, and its growth is exceedingly slow.

  PLN offers business models for EV charging station partnerships. More than 800 PLN and partner charging station (SPKLU) units are currently integrated into the PLN mobile platforms, with over 72 million PLN Mobile users having access to them (PLN websites, 2024). The first scheme is offered to partners who own land for the business. Thus PLN can give the charger set and include the SPKLU point in the PLN Mobile application.

[15] For example, Example: California - Approves $3 billion funding to building accessible charging stations for communities throughout the state. China aims to construct about 43,000 fast charging piles in public and private networks and about 790,000 slow charging piles in the basic network by 2025 (IEA, 2023).

[16] For instance, in China, government subsidies for charging point and battery swapping installations with varying rates for community or commercial projects, as well as subsidised charging for taxis. In Canada, the government contributes up to 50% of the project cost (75% for indigenous businesses and communities) when installing charging infrastructure. In Yukon, Canada, homeowners can receive grants of 50%, businesses 75%, and municipalities/first nations 90% per charger installed (IEA, 2023).

[17] PLN (2023, January 21). Nge-charge Mobil Listrik di Rumah Lebih Hemat, Ada Promo Sambung Listrik dari PLN. https://web.pln.co.id/media/siaran-pers/2023/01/nge-charge-mobil-listrik-di-rumah-lebih-hemat-ada-promo-sambung-listrik-dari-pln

The second concept is an offer to partners who own land and the charger set. Thus, PLN will supply the electricity and register the SPKLU location in the PLN Mobile. This option allows partners to be either a single entity or two entities. And the final scheme is an offer for partners who have land, charger set, and the permit. PLN will then include the SPBKLU location in the PLN mobile. This scheme is the most often used (Achmad Rofiqi, discussant from Periklindo, in CORE Indonesia's FGD).

Collaboration with various stakeholders potentially enhances the convenience of charging stations. Although EV drivers often prefer high-speed charging, this can negatively impact battery performance. Therefore, expanding charging infrastructure in locations such as shopping centres or malls is advantageous. It allows users to charge their vehicles while shopping, reducing the need for quick charging (Muhammad Nizam, academician from Universitas Sebelas Maret [UNS], in CORE Indonesia's FGD).

- **Regulatory standards for charging infrastructure**: This policy involves establishing regulatory standards and guidelines for the design, installation, operation, and safety of charging infrastructure for electric vehicles. Example: France has set the goal of 7 million chargers by 2030, including 400 thousand public ones with 50 thousand DC chargers, and unveils new measures to deploy charging stations (IEA, 2023). Charging infrastructure standards should also incorporate the provision of different battery voltage (48 volt, 68 volt, and 72 volt) and charger plug types in each charging infrastructure (Muhammad Nizam, academician from UNS, in CORE Indonesia's FGD). To ensure the industry compliance on the standardisation, some incentive and disincentive schemes can be set by the government (Arif Wismadi, academician from Pustral UGM, in CORE Indonesia's FGD).
- **Support for research and development in EV industries**, such as renewable energy generation and grid integration, to create a more sustainable and resilient energy ecosystem to support the widespread adoption of EVs. Moreover, RnD on both charging and battery technology is necessary to impede negative impact of battery abnormality (poses a safety hazard) caused by high-power charging mode (Arif Wismadi, academician from Pustral UGM, in CORE Indonesia's FGD).

VI.1.2 Incentives for EV Impact Scenario

This scenario follows the LCDI's Net Zero Emissions (NZE) scenario with additional policies to encourage the development of domestic EV manufacturing plants for battery cell, battery pack, and EV production. Domestic production is pushed to meet the demand of EV on the road targets.

The incentives in this scenario entail retaining existing incentives along with proposed incentives outlined in the first section i.e. NZE scenario. However, incentives for the development of the battery production industry, battery assembly, and car production are incorporated. Additionally, incentives for imports in Completely Built-Up (CBU) form are reduced to encourage the sourcing of EVs domestically. Therefore, the main policies and incentives for this scenario are as follows.

- **Incentives for battery and car manufacturing**: This includes tax credits or subsidies for battery producers and grants or loans for EV manufacturers. The aim is to attract investment not only in raw materials but also in the entire manufacturing and assembly process within Indonesia. For example, the government can adopt US regulation to encourage domestic EV battery manufacturing. To qualify for federal tax credits, a certain share of the critical minerals used to produce the battery must be extracted, processed, or recycled in the United States (IEA, 2023).
- **Gradual reduction of incentives for EV CBU imports**: Incentives for importing fully assembled EVs (CBU) will be reduced. This will encourage a shift towards domestically produced EVs, fostering a robust domestic EV industry and creating jobs.

Challenges and Barriers to EV Adoption Policies

Although the above incentives can help improve Indonesia's Green Economic Index by boosting EV adoption, there are also several potential challenges, implementation barriers, or unintended consequences that could arise from the proposed strategies.

Offering extensive incentives, such as tax exemptions or reductions across the EV supply chain, which are commonly adopted in advanced countries, may strain Indonesia's state budget by reducing potential income while simultaneously increasing government expenditures, particularly on infrastructure development. Additionally, the government faces significant development targets requiring substantial funding, which may receive greater political support or have a larger impact on the public from various perspectives. Hence, prioritizing incentives that strongly influence EV adoption with more efficient fiscal costs becomes crucial.

Furthermore, incentives primarily benefiting affluent individuals or corporations could widen socio-economic disparities, as lower-income groups may struggle to afford EVs or may not derive equal benefits from the incentives. Therefore, prioritising incentives with a strong impact on EV adoption at more efficient fiscal costs becomes crucial. Simultaneously, the government should enforce policies for electric vehicle-based public transportation adoption to ensure inclusive benefits and encourage public awareness of using such transportation instead of private vehicles.

The success of EV adoption hinges on adequate charging infrastructure. Research by PWC (2023) has shown that insufficient infrastructure development or accessibility challenges deter consumer interest in adopting EVs, despite the presence of incentives. To overcome this challenge, substantial investments and efforts are needed to expand and enhance the charging infrastructure network to support widespread EV adoption effectively.

However, it's worth noting that the rapid advancement of technology results in a quick obsolescence cycle both for electric vehicle models and charging infrastructure. For example, the global market competition in developing Lithium Iron Phosphate battery-based and hydrogen vehicles as low-emission alternatives is evolving amidst current EV development with nickel-based materials. If the development of Lithium Iron Phosphate battery-based becomes more widespread, there is a possibility that the mining and nickel industry in

Indonesia will lose its market for supplying EV raw materials because the EV industry established in Indonesia does not yet fully use domestic raw materials and still relies on global market demand. This poses a risk of investment losses due to the short lifespan of the technology before newer advancements render it outdated. Therefore, it is important for government incentives and policies to consider the rapid changes in EV technology and require the EV industry established in Indonesia to use domestic mineral resources.

Moreover, policies to encourage investment may face challenges amid the global economic conditions. High global interest rates can lead to capital outflow from Indonesia, hindering foreign direct investment (FDI) that is crucial for EV development, especially for EV manufacturing in Indonesia. Encouraging domestic EV manufacturing while reducing incentives for imports requires substantial investments in research, development, and infrastructure to ensure the competitiveness and quality of domestically produced EVs compared to imported models. Failure to encourage EV investments and compete with foreign players by developing domestic competitiveness may result in significantly reducing the benefits of EV adoption for the manufacturing industry and its derivatives, such as job creation and increased domestic economic value. Therefore, comprehensive and sustainable policies are needed to attract EV investment and encourage domestic EV production that meets domestic market demand effectively.

Abrupt changes or discontinuation of EV policies could also disrupt market confidence and investment plans, creating uncertainty among manufacturers, consumers, and investors. For instance, in previous administrations, the Indonesian government promoted the adoption of cheaper and lower-emission gas over petrol, encouraging private entities to convert fuels. However, these policies were not sustained in subsequent administrations, adversely affecting businesses that invested in aligning with the government's policies. Therefore, the certainty and continuity of policies significantly determine the success of EV implementation to enhance the Green Economic Index (GEI) in Indonesia.

Additionally, while EVs offer environmental benefits in transportation sectors, their impact may be limited if the electricity used by EVs is still predominantly derived from fossil fuels, or if the manufacturing and disposal processes of EV batteries and components still rely on fossil fuels. Therefore, promoting the adoption of a green economy and circular economy throughout the EV supply chain, including proper waste management of EV batteries, is essential to maximise environmental, economic, and social benefits for Indonesia, as measured by Indonesia's Green Economy Index. []

Reference

ACEA. (2023). *Electric cars: Tax benefits and purchase incentives*. Retrieved from: https://www.acea.auto/files/Electric_cars-Tax_benefits__purchase_incentives_2023.pdf.

Aditya Mahalana, Z. Y. (2021). Indonesia Transport Electrification Strategy. *Working Paper 2021-36: International Council on Clean Transportation*.

Baiyu, G. (2023, December 8). *Life after subsidies for China's EVs.* Retrieved from: https://www.eco-business.com/news/life-after-subsidies-for-chinas-evs/.

[Bappenas] *Ministry of National Development Planning*. (2022). *Green Economy Index: A Step Forward to Measure the Progress of Low Carbon & Green Economy in Indonesia.* Jakarta.

Brennan, R. (2022, December 29). *Policy Genius*. Retrieved from: https://www.policygenius.com/auto-insurance/electric-car-incentives-by-state/.

Charge Point. (n.d.). *How to Get Money for EVs and Charging*. Retrieved from: https://www.chargepoint.com/incentives/federal-tax-credit-home-ev?type=14&state=19.

China Daily. (2023, June 22). *Tax Break Extension for NEVs Expected to Boost Consumer Demand*. Retrieved from: https://english.www.gov.cn/news/202306/22/content_WS6493ab47c6d0868f4e8dd1d0.html.

Core Indonesia. (2024). *Transisi Energi Berkeadilan: Untuk Mendukung Pertumbuhan Ekonomi yang Berkelanjutan*. Jakarta: Yayasan Corong Reformasi Ekonomi Indonesia.

Creswell, J. W., & Creswell, J. D. (2018). *Research Design Qualitative, Quantitative, and Mixed Methods Approaches, Fifth Edition.* Los Angeles: SAGE Publications, Inc.

Databoks. (2022). *Pekerja RI Lebih Banyak Naik Kendaraan Pribadi Dibanding Angkutan Umum*. Retrieved from databoks: https://databoks.katadata.co.id/datapublish/2022/04/07/pekerja-ri-lebih-banyak-naik-kendaraan-pribadi-dibanding-angkutan-umum

European Alternative Fuels Observatory (2024). *Incentives and Legislation*. Retrieved from: https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27/incentives-legislations.

Gidofalvi et al. (2022). *Towards a sustainable use of electric vehicles*. Retrieved from: https://www.naturvardsverket.se/4acbd3/globalassets/media/publikationer-pdf/7000/978-91-620-7058-8.pdf.

[IESR] Institute for Essential Services Reform. (2023). *Dekarbonisasi Sistem Transportasi: Insight dari IESR's Indonesia Decarbonization Transportation Model*. Jakarta: IESR.

[IESR] Institute for Essential Services Reform. (2023). *Indonesia Electriv Vehicle Outlook 2023.* Jakarta: IESR.

Internal Revenue Services. (2024, January 17). *Credits for new clean vehicles purchased in 2023 or after*. Retrieved from: https://www.irs.gov/credits-deductions/credits-for-new-clean-vehicles-purchased-in-2023-or-after.

[IEA] International Energy Agency. (2023). *Global EV Outlook 2023*, Paris: IEA.

[IEA] International Energy Agency. (2022). *Global Supply Chains of EV Batteries.* Paris: IEA.

[IEA] International Energy Agency. (2021). *Global EV Outlook 2021*, Paris: IEA.

Korea Ministry of Environment. (2021, February 18). *Blueprint for popularizing electric and hydrogen vehicles. Establish an innovation plan for distribution of zero-emission vehicles*. Retrieved from: https://me.go.kr/home/web/board/read.do?pagerOffset=0&maxPageItems=10&maxIndexPages=10&searchKey=&searchValue=&menuId=286&orgCd=&boardId=1432380&boardMasterId=1&boardCategoryId=39&decorator=.

Liu, Y., Zhao, X., Lu, D., & Li, X. (2023). Impact of policy incentives on the adoption of electric vehicle in China. *Transportation research part A: policy and practice*, *176*, 103801.

Ministry of Energy and Mineral Resources of Indonesia. (n.d.). *Peluang Investasi Nikel di Indonesia.* Jakarta: Ministry of Energy and Mineral Resources of Indonesia.

Ministry of Transport. (2023). *Kontribusi Kementerian Perhubungan dalam*. Ministry of Transport.

Nikkei Asia. (2024, January 11). *China's 2023 auto sales grow 12% on overseas demand for EVs*. Retrieved from: https://asia.nikkei.com/Business/Automobiles/China-s-2023-auto-sales-grow-12-on-overseas-demand-for-EVs.

PLN. (n.d.). *Partnership SPKLU PLN.* Retrieved from: https://layanan.pln.co.id/partnership-spklu

Plug in America. (n.d.). *Federal EV Tax Credits*. Retrieved from: https://pluginamerica.org/learn/federal-ev-tax-credits/.

PWC Indonesia. (2023, September). *Electric Vehicle Consumer Survey 2023*. Retrieved from: https://www.pwc.com/id/en/publications/automotive/indonesia-electric-vehicle-consumer-survey-2023.pdf.

Rijksdienst voor Ondernemend Nederland (2023). *Subsidy and Funding Guide*. Retrieved from: https://english.rvo.nl/subsidy-guide.

Transport Malta (2024). *Purchase of New Electric Vehicles 2023*. Retrieved from: https://www.transport.gov.mt/land/sustainable-transport/financial-incentives-2023/new-electric-vehicles-6188.

U.S. Department of Energy. (n.d.). *Alternative Fuel Vehicles and High Occupancy Vehicle Lanes*. Retrieved from: https://afdc.energy.gov/laws/HOV.

U.S. Department of Energy. (n.d.). *Emissions from Electric Vehicles*. Retrieved from: https://afdc.energy.gov/vehicles/electric_emissions.html.

ZEV Transition Council. (2023, December 5). *Charging infrastructure policies*. Retrieved from: https://zevtc.org/tracking-progress/charging-infrastructure-policies/#.

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