

# Piloting Electric Vehicle Systems and Developing a Green Transportation Investment Roadmap

E-mobility Roadmap for Bali, Indonesia





# ABBREVIATIONS

<b>AC</b>	Alternating Current
<b>Bappeda</b>	Badan Perencanaan Pembangunan Daerah, which refer to Regional Development Planning Agency at provincial
<b>Bappenas</b>	Badan Perencanaan Pembangunan Nasional, which refer to Ministry of National Development Planning of the Republic of Indonesia
<b>BAU</b>	Business-As-Usual
<b>BESS</b>	Battery Energy Storage Systems
<b>BEV</b>	Battery Electric Vehicle
<b>CBA</b>	Cost-Benefit Analysis
<b>CPO</b>	Charge Point Operators
<b>CO<sub>2</sub></b>	Carbon Dioxide
<b>CO</b>	Carbon Monoxide
<b>Dishub</b>	Dinas Perhubungan, which refer to Transportation Agency at provincial
<b>E2W</b>	Electric Two-Wheelers
<b>E4W</b>	Electric Four-Wheelers
<b>EMSP</b>	e-Mobility Service Provider
<b>EVCU</b>	Electric Vehicle Control Units
<b>GI</b>	Gardu Induk refers to Substation
<b>GoI</b>	Government of Indonesia
<b>IESR</b>	Institute for Essential Services Reform
<b>JABODETABEK</b>	Jakarta, Bogor, Depok, Tangerang, and Bekasi
<b>MEMR</b>	Ministry of Energy and Mineral Resources of Indonesia
<b>MOF</b>	Ministry of Finance of Indonesia
<b>MOHA</b>	Ministry of Home Affairs of Indonesia
<b>MOI</b>	Ministry of Industry of Indonesia
<b>MTI</b>	Refer to the Indonesian Transportation Society
<b>GHG</b>	Greenhouse Gas
<b>GI</b>	Gardu Induk, which refer to Main Power Substation
<b>GoI</b>	Government of Indonesia
<b>HEV</b>	Hybrid Electric Vehicles
<b>KM</b>	kilometer
<b>kV</b>	kilovolt
<b>kW</b>	kilowatt

<b>kWh</b>	kilowatt-hour
<b>NOx</b>	Nitrogen Oxides
<b>PLN</b>	Perusahaan Listrik Negara, refers to National Electricity Company of Indonesia
<b>PHEVs</b>	Plug-in Hybrid Electric Vehicles
<b>Puspadi</b>	Refer to an NGO providing rehabilitation, mobility aid, and development programs for people with disabilities in Bali and East Indonesia
<b>RAD</b>	Rencana Aksi Daerah, refers to Regional Action Plan
<b>RoK</b>	Republic Government of Korea
<b>Sarbagita</b>	Agglomeration of regions in Bali including Denpasar, Badung, Gianyar and Tabanan.
<b>SDG</b>	Sustainable Development Goals
<b>SPBKL</b>	Stasiun Penukaran Baterai Kendaraan Listrik Umum refers to battery swap station mainly to serve for battery swap for E2W
<b>SPKLU</b>	Stasiun Pengisian Kendaraan Listrik Umum, refers to charging facility point mainly to serve for battery swap for E4W
<b>SPLU</b>	Stasiun Pengisian Listrik Umum refers to general charging facility for public
<b>SUMP</b>	Sustainable Urban Mobility Plan
<b>WRI</b>	The World Resources Institute

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# EXECUTIVE SUMMARY

## Overview

With the support of the Government of the Republic of Korea (ROK), the Global Green Growth Institute (GGGI) has been assisting the Government of Indonesia (GoI), specifically the Bali Provincial Government, in promoting sustainable mobility through the introduction of electric vehicles. The project “Piloting Electric Vehicle Systems and Developing a Green Transportation Investment Roadmap for Bali, Indonesia” is initiated by GGGI.

Addressing the key outcomes expected from the Project, the end objective is to develop an updated E-Mobility Roadmap for Bali, Indonesia. The key analytical focus areas are defined as follows.

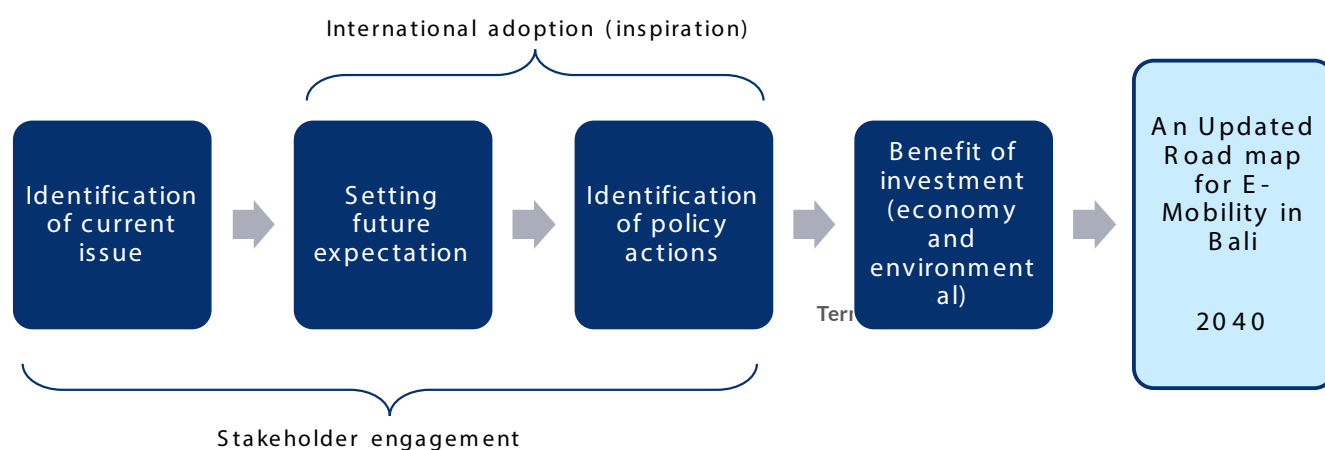
- current situation: in terms of market, strategic directions, policies, and regulatory framework
- potential future situation: in terms of market, policies, and regulatory framework
- high-level economic and environmental assessment

In terms of the overall approach, the development of the Roadmap considers a range of literature research activities combined with international benchmarking and intense dialogue with the stakeholders involved in this Project.

Such approach framework is considered to define the significant inputs to the Projects which include setting up the target projection of EV in Bali, as well as the possible policy adoption to push for the EV implementation for the range of scenarios.

Following diagram illustrate the process involved in developing the updated E-Mobility roadmap for Bali, Indonesia.

**Figure 1.** Step-by-step Process Consider for the Development of the E-Mobility Roadmap for Bali



## Key Findings

### EV Adoption Target Setting

To understand how the policies would influence the EV projection, an initial analysis of the EV projection is performed to set the target BAU—a scenario that considers the actual achievement of EV adoption and expects how it will continue to grow through a benchmarking exercise in setting the final projection in 20 years by 2040.

The Moderate and Ambitious scenarios are also set to target an increase in the EV population by 2040 compared to the BAU Scenario. In this case, the increases are set to be 5% for the Moderate Scenario and 15-20% for the Ambitious Scenario, particularly to highlight the E2W and E4W.

The roadmap’s targets are generally set based on benchmarking with selected significant countries, with consideration of the current achievement of EV adoption in Bali. Different targets/milestones for short-term (2025), medium-term (2030), and long-term (2040) plans will be set as part of the development of the following scenarios, as shown in the table below:

**Table 1. Summary of the Basis of Target Setting for the Scenarios**

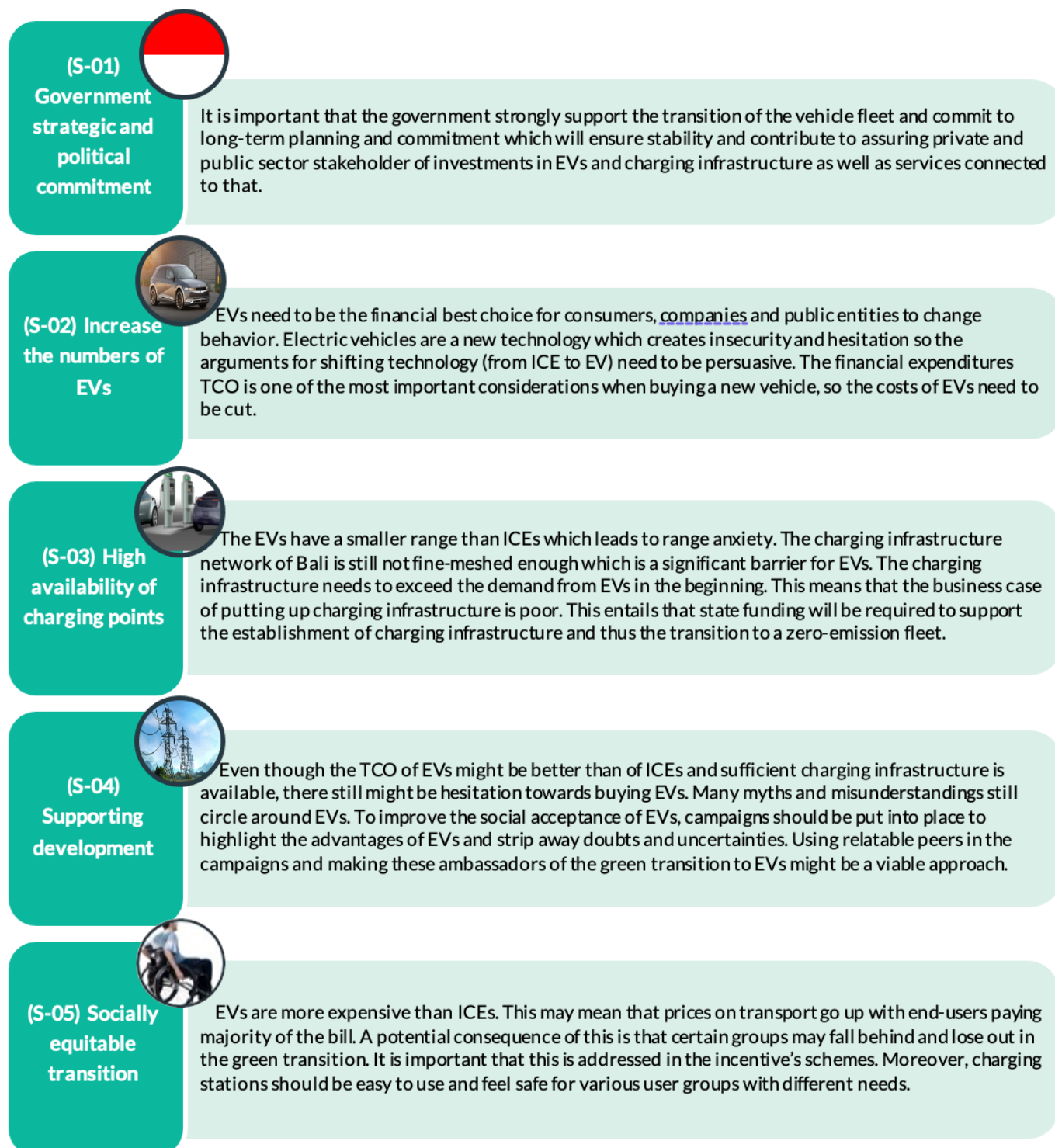
Scenario	Short-term (2025)	Medium-term (2030)	Long-term (2040)
BAU (Business-As-Usual)	<ul style="list-style-type: none"> <li>EV Bali RAD projection for 2026 that is between 'Pessimistic' and 'Moderate'.</li> <li>EV population share is 0.5-1% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>Alignment between short- and long-term in considering exponential growth pattern.</li> <li>EV population share is 1-3% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>Benchmarking with selected major countries.</li> <li>EV population share is 20% for E4W &amp; E2W</li> </ul>
Moderate	<ul style="list-style-type: none"> <li>EV Bali RAD projection for 2026 that is between 'Pessimistic' and 'Moderate' that are slightly higher from BAU.</li> <li>EV population share is 1-1.5% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>Alignment between short- and long-term in considering exponential growth pattern.</li> <li>EV population share is 3-4% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>5% increase of EV population share from BAU, which to be reflected as resulted from range and amount of policies implemented in Section 5.</li> <li>EV population share is 25% for E4W &amp; E2W.</li> </ul>
Ambitious	<ul style="list-style-type: none"> <li>EV Bali RAD projection for 2026 that is between 'Pessimistic' and 'Moderate' that are slightly higher than Moderate.</li> <li>EV population share is 2% for E4W &amp; E2W</li> </ul>	<ul style="list-style-type: none"> <li>Government target setting of 15 million EV by 2030.</li> <li>EV population share is 6-10% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>15-20% increase of EV population shares from BAU, which to be reflected as resulted from range and number of policies implemented in Section 5.</li> <li>EV population share is 35-40% for E4W &amp; E2W.</li> </ul>

### Strategy Development

By understanding the underlying strategic issues of implementing EVs in Bali and Indonesia, some key strategy recommendations have been developed to support the E-Mobility Roadmap for Bali. Such Strategy Recommendations are identified to further setting the recommended policies to push for EV.

The following Figure illustrates the key recommendations to address the five main strategic themes to improve EV implementation in Bali and Indonesia.

Figure 2. Key Recommendations of the Roadmap



## Priority Policies Setting

The target settings of EV adoption for the range of scenarios are expected to be driven by the range and amount of Priority Policies (PP) introduced to push the growth of EVs.

Careful consideration must be given to designing the details, mechanisms, and timeline for implementing the identified policies. Nominal / quantum introduced for each of the following policies has been formulated. These are based on how the Cost-Benefit Ratio is expected to increase for the Moderate and Ambitious Scenarios compared to the BAU scenario, which reflects the impact of increased EV projections for 2040 for both scenarios.

### **PP#1 More aggressive social campaigns for public awareness of using EV**

Social campaigns to promote the actual operational benefits of EVs, potential subsidy packages from governments/ industry players, and the implementation progress of the EV ecosystem, such as charging stations. The policy was identified to be urgently executed with coordination between the central government, local government, and private stakeholders, with the Regional Government Budget (APBD) and the National Government Budget (APBN) as the primary sources of funding. This policy shall also continue in the medium term (2035) and long term (2040).

### **PP#2 Reviewing petrol subsidy amount to support for transition to EV**

Reviewing the amount of subsidies applied to petrol prices to address the EV transition needs, in regulation with the Regional Government Budget (APBD) and the National Government Budget (APBN). The benefits could be diverted to subsidizing charging points and applying free parking and toll road fees for EVs. Reducing fuel prices also alludes to higher opex for ICE vehicles, leading to higher savings for EV users. GHG emissions are also expected to decrease at the regional and national levels. The central and local governments are encouraged to synergize and implement this policy immediately.

### **PP#3 Setting the end date of fossil-fueled vehicle sale**

ICE vehicle sales should be regulated to end within a specific timeline to ensure the government and society's commitment to future net zero and carbon reduction. This is promoted with the practice implemented by several major countries committed to achieving no ICE vehicle sales by, at most, 2050. The central government was perceived to be the most influential body to implement 100% sales of BEV for passenger cars and buses by 2040, requiring specific commitment from policymakers and industry players.

### **PP#4 Subsidy to purchase EVs for specific models and low- and middle-income groups**

A high capex is required to purchase a newly released EV. As such, subsidies targeting specific EV models are key to supporting low—and middle-income groups. The central government was suggested to gradually drive the policy as they hold the fiscal capability needed to be considered in determining the appropriate amount and detailed implementation mechanisms of this policy through the National Government Budget (APBN), in conjunction with the subsidy shift from gasoline to EV-powered vehicles.

### **PP#5 Subsidy to compensate for free parking / free toll road for EV users**

This policy aims to provide higher benefits for EV users through free parking / free total road fees, inclusive of the attractiveness of purchasing EVs. This requires subsidies for the operational cost of parking facilities and toll road infrastructures through the Regional Government Budget (APBD). The local government shall drive the policy in collaboration with developers and toll road operators to set the target subsidy figure.

## **PP#6 Mandating charging point installations at new developments/toll roads/government offices/public facilities**

A critical step in initiating the broader use of EVs is mandating charging stations in public facilities, including toll road rest areas and government offices. The availability of charging infrastructure requires broad effort from public and private entities, including the central government, municipalities, agencies, operators, and private developers.

## **PP#7 Initiatives in establishing private businesses that bring charging stations/battery swap stations as a benefit**

In support of the implementation of PP#6 above, the policy requires establishing a range of potential business models accounting to PPP for procurement of massive charging deployment, franchising for charging installation, and O&M, the contractual term for charging station O&M, through a grant as G2G collaboration. However, this is subject to further feasibility Studies to analyze potential business models and opportunity costs and benefits that can be achieved by establishing collaboration with the private sector.

## **PP#8 Setting a minimum quota for EV sales for producers/importers**

By the end of 2023, Gaikindo Wholesale data of sales of passenger cars (Sedans, Vans, and SUVs) indicates that the market sale share of EVs was nearly 3% in Indonesia. In the future, along with all other efforts to contribute to Net Zero Emissions (NZE) by 2060, this policy expects to set the minimum proportion of sales of BEVs by car producers and importers. This policy works in conjunction with PP#3 and PP#4, as described previously. Careful consideration and commitment are needed between policymakers and industry players to reach the proper timeline and target.

## **PP#9 Incentive and technical support for retrofitting of E-passenger car**

Providing an alternate solution for more affordable EVs, this policy expects to promote wider home industries for EV retrofitting, thus increasing the utilization of human resources and local mineral sources in building a cheaper EV product to provide better accessibility for certain economic groups to purchase EVs. This policy will require the establishment of guidelines and standards from Ministry of Energy and Mineral Resources, Ministry of Industry, and Ministry of Transportation, relying on the National Government Budget (APBN) and the Regional Government Budget (APBD) to produce safe and high-quality EVs.

## **PP#10 Incentives for R&D for environmentally friendly EVs, technology for cheaper battery cost, safe production, and sustainable**

Incentives to support better EV technologies and an ecosystem allow industry players to research and develop more sustainable EV and charging technology. Immediate implementation is recommended, spearheaded by Ministry of Energy and Mineral Resources, Ministry of Industry, and Ministry of Transportation, relying on the National Government Budget (APBN) and the Regional Government Budget (APBD).

## E-Mobility and Charging Infrastructure Demand Projection

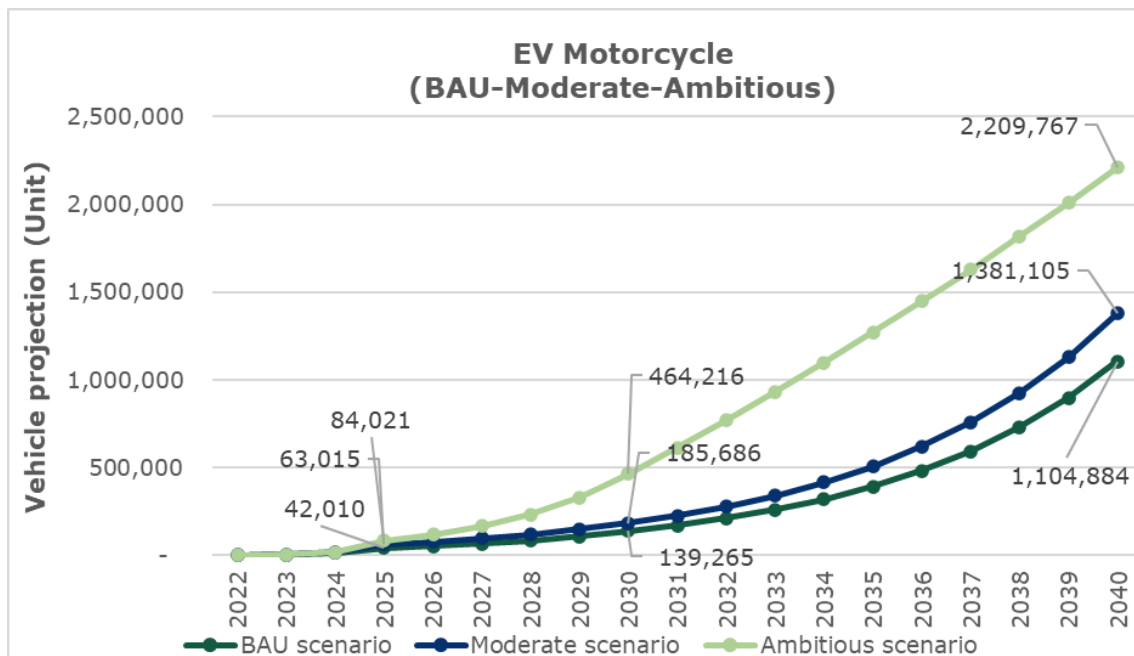
The roadmap presents an E-mobility projection for E2W, E4W, and E-bus that is driven by policy settings. The policies and policy amount driving the target are validated, along with a Cost-Benefit Analysis for BAU, Moderate, and Ambitious Scenarios.

The following sections summarize the target expectation of E-mobility projection for the three scenarios towards 2040 and the charging infrastructure demand required to support the E-mobility projection.

### E-Motorcycle Projection and Charging Infrastructure

The following chart and table present the e-mobility projection for the E2W (E-Motorcycle and E3W) towards 2040 and the charging infrastructure demand required to support the fleet projection in Bali.

Figure 3. Scenarios for Development in Numbers of e-Motorcycles in Bali, Indonesia



Source: Consultant analysis

Table 2. E2W Projection and Battery Swapping Unit (SPBKLU) for Bali

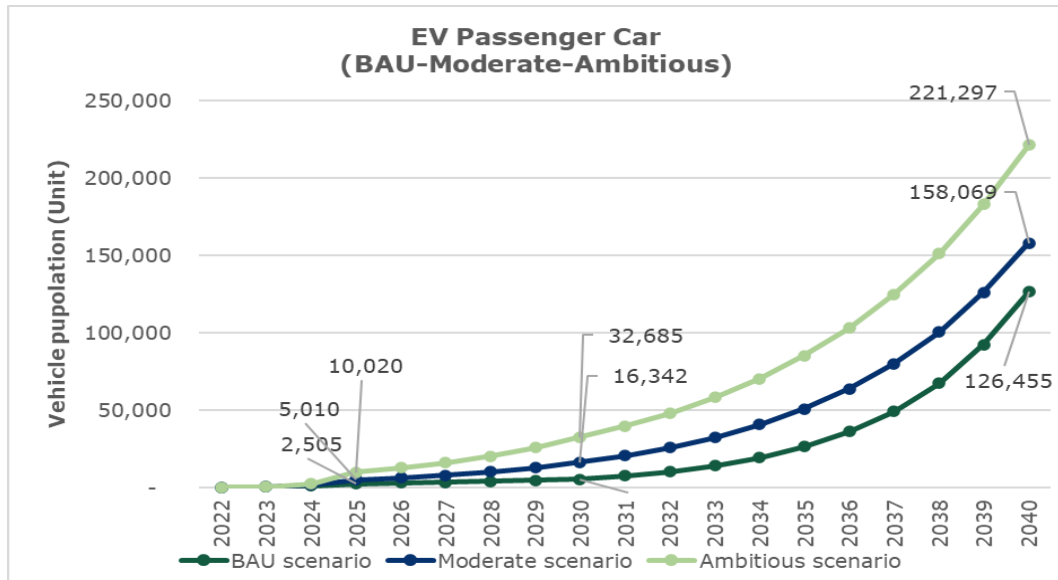
E2W Scenario	EV Population share (%)			EV projection (units)			Battery Swapping Station (units)		
	2025	2030	2040	2025	2030	2040	2025	2030	2040
BAU	1%	3%	20%	42,000	139,200	1,105,000	750	2,500	19,800
Moderate	1.5%	4%	25%	63,000	186,000	1,381,000	1,200	3,400	24,700
Ambitious	2%	10%	40%	84,000	464,200	2,210,000	1,500	8,300	39,500

Source: Consultant analysis

## E-Passenger Cars Projection and Charging Infrastructure

The following chart and table present the e-mobility projection for the E4W (E-Passenger Car) towards 2040 and the charging infrastructure demand required to support the fleet projection in Bali.

Figure 4. Scenarios for Development in Numbers of E-Passenger Cars in Bali, Indonesia



Source: Consultant analysis

Table 3. E4W Projection for Bali

E2W	EV Population share (%)			EV projection (units)			Total Public Charging Stations / SPKLU (units)		
	2025	2030	2040	2025	2030	2040	2025*	2030*	2040
BAU	0.5%	1%	20%	2,500	5,500	126,500	18	210	414
Moderate	1%	3%	25%	5,000	16,300	158,100	54	260	518
Ambitious	2%	6%	35%	10,000	32,700	221,300	108	360	726

\*) Figures are based on the assumption that provision for 2025 to consider for demand in 2030; Source: Consultant analysis

Table 4. In the Scenarios for 2025, 2030, and 2040, Several Outlets from the Different Charger Types are Expected to Meet the Demand for Charging Infrastructure from E-Passenger Cars

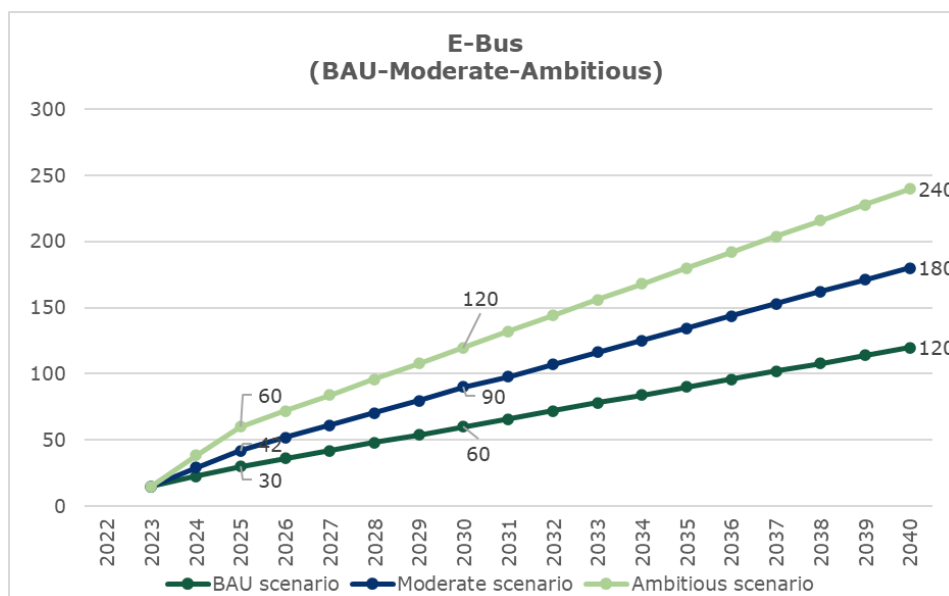
Scenario	7 kW AC Home (no. of outlets)	11 kW AC Public (no. of outlets)	50 kW DC (no. of outlets)	150 kW DC (no. of outlets)
<b>2025</b>				
BAU	2,000	7	1	1
Moderate	4,000	14	0	2
Ambitious	8,000	27	2	3
<b>2030</b>				
BAU	4,400	15	1	2
Moderate	13,100	45	3	5
Ambitious	26,100	90	7	11
<b>2040</b>				
BAU	101,200	347	25	42
Moderate	126,500	433	32	53
Ambitious	177,000	607	44	74

Source: Consultant analysis

## E-Bus Projection and Charging Infrastructure

The following chart and table present the e-mobility projection for the E-bus towards 2040 and the charging infrastructure demand required to support the fleet projection in Bali.

**Figure 5.** Scenarios for Development in Numbers of E-Bus in Bali, Indonesia



Source: Consultant analysis

**Table 5.** E-Bus Fleet Projection and Demand for Charging Infrastructures for Bali

E-Bus Scenario	EV Population share compared to existing fleet in 2023 (%)			EV projection (units)			No. of 180 kW DC Charger (units)		
	2025	2030	2040	2025	2030	2040	2025	2030	2040
BAU	25%	50%	100%	30	60	120	6	9	13
Moderate	25%	75%	150%	42	90	180	12	19	25
Ambitious	50%	100%	200%	60	120	240	25	38	42

Source: Consultant analysis

## Next Steps

The Roadmap sets the expectation of a different range of projection possibilities as resulted from the policy drivers. Due to the nature of the document, which sets a high-level strategic outlook, there are additional recommendation actions as next steps to be done along with the implementation of the policy drivers set. These include the following actions.

Regular monitoring and evaluation. To ensure successful policy implementation and achieve the targeted EV progression over the future years, the government, as policymakers, should evaluate and review the policy impact regularly.

More detailed studies. To provide more accurate information, a series of more detailed studies, such as Feasibility

Studies and Design Studies, need to follow the implementation of the recommended policies introduced in the document. Such study provides more detailed information, including (and not limited to) selection of charging specification, validation of the amount of investment, validation of government fiscal capacity, range of suitable business models, and so forth

- **Urban Transport Plan to support public transport.** To push for reasonable progression of E-bus in Bali, several other policies and strategies not specified in this document also need to be introduced. Such policies and strategies are mainly to ensure higher utilization of public buses in Bali, where this can be embedded as part of the urban transport plan for future Bali.
- **More collaborative and integrated coordination.** Given there multiple areas EV considers, positive commitment and collaborative effort among sectoral and regional government bodies are important to ensure optimum interfacing of different areas supporting EV implementation. For instance, establishment of charging infrastructure to support for EV will require regulatory and technical coordination across PLN as power provider to ensure availability of electricity supply, provincial government and developer as entities to ensure space availability, relevant ministries in setting the requirements in regulating for the commercial, and technical standard for charging infrastructure.



# 1. INTRODUCTION

## 1.1 Background

With the support of the Government of the Republic of Korea (ROK), the Global Green Growth Institute (GGGI) has been assisting the Government of Indonesia (GoI), specifically the Bali Provincial Government, in promoting sustainable mobility through the introduction of electric vehicles. The project “Piloting Electric Vehicle Systems and Developing a Green Transportation Investment Roadmap for Bali, Indonesia” is initiated by GGGI.

The project covers technical assistance to the Indonesian and Bali government bodies to achieve the goals discussed in two key documents: “Sustainable Urban Mobility Plan (SUMP) for the Sarbagita Metropolitan” and “Regional Action Plan for Electric Vehicle Implementation.” The “Sustainable Urban Mobility Plan (SUMP) for the Sarbagita Metropolitan” is a planning document that provides a direction towards encouraging a more sustainable transport system. At the same time, the Regional Action Plan is a document that discusses EV implementation for the entire island of Bali, covering the transition’s technical, institutional plan, and financial aspects.

The scope of this project covers aspects of planning, investment mobilization, and capacity building to create EV-inclusive cities. This project aligns with existing government roadmaps focusing on e-mobility and consists of three main outcomes:

1. Implementation of a logical and viable e-Mobility Roadmap,
2. Determining how to increase investment opportunities to accelerate the use of EVs,
3. Assessment of how to strengthen human resource capacity and institutional framework involving public and private stakeholders.

GGGI is leading the project implementation under the direction of the Ministry of National Development Planning (Bappenas) and the main beneficiary of this project will be the Bali Provincial Government. At the national level, the project will coordinate and collaborate with Bappenas and other technical ministries, such as the Ministry of Transportation and the Ministry of Energy and Mineral Resources.

## 1.2 Objective

The study's objective is to examine the distribution of electric vehicle markets and charging facilities and correlate it with population data related to the province of Bali and across Indonesia as a whole. The outcome will be a thorough analysis to understand how well the existing infrastructure meets the needs of electric vehicle users in the future to support the transition to an e-mobility ecosystem. By examining the geographical distribution of electric vehicle charging facilities in Bali, this study aims to discern patterns and identify gaps in accessibility.

Through a holistic approach of examinations of factors, including charging infrastructure endeavors to contribute to the promotion of sustainable mobility by introducing electric vehicles specifically to the user preferences and the overall impact on carbon emissions, the study aims to provide valuable insights into the feasibility and effectiveness of electric vehicles as a sustainable mobility solution in this specific geographical and cultural setting. Hence, it will be a fundamental document for future planning and development, ensuring that the expansion of charging facility infrastructure (also known as SPKLU in Indonesia, abbreviation) aligns with the dynamic requirements of electric vehicle users in the Bali region.

## 1.3 Alignment with Key Relevant Planning Documents

The roadmap is developed in alignment with the strategic objectives and targets set in the following key planning documents for Bali and the Indonesian-wide context.

**Table 6. A Non-Extensive List of Planning Documents Considered to Align This Study With**

Document subject	Original document subject and source	Brief description
SUMP for Sarbagita Metropolitan 2023-2030	Sarbagita Metropolitan Area (SMA) Sustainable Urban Mobility Plan (SUMP), published by KIAT in 2022	A comprehensive strategic transport masterplan covering transport strategy for various modes, baseline assessment, and future action plan for SMA
Regional Action Plan (RAD) for Electric Vehicles in Bali 2022-2026	Rencana Aksi Daerah (RAD), Percepatan Penggunaan Kendaraan Listrik Berbasis Baterai (KBLBB) di Provinsi Bali 2022-2026, by Komite KBLBB and Transport Agency for Bali (Dinas Perhubungan Bali)	An EV-specific planning document covering target settings for EV implementation for cars, motorcycles, and buses in Bali province.
Bali Transportation Master Plan 2018-2023	Master Plan Sistem Transportasi Bali (MPSTB) Tahun 2018-2023, by Bali Transport Agency (Dinas Perhubungan Bali)	A transport masterplan document covering strategy and transport project implementation in Bali province to 2023
Update to Bali's Medium-term Regional Development Plan 2018-2023	Perubahan RPJMD Semesta Berencana Provinsi Bali 2018-2023 published by Bali Provincial Government in 2022	A strategic planning document for various sectoral development for Bali Province, containing vision and mission statements, directive strategy and policy, and funding program.
Bali Economy Road Map 2021	Transformasi Ekonomi Bali, 2021: Peta Jalan Ekonomi Kerthi Bali Menuju Bali Era Baru, Tangguh, dan Sejahtera by Bappenas	A report for roadmap consisting of medium and long-term strategy and actions for economic recovery of Bali

National Medium-Term Plan 2020-2024 and Draft Concept of National Medium-Term Plan 2025-2029	Rencana Pembangunan Jangka Menengah Nasional (RPJMN 2020-2024) and Konsep Rancangan Teknokratik RPJMN 2025-2029, by Bappenas	Two documents contain national strategy and program for sectoral development for the medium term - for 2020-2024 (full document) and 2025-2029 (draft concept document)  (see more in Section 3.1.3 for elaboration of strategy and target set in this document)
PLN's Electricity Supply Business Plan 2021-2025	Rencana Usaha Penyediaan Tenaga Listrik 2021-2030 by PLN (National Electricity Company)	A strategic plan document for supply and demand of electricity in Indonesia wide by province and island.  (see more in Section 3.5 for the elaboration of the target set by PLN as discussed under the existing Electricity Grid)
EV Infrastructure Development Road Map 2020-2024	Road Map Pengembangan Infrastruktur Kendaraan Listrik 2020 – 2024, by Ministry of Energy and Mineral Resource	PowerPoint presentation summarizing vision and targets for EV infrastructure implementation in major cities in Indonesia by 2025
Green Growth Program for Indonesia (GGP3 2021-2025)	Indonesia Country Planning Framework 2021-2025 published by GGGI	A planning document presenting the strategic priorities that GGGI aims to pursue in partnership with the Government of Indonesia. It serves as a foundation for the GGGI country program and provides strategic direction to guide GGGI's activities and maximize their positive impact on Indonesia's development goals.  (see more in Section 3.1.4 for elaboration of strategy and target set in this document)
ADB Electric Motorcycle Roadmap 2022	Electric Motorcycle Roadmap 2022 by Asian Development Bank	A Report for road map of policies and action plans for implementation of electric motorcycles in Greater Jakarta and Bali, Indonesia

## 1.4 Methodology Adoption

### 1.4.1 Methodology

In the transition to a national transport system reliant on electricity, the main approach adopted in developing the E-Mobility Roadmap for Bali, Indonesia, is conducting a comprehensive analysis of the three main interrelated subjects that are the fundamental building blocks for E-mobility. These three subjects include:

- Charging infrastructure
- Electric vehicles
- Electricity grid

The development of coherent, efficient, and sufficient charging infrastructure is dependent on the level of uptake of EVs in the study area. The level of uptake of EVs is, on the other hand, related to the development of the charging infrastructure, as it is a fundamental basis for investment in EVs that the charging infrastructure is present. Hence, each factor becomes a prerequisite for the other. When establishing an efficient charging infrastructure network capable of delivering EVs' power (kWh), the electricity grid may become a bottleneck. It is, therefore, important from the outset to consider the capacity of the grid and the level of green power available.

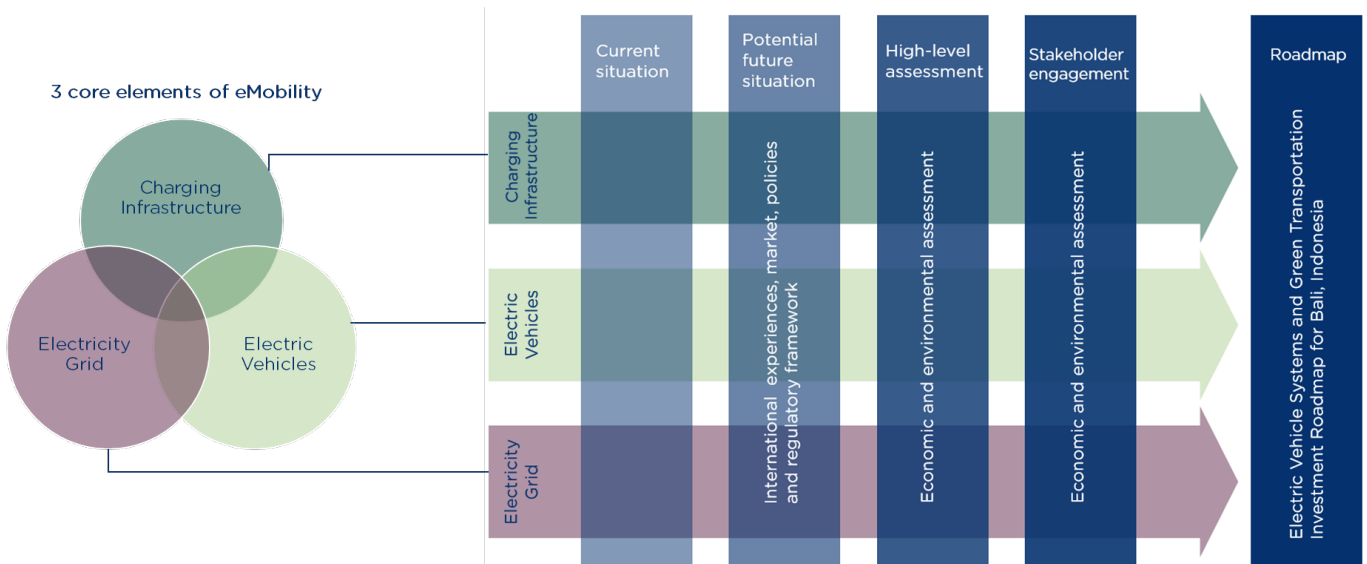
However, the batteries of EVs connected to the electricity grid via charging points may also, in time, become an important component of the energy system. They could work as battery energy storage systems (BESS), delivering ancillary services and sending energy back to the grid when demand is high, or the level of renewable energies is low. For this reason, the e-Mobility system can have a potential positive impact on the grid, as well as putting it under pressure.

When developing the roadmap for e-Mobility in Indonesia, each of the three subjects is analyzed and considered in terms of the following analytical focus areas:

- current situation: in terms of market, strategic directions, policies, and regulatory framework
- potential future situation: in terms of market, policies, and regulatory framework
- high-level economic and environmental assessment

Based on the findings, dialogues with stakeholders will be organized to develop an e-mobility roadmap for Bali, Indonesia.

**Figure 6. Focus Area and Overall Approach**



### 1.4.2 Focus of the Report

Being a popular tourist destination in Indonesia, Bali might have unique dynamics in terms of car and motorcycle ownership characteristics. Many residents and businesses may own cars to cater to the tourism industry, transportation services, and local commuting needs. On the other hand, due to the range of types of businesses on the island, terrains, and road characteristics, motorcycle use is arguably in demand.

This research focuses on efforts to promote sustainable mobility by introducing electric vehicles specifically to the Bali region. In a more high-level qualitative approach, the focus may also extend to cover the potential contribution to the promotion of electric vehicle implementation nationwide.

The study relies on gathering comprehensive data on the adoption and utilization of electric vehicles within Bali's unique context. The collected data will subsequently serve as a basis for meaningful comparisons in the subsequent analyses of the study, allowing for a nuanced understanding of electric vehicles' role in fostering sustainable transportation practices in Bali.

The analyses involve assessing the correlation between the population data on electric vehicles and the availability of charging facility infrastructure, as well as assessing other various aspects of current situations including policies that have been implemented. This provides insights into the alignment between infrastructure development and the actual demand for electric vehicles in Bali that is in conjunction with the effects made by the policies strategy, hence addressing any policy improvements needed to ensure its effectiveness in progressing the EV ecosystem in Bali.

The outcome of analyses will be largely based on analyzing the directive strategy set and potential interventions to the current policy that may influence EV utilization in the region. The extent of the details of the analysis conducted for this study will depend on the level of detail of the data available, which will be used as the basis of the review.

Through a comprehensive examination of the data and the analyses, the study recommends a detailed roadmap for e-Mobility in Bali for the upcoming period until 2040 that addresses the following (not limited to) topics of discussion:

- What are strategies for E-mobility that have been planned?
- What ranges of policies and measures have been implemented?
- How has it been successful?
- What are the gaps, and what needs to be improved?
- What would be the expected implementation scenario under this study?



## 2. BASELINE ASSESSMENT FOR BALI AND INDONESIA

The section explains the current situation to make a baseline for the EV Roadmap for Bali, Indonesia.

### 2.1 Review of Key Planning Documents

#### 2.1.1 Sustainable Urban Mobility Plan for the Sarbagita Metropolitan 2022-2030

The “Sustainable Urban Mobility Plan (SUMP) for the Sarbagita Metropolitan” (SUMP Sarbagita) is one of the relevant key planning documents that highlight the importance of Sustainable Urban Mobility Planning in the Sarbagita Metropolitan Area (SMA), which is an agglomeration covering several regions in Bali Province comprising Denpasar City, Badung, Gianyar, and Tabanan Regencies. The document focuses on accessibility, economic performance, and quality of life. The goal of the plan is a comprehensive, integrated approach to improve urban mobility, considering modes, safety, environmental impact, and economic viability. It aims to align with national objectives, regional plans, and transportation strategies by involving citizen and stakeholder engagement, cooperation across institutions, and integration with regulations.

The SUMP for Sarbagita is presented in three key document volumes: the Baseline Assessment, Scenarios and Strategies, and Action Plans. The key outcome of the document sets the transport strategy and action plans for 2022-2030 that focus on measures to address the following themes:

1. Quality transit services measures
2. Mobility improvements measures
3. Spatial development measures
4. Street vendors and freight strategy measures
5. Metropolitan urban mobility management measures

Strategy towards electric mobility is highlighted as part of measures focused explicitly on quality transit services, mobility improvement, and mobility management. Some action plans to support are summarized as follows:

- Promotion of e-mobility implementation in several zones, including Activity Centers (CBDs), Activity Centers (tourism), and community transit stops. This may include introducing charging facilities throughout SMA, parking facilities, and E-mobility zones in a few areas.
- The introduction of the Bali Low Emission Zones Initiative (BLEZI) will only be accessible to Zero-emission Vehicles. The Bali Transport Agency has introduced this zone to cover areas including Denpasar City, Kuta, Sanur, Nusa Dua (ITDC), Ubud, Nusa Penida, and Besakih.
- Promotion to shift from ICE motorcycles to electric-powered motorcycles (including e-scooters and e-bikes) through the provision of facilities such as charging, parking, e-motorbike lane, and the introduction of an e-bike sharing system.
- A full (100%) battery-electric public bus fleet is expected by 2030 by providing relevant facilities such as high-power charging at transit stops and maintenance facilities.
- Logistic hubs must be provided with relevant facilities, including charging spots.

### 2.1.2 Regional Action Plan (RAD) for Electric Vehicles in Bali Province 2022-2026

The “Regional Action Plan for Electric Vehicles in Bali (Bali EV *Rencana Aksi Daerah/* RAD) is a strategy document that discusses EV implementation for the entire island of Bali, covering the technical, institutional plan, and financial aspects of the transition that is designed to promote sustainable and efficient electric mobility within the province of Bali. The Indonesian government, particularly in Bali, initiated the plan to encourage the use of Electric Vehicles (*Kendaraan Bermotor Listrik Berbasis Baterai* or KBLBB) to reduce air pollution and greenhouse gas emissions and stimulate economic recovery.

The document is prepared based on two key regulations, including President Regulation No. 55, 2019, and Governor Regulation No. 48, 2019. In addition, the provincial government established a Committee for Acceleration of Electric Vehicles under Governor Decree No. 548/03-6/HK/2020, which is responsible for preparing the implementation of the Regional Action Plan.

The Bali EV RAD focuses on three main targets: (1) increasing the use of Electric Vehicles (cars and motorcycles), (2) incorporating electric buses into public transportation, and (3) reducing carbon dioxide (CO<sub>2</sub>) emissions.

The Bali EV RAD sets out five strategy pillars. The first pillar, Management, underscores the importance of qualitative management, shifting the focus away from numerical metrics. It emphasizes components vital to the electric vehicle ecosystem, considering factors such as infrastructure reliability, regulatory frameworks, stakeholder collaboration, gender equality, disability inclusion, and social inclusion in the committee’s composition.

The second pillar, Infrastructure, outlines specific targets for developing electric vehicle charging infrastructure. In a moderate scenario, the target set electric vehicle usage of 5,719 units of electric cars and 146,808 units of electric motorcycles by 2026. In addition, electric buses will be operated for 50 units by 2026. The above sets a reduction of CO<sub>2</sub> emission by 41,516 (tons of CO<sub>2</sub>) by 2025 for the moderate scenario. From charging station (*Stasiun Pengisian Kendaraan Listrik Umum/* SPKLU) perspective, by 2026, the moderate scenario targets implementation of vehicle charging stations (SPKLU) of 145 units, general electric charging stations (*Stasiun Pengisian Listrik Umum/* SPLU) of 876 units and battery swap stations (*Stasiun Penukaran Baterai Kendaraan Listrik Umum/* SPBKLU) of 2,920 units across Badung, Bangli, Buleleng, Gianyar, Jembrana,

Karangasem, Klungking, Denpasar and Tabanan. This target is set along with other targets for implementing charging facilities for public buses and household charging and its supporting maintenance facilities.

The third pillar represents a strategic target, concentrating on the battery life cycle within the electric vehicle framework. For instance, the plan targets several units for facilities supporting battery production, maintenance, and proper end-of-life disposal or recycling.

The fourth and fifth pillars set out some targets to address the concerns for several aspects, including community capacity building and a funding strategy to support the EV roadmap in Bali.

Given the main target sets, the implementation scenario of e-mobility adoption in Bali is expected to bring economic benefit due to the following parameters:

- Reduction in petrol fuel consumption
- Air quality and health improvement
- Reduction in Vehicle Operational Cost
- Reduction of Carbon Footprint

### 2.1.3 National Medium-Term Development Plan 2020-2024

The “Indonesia’s Medium-term National Development Plan 2020-2024” (RPJMN 2020-2024) provides a deeper insight into the long-term plans for Indonesian society, highlighting how crucial the 2020-2024 National Medium-Term Development Plan (RPJMN) is within the broader 2005-2025 National Long-Term Development Plan (RPJPN). Aligned with the RPJPN directives, the 2020-2024 goals aim to establish an independent, developed, just, and prosperous society by fostering accelerated development, emphasizing a robust economic structure based on regional competitive advantages and skilled human resources. The RPJMN integrates Sustainable Development Goals (SDGs), with several SDGs and indicators becoming integral to the government’s seven development agendas.

In RPJMN 2020-2024, as for the macroeconomic targets, Indonesia’s economic growth is expected to increase by an average of 5.7-6.0% per annum at the national level (by an average of 5.9% per annum at the Java and Bali level), which expected to be achieved through increased productivity, sustainable investment, and improvement in the labor market and the quality of human resources. While on RPJMN 2025-2029, the economic growth is expected to increase by an average of 6.8-7.9% per annum at the national level (by an average of 6.2-7.4% per annum at the Bali and Nusa Tenggara level).

In RPJMN 2020-2024, under the agenda of Strengthening Infrastructure to Support Economic and Basic Services development, where relevant to the strategy toward electrification of mobility, the government focuses on enhancing technology adoption and innovation, developing sustainable programs, seeking energy alternatives for replacing fossil fuels for cleaner energy utilization.

As a result, such focuses also determine the Ministry of Energy and Mineral Resources Strategic Plan 2020-2024 towards electric vehicle implementation in Indonesia, which may lead to recent actions in establishing a battery company and accelerating the number of charging point facilities across major cities in Indonesia. This period was the initial momentum plan up to 2023 for Indonesia to introduce and prepare the electric vehicle ecosystem.

## 2.1.4 Technocratic Concept for National-Medium Term Development Plan 2025-2029

In moving forward from the existing RPJMN, a draft or following RPJMN of Technocratic Concept for the National Mid-Term Planning 2025-2029 has been prepared. The draft RPJMN 2025-2029 includes policy direction for the development of electric vehicles and the construction of PEVCS (Public Electric Vehicle Charging Stations) in the provinces of DKI Jakarta, West Java, Yogyakarta Special Region, East Kalimantan, and Bali as a form of economic transformation.

From the perspective of future expectations of EVs in Indonesia, the government, through the Coordinating Ministry of Maritime and Investment, has expressed a target of 2 million units of 4-wheeler EVs in Indonesia by 2030 and 15 million units of 2-wheeler EVs for the same year.<sup>1</sup>

## 2.1.5 Draft Final National Long-term Development Plan 2025-2049

Moving forward from the previous long-term development, the Final Draft of the National Long-term Development Plan (RPJPN) 2025-2045, the Sustainable Agenda, is set as one of the visions towards Golden Indonesia 2045. As one of the target settings to achieve the vision, the intensity of Green House Gas Emission reduction towards net zero emission (2060) is set to be reduced by 38.6% in 2025 and by 93.5% in 2045. This implies that E-mobility progression will be expected to contribute to this target setting.

In terms of energy sector transition, the RPJPN 2025-2045 also indicates several targets relevant to e-mobility progression in Indonesia:

- E-mobility. The 2025-2029 period will expect a significant increase in EV use, followed by massive use of EVs in the following years towards 2045.
- Transition from fossil fuel energy to renewable energy. The 2025-2029 period will see a subsidy transition to renewable energy, followed by capacity expansion of renewable energy power in the following year, towards 2045.
- Electricity grid. The 2025-2029 period will see the development of an electricity grid that adopts interconnectivity and smart grid technology, followed by the expansion of this technology.

## 2.1.6 Green Growth Program (GGP3 2021-2025)

The Green Growth Program (GGP3 2021-2025) discusses the Country Planning Framework (CPF), which outlines the strategic priorities of the Global Green Growth Institute (GGGI) in collaboration with the Government of Indonesia. It aligns with Indonesia's commitment to green growth and national development plans, emphasizing sustainable infrastructure, human development, and public services. The CPF for 2021-2025 focuses on programmatic solutions, including Green Investments, Green Growth and Climate Action, Sustainable Forests, Renewable Energy, and Green Industries. GGGI aims to support Indonesia in achieving its Nationally Determined Contributions (NDCs) and green growth goals by leveraging policymaking, mobilizing investments, and building capacity. The CPF is informed by past successes, lessons learned, and evaluations, and it aligns with GGGI's global operational priorities and Strategy 2030. The collaborative effort aims to mainstream green

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1 HariantoM.,2023.AntaraNews:'Targetpemerintah2030,15jutakendaraanlistrik"mengaspal"diIndonesia'<https://bali.antaranews.com/berita/334728/target-pemerintah-2030-15-juta-kendaraan-listrik-mengaspal-di-indonesia#:~:text=Kementerian%20Koordinator%20Bidang%20Kemaritiman%20dan,dapat%20mencapai%2015%20juta%20unit.>

growth into national and provincial planning processes, contributing to sustainable and inclusive economic development in Indonesia.

## 2.2 Review of the Current Key Regulatory Framework

### 2.2.1 Overview of Fundamental Regulatory Framework

For the improvement of energy efficiency, energy resilience, and energy conservation in the transportation sector, as well as the realization of clean energy, clean air, environmentally friendly, and Indonesia's commitment to reduce greenhouse gas emissions, it is necessary to accelerate the Battery-based Electric Vehicle ("BEVs") program for road transportation. Based on this, Presidential Regulation No. 55/2019 concerning the Acceleration Program of Battery Electric Vehicles for Road Transport was established and amended by **Presidential Regulation No. 79/2023**.

In response to Presidential Regulation No. 79/2023, the Indonesian Government aims to expedite the electrification of electric vehicles (EVs) through a range of fiscal and non-fiscal incentives. Notably, the regulation amends Article 8, establishing a Minimum Local Content Requirement (*Tingkat Komponen Dalam Negeri/TKDN*) of 40 percent for EVs until 2026. Additionally, incentives are outlined in Article 18, benefiting companies in the BEV industry procuring Completely Built-Up (CBU) imported vehicles. Incentives, as specified in Article 17 paragraph (i), extend to companies providing Public Electric Vehicle Charging Stations ("**SPKLU**"), Public Electric Vehicle Battery Swap Stations ("**SPBKLU**"), and entities using private electrical installations. The regulation also addresses import quotas for EVs, linking them to commitments from automotive manufacturers investing in Indonesia. Furthermore, the regulation encourages research, development, and innovation in battery-based vehicle technology by industrial companies, universities, and research institutions. Various fiscal incentives, purchasing schemes, and exemption/reduction of local taxes are introduced to expedite the Battery-Based Electric Vehicle program. Specific details and penalties are outlined in ministerial regulations, emphasizing the importance of Ministerial specifications for BEVs and government incentives to support the program.

### 2.2.2 Regulation for EVs at the National Level

The national-level regulations applicable in Indonesia that govern EVs are as follows:

- Law Number 22 of 2009 concerning Traffic and Road Transport as amended by Government Regulation concerning Law Number 22 of 2022 ("Law 22/2009");
- Law Number 16 of 2016 concerning the Ratification of the Paris Agreement to The United Nations Framework Convention on Climate Change ("Law 16/2016");
- Law Number 4 of 2023 concerning the Development and Strengthening of Financial Sector ("Law 4/2023");
- Government Regulation Number 55 of 2012 concerning Vehicles as partly repealed by Government Regulation Number 30 of 2021 ("Government Regulation 55/2012");
- Government Regulation Number 46 of 2017 concerning Environmental Economic Instruments ("Government Regulation 46/2017");
- Presidential Regulation Number 55 of 2019 concerning the Acceleration Program of Battery Electric Vehicle for Road Transport as amended by Presidential Regulation Number 79 of 2023 ("Presidential Regulation 55/2019");

- Presidential Regulation 98 of 2021 concerning the Implementation of Carbon Economic Value for Achieving Nationally Determined Contribution Targets and Controlling Greenhouse Gas Emissions in National Development (“Presidential Regulation 98/2021”);
- Minister of Maritime Affairs and Investment Regulation Number 8 of 2020 concerning the Work Arrangement of the Coordination Team for The Acceleration of Battery Electric Vehicle Programs for Road Transportation and Working Groups (“Minister of Maritime Affairs and Investment Regulation 8/2020”);
- Minister of Transportation Regulation Number 9 PM 99 of 2020 concerning Subsidy for Urban Public Transport (“Ministry of Transportation Regulation 9/2020”)
- Minister of Transportation Regulation Number PM 44 of 2020 concerning the Physical Type Testing of Motor Vehicles with Electric Motor Propulsion as amended by Minister of Transportation Regulation Number PM 86 of 2020 (“Ministry of Transportation Regulation 44/2020”);
- Minister of Transportation Regulation Number 15 of 2022 concerning the Conversion of Motor Vehicles Other Than Motorcycles with Internal Combustion Engines into Battery Electric Vehicles (“Ministry of Transportation Regulation 15/2022”);
- Minister of Transportation Regulation Number PM 39 of 2023 concerning the Conversion of Motorcycles with Internal Combustion Engines into Battery Electric Motorcycles (“Ministry of Transportation Regulation 39/2023”);
- Minister of Energy and Mineral Resources Number 1 of 2023 concerning Provisions of Charging Infrastructure of Battery Based Electric Vehicles (“Minister of Energy and Mineral Resources Regulation 1/2023”);
- Minister of Industry Regulation Number 6 of 2022 concerning Specifications, Development Roadmap, and Provisions for Calculating the Value of the Domestic Component Level of Battery Electric Vehicles (“Minister of Industry Regulation 6/2022”);
- Minister of Industry Regulation Number 29 of 2023 concerning Battery Electric Motor Vehicles in a Completely Disassembled State and an Incompletely Disassembled State (“Ministry of Industry Regulation 29/2023”);
- Minister of Industry Regulation Number 6 of 2023 concerning Guidelines for Government Assistance for the Purchase of Two-Wheeled Battery Electric Motor Vehicles as amended by Minister of Industry Regulation Number 21 of 2023 (“Ministry of Industry Regulation 6/2023”);
- Ministry of Home Affairs Regulation Number 6 of 2023 concerning the Basis for Imposing Motor Vehicle Taxes, Vehicle Ownership Transfer Fees, and Heavy Equipment Taxes for the Year 2023 (“Ministry of Home Affairs Regulation 6/2023”);
- Minister of Finance Regulation Number 38 of 2023 concerning Value Added Tax on The Delivery of Specific Four-Wheeled Battery-Based Electric Vehicles and Specific Battery-Based Electric Buses Covered by The Government Fiscal Year 2023 as amended by Minister of Finance Regulation Number 116 of 2023 (“Ministry of Finance Regulation 38/2023”);
- Minister of Environment and Forestry Regulation Number 21 of 2022 concerning the Implementation of Carbon Economic Value (“Minister of Environment and Forestry Regulation 21/2022”);

- Minister of Environment and Forestry Regulation Number 6 of 2021 concerning Procedures and Requirements for the Management of Hazardous and Toxic Substance Waste (“Minister of Environment and Forestry Regulation 6/2021”);
- Financial Services Authority (OJK) Regulation Number 60/POJK.04/2017 concerning Issuance and Requirements of Green Bond (“OJK Reg. 60/2017”);
- Financial Services Authority (OJK) Regulation Number 14 of 2023 concerning Carbon Trading through the Carbon Exchange (“OJK Reg. 14/2023”);
- and other related laws and regulations.

### 2.2.3 Regulation for EV at the Bali Regional Level

The Bali Province Level Regulations applicable in Indonesia that govern EVs are as follows:

- Bali Regional Regulation Number 4 of 2016 on Traffic and Road Transport (“**Bali Province Reg. 4/2016**”)
- Bali Governor Regulation Number 48 on 2019 concerning Use of Battery-Based Electric Motor Vehicles (“**Bali Governor Reg. 48/2019**”)
- Bali Governor Regulation Number 44 of 2023 on Integrated Transportation Infrastructure Masterplan in Bali (“**Bali Governor Reg. 44/2023**”)
- and other related laws and regulations.

### 2.2.4 Summary of the Range of Existing Policies Implemented To Promote EV

Based on various regulations governing E-mobility preparation and implementation as part of an effort to reduce the carbon footprint in Indonesia, the following Table 7 summarizes the current range of policies driving E-mobility realization at Indonesia nation-wide and Bali provincial-wide levels.

**Table 7. Summary of the Range of Existing Policies Implemented to Promote for EV in Indonesia & Bali**

Existing Fiscal Policies	Existing Non-Fiscal Policies
<ul style="list-style-type: none"> <li>• Law No. 1/2022: Vehicle tax ownership (PKB) and transfer name fee (BBNKB) exemption (0%) for renewable energy vehicles.</li> <li>• Presidential Reg. (PR) No. 55/2019 as amended by Presidential Reg No. 79/2023: Range of reduction/ exemption of taxes to importation, luxurious goods, sales, purchase vehicle ownership.</li> <li>• Government Reg. No. 74/2021: Exemption (0%) of sales tax on luxury goods (PPnBM) for EV.</li> <li>• Ministry of Home Affairs Reg. No. 6/2023: yearly tax ownership (PKB) and title transfer fee (BBNKB) that 0% of its imposition taxation fee.</li> <li>• Ministry of Industry Reg. No. 6/ 2023 as amended by MoI Reg. No. 21/2023: IDR 7 Mill. Subsidy is required for individuals or companies to purchase e-motorcycles.</li> <li>• Ministry of Finance Reg. 38/2023 as amended by Ministry of Finance Reg No. 116/2023: 5-10% tax relief for the VAT for delivery of certain EV and E-bus that meet local component criteria.</li> <li>• Ministry of Finance Reg. 138/PMK.02/2021: Vehicle Type Test cost for BEV is cheaper than ICEV; IDR 4.5 million for E2W, IDR 13.2 million for E4W and E-bus. Type Test Certification (Sertifikat Uji Tipe/SUT) for E2W is 25 times cheaper, while E4W and E-bus are six times cheaper than ICEV.</li> <li>• OJK (Otoritas Jasa Keuangan/ Financial Services Authority) Circulation: Risk Weighted Assets (RWA/ATMR) for EV financing (producing and buying) is reduced from 75% to 50%. EV credit purchase payment could cost 0% (without a down payment).</li> </ul>	<ul style="list-style-type: none"> <li>• Presidential Reg. (PR) No. 55/2019 as amended by PR No. 79/2023: range of non-fiscal policy for EV</li> <li>• Ministry of Transportation Reg. No. 65/2020: Regulate the conversion to EV for 2W vehicles.</li> <li>• Ministry of Transportation Reg. No. 15/2022: Regulate the conversion to EV for <u>vehicles other than 2W</u>.</li> <li>• Ministry of Industry Reg. No. 6/2022: Technical requirements and LCR guideline.</li> <li>• Presidential Instruction No. 7/2022: Adoption for government official vehicle.</li> <li>• Ministry of Energy and Mineral Resources Reg. No. 13/2020: Standardizing charging plugs and electricity tariff policy for public electric vehicle charging stations and public electric battery vehicle replacement.</li> <li>• Ministry of Transportation Reg. 44/2020: EV testing and certification process.</li> <li>• Ministry of Transportation Reg. No. 45/2020: It regulates special vehicles with electrical motors, including safety requirements, riding behavior, and vehicle lane.</li> </ul>
<p>Bali Regional Policy</p> <ul style="list-style-type: none"> <li>• Bali Province Reg. No. 4/2016: Operation cost subsidy of operating E-bus.</li> <li>• Bali Governor Reg. No. 48/2019: Incentives to support EV owners and users and incentives to various industries that utilize EV technology or contribute to any life cycle of EV implementation.</li> <li>• Bali Governor Reg No. 9/2021 with latest amended by No. 52/2023: Tax relief for vehicle ownership (PKB) and transfer title fee (BBNKB).</li> </ul>	<p>Bali Regional Policy</p> <ul style="list-style-type: none"> <li>• Bali Governor Reg.No.48/2019: Restriction to fossil-fuel vehicle at certain areas/zones – to be defined; establishment of a committee for accelerating EVs in Bali.</li> <li>• Governor Circulation 8/2023: Government officers to use electric vehicles and non-motorized transport.</li> </ul>

## 2.3 Current Vehicle Fleet in Bali and Indonesia

This section provides information about the statistics and characteristics of vehicle fleets in Bali and Indonesia, highlighting specifically the above vehicle categories.

In assessing the current conditions of vehicle utilization and deployment for transition to EV, the following are vehicle categories discussed in this report and their definitions by Indonesian Law (UU No. 22 /2009).

1. The motorcycle category includes motorized 2-wheelers with or without a sidecar and motorized 3-wheelers without a sidecar.
2. Passenger car category includes motorized vehicles that can accommodate up to 8 passengers and weigh less than 3,500 kg. These may consist of sedans, jeeps, MPVs, and SUVs.
3. Bus category includes motorized passenger vehicles/ public vehicles that can accommodate more than eight passengers and weigh more than 3,500 kg. This may consist of public and shuttle buses that provide services to the public.
4. Other category. Where relevant, the study may extend the assessment to include other categories, such as all other vehicles used for commercial use.

### Overview of Vehicle Use

As per data on the population of motorized vehicles gathered from the Central Bureau of Statistics (*Badan Pusat Statistik Indonesia*/ BPS), there are more than 4 million units of cars in Bali (including trucks) out of more than 148 million units in the countrywide in 2022. The data shows that there has been a consistent upward trajectory in the total number of motorized vehicles in Indonesia from 2018 to 2022. The projections indicate a notable increase in every category of vehicles during this period. This growth encompasses various types of vehicles, including cars, motorcycles, trucks, and other motorized modes of transportation. The statistics highlight a significant expansion in the automotive landscape, reflecting economic development and increased accessibility to motorized transportation.

**Table 8. Population of Vehicles Based on Types in Bali Province and Indonesia (Units) 2018 – 2022**

Vehicle Type	Number of Motorized Vehicles (Units)									
	Motorcycle		Passenger Car		Bus		Truck		Total	
Year	Bali	Indonesia	Bali	Indonesia	Bali	Indonesia	Bali	Indonesia	Bali	Indonesia
2018	3,540,179	106,836,985	435,965	14,838,106	9,163	223,011	145,927	4,804,178	4,131,234	126,702,280
2019	3,742,000	112,771,136	455,993	15,592,419	9,345	231,569	150,787	5,021,888	4,358,125	133,617,012
2020	3,798,850	115,023,039	459,369	15,797,746	9,390	233,545	151,884	5,083,405	4,419,493	136,137,735
2021	3,862,637	120,045,878	466,300	16,413,522	9,405	237,829	154,802	5,299,603	4,493,144	141,996,832
2022	3,928,964	125,267,349	474,878	17,175,632	9,417	241,215	157,894	5,528,669	4,571,153	148,212,865

Source: *Badan Pusat Statistik Indonesia, 2023*

Based on the trend for overall categories in the past five years, an average vehicle growth of 2.6% per annum for Bali and 4% per annum for Indonesia-wide can be observed. In terms of the mode split, there are similarities between mode split for the Bali level and Indonesia level, where the highest split is made by motorcycle at 85% of the total vehicle's population, about 10% is car, 0.2% is bus and remaining of 3.5% is by truck. This underscores the evolving mobility patterns and the rising demand for diverse types of vehicles across the country. This upward trend is indicative of the ongoing modernization and urbanization in Indonesia, contributing to the dynamic changes in its transportation infrastructure and signaling a robust and expanding automotive market.

Based on the 2023 data above, it can be seen that Bali possesses a fleet exceeding 4 million diesel vehicles out of the country's total of 148 million units in 2022. This establishes Indonesia as the primary sales market in South-east Asia. Consequently, there is a pressing need for a transition to mitigate carbon emissions, aligning with the objectives set by the Bali government.

In conjunction with the vehicle growth, according to the latest data from the Central Bureau of Statistics (*Badan Pusat Statistik Indonesia/BPS*), the country's population has surged to 275 million in 2022, while in Bali Province the population was recorded to be 4.3 million in 2022.

To put into context of characteristics of vehicle ownership in Bali and Indonesia in 2022, the motorcycle ownership rate was 450 units per 1,000 population in Indonesia. In Bali, it was 900 units per 1,000 population – which is twice higher ownership rate of it is for Indonesia-wide. As for car ownership, the rate was 63 units of cars per 1,000 population in Indonesia and 108 units of cars per 1,000 population in Bali province. The above suggests that in Bali, the number of motorcycles has been more than 8 times the number of cars.

When considering the assumption that an average family would consist of four individuals, each family in Bali would have had at least 3 units of motorcycles. Whilst in Indonesia-wide, each family would have 1-2 units of motorcycle. In addition, motorcycle use is expected to be even higher beyond family use, due to the tourism industry that takes into consideration the motorcycle rental industry for the benefit of significant numbers of individual tourists traveling with motorcycles within Bali.

Briefly, such a significant growth in the use of vehicles in Bali would impose significant issues of traffic congestion and more immediate road deterioration. On the other hand, the government's plan to implement a railway system in Bali would become an influencing driver, and the number of vehicles used in Bali will have a slower growth when this system is in place.

Considering the number of cars and motorcycles registered in Sarbagita and Bali Province, we can gain valuable insights into Indonesian car and motorcycle ownership rates, specifically in the context of Bali. It is important to note that although the population in these regions represents a diverse demographic, analyzing the registered vehicles in these regions can provide insight into the vehicle landscape. A comparison of these data can be made between the car ownership rate, which indicates the prevalence of private vehicles, and the motorcycle ownership rate, which reflects the popular use of two-wheelers for personal transportation. It is crucial to understand these ownership rates to determine mobility patterns and preferences within a local community, which will lay the groundwork for a more comprehensive exploration of the factors influencing vehicle choices and transportation habits.

## 2.3.1 Motorcycles

### 2.3.1.1 Motorcycle Population and Sales Over the Last 3-5 Years

On the national scale, highlight motorcycles have become a pervasive mode of personal transportation, with over half of the population relying on them for commuting. The prevalence of 2-wheelers is a testament to their affordability, fuel efficiency, and adaptability to the country's diverse road characteristics. On the other hand, the ownership of 4-wheelers is relatively less common, with an average of 5.9% of the population having private cars. The statistics highlight the dominant role of 2-wheelers in fulfilling the transportation needs of the majority in Indonesia, reflecting the practical choices made by a significant portion of the population in navigating the country's transportation landscape.

According to data from the Indonesian Statistic Body, the number of registered motorcycles in Indonesia continues to increase from 107 million units in 2018 to 125 million units in 2022. The past yearly growth was about 5.6% per annum in 2019 (before the pandemic) and dropped to 2% per annum in 2020 due to COVID-19. In 2021 and 2022, the growth regained above 4% per annum.

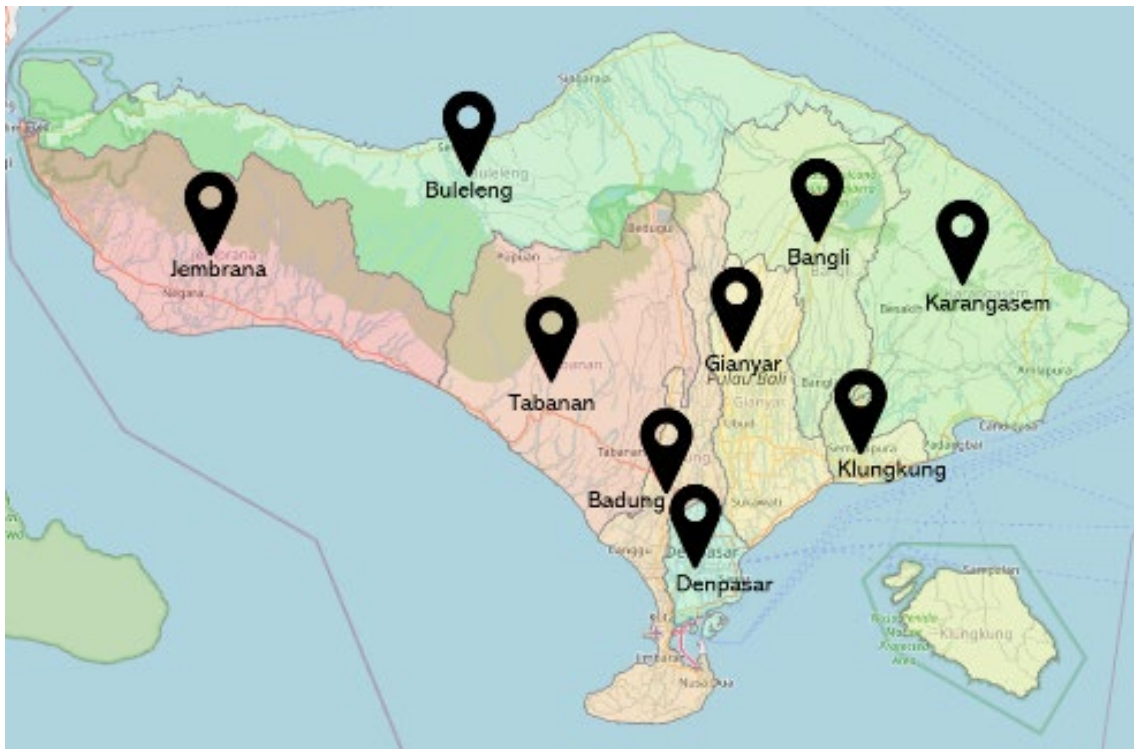
**Table 9. Number of Registered Motorcycles in Indonesia 2018-2022 (Units)**

Vehicle Type	2018	2019	2020	2021	2022
Motorcycle (units)	106,836,985	112,771,136	115,023,039	120,045,878	125,267,349
Growth (% p.a)	-	5.6	2.0	4.4	4.3

Source: Badan Pusat Statistik Indonesia, 2023

When looking into Bali province, it is essential to understand that the island is divided into eight regencies and one city, including Badung, Bangli, Buleleng, Gianyar, Jembrana, Karangasem, Klungkung, Tabanan, and Denpasar City as the primary administrative and economic hub of Bali.

**Figure 7. Map of Distribution of Bali Province Based on Regencies**



Source: <https://balisatudata.baliprov.go.id/>

Based on the Bali Province Statistic Center data, the number of registered motorcycles in Bali Province from 2019 to 2023 has increased from 3,516,415 units in 2018 to 4,303,266 units in 2023. Overall, motorcycle growth in Bali has been in a range of 5.2-5.8% per annum, except for the slow growth in 2020 (2.5%) and 2021 (1.7%) due to the impact of COVID-19.

**Table 10.** Number of Registered Motorcycle in Bali Province 2019-2023 (Units)

Regency / City	Years					
	2018	2019	2020	2021	2022	2023
Jembrana Regency	182,346	191,665	197,148	201,486	241,259	250,746
Tabanan Regency	353,638	372,297	381,547	387,740	403,076	421,599
Badung Regency	716,307	760,808	780,630	793,885	831,501	885,934
Gianyar Regency	378,049	400,424	410,553	416,902	459,933	486,450
Klungkung Regency	113,213	120,634	123,979	126,236	162,346	170,966
Bangli Regency	98,529	104,972	108,383	110,761	118,476	124,491
Karangasem Regency	168,654	181,836	187,976	192,256	206,877	221,683
Buleleng Regency	387,154	410,279	421,426	429,917	450,766	476,575
Denpasar City	1,118,525	1,175,721	1,200,315	1,218,412	1,205,383	1,264,822
Bali Province	<b>3,516,415</b>	<b>3,718,636</b>	<b>3,811,957</b>	<b>3,877,595</b>	<b>4,079,617</b>	<b>4,303,266</b>
Growth (%p.a.)		5.8	2.5	1.7	5.2	5.5

Badan Pusat Statistik Bali Province, 2024

### 2.3.1.2 Progression of E-Motorcycle Development

As indicated in the previous section, E-motorcycle use in Bali increased from 1,532 units to 4,995 units in 2022 and 2023, a growth rate of 226% per annum in 2023. Compared with Bali EV RAD, these are about 4-5 times lower than expected for the Moderate scenario. However, in comparison with the Pessimistic scenario, the actualization for 2022 and 2023 has shown slightly higher figures.

**Table 11.** Actualization of E-Motorcycle in Bali vs. Bali EV RAD (Units)

Years	2022	2023
Actualization of E-motorcycle in Bali (units)	1,532	4,995
EV Bali RAD projection for E-motorcycle (Moderate Scenario)	7,858	20,463
EV Bali RAD projection for E-motorcycle (Pessimist Scenario)	1,179	2,456

Source: Consultant Analysis

Based on data collected by Grütter Consulting (2021) and included in the Asian Development Bank's report on an electric motorcycle charging infrastructure Roadmap for Indonesia (2022) focuses on Greater Jakarta, i.e., DKI Jakarta, Bogor, Depok, Tangerang and Bekasi (JABODETABEK), and Bali. It is possible to develop charging infrastructures suitable for densely populated urban areas and nonurban areas with dense populations. A comparison between urban and nonurban zones can be made based on the results from these "typical" areas.

**Table 12.** Projected Number of E-Motorcycles With Existing Regulatory Interventions (Million Operational Units)

Area	2022	2023	2024	2025	2026	2027	2028	2029	2030
Indonesia	0.80	2.90	7.30	12.00	18.60	26.00	35.00	45.00	56.00
Bali	0.03	0.09	0.24	0.40	0.60	0.86	1.16	1.48	1.85

Source: Grütter Consulting, 2021

In contrast with the projection for e-motorcycle in Bali EV RAD, the projected number of e-motorcycles in the Grütter Consulting report is expected to witness a significant increase, especially with regulatory interventions playing a crucial role in shaping the landscape. The adoption of electric motorcycles is not only a national consideration but is particularly vital in densely populated regions in Indonesia, such as Bali (as well as Greater Ja-

karta). Given their prevalence and popularity, e-motorcycles have become the vehicle of choice for operational daily usage, contributing to sustainable and environmentally friendly transportation practices.

**Table 13. E-Motorcycle (E2W) Availability and Specifications for Indonesia**

No.	Vehicle Model & Type		Battery Capacity (kWh)	Battery Range/ Mileage (km)	Charging Type	Charging Time (hour)	Max. Speed (km/h)
1	Selis Mandalika	Selis	0.43	30	Not Detachable (DC)	6 with 80 W charging power	30
2	New Q1	Viar	1.38	60	Detachable (AC)	4-5 hours	60
3	Gesits	Gesits	1.44	50	Detachable (DC)	3-4 hours	70
4	Gova 03	Niu	2.4	70	Built In (DC)	7	70
5	United T1800	United	1.68	65	Detachable (AC)	5	70
6	Smoot Tempur	Smoot	1.44	60	Detachable (DC)	4	60
7	Volta 401	Volta	1.2	60	Detachable (DC)	6	60

Source: Consultant Analysis

The market availability information for Electric Two-Wheelers (E2W) is presented in Table 13 above. According to interviews with representative dealers, the E2W vehicles in Indonesia exhibit a range of specifications. The Selis Mandalika features a battery capacity of 0.43 kWh, providing a range of 30 km. Its charging type is Not Detachable (DC), requiring 6 hours with 80 W charging power, and it has a maximum speed of 30 km/h. The New Q1 by Viar has a larger battery capacity of 1.38 kWh, offering a range of 60 km. This model has a Detachable (AC) charging type, with a charging time of 4-5 hours and a maximum speed of 60 km/h. The Gesits electric vehicle boasts a 1.44 kWh battery capacity, enabling a 50 km range. Its Detachable (DC) charging type requires 3-4 hours for a full charge and has a maximum speed of 70 km/h.

The Gova 03 from Niu features a substantial 2.4 kWh battery capacity, providing a 70 km range. A Built-In (DC) charging type requires 7 hours for a full charge and can reach a maximum speed of 70 km/h. The United T1800 has a battery capacity of 1.68 kWh, offering a range of 65 km. It utilizes a Detachable (AC) charging type, with a charging time of 5 hours and a maximum speed of 70 km/h. The Smoot Tempur electric vehicle has a 1.44 kWh battery capacity, providing a 60 km range. Its Detachable (DC) charging type requires 4 hours for a full charge and has a maximum speed of 60 km/h. Lastly, the Volta 401 features a 1.2 kWh battery capacity, offering a 60 km range. Its Detachable (DC) charging type requires 6 hours for a full charge and can reach a maximum speed of 60 km/h.

In Indonesia, government initiatives and policies aimed at promoting electric vehicles, coupled with regulatory interventions, are likely to accelerate the adoption of e-motorcycles. The same applies to regions like Bali (and Greater Jakarta), where urban mobility challenges necessitate innovative and eco-friendly transportation solutions. These areas are expected to witness a notable surge in the operational use of e-motorcycles due to their efficiency, lower operational costs, and reduced environmental impact.

Furthermore, successfully implementing regulatory measures, such as incentives, subsidies, and infrastructure development for charging stations, will drive the projected growth. As e-motorcycles continue to establish themselves as the primary mode of transportation for daily operations, the collaboration between the government, industry stakeholders, and local communities will be essential to ensure a seamless transition towards sustainable and electric mobility. This trend aligns with global efforts towards environmental conservation. It sets the stage for Indonesia's more resilient and eco-conscious transportation ecosystem, particularly in bustling urban centers like Bali (and Greater Jakarta).

### 2.3.1.3 Daily travel distances, parking times, and duration - for passenger motorcycle

Motorcycle users' daily travel distance is contingent upon their specific needs. On weekdays, typical work journeys span more than 8 km and involve approximately 1 to 2 hours of travel (Tunimbang et al., 2020). The information is derived from the data provided by Badan Pusat Statistik Indonesia in 2019, particularly from a table that sheds light on the prevalent use of motorcycles among commuters as their primary means of transportation.

To understand an approximate typical motorcycle users' daily travel distance between the point of origin and the destination, references from several regions were observed. The selected regions include Jabodetabek (the Greater Jakarta) and Kedungsepur Metropolitan Area (the Greater Semarang), where relevant data is available for the public. Given the limitation of the relevant data, the references from these regions are believed to represent general travel behavior of motorcycle users of Indonesia, which as well as in Bali.

In Jabodetabek region it is apparent that a significant portion of commuters travel from 10 to 19 km for relatively close distances.

In Kedungsepur Metropolitan Area (the Greater Semarang), as per BPS data, in 2020, there were 3,551,138 million motorcycles), constituting 90% of the total motorized passenger vehicle fleet. This figure implies a density of 540 motorcycles per 1,000 residents, which is 33% higher than the national average of 404 motorcycles per 1,000 residents. The majority of motorcycles (39%) were concentrated in Semarang City, with smaller distributions in Demak (15%), Kendal (14%), and Semarang Regency (13%). Salatiga had the lowest motorcycle ownership at 3%, according to the survey analysis conducted by PT. Mitra Pembangunan Jaya, the average daily travel distance for motorcycle users in Semarang City was 11.72 km, with an average daily travel time of 32 minutes and an average cost of Rp 8,400 (US \$ 0.58) per day. This amount is 44% cheaper than the average cost of travel by car.<sup>2</sup>

**Table 14.** Statistics Show that Commuters in Greater Jakarta Traveled by Distance, and the Number of Commuters Was Made by Motorcycle

Distance Travelled to the Activity Destination (km)	Number of commutes made by Motorcycle
<10	590,578
10 – 19	<b>705,399</b>
20 – 29	465,138
30 – 39	178,690
40 – 49	63,819
50 – 59	30,244
60+	28,678
Total	<b>2,062,546</b>

Source: Badan Pusat Statistik (BPS) Indonesia, 2019

Moreover, the data highlights that traveling to the nearest train station or bus stop plays a role in commuters' decision to use motorcycles, with the added convenience of utilizing park-and-ride facilities. A noteworthy 72% of commuters optional practical training for private vehicles as their primary mode of transportation for their daily round-trip commutes, underscoring the significance of individualized travel choices in this context<sup>3</sup>.

2 Penilaian Data Dasar (Baseline) Mobilitas Perkotaan di Kawasan Metropolitan Kedungsepur (KMA). KIAT. August, 2022.

3 Badan Pusat Statistik (Statistics Indonesia). 2019. Statistik Komuter Jabodetabek 2019 (JABODETABEK Commuter Statistics 2019). Statistik Komuter Jabodetabek 2019 - Badan Pusat Statistik Indonesia (bps.go.id). Accessed January 29, 2024

Furthermore, the data provides insights into commuting patterns, revealing that 79% of commuters travel less than 30 km to their desired destinations. Notably, a significant portion of commuters, approximately 34.6%, spend between 30 and 59 minutes on their daily commute, emphasizing the time dynamics involved in these journeys. Overall, the data paints a comprehensive picture of the diverse commuting habits and preferences in the Jabodetabek region, offering valuable information for understanding transportation patterns and needs.

### 2.3.1.4 Ownership and purchasing models when procuring EVs – for motorcycle

According to the Asian Development Bank, 90% of e-motorcycles are assumed to be private units, while the rest are commercial units.<sup>4</sup>

In Indonesia’s burgeoning market for electric motorcycles, several brands like Selis, Geist, Volta, and NIU have gained popularity by offering a range of products tailored to diverse consumer needs. These brands typically provide various models or types of electric motorcycles, each with different features, specifications, and corresponding price points. Taking Gesits<sup>5</sup> for example, their product line ranges from IDR 27,990,000 (USD 1797) to IDR 28,970,000 (USD 1860).

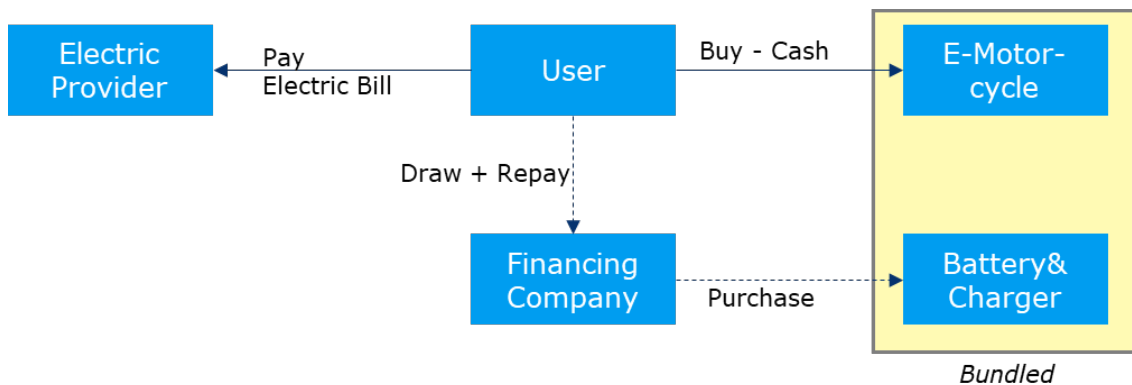
However, a noticeable disparity emerges when comparing the prices of electric motorcycles to the widely favored internal combustion engine (ICE) motorcycles, such as those from Honda. Honda<sup>6</sup>, an established brand in the ICE motorcycle market, offers models priced between IDR 18,050,000 (USD 1159) and IDR 22,550,000 (USD 1,454). Electric motorcycles from brands like Gesits appear to have a higher upfront cost than some Honda ICE motorcycles.

In terms of ownership/purchasing business model, there are several model adoptions applicable to procuring e-motorcycles, including:

#### 1. Option 1: Buy the motorcycle with the battery

The business model for this option is shown in the following Figure 8.

Figure 8. Option 1: Buy the Motorcycle with the Battery Business Model



Source: Consultant Analysis (Adopted by United, Selis, Gesit and most of e-motorcycle provider)

4 Electric Motorcycle Charging Infrastructure Roadmap for Indonesia. Asian Development Bank. October, 20225

5 <https://gesitsmotors.com/>. Accessed January 29, 2024

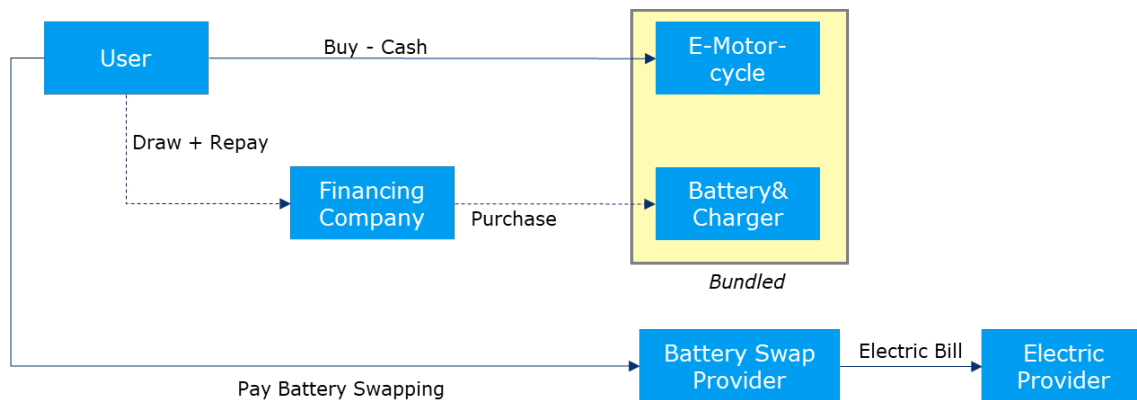
6 <https://www.astra-honda.com/product>. Accessed January 29, 2024

- At present, most EV motorcycles use this business model.
- The user could buy cash or use a financing institution.
- The battery is bundled with the motorcycle purchase.
- The user will pay the electric bill for the charging activity to PLN (electric provider)

## 2. Option 2: Buy a motorcycle with a swappable battery

The business model for this option is shown in the following Figure 9.

Figure 9. Option 2: Buy the Motorcycle with a Swappable Battery Business Model



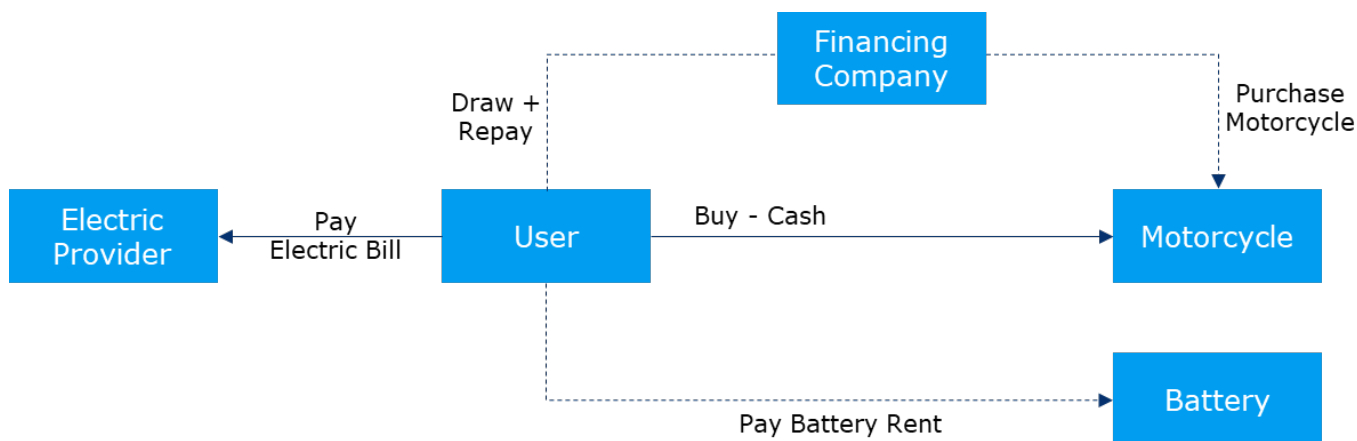
Source: Consultant Analysis (Adopted by Volta)

- Some EV motorcycles that use this business model are Volta, Smoot, and Minerva.
- The user could buy cash or use a financing institution.
- The battery is bundled with the motorcycle purchase.
- The user pays for the battery swapped to the provider, usually in range quota. There is an application to monitor the quota payment.
- The battery swap provider will pay the electric bill to PLN.
- If the user decides not to buy the range quota or if the range quota is running out, the user will still be able to use the motorcycle but will not be able to use the battery swap facility. The user will be the one to pay the electric bill to PLN for charging the battery at home.

## 3. Option 3: Buy the motorcycle only and rent the battery

The business model for this option is shown in the following Figure 10.

Figure 10. Option 3: Buy the Motorcycle and Rent the Battery Business Model



Source: Consultant Analysis (Adopted by Polytron)

- Currently, only Polytron offers this rent-the-battery business model.
- The user could buy cash or use a financing institution.
- The battery is included with the motorcycle purchase, but the user will not pay the battery price (resulting in a lower EV motorcycle purchase price).
- The user will purchase the motorcycle only and pay monthly battery rent to be able to use the motorcycle.
- The motorcycle will be bound to the online app provider by the OEM to monitor the status of the motorcycle and the rent payment.
- The user will pay the electric bill to PLN (electric provider) for the charging activity.

Besides the aforementioned business models for EV motorcycles, there is also an incentive of 7 million Rupiah to offer a discount on the purchase of the EV. However, the buyer must register their national ID to the Ministry of Industry’s online system (SISAPIRa/ <https://landing.sisapira.id/>) to get the incentive.

## 2.3.2 Passenger Car

### 2.3.2.1 Passenger Car Population and Sales Over the last 3-5 years

In Indonesia-wide, the national statistic shows a significant increase in registered passenger cars from 14.8 million to 15.5 million units before the COVID pandemic in 2019. This figure slowly increased in 2020, then increased to 16.4 million units in 2021 and 17.1 million in 2022. In terms of growth, it has been in the range of 3.9-5.1% per annum, except for the growth in 2019-2020, which is 1.3% per annum, which is likely due to COVID-19.

Table 15. Number of Registered Passenger Cars in Indonesia 2018-2022 (Units)

Vehicle Type	2018	2019	2020	2021	2022
Passenger car (units)	14,838,106	15,592,419	15,797,746	16,413,522	17,175,632
Growth (%p.a.)		5.1	1.3	3.9	4.6

Source: Badan Pusat Statistik Indonesia, 2023

The data obtained from Gaikindo (Indonesian Automobile Industry Data) regarding Indonesia's new vehicle sales by make for the period in 2022 and 2023 indicates a total of 1 million units per annum. Compared to sales in 2021 of 887,202 units, there was a 1.8% increase in sales. Beyond the quantitative production metrics, it underscores the necessity for robust market development and effective socialization strategies. As the industry aims to expand its presence, creating a conducive market environment and disseminating awareness emerge as essential factors.

**Table 16. Indonesia Wholesale New Vehicle Sales by Brand in 2022 and 2023**

No.	Brand	Wholesales (units)	
		2022	2023
1	Toyota	331,410	336,777
2	Daihatsu	202,665	188,000
3	Honda	131,280	138,967
4	Suzuki	90,408	81,057
5	Mitsubishi Motors	99,051	77,416
6	Hyundai - HMID	31,965	35,500
7	Mitsubishi FUSO	37,586	31,553
8	Isuzu	36,646	31,427
9	Hino	30,853	28,449
10	Wuling	29,989	23,540
11	Mazda	3,888	5,320
12	BMW	2,892	4,362
13	Chery	-	4,099
14	Mercedes-Benz PC	3,235	3,428
15	Lexus	1,033	2,515
16	Mercedes-Benz CV	3,042	2,070
17	UD Trucks	1,993	1,799
18	Nissan	-	1,639
19	KIA	2,086	1,378
20	DFSK	2,413	1,360
21	Morris Garage	974	1,183
22	Mini	700	910
23	Scania	-	714
24	Faw	191	617
25	Subaru	214	561
26	Jeep	-	334
27	Volkswagen	403	247
28	Peugeot	451	199
29	Neta	-	181
30	Series	-	111
31	Audi	53	58
32	Tata	205	31
33	Hyundai - HIM	1	-
	<b>TOTAL</b>	<b>1,048,040</b>	<b>1,005,802</b>
	<b>% EV sales</b>	<b>15.09%</b>	<b>20.4%</b>

Source: GAIKINDO, 2023

Based on statistical data from the Bali Province Statistic Center, the total number of registered passenger cars in Bali province has increased from 422,838 units in 2018 to 524,619 units in 2023. Overall, the passenger car population in Bali has grown about 6% per annum, except for the slow growth in 2020 (2.5%) and 2021 (0.9%) due to the impact of COVID-19.

**Table 17. Number of Registered Passenger Car Bali Province 2021-2023 (Units)**

	2018	2019	2020	2021	2022	2023
Passenger Car (units)	422,838	449,541	460,909	465,282	493,887	524,619
Growth (%p.a.)		6.3	2.5	0.9	6.1	6.2

Badan Pusat Statistik Bali Province, 2024

### 2.3.2.2 Progression of EV Development for Passenger Car Category

In Indonesia, according to data from PT MNC Sekuritas and Gaikindo (2023), the continuation of the trend to showcase Electric Vehicles (EVs) remains evident this year, with numerous car brands vying to unveil their eco-friendly vehicles, encompassing both EVs and hybrids. Having achieved notable success by selling over approximately 10,000 units from 2022 to 2023, this data suggests a positive trajectory within the automotive industry, highlighting a noteworthy inclination towards green transportation adoption. This involves addressing the demand for environmentally friendly vehicles and adopting a comprehensive approach that includes commercial outreach and public engagement. This data is a foundation for detailed study and analysis, offering insights into the dynamics influencing the transition towards sustainable mobility in the automotive sector.

**Table 18. BEV & PHEV Domestic Whole Sales by Brand 2022 – 2023 (Units)**

No.	Brand	2022	9M2023
1	Hyundai	1,829	5,273
2	Wuling	8,053	2,929
3	Nissan	63	73
4	DFSK	11	101
5	Lexus	127	252
6	BMW	-	491
7	Morris Garage	-	80
8	Mini	-	109
9	Mercedes Benz	-	118
10	Mitsubishi	-	1
11	Toyota	-	472
12	Kia	-	43

\*9M2023: January – September 2023; Source: MNCS, GAIKINDO, 2023

As indicated in the previous section, e-car use in Bali increased from 226 units to 601 units in 2022 and 2023. This is 163% per annum of growth in 2023. Compared with Bali EV RAD, these are about two times lower than expected for the Moderate scenario. However, in comparison with the Pessimistic scenario, the actualization for 2022 and 2023 appears to be about three times higher.

**Table 19. Actualization of E-Cars in Bali vs. Bali EV RAD (Units)**

Years	2022	2023
Actualization of E-car in Bali (units)	228	601
EV Bali RAD projection for E-car (Moderate Scenario)	527	1,096
EV Bali RAD projection for E-car (Pessimistic Scenario)	79	165

Source: Consultant Analysis

### 2.3.2.3 Propellant Type (PHEV, BEV, Petrol, Diesel, etc.) and for PHEV and BEV also Charging Technology (charging power (kW), AC or DC, Battery capacity (kWh))

Indonesia predominantly depends on diesel vehicles; however, there is a noticeable shift with the emergence of battery electric vehicles (BEVs) sales. This shift is a pivotal strategy in the nation’s efforts to combat climate change by addressing greenhouse gas (GHG) emissions. The subsequent phase involves the electrification of vehicles, commencing with hybrid electric vehicles (HEVs), followed by Plug-in Hybrid Electric Vehicles (PHEVs), Battery Electric Vehicles (BEVs), and Fuel Cell Electric Vehicles. The specific type of electrification is determined based on the vehicle category, as outlined by the Indonesian Ministry of Industry. This transition underscores Indonesia’s commitment to adopting cleaner and more sustainable technologies in the automotive sector to mitigate environmental impacts.

**Table 20. EV Specifications for Typical Passenger Car Models in Indonesia**

No.	Model	Brand	Battery Capacity (kWh)	Battery Range/Mileage (km)	Charging Type	Charging Time (hour)
1	Ioniq 5	Hyundai	58 (Standard Range) 72.6 (Long Range)	384 (Prime & Signature) 481 (Long Ride Prime) 451 (Long Range Signature)	AC & DC	DC Approx. 46 minutes Standard Range 57 minutes Long Range (with DC Charging Station 50 kW power supply) AC Approx. 5 hours (Standard) & 6 hours (Long Range)
2	Ioniq 6	Hyundai	77.4	519	AC & DC	DC Approx. 73 minutes (with DC Charging Station 50 kW power supply) AC Approx. 12 hours (with AC charging 7kW)
3	Ev Air	Wuling	17.3 (Standard) 26.7 (Long)	200 (Standard) 300 (Long)	AC	8.5 hours with 2.0 kW AC (Standard Range) 4 hours with 6.6 kW AC (Long Range)
4	Bin-guo	Wuling	31.9 - 37.9	333 - 410	AC & DC	Approx. 5.5 hours (20% - 100%)

Source: Consultant Analysis

According to interviews with representative dealers, Hyundai Ioniq 5 comes with two battery options, 58 kWh for the Standard Range and 72.6 kWh for the Long Range, offering respective ranges of 384 km, 481 km, and 451 km. Charging options include both AC and DC, with DC charging times of approximately 46 to 57 minutes. The Ioniq 6 features a 77.4 kWh battery capacity, providing a range of 519 km. It supports AC and DC charging, with DC charging taking around 73 minutes and AC charging requiring approximately 12 hours.

Wuling’s Ev Air offers Standard and Long-Range models with battery capacities of 17.3 kWh and 26.7 kWh, respectively, providing ranges of 200 km and 300 km. Charging is through AC, with the Standard Range taking 8.5 hours and the Long-Range requiring 4 hours.

The Binguo model has a variable battery capacity of 31.9 to 37.9 kWh and a variable range of 333 to 410 km. Charging options include AC and DC, and the charging time is approximately 5.5 hours, which is 20% to 100%.

### 2.3.2.4 Daily Travel Distances, Parking Times, and Duration – For Passenger Car

Periodically, residents across Indonesia, including those residing in Jakarta, embark on journeys to their hometowns within and beyond Java Island, such as West Java, Central Java, East Java, Bali, Sumatra, Kalimantan, and Sulawesi. These journeys, which occur during seasonal periods, involve average travel distances exceeding 1000 km, typically taking anywhere from 10 to 24 hours, predominantly utilizing land routes. Notably, such nationwide migrations significantly influence the expectations regarding the range of vehicles and contribute to the demand for charging infrastructure along the main roads. This emphasizes the broader implications of these journeys beyond Jakarta, illustrating the diverse travel patterns across the Indonesian population and the associated considerations for vehicle capabilities and charging infrastructure development.

Based on BPS data, in 2020, there were 371,004 cars in the Kedungsepur Metropolitan Area (KMA), indicating a density of 56 cars per 1,000 residents. The majority (62.3%) were concentrated in both Semarang City and Semarang Regency (11.6%), while the three other regencies (Demak, Kendal, and Purwodadi) each contributed around 7%, and Salatiga contributed 5.3%. The average daily travel distance for car users in Semarang City was 12.9 km, with an average daily travel time of 36 minutes and an average cost of Rp 19,300 (US\$1.34) daily.<sup>7</sup>

**Table 21. Statistics Show That Commuters in Greater Jakarta By Distance Travelled and The Number Of Commuters Made With Passenger Car**

Distance Travelled to the Activity Destination (km)	Number of commuting made by passenger car
<10	38,337
10 – 19	90,425
20 – 29	71,301
30 – 39	34,125
40 – 49	20,766
50 – 59	16,602
60+	16,554
Total	<b>288,110</b>

Source: Badan Pusat Statistik (BPS) Indonesia, 2019

The data analysis provides valuable insights into the varied commuting patterns of individuals in the Jabodetabek area based on the distance of their activity locations and the mode of passenger cars utilized. Notably, a substantial number of commuters, approximately 38,337, covering less than 10 km, likely represent localized trips within residential or immediate work areas. The dataset further reveals a significant portion, numbering 90,425, undertaking journeys ranging from 10 to 19 km, suggesting a considerable proportion of individuals commuting within moderate distances, potentially spanning nearby cities (Bogor, Depok, Tangerang, and Bekasi) or different neighborhoods. Additionally, the commuter population includes notable groups traveling between 20 to 29 km, 30 to 39 km, 40 to 49 km, and 50 to 59 km. The sizeable segment of 16,554 commuters embarking on journeys exceeding 60 km indicates a subset of individuals undertaking considerable inter-city commuting within or beyond the Jabodetabek region.

### 2.3.3 Ownership and Purchasing Models When Procuring Evs – For Passenger Car

In Indonesia, as with many countries, the ownership of passenger cars is influenced by various factors, including economic conditions, government policies, and cultural preferences. The ownership rate has increased in recent years, reflecting economic growth and a rising middle class. The ownership of a passenger car is typically evi-

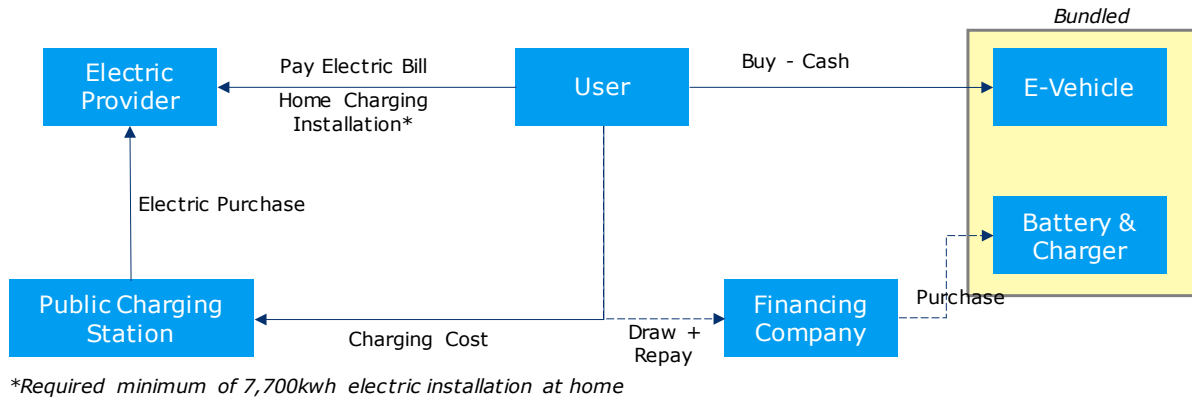
<sup>7</sup> Penilaian Data Dasar (Baseline) Mobilitas Perkotaan di Kawasan Metropolitan Kedungsepur (KMA). KIAT. August, 2022.

denced by a vehicle registration certificate (Vehicle Registration Certificate, or STNK) and a vehicle ownership certificate (KIR Book).

Bali, being a popular tourist destination in Indonesia, might have unique dynamics in terms of car ownership. Many residents and businesses may own cars to cater to the tourism industry, transportation services, and local commuting needs.

The ownership/purchasing business model for EVs for passenger cars is illustrated in the following Figure 11.

**Figure 11. EV Car Ownership Business Model**



Source: Consultant Analysis

- The user could buy cash or use a financing institution.
- The battery bundled with the EV car purchase.
- The user will pay (i) the home charging installation and (ii) the electric bill for the charging activity to PLN (electric provider).
- There is an option to do the charging activity to SPKLU / Public Charging Station.
- The public charging station provider pays the electric purchase to PLN.

In addition to the aforementioned business models for EV cars, there is also an incentive to purchase an EV car with a VAT discount of up to 10%.

## 2.3.4 Buses

### 2.3.4.1 Bus Population And Sales Over The Last 3-5 Years

Indonesia-wide, the national statistics show the number of registered buses continuing to increase from 223,011 units in 2018 to 241,215 units in 2022. In terms of growth, it is seen to be 3.8% per annum in 2019 and drop significantly to 0.8% per annum in 2020, likely due to COVID-19. The growth then regains slowly in 2021 and 2022 at 1.8% and 1.4% per annum, respectively.

**Table 22. Number of Registered Buses in Indonesia 2018-2022 (Units)**

Vehicle Type	2018	2019	2020	2021	2022
Buses (units)	223,011	231,569	233,545	237,829	241,215
Growth (%pa)		3.8	0.9	1.8	1.4

Source: Badan Pusat Statistik Indonesia, 2023

In Bali, based on the statistical data from the Bali Province Statistic Center, the total number of registered buses in Bali province has been increasing from 8,643 units in 2018 to 11,584 units in 2023. Growth is shown to be 5.1% per annum in 2019 and dropped to 1.3% (2020) and further down to negative growth of -3.2% (2021) due to the impact from COVID-19 and bounced back up significantly to 26.3% in 2022, then moderated back to 3.1% per annum in 2023.

**Table 23. Numbers of Registered Buses in Bali Province 2021 – 2023 (Units)**

	2018	2019	2020	2021	2022	2023
Bus (Units)	8,643	9,088	9,205	8,911	11,257	11,584
Growth (%pa)		5.1	1.3%	(-)3.2	26.3%	2.9%

Source: Badan Pusat Statistik Bali Province, 2024

Indonesia permits the utilization of public vehicles within a maximum age limit of 10 years, particularly for diesel buses. Most Bus Rapid Transit (BRT) fleets in Jakarta and other cities are set for a similar lifecycle. In light of the transition to E-Bus, the replacement rate could be more than ten years (12-14 years). However, the battery must be replaced in the 8th year of the vehicle's operation.

In Bali, the type of bus operated is usually medium-sized. This is likely due to the relatively lower demand for passenger transport and the fact that the road characteristics in Bali could be more expansive. Larger buses are often repurposed for tourism, serving as travel options for excursions outside the city or to regions beyond the island of Bali. This bus size choice aligns with Bali's unique characteristics, where the local transportation demands and the island's geography influence the selection of smaller and more maneuverable buses for everyday commuting.

In looking at the statistics of hierarchy and road network coverage in Bali in the Table 24 below, 80% of the road network in Bali is under the category of Regency/ Municipality Road. According to the stipulations of Government Regulation No. 34/2006, this category falls under District Road, which is defined as a road linking the district capital to the sub-district capital, connecting the district capital with village centers, facilitating transportation between sub-district capitals, connecting the sub-district capital with villages, and interconnecting villages. The prescribed maximum width of this class of road is 2.5 meters.<sup>8</sup> Based on this understanding, it can be expected that buses larger than medium-sized ones will face a significant challenge operating on this category of road. However, larger buses may still be able to cover the public transport needs for services for the extent of the National and Provincial Road categories, which accounted for less than 20% of the road network in Bali.

8 Undang-Undang Republik Indonesia No. 22 Tahun 2009, Tentang Lalu Lintas dan Angkutan Jalan (Law of the Republic of Indonesia No. 22 of 2009, Concerning Road Traffic and Transportation)

**Table 24.** Statistic of the Road Network by Category in Bali by End of 2023

Regency/Municipality	Road Status and Length in KM			
	National Roads	Provincial Roads	Regency/Municipality Roads	Total
Jembrana	72.91	29.37	1003.74	1106.02
Tabanan	75.34	155.65	872.00	1102.99
Badung	54.12	63.64	809.59	927.35
Gianyar	66.56	88.85	556.98	712.39
Klungkung	30.82	12.69	464.96	508.47
Bangli	12.40	167.37	999.00	1178.77
Karangasem	91.24	128.56	1202.59	1421.39
Buleleng	146.61	106.28	949.82	1202.71
Denpasar	39.64	52.94	450.13	542.71
Total	589.64	805.35	7308.81	8702.80

Source: Public Works and Spatial Planning Department of Bali Province

**Figure 12.** Trans Metro Dewata in Bali



Source: Kompas.com

### 2.3.4.2 Progression of EV Development for E-Bus

In 2022 and 2023, as indicated in the previous section, E-bus use in Bali was recorded as 6 and 40 units, respectively. This implementation of the E-bus in Bali cannot be separated from one of the agendas for delivering the G20 Bali summit in November 2022. Compared with Bali EV RAD, the implementation over the two years is somewhat aligned. However, stakeholder interviews indicated that some of the E-buses deployed during the G20 have been transferred to Surabaya. However, specific numbers have yet to be explained.

**Table 25. Actualization of E-Bus in Bali vs. Bali EV RAD (Units)**

Years	2022	2023
Actualization of E-bus in Bali (units) <sup>9</sup>	6	0
EV Bali RAD projection for E-bus (Moderate & Pessimistic Scenario)	10	20

Source: Consultant Analysis

### 2.3.4.3 Propellant Type (PHEV, BEV, Petrol, Diesel, etc.) and for BEV also Charging Technology (Charging Power (kW), AC or DC, Battery Capacity (kWh))

In the operational context of buses, several types of fuels exist, including Compressed Natural Gas (CNG), Diesel, and electric buses. Currently, diesel fuel predominates in bus operations. However, an initiative has emerged from various regions to embrace electric buses. These electric buses come with varying battery capacities, ranging from 180 kWh to 348 kWh, depending on the specific type of electric bus. The majority of these buses utilize Lithium Iron Phosphate (LiFePo4) batteries. Notably, the power capability of these electric buses can reach up to 180 kW maximum power, with a significant portion of them being products originating from China, such as Skywell, BYD, and Golden Dragon.

**Table 26. E-Bus Specifications in Indonesia**

No.	Vehicle Model & Type		Battery Capacity (kWh)	Battery Range/ Mileage (km)	Charging Type	Charging Time (hour)	Capacity
1	BYD K9	BYD	324	250	DC	2-3 hours	37 seats + Driver
2	E12	Golden Dragon	326-345	250	DC	1-2 hours (200kw, 20% - 100%)	35 seats, 79 including driver
3	NJL612BEV	Skywell	258-322	250 - 350	DC	2-3 hours (0-100%)	30 seats 60/75 total
4	City Bus	MAB	315,85	250	DC	3	64
5	E-Inobus	Inka	335	250	DC 120kW	3-4 hours	50

According to interviews with representative dealers, the BYD K9, manufactured by BYD, boasts a substantial 324 kWh battery capacity, providing a range of 250 km. This bus utilizes a DC charging type with 2-3 hours of charging time, accommodating 37 seats and the driver.

Golden Dragon's E12 model features a flexible battery capacity ranging from 326 to 345 kWh, offering a 250 km range. With a DC charging type and a rapid charging time of 1-2 hours (200 kW, 20% - 100%), this bus has a seating capacity of 35, with a total capacity of 79, including the driver.

The NJL612BEV from Skywell has a battery capacity of 258 to 322 kWh, providing a range of 250-350 km. Its DC charging type requires 2-3 hours for a full charge (0-100%), and the bus accommodates 30 seats, with a total capacity of 60 to 75.

The City Bus by MAB features a 315.85 kWh battery capacity, offering a 250 km range. Utilizing a DC charging type, this bus requires 3 hours for a full charge and has a seating capacity of 64.

Lastly, the Inka E-Inobus has a 335 kWh battery capacity and a 250 km range. It utilizes a DC 120 kW charging type with 3-4 hours charging time and accommodates 50 passengers.

<sup>9</sup> <https://interport.co.id/mobilisasi-bus-listrik> and <https://www.detik.com/bali/berita/d-6414950/bali-dapat-jatah-bus-listrik-bekas-ktt-g20>

#### 2.3.4.4 Daily Travel Distances, Parking Times, and Duration

Bali has two bus operator companies, Trans Metro Dewata and Trans Sarbagita. Trans Metro Dewata, which is currently part of the 'Teman Bus/Buy the Service' program initiated by the Indonesian Ministry of Transportation, operates five corridors as follows (data before update per 1<sup>st</sup> August 2024 by Dishub)

- K1B Sentral Parkir Kuta to Terminal Persiapan (30.22 km)
- K2B Terminal Ubung to Bandara Ngurah Rai (17.76 km)
- K3B Terminal Ubung to Matahari Terbit (12.44 km)
- K4B GOR Ngurah Rai to Monkey Forest (31.30 km)
- K5B Sentral Parkir Kuta to Politeknik Negeri Bali (30.2 km)

The travel times for various corridors under Trans Metro Dewata are as follows: Corridor K1B takes 1.44 hours, K2B1 has a travel time of 0.77 hours, K3B requires 1 hour, and K4B has a travel time of 1.39 hours.<sup>10</sup> As for Corridor K5B, which was introduced in 2022 as the newest addition to the network<sup>11</sup>, specific travel time details have not been provided. With a total of 121.92 km, this information is crucial for commuters, offering insights into the expected duration of their journeys on different corridors, and is also instrumental for transportation planners in optimizing services and ensuring the efficiency of the public transportation network.

Meanwhile, TransSarbagita operates with two corridors, each serving distinct routes. Corridor I span from Kota to Garuda Wisnu Kencana (TS1), covering a distance of 44.2 km. On the other hand, Corridor II (TS2) runs from Kota to Nusa Dua, extending over a length of 68.8 km<sup>12</sup>. In total, the service provides coverage over a substantial distance of 113 km.

As benchmarking exercise, reference of travel distance in other region was also observed to understand how a typical travel distance can span, when considering higher utilization of public transport. This to potentially cover the gap where public utilization in Bali is still considerably low today. Compared with Jabodetabek (based on the survey conducted by the Badan Pusat Statistik Indonesia in 2019 in Table 27 below), the majority of commuters in the Jabodetabek area, especially those traveling distances primarily focused on transportation modes, specifically the cumulative data from public buses and the operations of TransJakarta buses. The calculation of traveled kilometers was derived from the responses of commuters in the Jabodetabek region. TransJakarta buses alone accounted for an impressive total distance of 251.2 km<sup>13</sup>. It is notable that a substantial distance between 10 to 19 km, heavily depends on public bus transportation. These buses play a pivotal role in establishing connectivity and linking Jakarta with neighboring areas in the region. The extensive distance covered by TransJakarta emphasizes the critical role of public transportation, particularly buses, in ensuring essential connectivity and meeting the diverse commuting needs of residents in and around Jakarta.

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10 Hermawati et al. Performance Study of Buy the Service Bus Trans Metro Dewata Based on Minimum Service Standards and Balance Number of Vehicle Fleet. *Journal of Mechanical, Civil, and Industrial Engineering*, 2022

11 <https://www.kilasbali.com/2020/09/07/dibuka-5-koridor-bus-trans-metro-dewata-di-launching-di-denpasar/>. Accessed January 29, 2024

12 Adriana et al. Investigating Satisfaction and Its Determinants of BRT-Lite Services in Indonesian Cities. *Journal of the Eastern Asia Society for Transportation Studies*, Vol.13, 2019

13 PT. Transportasi Jakarta. <https://transjakarta.co.id/produk-dan-layanan/layanan-bus/transjakarta/>. Accessed January 31, 2024

**Table 27. Statistic Commuters in Greater Jakarta By Distance Traveled and Number of Commuting Made By Bus**

Distance Travelled to the Activity Destination (km)	Number of commuting made by bus
<10	20,200
10 – 19	50,476
20 – 29	42,875
30 – 39	28,209
40 – 49	20,496
50 – 59	10,523
60+	9,470
Total	<b>182,222</b>

Source: Badan Pusat Statistik (BPS) Indonesia, 2019

For 2023, BTS Trans Metro Dewata recorded a passenger count 2,011,059, achieving a load factor of 34.83% with an average of 5,681 passengers per trip. The existing fleet comprises 105 buses managed by the sub-contractor PT. Satria Trans Jaya.<sup>14</sup> The statistic metrics for BTS Trans Metro Dewata and Trans Sarbagita services are presented in Table 28 below.

**Table 28. Service Performance of BTS Trans Metro Dewata & Trans Sarbagita**

Koridor	Unit	Occupancy Level (%)	Average daily passenger
<b>TRANS METRO DEWATA</b>			
K1B: Sentral Parkir Kuta – Terminal Persiapan	25	60.50	1,177
K2B: Terminal Ubung – Bandara Ngurah Rai	20	46.30	980
K3B: Pantai Matahari Terbit – Terminal Ubung	15	40.30	717
K4B: GOR Ngurah Rai – Monkey Forest Ubud	22	57.40	796
K5B: Sentral Parkir Kuta – Politeknik Bali	23	61.30	813
<b>TRANS SARBAGITA (Jan – Mar 2023)</b>			
Koridor I: Kota - GWK	5	35.2	265
Koridor II: Batubulan – Nusa Dua	10	12.96	86.3

Source: Ministry of Transportation Indonesia, 2023

### Box 1. Benchmark to TransJakarta E-Bus Charging Duration

#### Benchmark to TransJakarta E-Bus Charging Duration

The parking duration for TransJakarta’s electric buses during the charging process is typically around 2 to 8 hours, depending on the charging capacity with an average travel distance of 233 km/day<sup>15</sup>. During this time, the buses are not only parked but also recharging their electric batteries. This aspect of the operational cycle is essential to ensure that electric buses have sufficient power to cover their routes efficiently and contribute to sustainable urban transportation. The charging period is strategically integrated into the schedule, allowing for a seamless and continuous service once the buses return to the road. Moreover, the realm of inter-provincial bus transportation extends across the vast islands of Java and Sumatra. Taking the example of a journey from Jakarta to Surabaya covering a distance of approximately 800 km, the passenger transport service requires a considerable travel time ranging from 10 to 14 hours. Within this timeframe, a one-hour parking interval is typically included.

14 Pelaksanaan Kegiatan Pelayanan Transportasi Publik Skema BTS di 10 Kota. Ministry of Transportation Indonesia, 2023

15 Heading Towards 100,000: Scaling Electric Bus Fleets Case Study: Jakarta. ITDP. September, 2023.

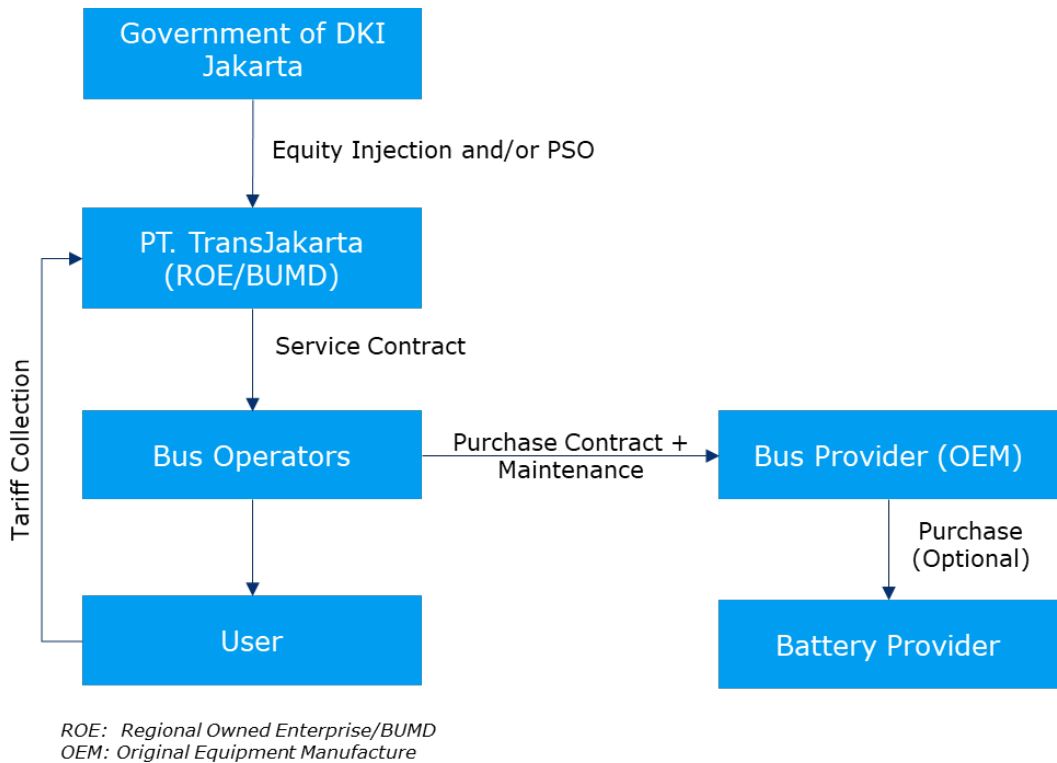
The government conducts standardized kilometer calculations for each operator enlisted in contracts under the BTS or Teman Bus programs. It utilizes a cost-per-kilometer (Rp/km) framework known as Buy The Service or a gross cost contract. Operators are reimbursed based on the distance traveled to provide their services. To illustrate, daily, electric buses (e-bus) are required to cover a minimum distance of 175 km to 200 km within 17 hours of operation, surpassing the operational range of diesel buses, which typically operate over 100 km within 24 hours of operation. This emphasis on kilometer-based calculations is crucial for ensuring a fair and transparent compensation structure, encouraging more environmentally friendly options such as e-buses, and reflecting the government’s commitment to promoting sustainable and efficient public transportation solutions. Including such standards in contracts incentivizes operators to adopt eco-friendly technologies and aligns with broader transportation goals aimed at reducing environmental impact and enhancing overall system efficiency.

### 2.3.4.5 Ownership and Purchasing Models When Procuring and Operating E-Bus

The ownership/purchasing business model for E-bus is generally illustrated in the following Figure 13, which adopts Transjakarta’s business model as the pioneer operator of E-bus in Indonesia.

The existing business model in the bus operational service system utilizes a gross cost contract approach, also known as BTS (Buy the Service). Under this model, operators are responsible for providing buses for specific services. In return, they receive payments from the local government based on the distance covered, calculated as Rupiah per kilometer (Rp per km). This payment structure includes the cost of the buses, meaning that the operators’ compensation per kilometer is designed to cover both operational costs and the depreciation or cost of the buses themselves.

Figure 13. E-Bus Ownership Business Model (Transjakarta Case)

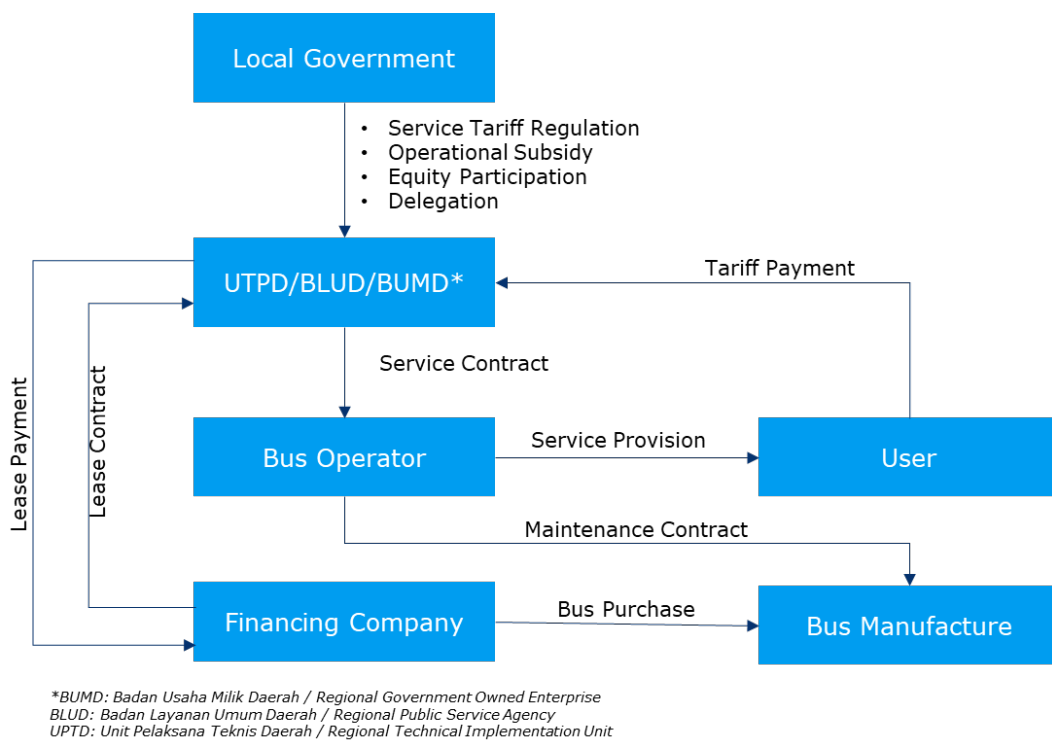


Source: Consultant Analysis (adapted from TransJakarta)

- DKI Jakarta appointed PT TransJakarta to carry out the BRT services in Jakarta.
- DKI Jakarta provided subsidy and/or equity injection to fill the deficit on the operational of PT TransJakarta.
- PT TransJakarta would have a contract with e-bus operators with the service contract arrangement (IDR per km)/Gross Cost Contract (GCC).
- The GCC included fleet, charging, operation, maintenance, and e-bus depot facility.
- The bus operators purchased the e-fleet from the bus providers (OEM). They could have the option to separate contracts with the bus providers to ensure the e-bus warranty and bus maintenance.
- The bus operator will provide public transport to the user.
- PT TransJakarta will collect the tariff/fee.

On the other hand, the leasing model in Figure 14 presents a different arrangement. In this model, operators do not own the buses. Instead, they lease them from third-party providers. This shift in responsibility means that the financial and maintenance burdens associated with the buses fall on the leasing company or the bus provider rather than the operator. By doing so, operators can focus more on service delivery without the added concerns of asset management and associated costs.

Figure 14. Leasing Scheme Diagram



Source: Consultant analysis (adapted from ITDP, 2024)

In essence, bus ownership in Indonesia is predominantly held privately within each company operating in the bus transportation sector. An example is Trans Metro Dewata Bali, the operator of the Teman Bus program under the central government’s Ministry of Transportation. The assets of Trans Metro Dewata Bali and Trans Sarbagita are entirely owned by the operating company, as Teman Bus follows the “Buy the Service” or gross cost contract model, where they solely pay for the services rendered to the operator. Similarly, the operational structure of TransJakarta involves partnerships with private operators to execute public transportation ser-

VICES. In this arrangement, all assets are owned by the private operators, who manage their fleets according to the terms and specifications outlined by TransJakarta. This decentralized ownership structure characterizes the bus transportation industry in Indonesia, with individual companies holding ownership of their respective assets while collaborating with governmental programs or agencies.

The Trans Sarbagita service in Bali operates under a different model than other regional transportation systems like Trans Metro Dewata. In this model, the Bali Provincial Government owns the buses used in the Trans Sarbagita service. The government hires DAMRI, a state-owned enterprise, to manage and operate these services. Unlike the Buy the Service model used by Trans Metro Dewata, where private operators own the assets, Trans Sarbagita’s buses are government-owned. This centralized ownership structure means that the Bali Provincial Government retains ownership of the buses while DAMRI handles daily operations and management. This model is the same as TransJakarta.

The “Buy the Service” initiative represents a government system for procuring road transportation services from public transport operators to ensure the delivery of high-quality transportation services. This program, named “Teman Bus” (Economical, Easy, Safe, and Comfortable Transportation), is being implemented in 10 cities, including Palembang, Medan, Bali, Surakarta, Yogyakarta, Makassar, Banyumas, Banjarmasin, Bandung, and Surabaya. The Buy the Service (BTS) scheme is a multi-year contract (maximum three years), whereas urban transport needs can be around 8-10 years (the need for certainty of funding and project financing). Regulations related to BTS refer to Minister of Transport Regulation PM 9/2020 on Subsidizing Urban Public Passenger Transport.<sup>16</sup>

Figure 15. Business Process for the BTS Scheme

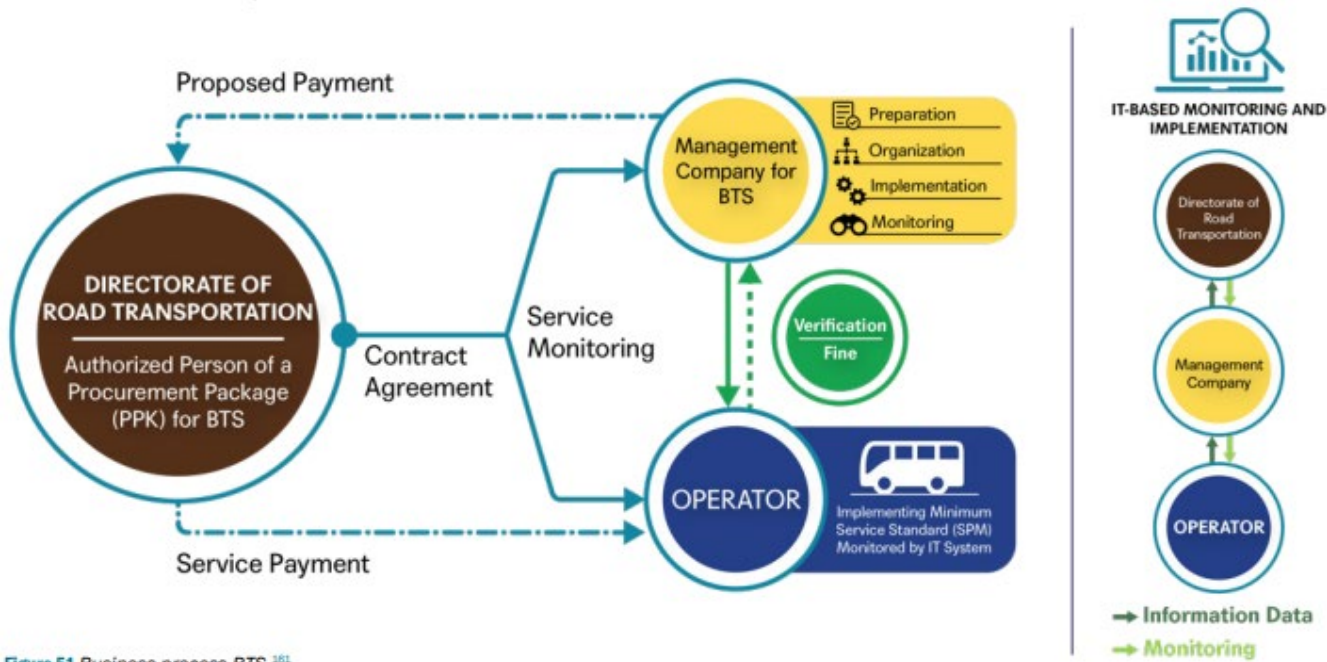


Figure 51 Business process BTS 261

Source: The World Bank, 2022

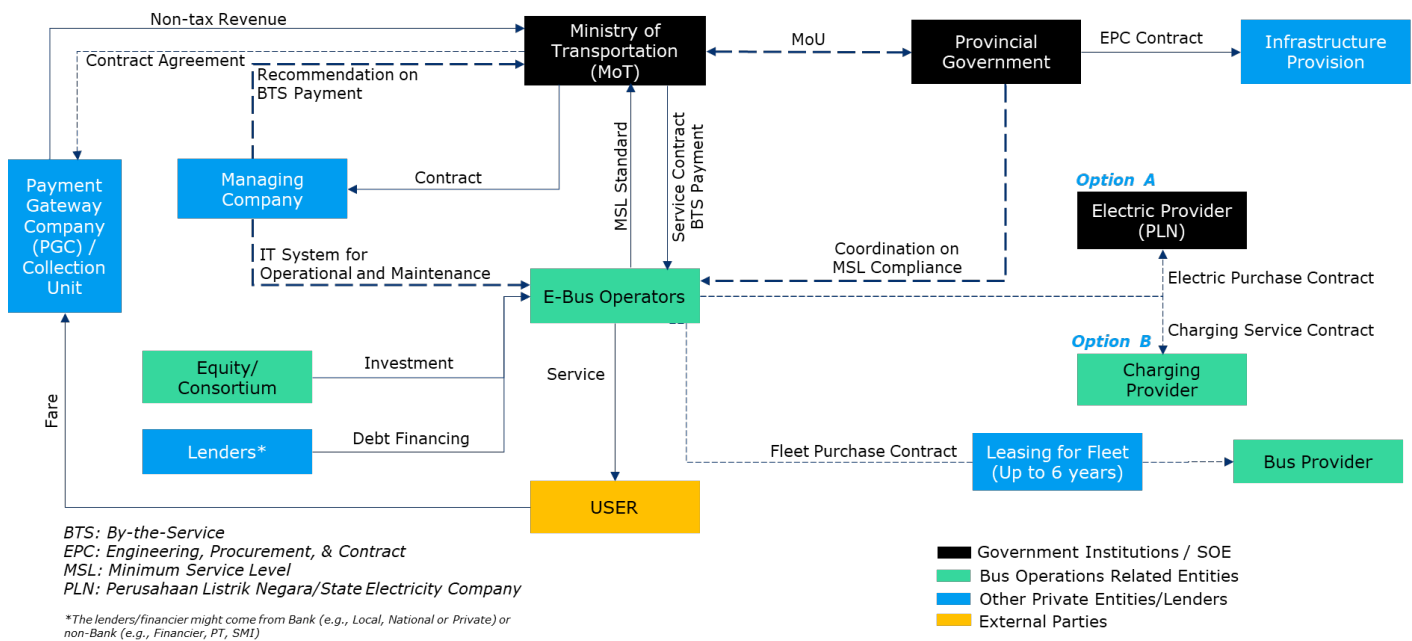
The diagram outlines the business process for the Buy the Service (BTS) scheme, detailing the interactions between the Directorate of Road Transportation, the Management Company for BTS, and the Operator. The Directorate of Road Transportation, acting as the Authorized Person of a Procurement Package (PPK) for BTS, pro-

16 Developing A Suitabke Scheme for Funding Urban Bus System. GIZ, 2022.

poses and makes payments for services and enters into contract agreements with the Management Company. The Management Company for BTS is responsible for overseeing the BTS process, which includes preparation, organization, implementation, and monitoring of the services. It receives proposed payments from the Directorate, monitors the service performance of the Operator, and implements verification and fines for non-compliance or underperformance.

The Operator is tasked with executing the BTS services in line with the Minimum Service Standard (SPM) monitored by an IT system. The service monitoring ensures that the Operator adheres to the required standards and that any deficiencies are addressed through a verification and fine system managed by the Management Company. This structured interaction is supported by an IT-based monitoring and implementation system that involves all three parties—Directorate of Road Transportation, Management Company, and Operator—ensuring transparency and efficiency in service delivery and compliance.

**Figure 16. E-Business Model for BTS**



Source: The World Bank, 2022

The diagram outlines the interactions and relationships in Indonesia’s BTS (Buy the Service) program for electric buses, involving government institutions, private entities, state-owned enterprises (SOEs), and external parties. The Ministry of Transportation (MoT) oversees the program, recommends BTS payments, and establishes contracts with Provincial Governments and Managing Companies. Provincial Governments coordinate with the Ministry of Transportation to ensure Minimum Service Level (SPM) compliance and provide the infrastructure through EPC contracts. Equity or consortiums invest in E-Bus Operators, securing financing from lenders. The Payment Gateway Company (PGC) manages fare collection. E-bus operators, adhering to SPM, offer transportation services with two options: entering into an electric purchase contract with an electric provider (Option A) or leasing the fleet and charging services (Option B). Managing Companies monitor operations and maintenance via IT systems. This collaborative framework supports the transition to electric buses, integrating various stakeholders to ensure efficient and sustainable urban transport solutions.

## Box 2. Benchmark to TransJakarta E-Bus Operations Case

### Benchmark to TransJakarta E-Bus Operations Case



Indonesia has initiated the introduction of electric buses in its urban centers, marking a significant step towards sustainable transportation. The national-owned company, TransJakarta, is at the forefront of this endeavor, being the first to implement electric buses in Jakarta. The commitment to transitioning to electric vehicles is underscored by the issuance of Governor of DKI Jakarta Decree 1053 of 2022.

This decree outlines a comprehensive plan for the acceleration of adopting battery-based electric motorized vehicles for public transportation services within TransJakarta until the year 2030. The key provisions of the decree include a target of deploying 10,047 electric vehicles. Furthermore, it specifies a phased approach, intending to increase the percentage of electric vehicles operating within the TransJakarta Transport Service from 50% by the year 2027 to a full 100% by the year 2030. This ambitious timeline reflects the commitment of Jakarta to embrace sustainable and environmentally friendly public transportation solutions.

The ambitious target of achieving an electric bus fleet by 2030 for TransJakarta comes with its set of challenges, including the absence of a robust business model. TransJakarta operates with 10 private company sub-operators handling various bus types and an additional 10 cooperative sub-operators overseeing minibuses. The implementation of electric buses faces hurdles, particularly in non-BRT (Bus Rapid Transit) services. This is because TransJakarta currently employs high-deck buses in BRT corridor operations.

TransJakarta has a unique operational center for BRT services, modeled after a South American country. To navigate the transition to electric buses, a plan has been proposed to retrofit existing vehicles. This retrofitting strategy is seen as a viable solution to adapt current bus vehicles in the TransJakarta fleet to accommodate the changes in energy sources. Addressing these challenges will be crucial for the successful integration of electric buses into TransJakarta's public transportation system, ultimately contributing to the region's sustainability goals.

TransJakarta has operated several EV buses to electrify its fleet since 2022. Up to the end of 2023, there are 100 units of E-bus operated in their services. By the end of 2024 200 more units are expected to be added to make the total E-bus fleet of 300 units.

Several studies have been conducted to explore TransJakarta's ambitious plan to transition from diesel buses to electric buses by the year 2030. As an initial step in the fleet electrification pilot phase, TransJakarta aims to introduce 100 electric buses in the year 2023. PT Mayasari Bakti, as part of this initiative, is currently operating a fleet that includes 52 BYD low-entry buses from 2021, PT. Bianglala Metropolitan started to operate 22 Golden Dragon low-entry buses in November 2023 following PT. Damri inaugurated 26 Skywell low-entry in December 2023 specifically for TransJakarta.

### 2.3.4.6 Current Policies and Regulatory Framework, Including Any Goals/Visions

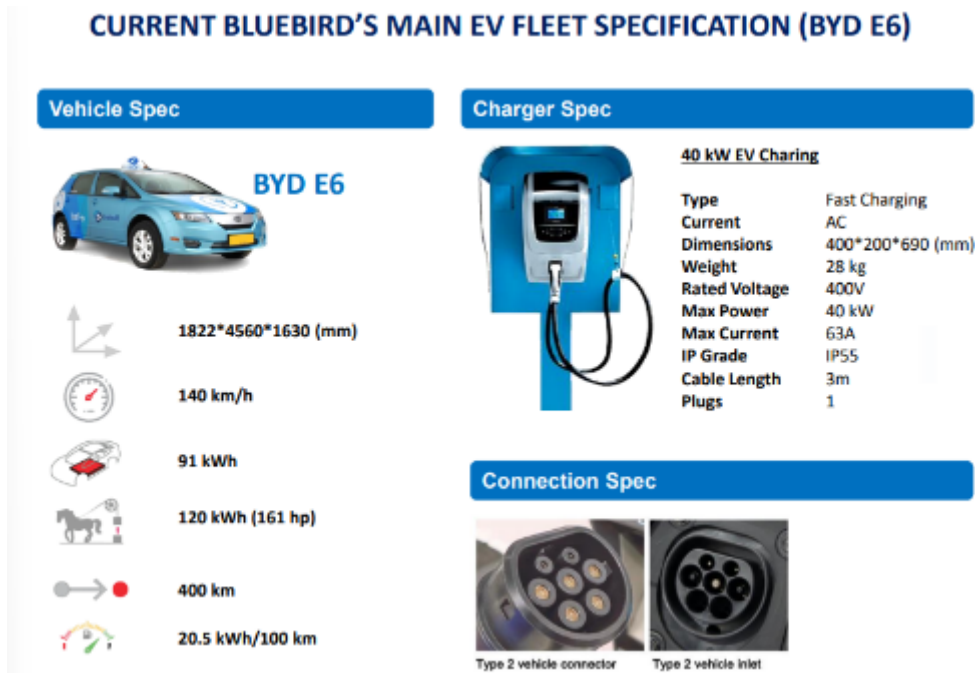
So far, the Indonesian Government has made various efforts to reduce carbon emissions by promoting the accelerated transition from fossil fuel-based public transportation to EV buses. One form of such efforts is through fiscal and non-fiscal incentives the Central and Regional Governments provide. However, in its implementation, the transition from diesel buses to E-buses faces challenges, namely the uneven distribution of bus rapid transit infrastructure throughout Indonesia. In the context of Bali Province, regulatory measures are needed to align the accelerated program for transition to E-bus for the existing bus route. More importantly, the development of policies may need to focus on increasing the demand for public transport in general, along with the transition to E-bus.

### 2.3.5. Other Commercial Passenger Vehicle

#### 2.3.5.1 Taxi Company

Major players in the transportation industry are exploring various business models in support of green transportation. Blue Bird, one of the largest taxi companies, is leading the charge in decarbonizing emissions by taking a position to jumpstart Indonesia’s EV adoption by adding the largest fleet of electric vehicles in Jakarta and Bali, using BYD E6 and Tesla Model X vehicles throughout 2023 with a Type 2 CCS 40 kW AC EV charging specification.

Figure 17. Current Bluebird’s Main EV Fleet Specification (BYD E6)



Source: Bluebird Taxi Fleet Electrification, 2020

### 2.3.5.2 Gojek and Grab

Currently, Gojek, a prominent technology company based in Indonesia, boasts an extensive network comprising 2.7 million Driver-Partners. Additionally, the company caters to a substantial user base, with an impressive 63.8 million Annual Transacting Users (ATU).<sup>17</sup> Online transport companies like Grab and Gojek are expanding their fleets to include motorcycles with swappable batteries. In 2021, Gojek and Gogoro announced a partnership to electrify two-wheel transportation in Indonesia.

Key areas include GoTo Group's investment in Gogoro's PIPE and a pilot scheme in Jakarta involving 250 Gogoro Smartscooters and four GoStation battery swapping stations at Pertamina gas stations, with plans to scale to 5,000 scooters. Gojek aims to electrify its fleet by 2030, achieving zero emissions fully. Gogoro, a global leader in battery swapping, supports over 400,000 riders with 2,100 stations, facilitating 270,000 daily battery swaps. In September 2021, GoTo invested in Gogoro's PIPE financing, which is expected to close in early 2022. This partnership enhances Gojek's and Gogoro's efforts to promote electric vehicle adoption and sustainable urban mobility in Indonesia.<sup>18</sup>

### 2.3.5.3 Daily Travel Distances, Parking Times, and Duration

**Table 29. Statistics Show That Commuters in Greater Jakarta Traveled By Distance and the Number of Commuters Made With Commercial Passenger Vehicles**

Distance Travelled to the Activity Destination (km)	Number of commuting made by	
	Online Taxi's Motorcycle	Online Taxi's Car
<10	58,547	285
10 – 19	43,639	2,238
20 – 29	6,922	1,006
30 – 39	11,576	-
40 – 49	2,176	988
50 – 59	-	658
60+	-	-
Total	122,860	5,175

Source: Badan Pusat Statistik (BPS) Indonesia, 2019

The majority of ride-hailing motorcycle users in the Jabodetabek region cover distances below 10 km for their travels. This trend may be attributed to the community's inclination to utilize ride-hailing services primarily for commuting to the nearest bus stops or train stations from their residences. The following are distances around 10 to 19 km, representing the outer limit for fares chosen by users to reach their destinations. Additionally, on-line car rentals are a prevalent option, with a significant portion of the population covering distances between 10 to 19 km. This usage pattern suggests that, for many residents, ride-hailing services are utilized for shorter, more localized trips. At the same time, longer journeys involve alternative transportation options, reflecting the diverse and nuanced preferences of commuters in the Jabodetabek area.

### 2.3.5.4. Existing or Planned Business Models for e-Mobility for Major Taxi Companies

According to data from SMA Sarbagita by KIAT (2022), the following nine companies operate around 3,000 taxis in Sarbagita:

17 PT GoTo Gojek Tokopedia Tbk. 2022 Annual Report "One Enduring Ecosystem". Accessed February 5, 2024.

18 <https://www.gojek.com/news/gojek-and-gogoro-announce-strategic-partnership-to-electrify-two-wheel-transportation-in-indonesia>. Accessed May 27, 2024.

**Table 30. Taxi Operators in Bali and Total Fleet Size (in 2022)**

S/N	Taxi Operator	Fleet size (units)
1	Blue Bird Taxi	1,000
2	Bunga Bali Cooperative	75
3	Jimbaran Taxi Cooperative	213
4	Komotra Taxi	400
5	Kowinu Bali Taxi	<i>no data</i>
6	Ngurah Rai Taxi	972
7	Nusa Dua Tourism Cooperative	300
8	PT. Ubud Taxi	9
9	Wahana	345

Source: SMA Sarbagita by KIAT (2022)

Tourists are the target market for many of these taxi services. Airports, shopping centers, universities, and office complexes are all places where taxis can be found. Many companies, such as the Grab Airport service, which launched in 2020, use smartphone apps to hire cabs online.

### 2.3.5.5. Existing or Planned Business Models for e-Mobility for Commercial Ride-Hailing

In Indonesia’s dynamic transportation landscape, Grab and Gojek, two major ride-hailing platforms, have introduced electric motorcycles to promote sustainable and efficient mobility solutions. This initiative aligns with Gojek and Grab commitment to reducing carbon emissions and addressing environmental concerns. Both Grab<sup>19</sup> and Gojek have ambitious plans to expand their electric motorcycle services across various cities in Indonesia, promoting a shift towards cleaner and greener transportation alternatives. This expansion aligns with the Indonesian government’s initiatives to encourage the adoption of electric vehicles and reduce the transportation sector’s carbon footprint.

A joint venture between Gojek and TBS Energi Utama (known as Electrum) announced an expanded collaboration with Pertamina, Gogoro, and Gesits to accelerate the development of Indonesia’s electric vehicle (EV) ecosystem. This initiative supports the Indonesian Government’s sustainable energy transition goals for the upcoming G20 Summit. The partnership will scale up the current commercial trial of two-wheel EVs in South Jakarta to thousands of units operated by Gojek driver-partners through the end of 2022. The trial, which has shown operational cost savings of up to 30% for drivers, will inform future efforts in EV manufacturing, battery packaging, swapping infrastructure, and financing. Electrum will lead the integration and development of the EV ecosystem, leveraging Gojek’s extensive presence and TBS’s energy sector expertise. At the same time, Pertamina will provide battery swapping at its gas stations with support from Gogoro and Gesits.<sup>20</sup>

However, distinct disparities emerge in the operational context of ride-hailing services such as Gojek and Grab. This divergence necessitates further exploration, as riders’ assessments, reflected in their daily averages, indicate rider service performance. Notably, a rider’s minimum travel distance of approximately 100 kilometers is considered a benchmark for achieving a service rating of 4 to 5 stars from users (Patdono et al., 2023). This underscores the significance of understanding the nuanced dynamics associated with ride-hailing operations and the pivotal role riders play in upholding service quality standards. Follow-up actions are necessary to acquire more precise insights into the operational aspects of Gojek and Grab.

19 There is a lack of available data regarding Grab’s existing and plan electric vehicles information.

20 <https://www.gojek.com/news/electrum-pertamina-gogoro-and-gesits-enhanced-collaboration-accelerates-indonesias-two-wheel-electric-vehicle-ecosystem>. Accessed May 31, 2024.

Grab Indonesia, in collaboration with GML and Smoot, supports the Indonesian government’s subsidy program by providing a subsidy of IDR 55,000 per day, allowing individuals to take home electric motorcycles. There are two schemes available: Scheme A, which has a shorter duration of 8 months, and Scheme B, which extends to 12 months. Scheme A requires a minimum down payment of IDR 1,000,000, while Scheme B does not require a down payment. Both schemes include insurance coverage, but Scheme A does not provide repair and maintenance facilities, while Scheme B offers these benefits except spare parts. This initiative aligns with the government’s efforts to encourage the adoption of electric vehicles, making it financially viable for individuals to own and utilize electric motorcycles, contributing to a more sustainable and eco-friendly transportation ecosystem.

Grab also offers motorcycle rentals to driver-partners specifically for operating electric motorcycles in the Jabodetabek, Bandung, Medan, Jogja, Solo, Semarang, Surabaya, and Bali regions. With a deposit of IDR 200,000, subject to specific document requirements, individuals can access this service by paying only IDR 50,000 daily. This initiative not only promotes the use of electric vehicles for ride-sharing services but also provides an affordable and accessible option for driver-partners to embrace environmentally friendly transportation solutions. The deposit and daily payment structure make it feasible for drivers to engage with electric motorcycles, contributing to the broader efforts to enhance sustainability and reduce the environmental impact of transportation in these key regions.

**Table 31. Grab Indonesia Electric Motorbike Allowance Scheme and Benefits**

Scheme		
	A	B
Daily Allowance	55,000	55,000
Duration (month)	8	12
Down-Payment (IDR)	1,000,000	X
Benefit		
Assurance	✓	✓
Service & Maintenance	X	Except Spare Parts

Source: Grab Indonesia, June 2023

### 2.3.6 Impact of Current Policies and Regulatory Framework on the Realization of EVs in Bali

So far, the Indonesian Government has made various efforts to reduce carbon emissions by promoting the accelerated transition from fossil fuel-based public transportation to EV public transportation. One form of such effort is fiscal and non-fiscal incentives the central and regional governments provide for public transportation operators using electric vehicles. However, in its implementation, the use of EVs by public transportation operators faces challenges, namely the limited infrastructure for electric vehicle charging and the EV market for passenger transport, aside from buses, still has limited variations in models and capacities, which can restrict the available options based on the operational needs of these operators.

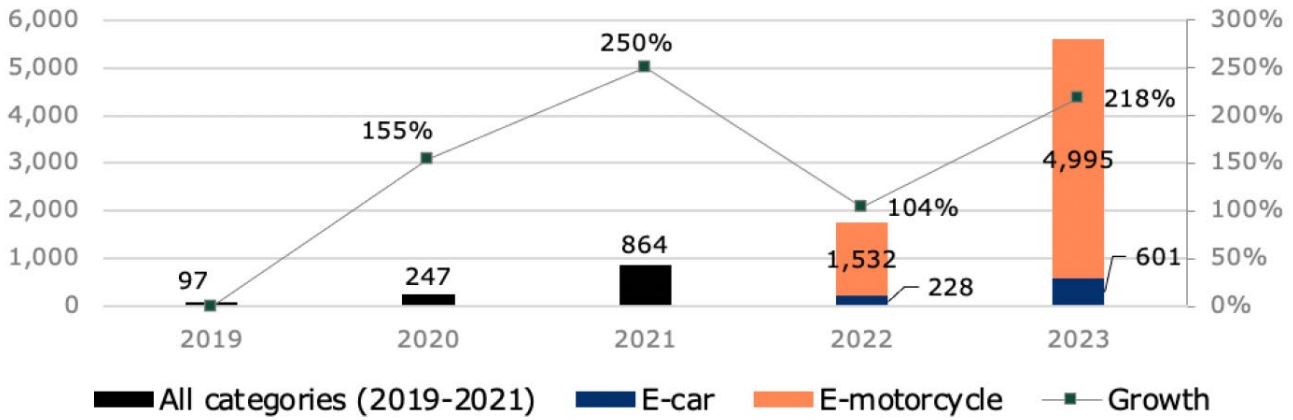
The success level of the policy setting towards EV implementation in Bali should be seen as a contribution from regulations set for both national and Bali levels. This can be seen from the trend of the EV population at both the Indonesian and Bali levels.

#### 2.3.6.1 Electric Vehicle Use

In Indonesia-wide, as reported by the Association of Indonesian Motor Vehicle Industries (GAIKINDO), EV car sales have increased significantly since 2019 and will hit 90,000 units in 2023. This has increased by 343%, or

four times, in 2022 and 18 times compared to 2021. Over the years, EV population growths in Indonesia have been observed to be in a range between 190% - 350% per annum since 2019.

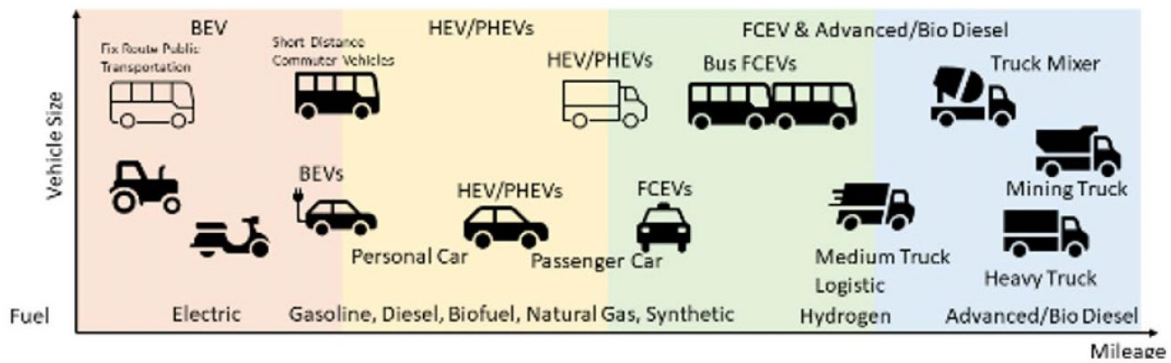
Figure 18. Population of E-cars in Indonesia 2019-2023 (Units)



Source: GAIKINDO EV sales data, 2023

In Bali, the progression of electric vehicles has continued to increase since the first sale in 2017. As per data from the Bali Province Transport Agency of EV sales for all categories in the Figure 19 below, the EV population by the end of 2023 was recorded to be 5,596 units. This is three times compared to 2021 and 6 times compared to it in 2021. Over 2019-2023, EV population growth in Bali Province is observed to be between 100% and 250% per annum. Such growths are seen to be primarily contributed by the growth of E-Motorcycle (accounting for 2-wheeler and 3-wheeler EVs). This data reflects a notable and sustained interest in and adoption of electric vehicles in Bali over the years from specific user groups.

Figure 19. The Population of Electric Vehicles in Bali Province in 2022 and 2023 (Units)



Source: Bali Province Transportation Agency

Compared with the expectation set in the EV Projection in the Bali EV RAD (Bali Province Regional Action Plan for EV), the achievement of the use of each E-motorcycle and E-passenger car in 2022 and 2023 appears to be between the Pessimistic scenario and Moderate scenario projections in the context of the RAD for Bali EV.

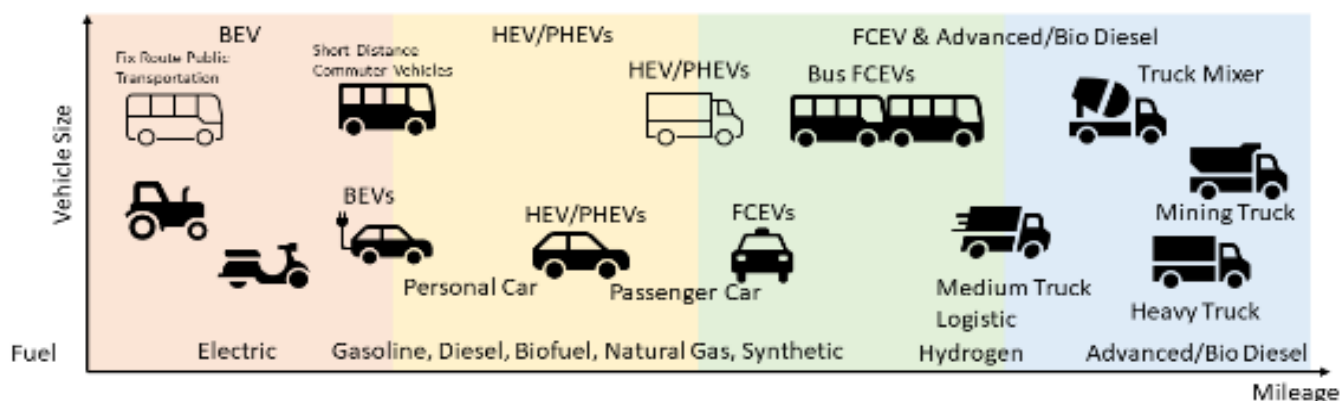
2.3.6.2 Low Carbon Emission Vehicle (LCEV) Scheme in Indonesia

The Indonesian government has embraced the Low Carbon Emission Vehicle (LCEV) scheme since 2013, as referred to in the Roadmap by the Ministry of Industry. By the stipulations outlined in Government Regulation Number 73 of 2019, this initiative involves the electrification of vehicles, categorizing them into Hybrid Elec-

tric Vehicles (HEV), Plug-in Hybrid Electric Vehicles (PHEV), and Battery Electric Vehicles/Fuel Cell Electric Vehicles (BEV/FCEV). The program underscores a commitment to mitigating carbon emissions and promoting adopting environmentally friendly technologies within the automotive sector, aligning with broader efforts to achieve sustainable and eco-conscious transportation solutions. As a response to the Low Carbon Emission Vehicles (LCEV) program mentioned above, through PR 55/2019 as amended by PR 79/2023, the Government provides support through fiscal incentives. These incentives include luxury goods sales tax incentives, exemptions or reductions in central and regional taxes, and other budgetary incentives, as explained in section 2.2.4 above.

The data presented by the Ministry of Industry Indonesia (2019) following Figure 20 suggests a significant evolution in the coverage of the electric vehicle (EV) landscape. While the figure may underscore the growing prominence of EVs, it is crucial to interpret these trends within a broader context. Notably, the current focus on electric trucks is a more minor segment than the overall trajectory of EV adoption. Therefore, prioritizing electric trucks may not be the immediate key to the roadmap, and attention should be directed toward fostering a more widespread uptake of EVs in general. This broader approach is justified by the premise that a pervasive integration of EVs across various vehicle types, including personal cars, will create a more supportive environment for the transition to electric technologies. A holistic adoption of EVs in diverse contexts, such as commuting to work in electric cars, is likely to contribute positively to public perception, fostering a more favorable attitude towards EVs and, by extension, facilitating the eventual integration of electric trucks into the mainstream transportation landscape.

Figure 20. LCEV Program Based on Drive and Fuel Technology Characteristics



Source: Ministry of Industry Indonesia, 2019

### 2.3.6.3 Observing Current Policies Driving the EV in Bali and Indonesia

#### a) Hybrid vehicle era in 2017 to 2019

From 2017 to 2019, Indonesia’s use of EVs was mainly driven by the lifestyle trend of adopting new hybrid car technology.

#### b) Adoption of BEV 2019-2021

Since the enactment of Presidential Regulation No. 55 in 2019, the growth of EVs Indonesia will continue to increase to 2021. According to GAIKINDO data, the first BEV was sold in 2020. Progression of EV from 2019 – 2021 was observed as a result of following policies initiated at national level.

- Government regulation for 0% tax on luxury goods (PPnBM)
- Tax relieves of 10% vehicle ownership (PKB) and transfers title fee (BBNKB)
- MoF regulation for a subsidy to vehicle testing and certification
- Ministry of Energy and Mineral Resources regulation for charging tariff
- Other non-fiscal policies set in Ministry of Energy and Mineral Resources and Ministry of Transportation regulations about charger plug-ins standard, standard for conversion to E2W, and EV testing requirement

In Bali, the Governor Regulation appears to successfully increase EV use in 2020-2021, which is expected to be a result of the following policies:

- Restriction of fossil fuel through introducing a free emission zone
- Instruction for a range of incentives to users and industry players participating in EV business

### **c) Home charging initiative in 2022**

In 2022, EV car sales in Indonesia continued to increase. Since March 2022, PLN offered support in installation for home charging and a promotional price of a 30% discount on the electricity rate for late-night charging.

### **d) More significant fiscal policies in 2023**

In 2023, higher growth in the previous year for Indonesia and Bali levels can be seen, which is expected due to the following policies set mainly at the national level, including:

- Further revision to the ministerial incentive to further reduce PKB and BBNKB amount to 0% (from 10% initially)
- MoF policy setting of 5-10% VAT relief and 0% import tax
- For motorcycles, MoI has set an IDR 7 million subsidy policy for purchasing E2W. This has a significant impact on Bali due to the high usage of motorcycles within the island
- Other non-fiscal policies set in the associated regulations

As mentioned above, Bali's subsidy to purchase E2W has successfully increased e-motorcycle use in 2023. In addition, the governor's circulation of EVs among public officials also contributes to EV use in 2023. In practice, the implementation has discouraged the use of non-fossil fuel vehicles for public official staff to commute every Friday. This can also support carbon emissions by using public transport as an alternative to EVs. In the longer term, when EVs become more accessible, officers may opt to commute with EVs or public transport.

Based on the above, it can be observed that subsidies to various taxes imposed on EVs have contributed to EV growth over the years. Given the high price capex component of EVs, such a policy may well address the needs of EV consumers from middle- and upper-income groups. However, a subsidy for purchasing EVs is the more contributing factor to promoting higher EV use. This is due to the portion of the total cost of buying an EV that is higher on the vehicle price alone. The current trend of e-motorcycle use in Bali can be evidence of the success of a purchase subsidy of IDR 7 million for certain groups to purchase E-motorcycles.

## Summary – Current Key Regulatory Framework in Bali, Indonesia

### Current EV implementation in Bali

In comparing with the expectation set in EV Projection in the Bali EV RAD (Bali Province Regional Action Plan for EV), achievement of the use of each E-Motorcycles and E-passenger cars in 2022 and 2023 appear to be in between the Pessimistic scenario and Moderate scenario projections.

### Impact of current policies to EV ecosystem in Bali and Indonesia

Subsidy to various taxes imposed to EV have been contributed to EV growth over the years. Given the high price capex component of EV, such policy may well address the need of EV consumers from middle- and upper-income groups. However, a subsidy for purchasing EV can be seen to be the more contributing factor to promote for higher EV use. This is due to portion of total cost of purchasing EV that is higher on the vehicle price alone. The current trend of E-motorcycle uses in Bali can be evidence of the successful of purchase subsidy of IDR 7 million for certain group to purchase E-motorcycle.

## 2.4 The Current Charging Infrastructure in Bali, Indonesia

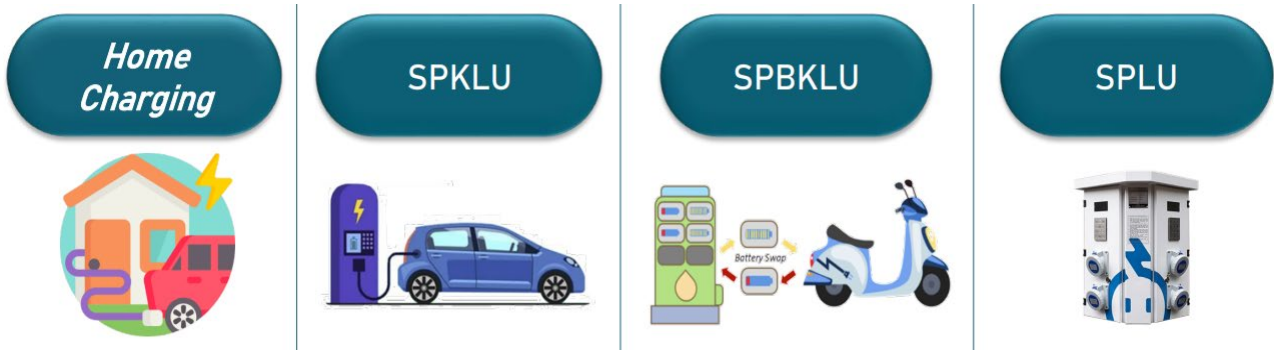
### 2.4.1 Current Charging Infrastructure

#### 2.4.1.1 Publicly Available Charging Points

As of August 2020, the Minister of Energy and Mineral Resources released “Regulation No. 13” detailing the legislation on the provision of charging infrastructure for electric vehicles. Currently, the legislation covers three different charging infrastructure models:

1. Private Electricity Installations – private charging facilities for one’s usage, including Home Charging.
2. Public Electricity Charging Station (Stasiun Pengisian Kendaraan Listrik Umum or “SPKLU”) – A Facility that can supply electricity commercially to the public. They can be installed in public spaces such as petrol stations, malls, offices, etc.
3. Public Electricity Battery Exchange Station (Stasiun Penukaran Baterai Kendaraan Listrik Umum or “SPBKLU”) – Facilities that allow the public to rent/replace batteries instead of charging. Similar to SPKLU, they can be installed in various public spaces.
4. Multipurpose Public Electricity Station (Stasiun Pengisian Listrik Umum or “SPLU”) – A facility that allows public multi-purpose electricity charging ranging from small to medium power.

Figure 21. Types of Charging Infrastructures



Source: PLN presentation slide, 2024

### Types of charging

There are currently four levels of charging infrastructures in Indonesia:

1. Level 1 – Slow Charging
2. Level 2 – Medium Charging
3. Level 3 – Fast Charging
4. Level 4 – Ultra Fast Charging

Based on the existing regulation, it obliges every SPKLU to have 3 types of plugs: AC Type 2 plug, DC charging CHAdeMO, and DC charging CCS. It also standardizes the battery voltage to 48, 60, or 72 volts with a minimum battery capacity of 20 Ampere Hours (Ah).

Figure 22. Types of Charging Types

CHARGING TYPE				
Description	Level 1 (Slow Charging)	Level 2 (Medium Charging)	Level 3 (Fast Charging)	Level 4 (Ultra Fast Charging)
Location	Private Installation (House)	Private Installation (Office)	SPKLU (Charging station)	SPKLU (Charging station)
Maximum Output Current (A)	16 AC	63 AC	100 AC/250 DC	300 AC/500DC
Power Output (kW)	≤ 7 kW	≤ 22 kW	≤ 50 kW	≤ 150 kW
Plug-in Connector Type	Type 1 and 2 (IEC 62196-2)	Type 2 (IEC 62196-2)	Combined Charging Type CSS and Chademo (IEC 62196-3)	Combined Charging Type CCS2 and Chademo (IEC 62196-4)
Charging Time	8 hours	4 hours	30 minutes	15 minutes

Source: PT PLN (Persero)

Source: MEMR presentation slide for Discussion and Socialization Forum for Decarbonisation in Transport through Adoption of EV for Better Indonesia, Bandung 2023

In terms of deployment of public charging infrastructure across Indonesia, by the end of 2022, there were 1,114 public and private chargers across Indonesia and 80% of those were in three provinces: Bali, Jawa Barat, and

DKI Jakarta.<sup>21</sup>

### Deployment of home charging

At the beginning of 2023, PLN reported that a total of 4,610 units of home charging stations had been installed across the archipelago in Indonesia. This has been about 5 times the installation rate in the previous year, 2022.<sup>22</sup>

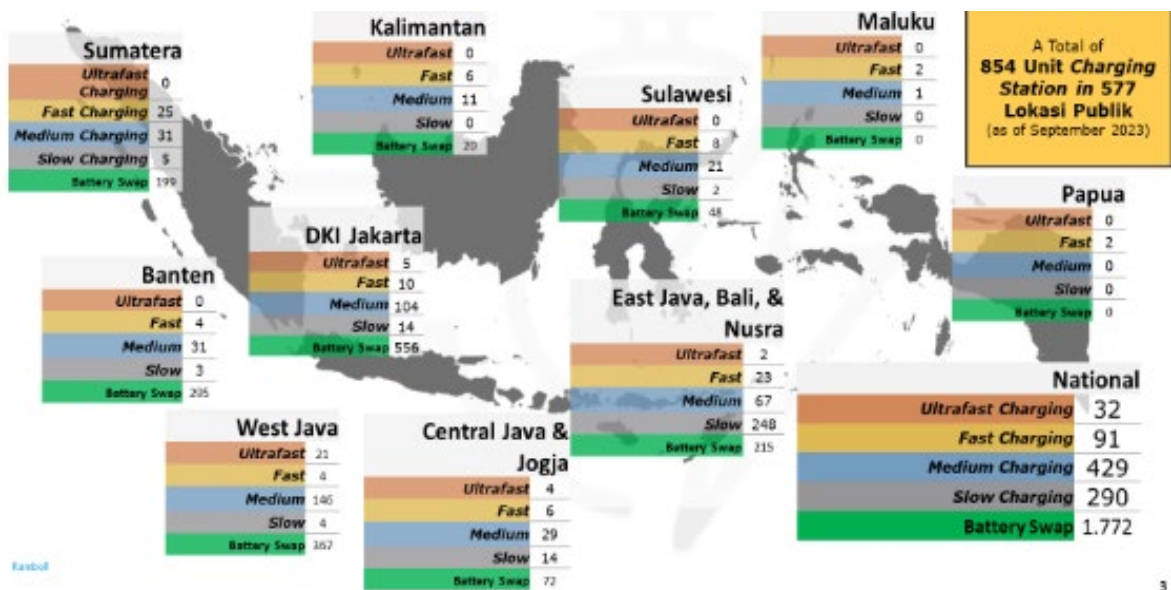
Reflecting from the total registered passenger car EVs in the country by the end of 2022 in Figure 18 , which appear to be about 20,300 units. It can be estimated that 1 out of 4 EV users has a home charging installed for overnight charging. In other words, by the end of 2022, 25% of EV users in Indonesia will rely on home charging facilities. This reliance rate to home charging is still far from the assumption set for Indonesia which to be at 80%.

In Bali, in 2022, the government provided 200 home chargers through PT PLN. Where these are deployed in 12 locations of hotels and resorts, including Merusaka, Ritz Carlton, Grand Hyatt, Nusa Dua Beach, St.Regis, Laguna, Westin, Hilton, Samabe, Mulia, Bali Nusa Dua Convention Centre (BNDCC), and Indonesia Tourism Development Corporation (ITDC).<sup>23</sup>

### Deployment of public charging points and battery swap station

As of December, 2023, there are 854 charging stations (1,117 units as reported in December 2023) located at 577 locations in Indonesia. Meanwhile, there are 1,772 battery swap stations located across Indonesia. The majority of these provisions are currently concentrated in Java Island.

Figure 23. Charging Infrastructure Deployment in Indonesia



Source: MEMR presentation slide for Discussion and Socialization Forum for Decarbonisation in Transport through Adoption of EV for Better Indonesia, Bandung 2023

21 ICCT, 2024. Charging Indonesia's vehicle transition: Infrastructure needs for electric passenger cars in 2030. [https://theicct.org/wp-content/uploads/2024/02/ID-88-%E2%80%93-Indonesia-charging\\_final2.pdf](https://theicct.org/wp-content/uploads/2024/02/ID-88-%E2%80%93-Indonesia-charging_final2.pdf)

22 PLN, 2023. Terus Tingkatkan Jumlah SPKLU Selama 2023, PLN Berhasil Penuhi Kebutuhan Pengguna Kendaraan Listrik di Indonesia. <https://web.pln.co.id/media/siaran-pers/2024/01/terus-tingkatkan-jumlah-spclu-selama-2023-pln-berhasil-penuhi-kebutuhan-pengguna-kendaraan-listrik-di-indonesia#:~:text=PLN%20mencatat%20total%20home%20charging,tahun%202022%20sebesar%20399%20MWh.>

23 Tempo, 2023. KTT G20 Bali, ESDM: Ada 66 SPKLU dan 200 Home Charging untuk Kendaraan Listrik. <https://bisnis.tempo.co/read/1656009/ktt-g20-bali-esdm-ada-66-spclu-dan-200-home-charging-untuk-kendaraan-listrik>

In Bali, by December 2023, 88 units of SKPLU had deployed across the island. The operation is dominated by PLN, followed by a few other entities, including Hyundai. These include 29 units of standard charging, 9 units of medium charging, 19 units of fast charging, and 18 units of ultra-fast charging.

Figure 24. Charging Infrastructure Deployment in Bali



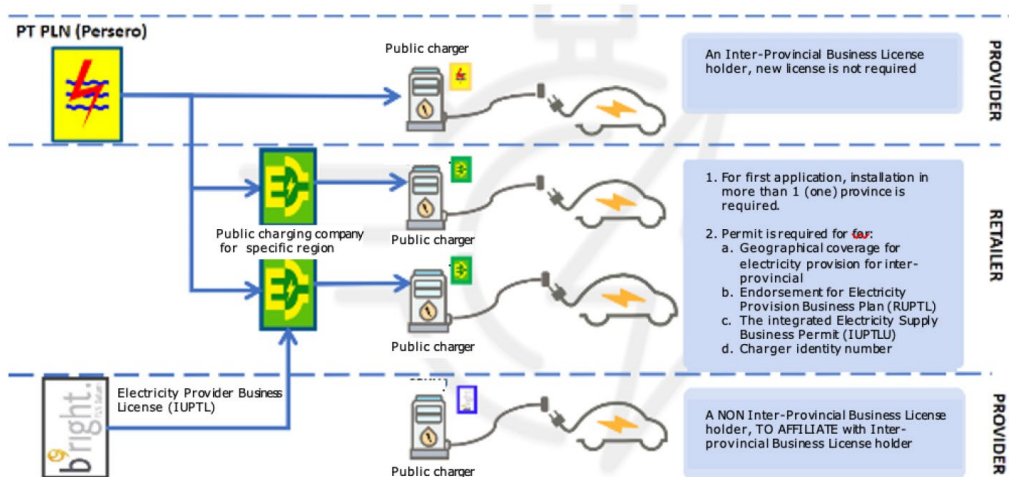
Source: PLN presentation slide, 2024

### 2.4.1.2 Business Model and Market Players

#### Business Model for Charging Infrastructure Provision in Indonesia

The following illustrates the current regulation for establishing a business of public charging infrastructure based on Ministerial Regulation of Energy and Mineral Resources No. 1/2023 concerning Provision of Electric Charging Infrastructure for Battery-Based Electric Motorized Vehicles.

Figure 25. Charging Infrastructure Business Model in Indonesia



Source: MEMR presentation slide for Discussion and Socialization Forum for Decarbonisation in Transport through Adoption of EV for Better Indonesia, Bandung 2023

The following lists some of the existing charging infrastructure providers as of the 4<sup>th</sup> week of September 2023 shared by the PLN include:

**Table 32. Existing Charging Stations and Future Plans by Providers**

Platform	Existing Charging Stations	2023 Plan for New Charging Stations
Voltron	125	250
Starvo	20	-
Charger+	17	50
Cas-ion	13	20
Daya Green	20	27
GES (Pertamina)	3	-
Shell	4	-
Hyundai	157	500
Mitsubishi	17	-
Astra Otopower	15	20
Total	391	911

Source: PLN presentation slide, collaborating to Build an EV Ecosystem through the SPKLU Partnership Scheme

## Charging rate

In terms of charging rate, according to the Ministry of Energy and Mineral Resources, the current cost to charge using SPKLU ranges from IDR 1,650 per kWh to IDR 2,475 per kWh as vary across slow charging and ultra-fast charging.

The SPKLU price is higher than household electricity rates as it offers faster charging facilities to save the user time. This also makes it more attractive to charge at home. The average E-car is currently equipped with a battery with a capacity of 40 kWh, and the total cost to charge a vehicle using SPKLU is estimated to be IDR 66,000. However, the total cost to charge using the fast charging and ultra-fast charging stations is set at a flat rate regardless of the duration, as indicated below:

**Table 33. PLN Rates for Charging Fee**

Type of charging	Tariff
Fast charging (>50kW)	IDR 25,000 per 1-time charging
Ultrafast charging (>150kW)	IDR 57,000 per 1-time charging

Source: PLN presentation slide, collaborating to Build an EV Ecosystem through the SPKLU Partnership Scheme

In comparison with charging rates across the globe, as tabulated in the Table 34 below, the EV charging rate in Indonesia is considerably low compared to European countries and the United States. However, it is within the range of rates for China.

**Table 34. Comparison of Charging Rates in Indonesia and Other Countries**

S/N	Country	Charging tariff (IDR/kWh)
1	Germany	8,316 – 13,662
2	Norway	7,871
3	Denmark	7,277
4	Netherland	7,128 - 10,692
5	Austria	5,792 – 13,354

6	Sweden	5,729
7	France	4,307 - 7,574
8	United States	4,010 - 10,247
9	United Kingdom	3,119 - 7,277
10	Canada	3,119 - 4,158
11	Switzerland	2,970 - 7.722
12	Estonia	2,970 - 7.722
13	<b>Indonesia</b>	<b>1,650 - 2,467</b>
14	China	1,485 - 5,643

Source: okezone.com, 2021

## 2.5 The Current Electricity Grid in Bali, Indonesia

### 2.5.1 Current Capacity, Structure, and Operations of the Electricity Grid

The analysis will be based on a desktop investigation. Appendix 2 of the Power Supply Business Plan (RUPTL) 2021-2030 presents the PLN electricity supply projection for overall sectoral usage for Indonesia and Bali.

In terms of electricity grid context that is relevant for e-Mobility, it is expected that information regarding the low voltage grid (<20 kV) may be limited. Therefore, an interview with PLN is proposed to provide more information in the most possible detail.

Bali is part of the broader Indonesian electrical grid system, managed by PLN (Perusahaan Listrik Negara), the state-owned electricity company in Indonesia. High-voltage transmission lines transport electricity from power generation sources, connecting Bali to Java, the main island in Indonesia. These transmission lines are part of the national grid that facilitates the transfer of electricity between regions. Substations on Bali play a role in receiving high-voltage electricity and transforming it to lower voltages for distribution within the island. The distribution network on Bali includes medium and low-voltage lines that carry electricity from substations to various areas, including residential, commercial, and industrial zones. Bali has an extensive network of low-voltage distribution lines that bring electricity directly to homes, businesses, and other consumer facilities.

Following Figure 26, this shows a map overview of the high-voltage electrical grid network in Bali in February 2024, including transmission lines, the location of existing power stations, and the size of the substations (with the number of transformers and their sizes).

Bali's current interconnection with Java consists of four 150 kV submarine cables with a total capacity of 400 MW. The first two cables, which had a total capacity of 200MW, were commissioned in 1999 and 2000, respectively, while the other two were added in 2014.

According to the PLN's Power Supply Business Plan (RUPTL) 2019-2028, there is a plan to decommission the four 150kV transmission lines in 2024 and instead start the operation of Java-Bali Connection 500 kV. This Java-Bali 500kV transmission line plan is illustrated later. Figure 27. This project aims to establish a 500 kV transmission line that spans 220 km, including 18.6 km along the periphery of Baluran Park in East Java and 10 km along the periphery of Bali Barat National Park (BNNP). The anticipated commencement of operations for this new transmission line is set for 2025, as of the December 2022 update. The primary purpose of this new extra high-voltage line is to facilitate the transmission of 1,500 MW of capacity. The project involves extending a 500/150 kV substation in East Java, constructing a new 500/150 kV substation in Antosari, Bali, and also upgrading 11 existing 150/20 kV substations.



From the perspective of the transmission and distribution electrical grid, Table 35 provides the actual kilometers and power transfer installed for the transmission lines with 150 kV and the distribution lines with 15–20kV.

**Table 35. PLN Transmission and Distribution Lines Kilometers and MVA in Bali and Indonesia, 15 to 150 kV, 2022**

Voltage level	150 kV		15-20 kV	
	km	MVA	km	MVA
Region				
Bali	1,074.06	2,630.00	8,767.96	2,099.23
Total in Indonesia	<b>51,395.58</b>	<b>102,850</b>	<b>430,509.2</b>	<b>65,439.3</b>

Source: PLN RUPTL 2021-2030

The transmission and distribution networks are undergoing significant modifications due to Bali’s energy transformation. This includes expanding renewables, extending the previously mentioned interconnection, and creating new substations. As the region integrates more renewable energy sources, the transmission network upgrades become essential for efficiently transporting clean energy from remote generation sites to main centers.

## 2.5.2 Evolution of Electricity Grid

### The energy source for the electricity grid

The state-controlled electricity company PT PLN (Persero) manages Indonesia’s power grid, which includes the nation’s energy sources. These are a hybrid of fossil fuels and renewable types, encompassing coal, natural gas, hydroelectric, and geothermal energy. In recent years, Indonesia has taken steps towards expanding its renewable energy capabilities to reduce dependency on fossil fuels by incorporating more Renewable Energy Sources into its energy portfolio.

Under the Power Supply Business Plan (RUPTL) 2021-2030, the key strategy for expanding the electricity grid in Indonesia to 2030 is based on the demand for electricity across the provinces while also considering the availability of local regions to mix renewable energy sources such as geothermal, hydro, wind, biomass, biofuel, biogas, etc.

The generation mix for electricity in Bali in 2022 is described in the Table 36 below. Renewables—hydro, solar, and wind—account for only 1.5% of the total capacity installed.

**Table 36. Electricity Generation Mix for 2022 in Bali**

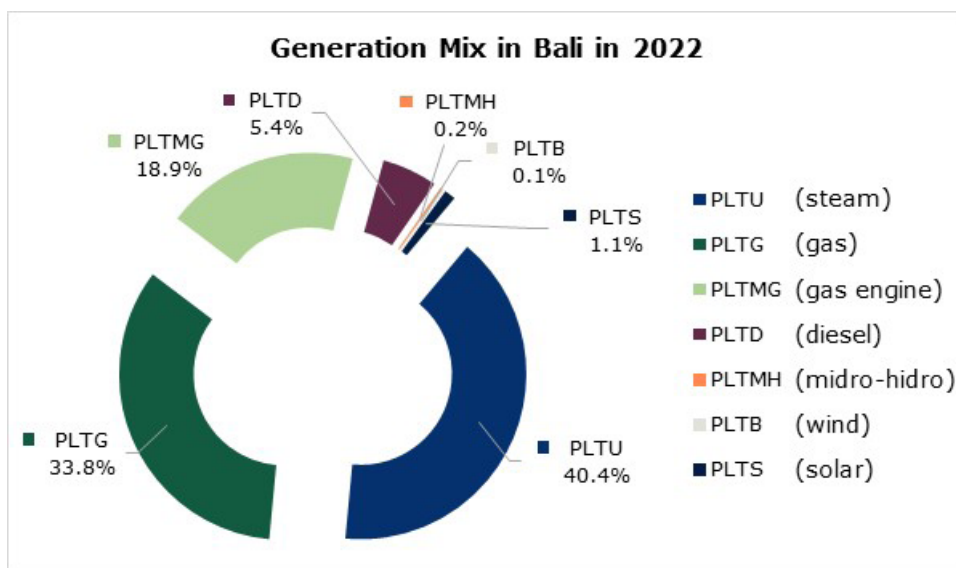
Type		Total Capacity (MW)		Net Capable Power (MW)	
		Indonesia	Bali	Indonesia	Bali
PLTU	Steam Generation (Non-PLN)	42,343.26	426.00	39,301.46	380.00
PLTG	Gas Generation	4,456.74	356.85	4,020.80	322.04
PLTMG	Gas Engine Generation	2,935.53	199.68	2,752.54	182.40
PLTD	Diesel Generation	4,352.09	56.96	3,003.77	51.41
PLTMH	Micro Hydro Power Plant	127.68	2.53	121.14	2.20
PLTB	Wind Power Plant	2,925.05	1.38	2,138.94	0.48
PLTS	Solar Power Plant	307.59	11.63	727.47	10.23
	Other Power Plants	26,365.15	-	24,064.73	-
TOTAL		83,813.09	1,055.03	76,130.85	948.76

Source: PLN RUPTL 2021-2030

In Indonesia, there are many non-PLN generators, which are owned by private companies or Independent Power Producers (IPPs) and companies that have a Business Permit for the Supply of Electricity (IUPTL), such as holders of territory of electricity business areas and operating license holders. The total generating capacity of non-PLN generators in 2022 was 41.318,00 MW; of these, 426 IPP are in Bali, corresponding to the steam generation in the Table 36 above.

Despite the limited amount of renewables in 2022, as can be seen in the chart below, renewable energy power plant only represents 1.4% of the total power plants (including wind, solar, and micro-hydro) of the generation in Bali; the target is to achieve 11.5% by 2025 and 20.1% by 2050.

Figure 28. Generation Mix in Bali in 2022 in %



Source: PLN RUPTL 2021-2030

In terms of peak consumption, PLN Bali Main Distribution Unit (UID) recorded a peak load on New Year’s Eve, Sunday (31/1/2023), reaching 1075.4 MW. This figure is the highest peak load throughout 2023, exceeding the peak load before the Covid-19 pandemic, which was only 980 MW<sup>24</sup>.

A collaboration initiative towards low carbon energy transition has been established between the UK and Indonesia, the MENTARI (*“Menuju Transisi Energi Rendah Karbon Indonesia”*). The final year of the collaboration was extended in 2023 from 2024 to 2027, with the UK additionally committing an extra GBP 6.5 million (equivalent to IDR 135 billion) to aid Indonesia’s initiative towards achieving a Net Zero Emission (NZE) target<sup>25</sup>. This is done by encouraging increased cooperative efforts and facilitating investment partnerships among Indonesian and UK-based organizations, financial institutions, and businesses. These partnerships aim to support sustainable infrastructure projects, bolster the low-carbon industry, support upstream and downstream sectors, boost electric vehicles, and foster green technology advancements.

Moreover, the Asian Development Bank has sanctioned an investment of \$500 million for Indonesia’s green recovery efforts, including a specific allocation of \$224 million dedicated to improving the Java-Bali 500 kV transmission line. This also includes provisioning a new substation to support the upgraded transmission.

24 Source: <https://www.nusabali.com/index.php/berita/158247/pemakaian-tembus-10754-mw>

25 Source: Indonesia Just Energy Transition Partnership Launched at G20 - GOV.UK ([www.gov.uk](http://www.gov.uk))

## Plan for Electricity Grid Supply For EVs As Cleaner Energy Transport

In considering the transition from fossil fuel vehicles to electric vehicles, which is as government efforts to reduce the GHG emission contributed by fossil fuel vehicles, the strategy expansion of the electricity grid in Indonesia is also intended to address the demand of trend of EVs in the future. Based on data from the Ministry of Industry, the RUPTL estimated the following projection for EV sales in Indonesia for passenger cars (both PHEV and BEV) up to 2024, after adjustment in considering the impact of COVID-19. However, it is essential to know that Ramboll might adjust these projections as more accurate data is received from stakeholders.

**Table 37. Assumed Projection of Passenger Car EV Sales For Both PHEV and BEV Used by PLN in Estimating the Electricity Demand in Indonesia Towards 2024**

Assumed EV sales projection to 2024	2020	2021	2022	2023	2024
Total EV sales (unit)	1,624	5,352	12,834	21,196	30,438
Total EV sales (unit) – after COVID-19 adjustment	729	4,734	11,873	22,471	38,491

Source: PLN RUPTL 2021-2030

PLN used the following assumptions in the RUPTL to estimate the energy supply for the above EV demand.

**Figure 29. Assumptions of Travel Distance and Energy Consumption Used by PLN in the RUPTL**

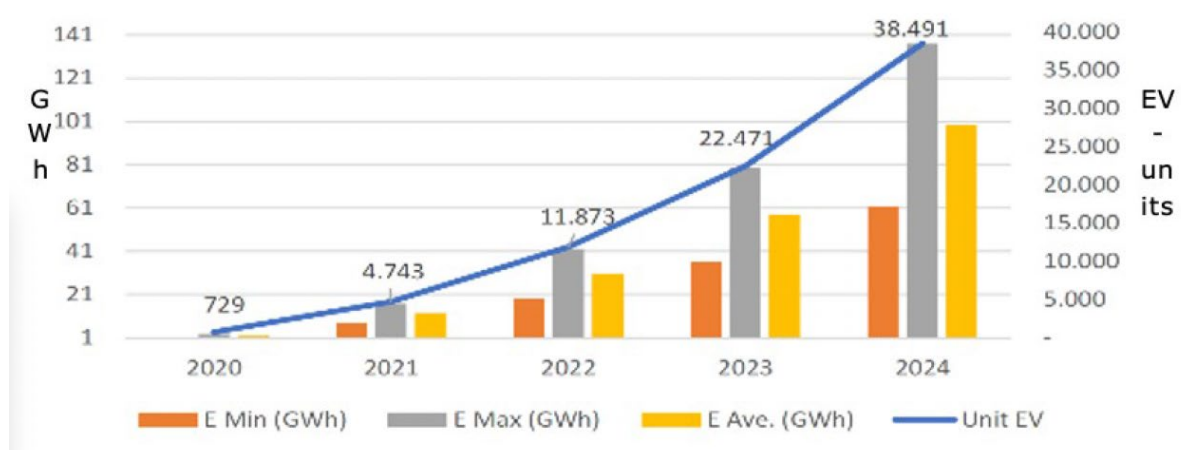
Assumptions	Volume	Unit
Minimum traveling distance	8,500	km/year/vehicle
Maximum traveling distance	18,800	km/year/vehicle
Average traveling distance	13,650	km/year/vehicle
Energy consumption	0.189	kWh/km/vehicle

Source: PLN RUPTL 2021-2030

With the above demand assumptions and also considering specific charging durations based on various types of chargers, the RUPTL suggests following the projection of electricity energy to supply for EVs as a roadmap to 2024.

However, PLN may further review such a projection for electricity energy supply, with potential changes in the EV projection for up to 2024 and beyond.

**Figure 30. Projection of Electricity Supply in Indonesia for EV Sector (GWh)**



Source: PLN's RUPTL 2021-2030

From a technology perspective, and supported by Governor Regulation No. 48, 2019, the development of the electricity grid in Bali is expected to align with the implementation of smart grid and Electric Vehicle usage to move towards Bali Eco Green. One smart grid technology that is already being adopted in Bali is advanced metering infrastructure (AMI) by implementing 2-Way Smart Meter based on low range wide area network (LoRa WAN) as replacing pre- and postpaid existing digital meter. PLN Bali deploy 1,000 of 2-Way Smart Meter based on LoRa WAN at Kuta area.

## **2.6 Summary Analysis of Baseline Assessment**

Based on the analysis of the existing charging infrastructure, EV market, and electricity grid, an overall evaluation of Bali and Indonesia's e-mobility readiness will be provided. During this process, the main strengths and weaknesses, as well as possible opportunities and threats, will be identified. The analysis's outcome will be used to point out issues that need to be addressed when considering the potential future situation.

To ensure we cover all relevant macroeconomic factors, the following summarizes a SWOT analysis of EVs in Bali, Indonesia.

**Table 38. Summary Analysis of Baseline Assessment**

	Social & Politic	Commercial Market & Financial	Technical & Specification	Economic & Environmental
Strength and Opportunities	<ul style="list-style-type: none"> <li>In Indonesia, ranges of fiscal and non-fiscal incentives have been regulated and enforced at the national level by presidential and various ministerial including Coordinating Ministry for Maritime &amp; Investment Affairs, Ministry of Energy and Mineral Resources, Ministry of Industry, and Ministry of Finance.</li> <li>Similar things have been introduced at the Bali regional level, such as no progressive tax for EVs and Zero Carbon Emission Zones, specifically Bali Low Emission Zone (Bali).</li> <li>Committee for Acceleration of EV use in Bali has been established. This resulted in a target of EV implementation up to 2026.</li> </ul>	<ul style="list-style-type: none"> <li>In Indonesia, EV sales have been growing at an average of 270% p.a. in the past 5 years – based on GAIKINDO sales of passenger cars.</li> <li>Market focus of EV sales to target passenger cars, M/C, and buses. This includes taxis and online ride-hailing (Grab, Gojek, etc.).</li> <li>E-buses have been operated in Jakarta and are under trial in Bandung and Semarang, Surabaya and Medan.</li> <li>For Bali, the use of EVs in Bali has increased by more than 200 % from 2022 to 2023, with more than 80% EV fleets of are e-motorcycles.</li> <li>PLN has included a plan for the expansion of the electricity grid to consider the demand for the provision of charging stations in Indonesia (and Bali).</li> <li>Up to Q4 of 2023, there has been approx. 900 EV charging stations (SKPLU) being deployed in Indonesia and 30 in Bali.</li> </ul>	<ul style="list-style-type: none"> <li>Plug-type standardization has been established. However, careful consideration should be given to accommodate a broader market globally.</li> <li>Battery swap – new regulation, where all e-motorcycles should have battery standardization. E-motorcycle to be sold without battery.</li> <li>Support for households to upgrade or install new grids in their household for home charging purposes.</li> <li>Retrofitting fuel combustion motorcycles to e-motorcycles has been regulated and supported by Ministry of Transportation and Ministry of Energy and Mineral Resources.</li> <li>Reliance on the availability of Indonesian nickel and other mineral resource for battery production.</li> </ul>	<ul style="list-style-type: none"> <li>Total cost of ownership is lower for an EV than a conventional vehicle.</li> <li>Commitment to push for carbon emission reduction through: (i) acknowledgment of Paris Agreement in Law No. 16/2016; and (ii) determination of the target setting of nationally determined contribution (NDC) of emission that is 29% unconditional and 41% conditional with international support - by 2030, under ASEAN Country Members Climate Mitigation Pledges.</li> <li>Disposal of the battery of EVs is considered to have similar treatment to current regulations for disposal of toxic waste.</li> <li>Economic savings from health due to pollutant reduction.</li> </ul>

	Social & Politic	Commercial Market & Financial	Technical & Specification	Economic & Environmental
Weaknesses and Threats	<ul style="list-style-type: none"> <li>• Coordination among ministries/agencies is not solid yet.</li> <li>• The current category of electric cars sold in Indonesia may yet to meet the needs of user groups in Indonesian, particularly for Lower Middle-Income level.</li> <li>• No regulation has been implemented yet regarding environmental protection due to the use and related industry of EV.</li> <li>• Uncertainty of the commitment of the next elected president to continue the EV program.</li> <li>• Limited collaboration must be sought between government and business players, especially in establishing charging stations.</li> <li>• GEDSI consideration to accommodate charging facilities that are safe for women at night as well as disabled persons.</li> <li>• In the initial stages of 2019, the EV transition still relied on Hybrid EVs. However, the focus needs to shift to pure EV (BEV).</li> </ul>	<ul style="list-style-type: none"> <li>• The initial cost of an EV, including charging infrastructure, is higher than a conventional vehicle.</li> <li>• Current incentives (of 10%) tax only reduce the gap between EV cost vs ICE cost.</li> <li>• Hence, financial incentives are needed to overcome the initial costs of purchasing an EV and charging electric vehicle infrastructure.</li> <li>• Low rate of buying power/ability to purchase EV considering the large portion of middle-low-income groups.</li> <li>• No specific incentives for the battery industry.</li> <li>• Other cost considerations: higher insurance premium due to high initial cost; no secondhand market due to low maturity of EV.</li> </ul>	<ul style="list-style-type: none"> <li>• Limited mileage of EV compared to an ICE vehicle, while limited coverage of available charging stations.</li> <li>• Limited data in monitoring the growth of implementation of EV facilities across Bali and Indonesia.</li> <li>• Assumption of the electricity grid is not strong enough in the entire grid.</li> <li>• The presence of alternative substitution technologies such as hydrogen and solar vehicles (solar) that may compete with EV technology.</li> <li>• Other tech considerations include decreasing battery capacity over time; charging infrastructure may not be smart chargers; weatherproof technology; technology adoption to adapt to dynamic change.</li> </ul>	<ul style="list-style-type: none"> <li>• Negative impact on land and water pollution due to the need for EV battery waste management and disposal, while limited numbers of battery recycling industries.</li> <li>• Lack of user awareness of the impact of EVs on health and the environment over the social lifestyle of having EVs.</li> <li>• Needs to address the perception of other negative impacts of EV, for example, ecological impact due to extensive nickel mining.</li> </ul>

Source: Consultant Analysis



# 3. INTERNATIONAL BEST PRACTICES

The shift from combustion engines to battery electric vehicles is an important initiative as part of the global green transition. However, the shift only comes with strong policy measures to boost nascent EV industries, and in some markets, e.g., China and the European Union, this has been happening for some years. Now, some markets, such as China, Korea, and the United Kingdom, are steadily reducing per-vehicle direct subsidies in recognition of the ongoing closing of the gap between the purchase price of electric and conventional cars and pushing auto manufacturers to lower costs. Others, such as the EU, are using regulatory measures such as tighter CO2 emissions standards. In some cases, the European Union, India, and Japan are increasing subsidies for EVs as part of post-COVID-19 recovery packages.

The barriers are generally the same across geographies; therefore, the initiatives to respond to these barriers may also be the same. The Table 39 below lists the main barriers to EVs and the general response to them. Some responses come from the manufacturing industry, others from the government.

**Table 39. General Barriers to the Transition to EVs and the Typical Response**

General barriers for EVs	Response
<p>Range of the EVs</p> <p>The range of EVs has been and, to some extent, still is a challenge. Range anxiety may result in a slower uptake of EVs.</p> <p>Owners of motorcycles and passenger cars see the range of EVs and downtime for charging as barriers. The consumer plans and buys vehicles based on rare occasions (e.g., longer trips) instead of everyday life.</p> <p>Electric buses must cover various routes, including intercity journeys, which demand a significant range of electric buses or, perhaps alternatively, fast charging facilities along the route. Longer trips are still a problem, making this not only a provincial problem but a question of regional and nationwide cohesion.</p>	<p>Battery technology innovation</p> <p>Enhanced energy density, longer ranges, and fast charging improves practicality and viability, especially for intercity travel.</p> <p>Moreover, technological breakthroughs like regenerative braking, energy-efficient systems, and intelligent energy management. Collaborations across sectors and geographies push EV technology boundaries, enhancing efficiency and comfort.</p>

General barriers for EVs	Response
<p><b>Charging Infrastructure Scalability</b></p> <p>As the EV market expands, scaling charging infrastructure becomes critical. Strategic planning and investment are needed to prevent charging congestion and support growing demand, ensuring smooth operations.</p> <p>A lack of charging infrastructure will slow down the uptake of EVs, resulting in a bad business case for the CPOs. Policies and fiscal incentives for the development of charging infrastructure are paramount.</p>	<p><b>Charging Infrastructure Development</b></p> <p>Charging infrastructure development is extensive world-wide but differs from geography to geography, partly due to the different incentive schemes for EVs and charging infrastructure.</p> <p>Charging stations placed along routes and urban areas address range anxiety for consumers and ensure efficient electric bus operations. This promotes adoption and operational ease.</p>
<p><b>Charging Time and Downtime</b></p> <p>Owners of motorcycles and passenger cars see downtime for charging as a barrier. The perception is that charging more frequently than the reality is necessary.</p> <p>Charging time impacts electric bus efficiency. Longer charging compared to diesel refueling affects schedules and utilization.</p>	<p><b>Charging strategies to improve effectiveness</b></p> <p>Charging time can be used effectively, e.g., when the driver needs breaks. Balancing fast charging with operational needs is crucial. Efficient charging strategies and battery management minimize downtime.</p> <p>Routes, schedules, and charging must align, maintaining operational efficiency without disruption.</p>
<p><b>Initial Cost and Total Cost of Ownership</b></p> <p>The upfront cost of EVs is higher than that of conventional vehicles. While incentives offset costs, the initial investment remains a challenge. Ensuring economic viability requires evaluating total ownership costs (TCO), including energy savings and maintenance.</p>	<p><b>Government Support and Policies</b></p> <p>Government commitments to sustainability shape a cleaner future for public transportation. Governments drive the EV market with visionary policies and incentives and support the adoption of EVs. Financial incentives foster a favorable environment for public and private adoption.</p> <p>Incentives, subsidies, and tax benefits facilitate electric bus procurement, fostering increased market share.</p>
<p><b>Public skepticism</b></p> <p>Battery electric vehicles are not brand-new technology per se, as the first electric car was built in 1888. However, the public and consumers are unfamiliar with technology, which is met with skepticism. Many myths revolve around the electric vehicle, which adds to the unwillingness to shift.</p>	<p><b>Public Education</b></p> <p>Public acceptance relies on understanding. Educating consumers, passengers, and stakeholders about EVs' benefits, features, and limitations is essential. Addressing range anxiety and charging concerns through communication and education fosters support.</p> <p>However, the narrative about the shift to EVs is straightforward to sell to the public concerned with the environment and sustainable transportation. Zero tailpipe emissions mitigate pollution and reduce carbon emissions, aligning with sustainability goals. Electric buses contribute to cleaner urban transport.<sup>1</sup></p>

Source: Consultant Analysis

To gather more knowledge on how the responses and to suggest international best practices for boosting the transition to EVs, experiences have been included from four selected countries:

1. Denmark (EU)

As a part of the EU, Denmark is governed by legal requirements by the European Union but has also applied its regulation and incentives to support the transition to EVs.

2. Norway

Norway is a global front-runner, with EVs having an 82.4% market share in 2023 through number of supportive regulations to push for EV since 1990.

3. California (USA)

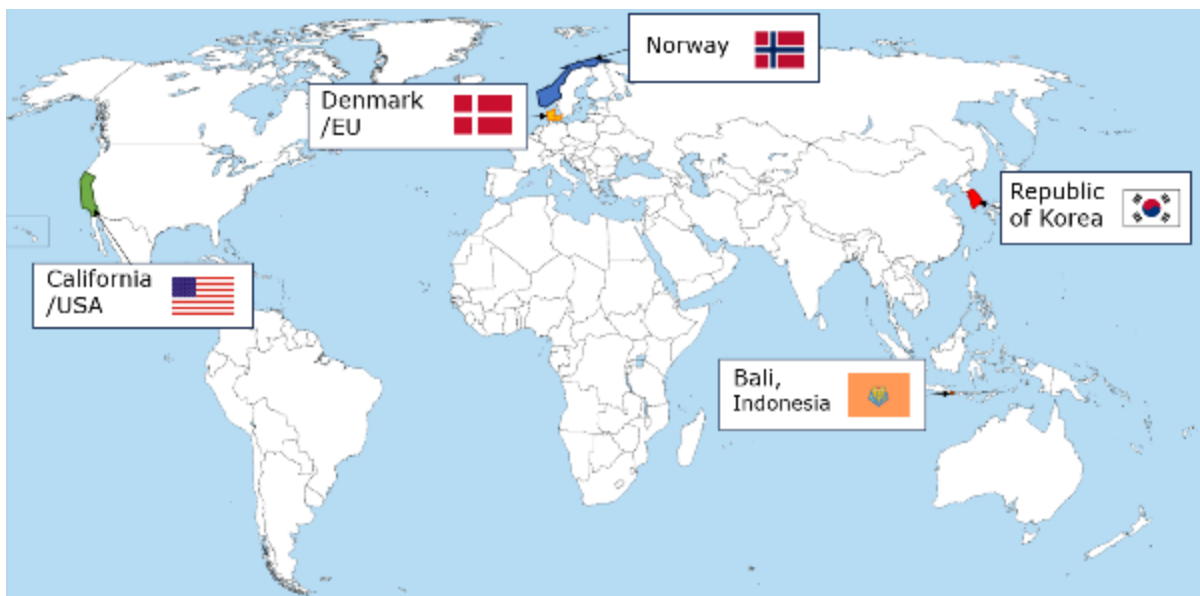
California has invested heavily in EV transition through the effort of providing significant amount of rebate to purchase EV under Clean Vehicle Rebate Project (CVRP). The city pushes for new passenger cars, trucks, and SUVs sold in California to have zero emissions by 2035.

4. Republic of Korea

Korea is front-runner in the transition to EVs in Asia that has implemented several policies to encourage the adoption of EVs. One is to halve the price of EVs by 2025.

The experiences will be used to make critical recommendations for Bali, Indonesia. Based on the analysis of the current situation in the province (paragraph 3).

**Figure 31.** Experiences Have Been Gathered from Around the Globe, Namely Denmark, Norway, California (USA), and Korea



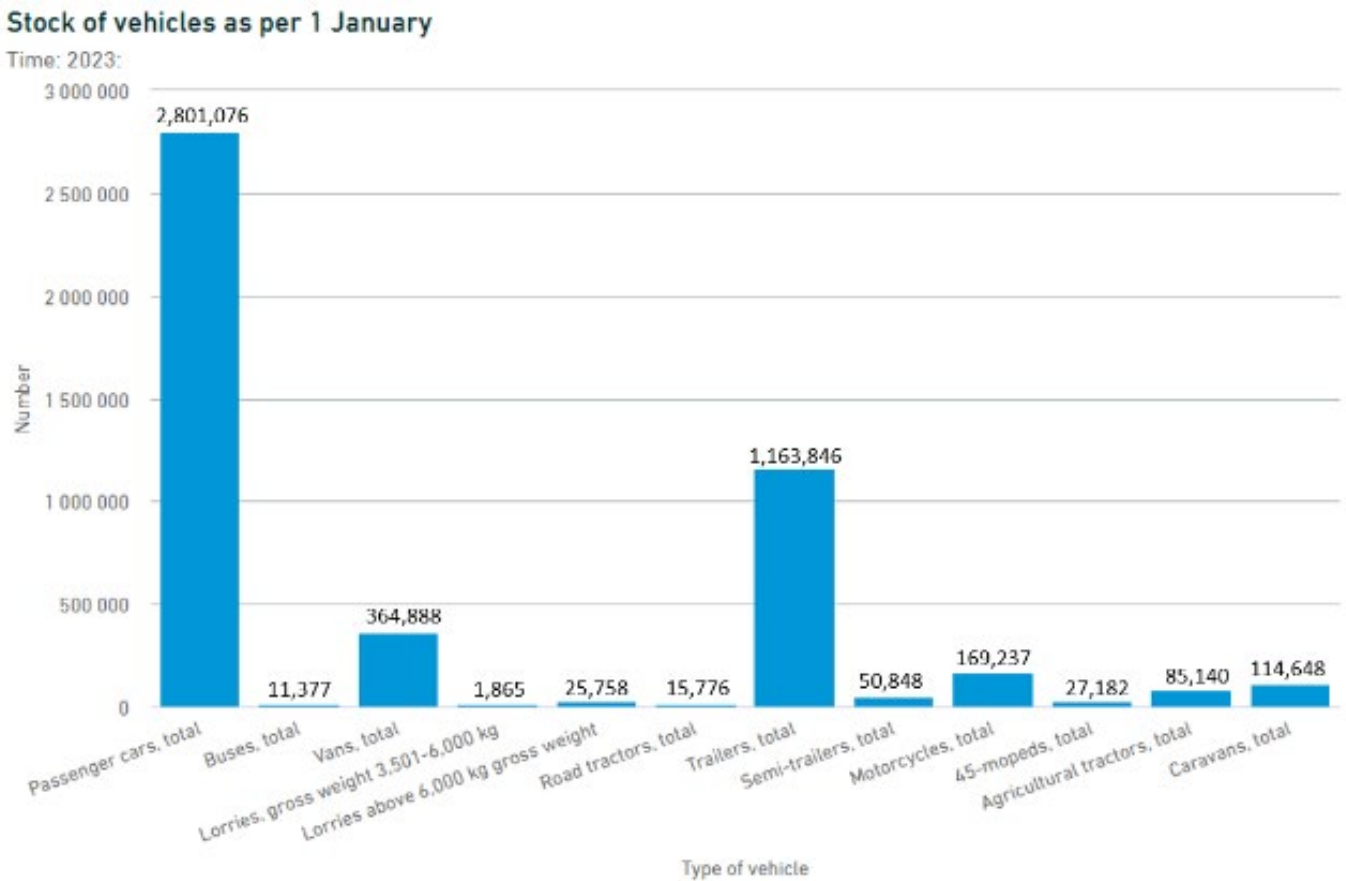
### 3.1 Denmark’s Approach To Electric Vehicle Adoption And Charging Infrastructure Development

With a self-image of being a pioneer country in the green transition, Denmark has emerged as one of the global leaders in fostering the adoption of electric vehicles (EVs) and developing an extensive charging infrastructure. The country’s success can be attributed to a combination of forward-thinking regulatory frameworks, targeted incentives, and strategic investments. This comprehensive approach has not only made EVs more attractive to consumers and businesses but has also effectively managed the impact on the electricity grid. Denmark is especially leading the European market for electric buses.

#### Introductory to the Danish vehicle market

In Denmark, light-duty vehicles (passenger cars) make up the vast majority of the total stock of vehicles (see Figure 32). Much focus is on the transition of this vehicle type. In 2023, 36.3% of new cars were BEVs, and 10% were PHEVs. This number is expected to grow exponentially in the years to come. The government’s declared goal in Denmark is that Denmark has 1 million EVs by 2030, and the current projections show that the goal is achievable. Around 200,000 of the current light-duty vehicle fleet are electric. The Danish consumers have a strong focus on sustainability in their everyday lives, and this is also increasingly affecting the transport sector. This culture positively affects the sales of EVs. In 2023, 46% of all new passenger cars were electric (PHEV+BEV); however, this may also be due to the different other incentives the Danish government and the EU laid forward.

Figure 32. Stock of Vehicles as of 1 January 2023 in Denmark. Source: Statistics Denmark



### 3.1.1 Regulatory Framework

Denmark has been promoting electric vehicles (EVs) and charging infrastructure from an early point. One of the key legislative pillars driving EV adoption is the Green Tax Reform.<sup>26</sup> Enacted in 1997, this reform introduced a differentiated vehicle registration tax based on environmental impact. Being environmentally friendly with zero tailpipe emissions, EVs enjoy tax advantages compared to their combustion engine counterparts. This strategic move not only makes EVs more affordable for consumers but also serves as a market signal for automakers to prioritize electric vehicle production.

Moreover, Denmark has implemented vehicle emission standards, motivating automakers to invest in cleaner technologies. The country has set targets to phase out internal combustion engine vehicles, aiming for a complete transition to zero-emission vehicles by 2030<sup>27</sup>. This long-term commitment provides a stable regulatory environment, assuring businesses and consumers of the government's dedication to sustainable transportation.

However, for a small country such as Denmark, national legislation has a minor effect compared to the EU's regulation regarding car manufacturers. Effective 1 January 2020, the regulation sets an EU fleet-wide target of 95 g CO<sub>2</sub>/km for the average emissions of new passenger cars and an EU fleet-wide target of 147 g CO<sub>2</sub>/km for the average emissions of new light commercial vehicles registered in the Union. These targets are further increased to around 81 g CO<sub>2</sub>/km for passenger cars and 125 g for light commercial vehicles by 1 January 2025. The targets from 1 January 2030 are 59 g CO<sub>2</sub>/km and 92 CO<sub>2</sub>/km. This effectively means that car manufacturers must mainly sell zero-emission vehicles to avoid billions in fines.

<sup>28</sup>The EU has also played a significant role in promoting more charging infrastructure in Denmark, primarily through the Energy Performance of Buildings Directive (EPBD) from 2018 implemented to the Danish Executive Order on Chargers and the Alternative Fuels Infrastructure Regulation (AFIR) in 2021, which is part of the 'Fit for 55'-package:

- The Executive Order on Chargers ('ladestanderbekendtgørelsen') is a regulation that requires the preparation and establishment of charging stations for electric vehicles in connection with buildings. This regulation was introduced in 2020 and applies to existing buildings with more than 20 parking spaces, more extensive renovations of buildings with more than 10 parking spaces, and new buildings with more than 10 parking spaces.
- The AFIR includes specific targets for ultra-rapid charging stations for both light- and heavy-duty vehicles along the EU's Trans-European Transport Network (TEN-T). There are specific targets for 2025, 2027, and 2030, and distances between the charging stations vary from 60 to 100 km also depending on the status of the road (core network or comprehensive network).<sup>29</sup> These measures are expected to further promote the adoption of EVs and charging infrastructure in Denmark and Europe.

Furthermore, the EU's Clean Vehicles Directive promotes clean mobility solutions in public procurement tenders, boosting the demand for and further deploying low—and zero-emission vehicles. The Directive applies

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<sup>26</sup> European Alternative Fuels Observatory

<sup>27</sup> Danish Ministry of Climate, Energy and Utilities

<sup>28</sup> Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO<sub>2</sub> emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011

<sup>29</sup> Regulation (EU) 2023, of the European Parliament and of the Council of on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU

to cars, vans, trucks, and buses when purchased, leased/rented, and public service contracts. It sets national targets on the percentage of clean vehicles in the aggregated public procurement in each Member State. For Denmark, the rate is 37.4% from 31 December 2030.<sup>30</sup>

Another tangible incentive to make it more attractive to acquire EVs is free parking initiatives in Denmark's five most prominent cities.

### 3.1.2 Financial Incentives

Denmark has implemented tax breaks and exemptions for companies investing in EVs for their fleets. The tax advantages extend to both the purchase of electric vehicles and the installation of charging infrastructure at business premises. This dual focus on vehicles and charging infrastructure creates a synergistic approach that accelerates the adoption of electric mobility in both individual and corporate settings.<sup>27</sup>

In Denmark, registration tax must be paid on all vehicles. The registration fee is calculated based on the vehicle's market value on the day in question when it is assessed. When you pay registration tax, you pay percentages of the vehicle's worth at the applicable time. Since 1924, the registration tax in Denmark has been among the highest in the world, peaking at 180 percent of the vehicle's value. Over recent years, however, the registration fee in Denmark has been lowered several times. For the first time in 2015, from the highest 180 percent to 150 percent for private cars.

However, as an incentive to speed up the green transition, there is a special deduction in the taxable value of DKK 900 per kWh battery capacity used for propulsion, but only if it uses a maximum of 45 kWh. For electric vehicles, the tax is calculated according to the general rules for passenger cars, motorcycles, vans, and buses. With the calculated tax, 40 percent is paid if the vehicle is registered before 2026. After 2026, the tax is phased in continuously until it is phased out in 2035.<sup>31</sup>

There are also annual taxes to be paid by the car owner. The Danish government has implemented two different taxes on cars:

- a CO2 ownership tax (CO2-ejerafgift) for cars registered after July 1st, 2021, calculated based on the car's CO2 emissions (grams of CO2 per km). The less CO2 per km, the lower the tax.
- Vans registered between March 18th, 2009, and July 1st, 2021, as well as passenger cars registered between July 1st, 1997, and July 1st, 2021, will pay a green ownership tax (Grøn ejerafgift). Green ownership tax is calculated based on the car's fuel consumption (km per liter), whether the vehicle is petrol or diesel. Electric cars and plug-in hybrid cars' electricity consumption (Wh) per km is converted into km per liter of gasoline. I.e., the longer the car drives per liter, the lower the tax.

Even though an electric car is still more expensive to purchase than a corresponding ICE vehicle, the TCO of the EV is lower because the maintenance costs and propellant expenses are lower. This also indicates that the further the vehicle drives, the more propellant costs are saved. Also, incentives for scrapping diesel cars, including a cash grant, are introduced.<sup>32</sup>

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30 Clean Vehicles Directive

31 <https://www.tjekbil.dk/registreringsafgift>

32 [https://economy-finance.ec.europa.eu/system/files/2023-05/DK\\_SWD\\_2023\\_604\\_en.pdf](https://economy-finance.ec.europa.eu/system/files/2023-05/DK_SWD_2023_604_en.pdf)

### 3.1.3 Charging Infrastructure Development

So far, Denmark has successfully built a robust charging infrastructure by implementing various initiatives and incentives to make charging stations ubiquitous and easily accessible. In November 2023, there were around 20 EVs (PHEV+BEV) per publicly available charging point.

The government actively supports the installation of public charging points through subsidy programs. For instance, the program 'Funds for Charging Infrastructure' ('Puljen til Elbilinfrastruktur') provides financial assistance to municipalities, businesses, and organizations for establishing public charging infrastructure.<sup>33</sup> By incentivizing the creation of a dense network of charging stations in urban areas, along highways, and at strategic locations, Denmark addresses the range anxiety concern and encourages more individuals to consider electric vehicles.

Public-private partnerships have played a crucial role in Denmark's charging infrastructure development. A notable example is the collaboration between E.ON and Clever (private CPOs) to establish ultra-fast charging stations along major highways. These fast-charging stations significantly reduce charging times, making long-distance travel in electric vehicles more convenient and practical.<sup>34</sup>

Furthermore, Denmark encourages private property owners to install charging points through the Building Regulations (*Bygningsreglementet*). Updated in 2018, these regulations require new residential buildings and major renovations to include 100% of the parking spaces prepared for charging infrastructure. New non-residential buildings and significant renovation must consist of at least this proactive approach to ensure that the residential sector contributes to the expansion of charging infrastructure.<sup>35</sup>

Charging infrastructure is insufficient for heavy-duty vehicles, for which incentives remain lower than for light vehicles until 2025. From 2025, a new kilometer-based and CO<sub>2</sub>-differentiated road toll will be imposed for heavy-duty vehicles, providing higher incentives within the framework of EU directive 2022/362.

### 3.1.4 Incentives For Electric Buses And Heavy-Duty Vehicles

Denmark is currently leading the way in the deployment of zero-emission urban buses in the EU, with electric buses making up 78% of its new vehicles.<sup>36</sup> The government and local entities have implemented several incentives to encourage the adoption of electric vehicles other than regular buses.

One of the national incentives is the tax exemption for commercial charging, which was extended to 2019, and favorable tariffs for electric buses were extended to 2024.<sup>37</sup>

The six largest municipalities in Denmark have set a commitment to buy only zero-emission buses from 2021 on. This means that all the new public transport buses in Copenhagen, among others, must be powered by electricity. Hydrogen buses are also an option.<sup>38</sup>

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33 "The need for charge points for electric vehicles will rise dramatically in the future."

34 "EVs and charging infrastructure."

35 "Denmark records significant rise in charging stations at the end of 2021."

36 Denmark leads EU on deployment of zero-emission buses: report

37 Incentives and Legislation | European Alternative Fuels Observatory

38 The six largest Danish cities commit to buying only ZE buses from 2021 ...

However, E-buses' TCO is lower than that of conventional vehicles, and the economy is constantly improving, so the transition will be attractive from a business perspective. Battery prices are continually decreasing,<sup>39</sup> and bus manufacturers are developing more and more models so that competition increases. One municipality (Esbjerg) will save DKK 3.5 million a year on bus driving and, at the same time, cut 70% of CO2 emissions from public transport in the municipality. The number of electric buses will continuously increase towards 2030, depending on the municipalities. Most will probably switch to electric buses as their offer for bus operation needs to be updated.<sup>40</sup>

Technologically, there are no concrete obstacles for municipalities to switch to city buses with batteries and electricity. The technology is in place for charging infrastructure, the buses themselves have already become off-the-shelf products, and the electricity price has been frozen. The range of buses is the next issue to be resolved, as electric buses cannot be used for long trips yet. However, when this is fixed, the transition is expected to be quick because the economy of the e-bus gets better the longer you drive.

### 3.1.5 Integration with Renewable Energy

Denmark's transition into electric vehicles and EV charging development is closely linked to the country's long-term focus on renewable energy, particularly wind power. Denmark has set an ambitious goal of covering 50% of its electricity consumption with wind power by 2020 as part of the Energy Agreement for 2020.<sup>41</sup> The Renewable Energy Act, enacted in 2011, supports the integration of renewable energy into the power grid, which facilitates the coupling of electric vehicles with renewable energy sources.<sup>42</sup> This legislation ensures that the charging process contributes to reducing carbon emissions.

Smart grid technologies can enable dynamic pricing mechanisms, allowing EV owners to charge their vehicles when renewable energy production is high. This not only optimizes the use of clean energy but also assists in grid balancing by aligning charging demand with periods of surplus renewable energy.<sup>43</sup> However, this requires that the charger itself be ready for smart charging. A smart charger is more expensive to buy than a charger that doesn't have this technology, so it depends on the consumer to spend that extra amount on the initial investment. With rising energy prices, this becomes an increasingly good investment. To utilize the full potential of smart charging, a third-party operator (CPO/EMSP) is needed, which may involve additional costs for the end-user.

### 3.1.6 Grid Management and Energy Storage

Denmark has implemented smart grid solutions to address the potential impact of widespread EV adoption on the electricity grid. The Smart Grid Strategy ('Smart Grid strategien'), launched in 2015, outlines the country's approach to incorporating intelligent grid technologies to manage the integration of renewable energy and electric vehicles.<sup>44</sup>

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39 According to the international analysis institute BloombergNEF, the price fell 18 percent per year between 2010 and 2018. Source: <https://www.verdensmaal.org/nyheder/danske-elbusser-har-foden-pa-speederen-hurtigste-udvikling>

40 <https://www.verdensmaal.org/nyheder/danske-elbusser-har-foden-pa-speederen-hurtigste-udvikling>

41 Danish Energy Agreement for 2012-2020 – Policies - IEA

42 Promotion of Renewable Energy Act - Energistyrelsen

43 Smart charging of electric vehicles could promote renewable energy adoption

44 "Smart Grid Strategy."

One key element of grid management is deploying smart charging infrastructure that enables real-time communication between charging stations and the grid. This allows for dynamic load management, ensuring that charging occurs efficiently without causing grid congestion during peak periods.<sup>45</sup>

Denmark also explores the use of energy storage solutions to balance the grid. The Energy Storage Roadmap (*Energilagingsstrategien*), introduced in 2014, outlines a plan for incorporating energy storage systems, including batteries, to store excess energy during periods of low demand and release it when demand is high. This approach contributes to grid stability and ensures a reliable power supply for both EVs and other consumers.<sup>46</sup>

Another option that might be possible within the next 5-10 years is utilizing the EVs' batteries as batteries in the energy system. With an upcoming amendment of the EPBD (EU), it becomes a requirement that the chargers be smart and even bidirectional if relevant.

### 3.1.7 International Collaboration

Denmark has been actively involved in international collaborations to promote e-mobility and charging infrastructure.<sup>47</sup> As a member of the European Union, Denmark has contributed to standardizing charging infrastructure across member states. The EU Directive 2014/94/EU on the deployment of alternative fuels infrastructure sets the framework for standardized and interoperable charging infrastructure, facilitating cross-border travel for electric vehicle owners.<sup>48</sup>

Denmark has also collaborated with neighboring countries such as Norway and the Netherlands to share best practices and lessons learned in the promotion of e-mobility.<sup>49</sup> This international engagement has enhanced innovation and accelerated the global transition to sustainable transportation.

### 3.1.8 Battery Life Cycle

The European Parliament and the Council adopted the new Batteries Regulation on 12 July 2023. This regulation aims to make batteries sustainable throughout their life cycle—from sourcing materials to collection, recycling, and repurposing. The new rules promote the development of a competitive, sustainable battery industry.

The law ensures that batteries in the future have a low carbon footprint, use minimal harmful substances, need less raw materials from non-EU countries, and are collected, reused, and recycled to a high degree in Europe. Starting in 2025, the Regulation will gradually introduce declaration requirements, performance classes, and maximum limits on the carbon footprint of electric vehicles, light means of transport (such as e-bikes and scooters), and rechargeable industrial batteries.

From 2025 onwards, targets for recycling efficiency, material recovery, and recycled content will be introduced gradually. All collected waste batteries will have to be recycled, and high recovery levels will have to be achieved, especially critical raw materials such as cobalt, lithium, and nickel. This will ensure that valuable materials are

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45 "Smart Charging Infrastructure."

46 "Energy Storage Roadmap."

47 The need for charge points for electric vehicles will rise ... - DTU

48 Directive 2014/94 - Deployment of alternative fuels infrastructure - EU

49 Denmark expands EV charging infrastructure | ITS International

recovered at the end of their useful life and brought back into the economy by adopting stricter targets for recycling efficiency and material recovery over time.<sup>50</sup>

## 3.2 Norway

Norway has been a global frontrunner in developing EV charging infrastructure and adopting electric vehicles. The country has implemented various methods to encourage the adoption of charging infrastructure and EVs, including regulatory work and other incentives. Norway is not part of the EU and thus is more autonomous in regulation but is still influenced by overall trends and regulations in Europe.

### 3.2.1 Long-term planning for EVs

Planning for the green transition has been underway for a long time in Norway. In 2001, the government agency Enova was established. Its mission is to promote a shift towards more environmentally friendly energy consumption and production, as well as the development of energy and climate technology. Enova's activities aim to strengthen energy security of supply and reduce greenhouse gas emissions.<sup>51</sup>

Enova has played a crucial role in facilitating Norway's transition to a low-emission society. It supports energy and climate technology development, innovation, and sustainability projects. The agency aims to cut greenhouse gas emissions, promote technological advancements, and create new economic values.<sup>52</sup>

Norway has set ambitious targets for reducing greenhouse gas emissions and establishing a low-emissions society by 2050. As an energy-rich country, Norway is uniquely positioned in terms of the energy transition. Enova's work is instrumental in this transition, especially in sectors like transport and industry, where emission reductions are more complex, challenging, and costly.<sup>53</sup>

#### Organisational about Enova

Enova SF is owned by the Ministry of Climate and Environment in Norway. The operation of Enova and the management of the Climate and Energy Fund are designed to be as cost-effective as possible. The funds that Enova manages are allocated from the Climate and Energy Fund, and distributed between agreed activities and administration fees. The framework for the administration fee is determined by the Ministry of Climate and the Environment in the annual assignment letter that Enova receives. Enova also has programs to fund specific initiatives, such as building charging infrastructure for heavy-duty electric commercial vehicles.

Source: Enova 2024

In summary, Enova's contributions have been vital to Norway's green transition, helping the country leverage its clean electricity system to decarbonize various sectors of the economy and meet its ambitious environmental targets.

Enova has also significantly promoted the uptake of electric vehicles (EVs) in Norway, especially regarding charging infrastructure development. Enova initially funded a 7-million-euro infrastructure program to encourage the transition to EVs, which provided 1,900 charging points in 2011. Today, there are almost 17,000

50 Circular economy: New law on more sustainable, circular and safe batteries enters into force

51 ENOVA - regjeringen.no. <https://www.regjeringen.no/en/dep/kld/organisation/selskaper/enova/id2599611/>.

52 Norway: Leading the journey to net zero - Amogy. <https://amogy.co/norway-leading-the-journey-to-net-zero/>.

53 Executive summary – Norway 2022 – Analysis - IEA. <https://www.iea.org/reports/norway-2022/executive-summary>.

chargers, with a fast-charging station installed on every main road in the country.

Enova has also launched a funding program to build charging infrastructure for heavy-duty electric commercial vehicles.<sup>54</sup> They have set up 19 locations offering 108 charge points for electric trucks.<sup>55</sup>

One of the most significant incentives in Norway is the national goal that all new cars sold by 2025 should be zero-emission (battery electric or hydrogen).<sup>56</sup> This goal has been supported by a substantial package of incentives developed to promote zero-emission vehicles into the market. Different governments and broad coalitions of parties have gradually introduced incentives since the early 1990s to speed up the transition. As of the end of 2023, 24% of registered passenger cars in Norway were battery electric (BEV), and battery electric vehicles held an 82.4% market share in 2023.<sup>57</sup>

The Norwegian vehicle tax system is designed to make it economically beneficial to choose zero- and low-emission vehicles over high-emission vehicles. This is obtained with «the polluter pays principle» in the car tax system—high taxes for high-emission vehicles and lower taxes for low and zero-emission vehicles. For a long time, taxes on polluting vehicles have partly financed incentives for zero-emission vehicles without any revenue loss. A combination of weight, CO<sub>2</sub>, and NO<sub>x</sub> emissions calculates the purchase tax for all new vehicles with emissions. The tax is progressive, e.g., making big cars with high emissions very expensive. For the last few years, the purchase tax has been adjusted gradually to have more emphasis on emissions and less on weight. EVs have had an exemption from both VAT and Norway's purchase tax on new cars since 2001, but as of 2023, VAT exemption applies only to the first 500,000 Norwegian kroner of the price. Starting in 2023, some purchase tax based on the weight of electric cars will also be introduced.<sup>58</sup>

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54 Enova to fund truck charging infrastructure in Norway. <https://www.electrify.com/2023/07/03/enova-to-fund-truck-charging-infrastructure-in-norway/>.

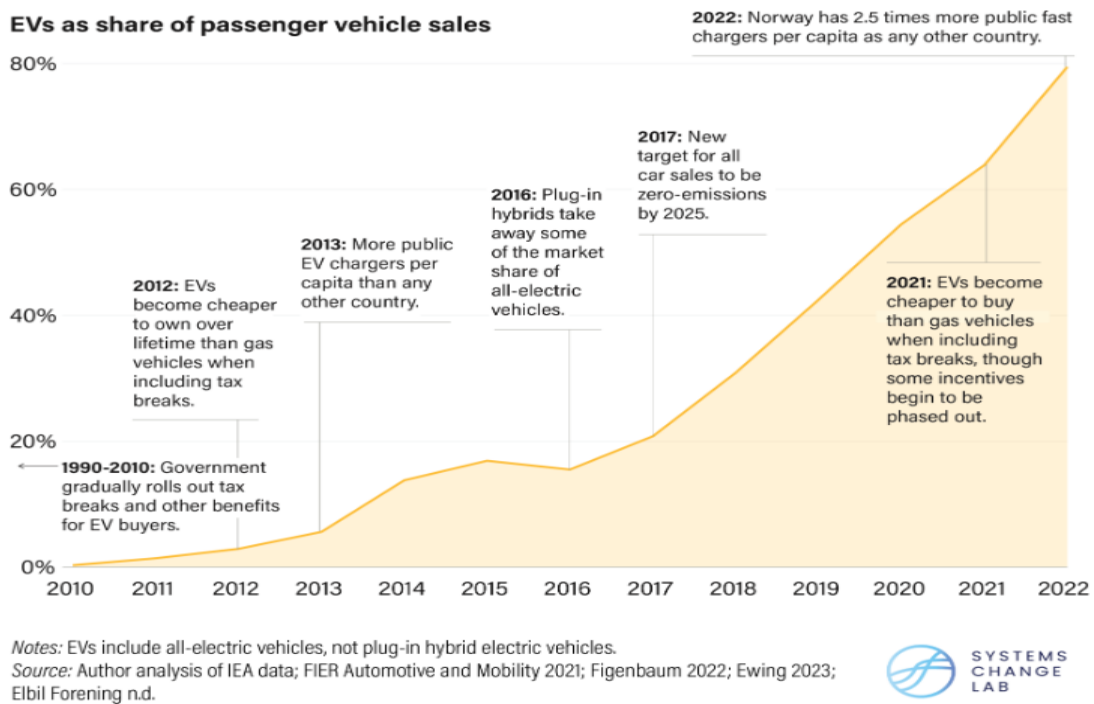
55 Enova releases first funding for electric truck charging hubs in Norway. <https://www.electrify.com/2023/12/20/enova-releases-first-funding-for-electric-truck-charging-hubs-in-norway/>.

56 Energy facts Norway, Norwegian ministry of petroleum and energy

57 The increase of electric vehicle usage in Norway, European Transport Research Review (2015)

58 Norwegian EV policy - Norsk elbilforening

Figure 33. Norway Was The World's Earliest EV Champion<sup>59</sup>



Source: World Resources Institutes, 2023

### 3.2.2 Toll Roads, Bus Lanes, And Reduced Fares

The Parliament has agreed on a national rule, meaning counties and municipalities cannot charge more than 70% of the price for fossil fuel cars on toll roads. Within the rules, there are local differences. EVs pay a maximum of 50% of the total amount on ferry fares for electric vehicles. The incentives were more generous in earlier years of EV adoption, such as free municipal parking for EVs and no charge on toll roads and ferries.

Another popular initiative in Norway is allowing electric cars to use bus lanes, typically reserved for public transport, taxis, and emergency vehicles. This has helped increase the proportion of electric cars, especially in the largest cities in Norway, where bus lanes are most developed. The rule has led to shorter travel times and more convenience for electric cars than other road vehicles. However, in recent years, the rule has been phased out or adjusted in some cities because the capacity of bus lanes can no longer handle the large number of electric cars.<sup>60</sup> Such a measure is expected to be phased out eventually as most people acquire electric cars.

### 3.2.3 Almost 100% Electric Buses

Norway has also seen success in electrifying the bus fleets, primarily due to public procurement rules, stating that by 2025, all new city buses must be zero-emission vehicles. In the capital city, Oslo, battery electric buses were introduced in 2017, and by 2024, all ~450 buses will be transitioned to battery electric. The buses are from different manufacturers (BYD, MAN, Solaris). In April 2023, Unibuss bought 183 articulated Solaris Urbino 18.75 equipped with 520 kWh battery packs, which typically have a range of over 250 kilometers, so only depot charging is necessary.

Oslo now has an almost 100% emissions-free public transportation system. However, a few routes have

59 These Countries Are Adopting Electric Vehicles the Fastest. <https://www.wri.org/insights/countries-adopting-electric-vehicles-fastest>

60 What Norway's experience reveals about the EV charging market, Mckinsey (2022)

bridges not rated for the extra weight of large battery-powered vehicles, requiring about a dozen diesel buses to remain in service.

In Norway, the experience is that bus drivers need to become familiar with operating them, and the recommendation is to start with a few electric buses so the drivers and the public can adjust to them before switching the entire fleet to battery power.

**Figure 34.** The Urbino 18.75 Electric Buses From Solaris Bought By Unibuss AS<sup>61</sup>



Source: Consultant Analysis

### **An exemplary mesh network of charging infrastructure**

Between 2017 and 2021, legislation establishing “a right to plug” for people living in apartment buildings was introduced. Even if EV owners charge at home and manage without fast charging daily, they think it is essential to have the option to ultra-rapid charge when needed. For longer-distance trips, a well-organized charging

61 <https://www.sustainable-bus.com/news/delivery-articulated-buses-oslo-unibuss/>

network must be in place. Fast charging stations have been established on all main roads in Norway. As of the end of 2023, more than 7,700 fast- and ultra-rapid chargers are available to the public.

In addition to the incentives mentioned above, Norway has invested heavily in public EV facilities and infrastructure, with substantial grants to housing associations across many municipalities. The government offered subsidies to housing associations that purchased and installed charging stations and then stepped in to ensure that charging points were efficiently and equitably distributed. In 2008, Oslo launched the world's first municipal EV charging system; by 2015, there were 10,000 charging stations nationwide.<sup>62</sup> In January 2024, this number has increased to 27,000.<sup>63</sup>

### 3.2.4 Why Norway is A Global Front-Runner

Norway is generally a wealthy country. This has allowed the government to subsidize EV purchases, making electric cars more affordable for citizens.<sup>64</sup> The country's abundant hydropower, which accounts for more than 90 percent of its power generation, supports a stable power system that enables a low-cost, green, and reliable power supply for EVs.

As an early adopter of EVs, Norway has learned from its initial mistakes and adapted its strategy, boosting the reliability of its infrastructure. The country has developed an overall plan for charging infrastructure, and this forward-thinking approach provides a robust framework for the development. Splitting parts of the road network and having operators compete for public funding fosters market competition, encouraging rapid expansion and innovation. Finally, Norway's commitment to uniformity in price information, payment options, and station design improves user experience and broadens EV adoption.

Despite these successes, scaling Norway's EV charging infrastructure to keep pace with its mounting demand has proved more problematic. Nonetheless, the expansion has not come without significant growing pains, and scaling the system will take some time.<sup>65</sup>

## 3.3 California, USA

The state of California has been at the forefront of electric vehicle (EV) development and charging infrastructure in the United States. The state is home to much technological development in EVs, with Tesla as a focal point. While traditional automakers have begun (often reluctantly) to introduce electric cars, their road trip charging options can be limited — sometimes confined to disparate third-party networks. In contrast, Tesla has its own proprietary Supercharger network which has grown to be the “gold standard” in the industry.<sup>66</sup>

Renowned for its progressive environmental policies, the state has introduced several incentives to encourage the adoption of EVs and charging infrastructure. The success of EV policies implementation in California is reflected through the city contribution of about 40-50%, to EV sales over United states over the past decade.<sup>67</sup>

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62 Nobil – Charging infrastructure statistics

63 Ruter – Public Transport Authority for Oslo and Akershus counties

64 <https://www.iea.org/reports/norway-2022/executive-summary>

65 What Norway's experience reveals about the EV charging market. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/what-norways-experience-reveals-about-the-ev-charging-market>.

66 What makes Tesla so unique compared to other automakers?. <https://evannex.com/blogs/news/what-makes-tesla-different-than-other-automakers>

67 <https://www.eia.gov/todayinenergy/detail.php?id=61082>

### 3.3.1 Incentives To Promote EVs

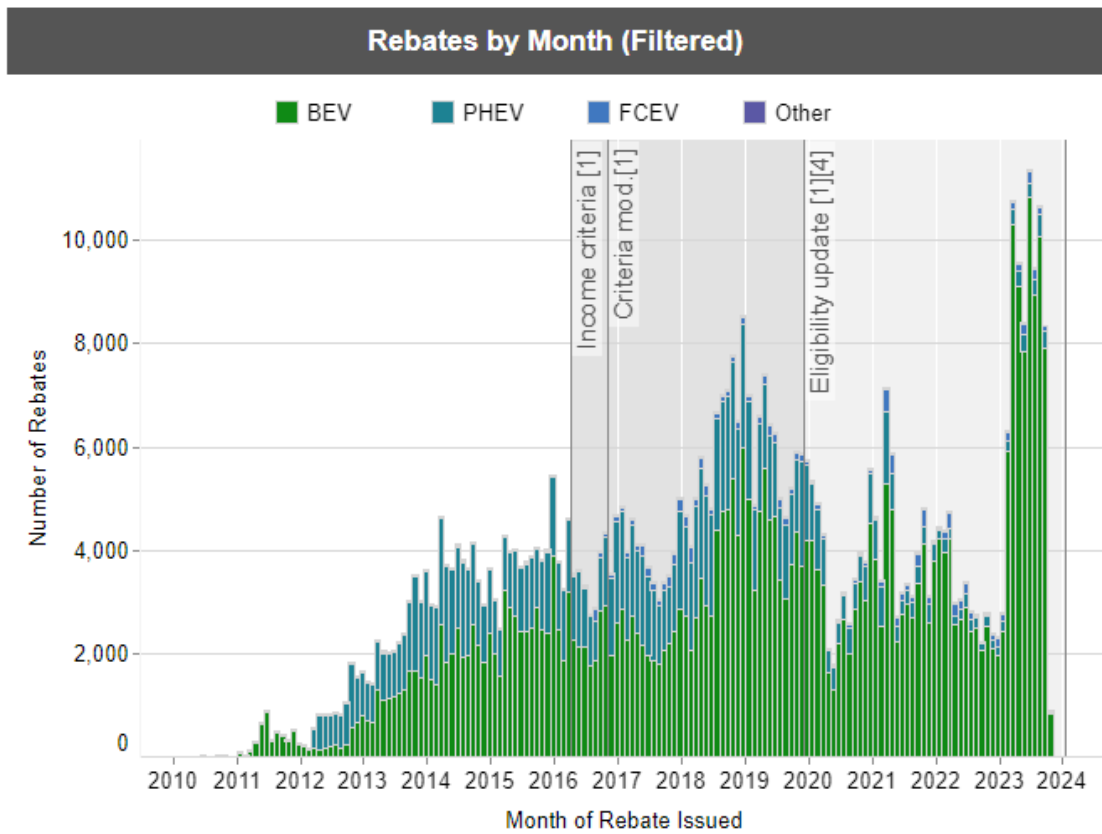
The incentives are strongly linked to the goals of better air quality, and the California Air Resource Board (CARB), a department within the California Environmental Protection Agency, is the agency in charge of much of the development. They enacted the Advanced Clean Cars package, a set of regulations that aim to improve air quality by setting stricter standards for vehicles sold in California - the overall goal is that all new passenger cars, trucks, and SUVs sold in California will have zero emissions by 2035.

The package was initially introduced in 2012 and combined the control of smog-causing pollutants and greenhouse gas emissions into a single coordinated set of requirements for model years 2015 through 2025. In 2022, the Advanced Clean Cars II regulations were adopted, imposing vehicle standards for model years 2026-2035. This program also included measures to support and accelerate the zero-emission vehicles (ZEVs) market, such as battery-electric, fuel-cell, and plug-in hybrid vehicles.

Since its inception, CARB has worked on updates and revisions, at the latest in October 2023, to adapt to technological advances and changes in the automotive market, aiming for bolder targets and the integration of new standards. The incentives include:

- **Zero-Emission Vehicle (ZEV) Mandate**  
This requires automakers to sell a certain percentage of clean, zero-emission vehicles, which means cars that produce no emissions at the tailpipe. This category includes fully electric vehicles (EVs) and hydrogen fuel-cell vehicles.
- **Greenhouse Gas Emission Standards**  
To combat climate change, cars, trucks, and other road vehicles must also meet stricter standards for the emission of greenhouse gases, primarily carbon dioxide (CO<sub>2</sub>).
- **Technology Forcing**  
The rules encourage car manufacturers to innovate by creating a market for cleaner technologies that might not develop as quickly without regulatory standards.
- **Consumer Adoption Support**  
The package aims to support the adoption of ZEVs through various incentives, including rebates, access to carpool lanes, and funding for installing charging infrastructure. One of the most notable supports has been the Clean Vehicle Rebate Project (CVRP), a state-run rebate (Up to \$7,500) incentive. Since the introduction of the rebate in 2010, about \$1,447 million has been granted to purchase ZEVs. On top of this, CARB has, from fiscal year 2014-2015, allocated over \$480 million to support clean transportation equity pilot projects.
- **Advanced Clean Truck Regulation**  
As part of CARB's broader strategy, similar efforts like the Advanced Clean Truck regulation require manufacturers to transition to zero-emission trucks. This requires all Class 2b+ trucks in California to transition to electric starting in 2024.

Figure 35. The Month of Rebate Issued as a Result Of Consumer Adoption Support



This figure displays the total number of rebates by month from 2010 to 2022 as a stacked bar chart with each bar containing number of rebates per vehicle technology type. Plug-in Hybrid Electric Vehicles are represented in blue, Battery Electric Vehicles are represented in green, Fuel-cell Electric Vehicles are represented in light purple, Other vehicle categories are represented in dark purple. Additionally, it contains three date markers that represent program changes – the income criteria on 3/29/2016, the modified income criteria on 11/1/2016, and eligibility update on 12/3/2019.

Other than state-led incentives for EV adaptation, there is also a new federal tax incentive of \$7,500 enabled by the IRA, designed to spur consumer adoption and domestic production of EVs.

Suggesting that the incentives are working, EV sales in California represented 21.5% of the market share in Q3 2023. That compares to the national EV market share of 7.4%.<sup>68</sup>

### 3.3.2 Incentives to Develop Charging Infrastructure

The California Energy Commission (CEC) adopted a \$2.9 billion investment plan update for the Clean Transportation Program in December 2022. This plan incorporates the largest California budget allocation approved for the Clean Transportation Program. These efforts will expand the deployment of plug-in electric vehicle (PEV) charging and fuel cell electric vehicle (FCEV) hydrogen fueling stations.<sup>69</sup>

One of the most significant incentives on the EV charging grant side is the California Electric Vehicle Infrastructure Project (CALeVIP) - the nation’s largest EV charging incentive initiative. The project provides funding for

68 EV sales reach one-fifth of market share in California

69 California Energy Commission (CEC) - California Governor’s Office of ... [https://business.ca.gov/wp-content/uploads/2023/03/2022\\_ZEV\\_Report\\_CEC.pdf](https://business.ca.gov/wp-content/uploads/2023/03/2022_ZEV_Report_CEC.pdf).

direct current fast charging (DCFC) stations, ensuring EV users can meet their charging needs while on the road. As of 2024, more than 73,000 public and shared chargers have been installed, with an additional 123,000 planned by 2025. However, these numbers fall short of the state's goal of 250,000 chargers by 54,000 installations.<sup>70</sup> The project is oversubscribed by hundreds of millions of dollars, demonstrating strong market and consumer demand for public funding. Incentives for fast chargers regularly sell out minutes after applications open.

As part of CALeVIP, the California Energy Commission (CEC) launched an initiative with \$38 million in equity-focused incentives to fund publicly accessible EV charging stations in low-income and disadvantaged communities in 28 northern and southern California counties. The program provides rebates for charging equipment that can cover up to 50% of a project's total costs or up to \$100,000 based on charger capacities. The latest application window closed on December 12, 2023, and was likewise oversubscribed. Thus, it is too early to say anything about the results of the initiatives so far.

Proposals were reviewed, and awards were made based on meeting requirements and project readiness. Rebates were available for installations by businesses, nonprofits, tribes, and public entities. Eligible locations had to be in disadvantaged and low-income communities as defined by the California Climate Investments Priority Populations Map. The project aimed to quickly deploy EV fast chargers in communities most impacted by air pollution (low-income and disadvantaged communities).<sup>71</sup>

Another incentive is the Communities in Charge program, which provides financial and technical resources for applicants wanting to install car charging stations. The program opened its first round of funding in March 2023, with \$30 million available from the California Energy Commission's Clean Transportation Program.

California receives additional financial support from the Federal Government for expanding charging infrastructure, most notably from a \$5 billion NEVI grant that will be distributed across the US. In 2023, it was announced that California is set to use \$40.5 million from this grant to build 270 DCFC stations at 26 sites along highways.

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70 Report Shows California Needs 1.2 Million Electric Vehicle Chargers by 2030. <https://www.energy.ca.gov/news/2021-06/report-shows-california-needs-12-million-electric-vehicle-chargers-2030>.

71 Report Shows California Needs 1.2 million Electric Vehicle Chargers by 2030. <https://www.energy.ca.gov/news/2021-06/report-shows-california-needs-12-million-electric-vehicle-chargers-2030>.

### Nationwide strategies for charging infrastructure development in the United States

- Bipartisan Infrastructure Law (BIL) 2021: The BIL among other things provides a total of \$7.5 billion to develop the country's EV charging infrastructure. The goal is to install 500,000 publicly accessible charging stations nationwide by 2030.
- National Electric Vehicle Infrastructure (NEVI) Formula Program 2022: The BIL assigns \$5 billion to the new NEVI Formula Program. This program is established to build out a national electric vehicle charging network.
- Community and Corridor Charging 2022: The BIL also provides \$2.5 billion in competitive grants to support community and corridor charging, improve local air quality, and increase EV charging access in underserved and overburdened communities.<sup>3</sup>
- American Jobs Plan: President Biden's American Jobs Plan includes a transformational \$15 billion investment to fund this vision and build a national network of 500,000 charging stations. Through a combination of grant and incentive programs for state and local governments and the private sector, it will support a transformational acceleration in deployment of a mix of chargers in apartment buildings, in public parking, throughout communities, and as a robust fast charging along our nation's roadways.

#### Sources:

- *America's electric-vehicle charging infrastructure | McKinsey.* <https://www.mckinsey.com/industries/public-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs>.
- *New Analysis Guides Development of National Charging Network.* <https://driveelectric.gov/news/2030-charging-network>.
- *President Biden, USDOT and USDOE Announce \$5 Billion over Five Years ....* <https://highways.dot.gov/newsroom/president-biden-usdot-and-usdoe-announce-5-billion-over-five-years-national-ev-charging>.

### 3.3.3 Incentives for E-Buses and Heavy-Duty Vehicles

California has taken significant steps to promote the use of electric buses in recent years. In December 2018, the California Air Resources Board approved the Innovative Clean Transit regulation. It is part of a statewide effort to reduce emissions from the transportation sector by setting a statewide goal for public transit agencies to gradually transition to 100% zero-emission bus fleets by 2040, starting with a requirement that all new buses must be zero-emission by 2029. The regulation is expected to reduce greenhouse gas emissions by 19 million metric tons from 2020 to 2050, equivalent to taking 4 million cars off the road.<sup>72</sup>

The state has also introduced several grants that aim to transform the bus fleet, such as the bus replacement Grant, the Zero Emission Transit Bus tax exemption, and a Zero Emission School Bus grant. The grants primarily benefit public transit agencies and school districts. Public transit agencies have received significant grants for fleet electrification. For example, the Public Transit Agency Santa Monica's Big Blue Bus received a \$22.9 million grant to purchase five battery electric buses and develop infrastructure to support on-site charging for more than 100 buses.<sup>73</sup>

72 Innovative Clean Transit (ICT) Regulation Fact Sheet | California Air .... <https://ww2.arb.ca.gov/resources/fact-sheets/innovative-clean-transit-ict-regulation-fact-sheet>

73 Big Blue Bus Receives \$22.9 Million State Grant for Fleet .... <https://www.santamonica.gov/press/2023/04/27/big-blue-bus-receives-22-9-million-state-grant-for-fleet-electrification-workforce-development-and-customer-experience-enhancements>

As another significant beneficiary of the grant, School districts are receiving funding to replace aging school bus fleets with ZEV.<sup>74</sup> The Zero Emission School Bus and Infrastructure (ZESBI) Program supports local educational agencies in transitioning to zero-emission school bus fleets and charging infrastructure with grants of up to \$495,000 per bus (vehicle + infrastructure costs).

The program prioritizes applicants in low-income and disadvantaged communities in small and medium air districts with historically limited access to funding for investments in zero-emission transportation. To get funding, the school districts must scrap an old school bus for every new bus purchased.<sup>75</sup>

The deployment of zero-emission buses in California is expected to accelerate quickly in the coming years, growing from 153 electric buses in 2018 to more than 2,000 E-buses in 2023.

California has introduced other incentives to replace buses and general heavy-duty vehicles. One of these incentives is grants for medium—and heavy-duty zero-emission vehicles and related charging infrastructure.

### 3.4 South Korea

In Asia, the Republic of Korea (Korea) has been one of the leading countries in adopting electric vehicles (EVs). It has implemented several policies to encourage charging infrastructure and EV adoption. This agrees with the country's climate ambitions to reduce GHGs. In 2021, Korea passed a bill aiming for carbon neutrality by 2050 with a medium-term target to reduce GHGs by 35% by 2030 compared with 2018.

The country has set ambitious targets for EV adoption and has implemented a range of policies to support the development of EV charging infrastructure. Korea's government has been continuously updating its EV policies since 2011. Currently, there are two main sources of guidance for EV goals:

- the 4th Master Plan for Eco-Friendly Cars from 2021. This aims to support 2.83 million eco-friendly cars by 2025 and 7.85 million by 2030
- the Korean New Deal. This is expected to be 1.3 million electric vehicles by 2025. It also involves increasing renewable energy usage and expanding the smart grid

The government revises the incentive scheme every two years to support these ambitious goals. Korea has stated that it will develop a taxonomy for green finance to achieve its net zero emissions commitments.

#### 3.4.1 Incentives for Electric Passenger Cars in Korea

Korea has implemented several policies to encourage the adoption of EVs. One is to halve the price of EVs by 2025<sup>3</sup>.

The scheme limited subsidies to cars priced below KRW 90 million (USD 78,671), with vehicles priced between KRW 60 million and KRW 90 million receiving only 50% of the subsidy amount. In 2022, the subsidy was limited to cars priced below KRW 55 million (USD 48,077), with only vehicles priced below KRW 85 million (USD 74,300) eligible for 50% of the subsidy amount. These changes benefited lower-cost EV car models, which saw increased sales shares (12% market share in 2021). The government extended the subsidy scheme until 2025

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74 Appendix E: 2022 SB1403 School Bus Incentive Program Report. [https://ww2.arb.ca.gov/sites/default/files/2022-10/fy2022\\_23\\_funding\\_plan\\_appendix\\_e.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-10/fy2022_23_funding_plan_appendix_e.pdf).

75 Funding to Switch to Zero-Emission School Buses Now Available. <https://www.energy.ca.gov/news/2023-07/funding-switch-zero-emission-school-buses-now-available>

and increased government funding for electric passenger car subsidies from KRW 210 billion (USD 184 million) in 2020 to KRW 574 billion (USD 502 million) in 2022.<sup>76</sup> In September 2023, Korea released a plan to expand subsidies for the purchase of electric cars after seeing a stagnation in sales.

Additional incentives:

- A sales quota whereby EVs must comprise at least 15% of each car manufacturer's sales.
- EV users in South Korea enjoy incentives, including a 50% discount on public parking facility fees and highway tolls.
- Korea's public institutions are required to purchase or lease environment-friendly vehicles only. This obligation previously recognized hybrid and LPG cars as environment-friendly, but from 2023, only electric and hydrogen vehicles are counted.<sup>77</sup>

### 3.4.2 Incentives for Charging Infrastructure in Korea

Another policy that has made investing in charging infrastructure and EVs more attractive and economically feasible is the "Electric Mobility Policies of Korea."<sup>78</sup> This policy aims to install charging stations at new buildings in a ratio of 0.5% (2020) to 5% (2022) and at existing buildings in a ratio of 0% (2020) to public 2% (2022) and private 2% (2023). In Korea, publicly available EV slow charging points increased by nearly 70% in 2021 to over 90,000.

Furthermore, the policy also aims to increase the number of chargers per rest area at expressways from 2.5 (2020) to 15 (2025). This has increased the number of high-speed chargers, as ultra-rapid chargers have been installed to ensure all drivers can cover at least 300 km (186 miles) after charging for 20 minutes.

By November 2020, Korea had installed 62,789 public chargers, including 9,661 rapid and 53,128 slow chargers. In 2021, Korea furthermore installed 3,000 fast chargers distributed at:

- 2,280 charging stations at locations such as private supermarkets
- 290 charging stations in parking garages
- 300 fast-charging stations at pit stops
- 123 high-powered charging stations by the automotive industry

By 2021, Korea had one of the world's lowest numbers of electric passenger cars per public charging point, with only 2.6. It is a declared goal to have 50% more chargers than EVs, including ultra-rapid chargers that take only 20 minutes to provide enough charge for a 300 km range.<sup>79</sup>

### 3.4.3 Korea as a Battery-Producing Country

Korea accounts for 5% of the global EV battery production capacity, and in 2021, the EV battery production capacity was 41 GWh. The ambition is for Korea to be the world's number one EV battery manufacturing

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76 Global EV Outlook 2022, Policy developments – Global EV Outlook 2023 – Analysis – IEA, South Korea aims to push EV innovation | electrive.com

77 <https://www.sustainability.gov/pdfs/south-korea-nzgi-roadmap.pdf>

78 South Korea earmarks \$10Bn for e-mobility | electrive.com

79 <https://bolt.earth/blog/south-korean-ev-market#resources>

country by 2030. Korea offers substantial R&D tax incentives and is allocating 70% of its yearly R&D budget to fund 40 projects in 11 key industrial areas, such as secondary batteries and future mobility. This includes investments of around \$4.7bn from 2023 to 2027, with a long-term target of \$10.2bn by 2030.

Korea is also funding battery-electric innovation, at least in e-mobility. In February 2021, the government, in close cooperation with the industry, announced the goal to decrease prices for electric cars by the equivalent of at least 7,500 euros by 2025 through innovation. The technological advance was to come through new platforms and domestic battery materials and resources. The plans include fuel cell vehicles as well as solid-state batteries. Korea has considerable shares of the supply chain downstream of raw material processing, particularly in cathode and anode material production. Korea is responsible for 15% cathode and 3% anode material production capacity.

### 3.4.4 On Electric Buses

In recent years, Korea has taken several initiatives to promote the use of electric buses. Due to evolving policies and technological advancements, the Korean electric bus market is expected to grow in the coming years.

Initiatives like the 'Green Car Roadmap,' including electric buses, set ambitious targets for EV adoption. Financial incentives such as subsidies and tax breaks stimulate electric bus deployment, creating economic reasons for public transportation agencies and private operators to transition.

Korea's technological expertise drives high-performance electric bus development, particularly in the batteries and automotive sectors. These buses incorporate advanced battery systems with energy density improvements, extended ranges, and fast-charging capabilities. Collaborations between manufacturers and battery companies lead to regenerative braking systems, energy-efficient heating and cooling, and intelligent energy management.<sup>80</sup>

A robust charging infrastructure is essential for electric bus adoption. Korea develops an extensive charging network, strategically placing charging stations along bus routes and urban areas. This infrastructure addresses range anxiety and ensures electric buses have reliable access to charging points for seamless operations.

Partnerships and international collaboration contribute to the growth of the Korean electric bus market. Korean manufacturers collaborate with global partners to exchange expertise and expand their market reach. International collaborations enhance the marketability of South Korean electric buses abroad by leveraging the country's reputation for technological innovation and reliable manufacturing. Electric bus exports align with Korea's aspiration to become a significant player in the global EV market.

## 3.5 Global Outlook

Based on the data from Bloomberg New Energy Finance, the Figure 36 below looks at annual global EV sales forecasts through 2040. This involves countries such as China, Japan, France, Germany, the UK, the rest of Europe, the United States, and the rest of the world. As can be seen, China, the U.S., and Germany will push the implementation of EVs in the future toward 2040.<sup>81</sup>

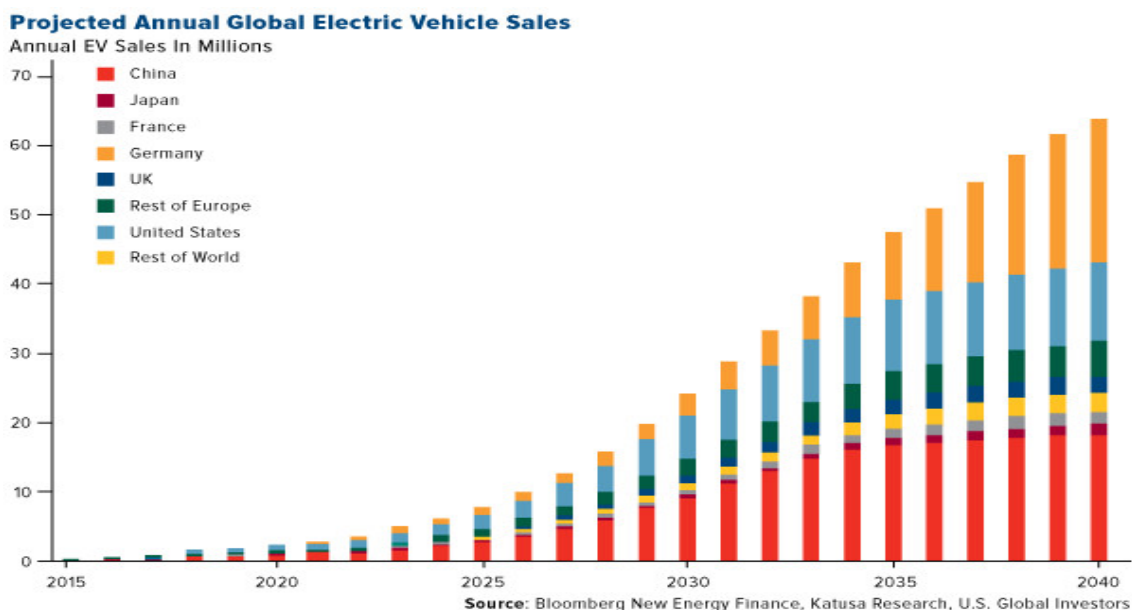
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80 South-Korea-Electric-Bus-Market-Set-for-Continued-Growth-with-Evolving-Policies-and-Technological-Advancements-Through-2028

81 <https://www.linkedin.com/pulse/move-over-tesla-china-holds-keys-electric-vehicles-frank-holmes/>

In terms of the trend, the chart shows an overall S-curve trend towards 2040 as contributed by all the countries. The experience is that it might take six years for EVs to go from 1% to 10% of new car sales, but for some countries, it only takes another six years to go from 10% to 80% of new car sales. Even though leading countries like Norway have been working to support the transition for many years before seeing the effect of these initiatives, the development is expected to grow faster. Slower starting countries are expected to pick up quickly and catch up with the early starters.

Figure 36. Projected Annual Global EVs Sales



Source: Bloomberg, 2017

### Summary – International experience gathering

After examining the four different countries initiatives to support the transition towards EVs it is possible to come with some overall recommendations for Bali, Indonesia:

Overall supportive policies

- An overall guidance for EV goals in the country's climate policy is an important supporting policy which can be used as an indicator for necessary incentives.
- Set an end date of sales of ICE vehicles for motorcycles, passenger cars and buses respectively.
- The incentive scheme should follow the development closely and should be revised regularly. However, consumers and companies also need stability in policies/incentives to make investments.
- A taxonomy could be helpful and support the transition to EVs.

### To increase the number of EVs

- The purchase cost of an EV must be lowered to be competitive with ICE. The incentive must be quite high to overcome other barriers (skepticism etc.) (half price in Korea, 0 taxes in Norway). In Norway lower prices paid on EVs is financed by higher prices on ICE.
- Pressure is put on car manufacturers by having CO<sub>2</sub>-emission targets (DK/EU) or sales quota (Korea and California).
- Targets for fleets of public institutions (Korea: required to only buy/lease EVs and DK/EU: goals of EV share for the public fleets).
- Electric buses are supported through subsidies and tax breaks (Korea) and grants for zero-emission buses (California) or through public procurement rules (Norway).

### Support the emergence of Charging Infrastructure

- Requirements for charging infrastructure at buildings (new and existing) (DK/EU and Korea)
- Distance requirements for charging infrastructure at rest areas along motorways (DK/EU)
- State funded charging infrastructure (Korea) vs. Public-Private Partnerships (PPPs) (DK/EU)
- Incentives to ensure a socially just transition:
  - funding for low-income and disadvantaged communities (California: 50%)
  - A 'right to plug' + subsidies for housing associations (DK/EU and Norway)

### Physical planning

- Advantages of EVs should be gradually removed/decreased as more vehicles becomes electric and only act as a catalyst
- Allow EVs to use bus lanes (Norway) and/or carpool lanes (California)
- Discount on highway tolls (Korea and Norway) and ferries (Norway)
- Free parking (Denmark, Norway and Korea)
- Zero-emission zones (Denmark)

### Technology

- Incentives for battery R&D - also to lower costs of EVs (Korea)
- Battery waste management regulation (DK/EU)
- Push manufacturers be creating a market for cleaner technologies (California)
- Requirement of smart chargers & in time also bidirectional chargers to support electricity grid (DK/EU).

### Accessibility

- Requirements that all charging infrastructure is accessible to disabled (DK/EU)

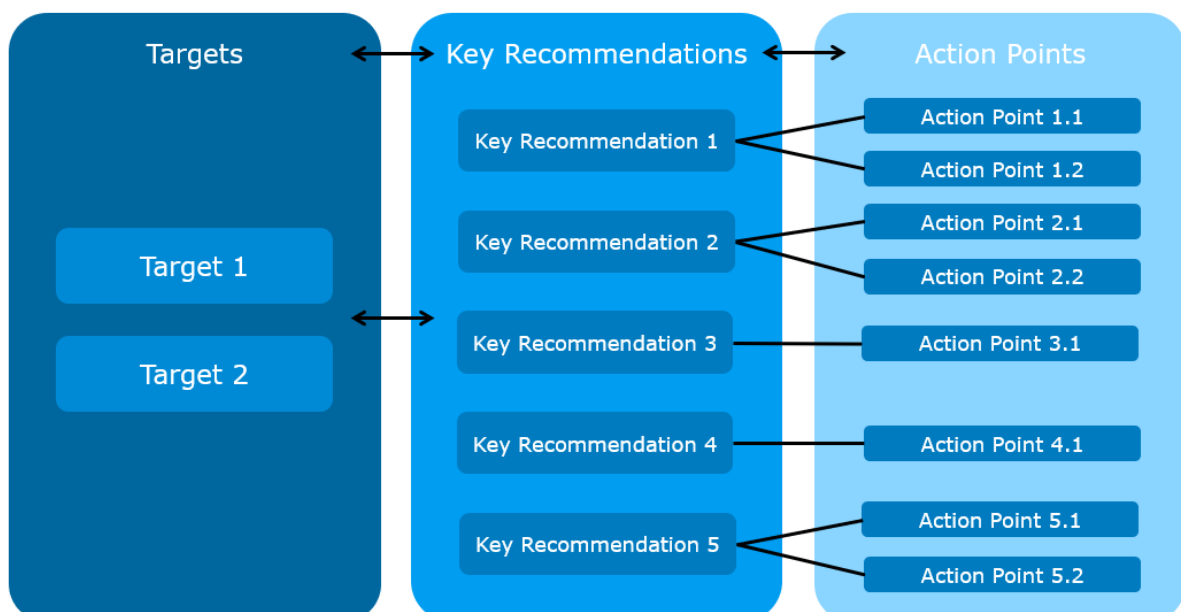


# 4. TARGETS SETTING AND PROJECTION FOR E-MOBILITY FOR E2W, E4W, AND E-BUS

## 4.1 Overview

The roadmap operates with the terms of Targets, which are the implementation goals for short-, medium- and long-term milestones of EV adoption and deployment of charging infrastructures. Key Strategic Recommendations are defined to achieve these targets, and Action Points are set up to implement such Key Recommendations. The diagram below illustrates the hierarchy between these terms.

Figure 37. Illustration of the Hierarchy of Targets, Key Recommendations, and Action Points of the Roadmap



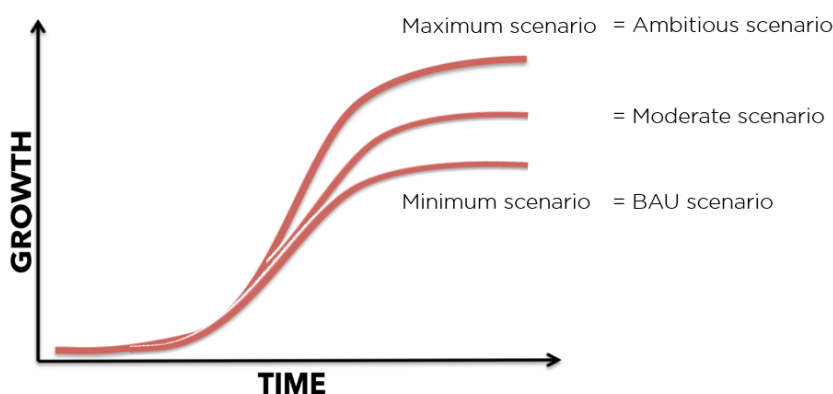
The roadmap's targets are generally set based on benchmarking with selected major countries, with consideration of the current achievement of EV adoption in Bali. When setting the targets, different scenarios are considered to reflect the range of possibilities of achieving such targets that correspond with the action points set to support the target. Section 4.2 elaborates on the assumptions used in setting targets for different scenarios, including BAU-, Moderate-, and Ambitious Scenarios.

An overview of the global outlook of EV adoption was discussed in Section 3.5, looking at what is believed to be the trend towards 2040, which countries including China, Japan, France, Germany, the United Kingdom, the United States, rest of Europe and rest of the world will contribute. All these countries follow a similar pattern of exponential growth shaped as an S-curve, as illustrated by Figure 38. The experience is that it might take six years for EVs to go from 1% to 10% of new car sales, but for some countries, it only takes another six years to go from 10% to 80% of new car sales.

Even though leading countries like Norway have been working to support the transition for many years before seeing the effect of these initiatives, the development is expected to grow faster. Slower starting countries are expected to pick up quickly and catch up with the early starters. One factor that supports this is that EVs are expected to decrease in price mainly due to decreasing battery costs (50% by 2030) while range, model availability, and charging infrastructure continue to improve.

The global EV market is generally growing faster than anticipated, driven mainly by strong government policy and financial incentives. Consistent policies are important, however, and updating/altering them should be done with caution so as not to worry investors. The following paragraph describes the three scenarios for development.

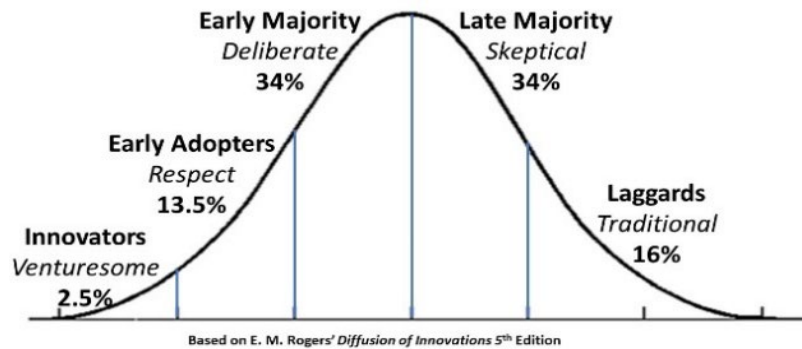
**Figure 38.** Typical Exponential Growth for Trend of EV Adoption in Global



From the perspective of Diffusion of Innovation Theory for understanding how a new technology progressively being adopted, E.M. Rogers (1962)<sup>82</sup> classified several categories of roles in social system associated with the technology. These are Oinnovators, Early Adopters, Early Majority, Late Majority and Laggards. See illustration in Figure 39.

<sup>82</sup> Boston University, 2022. <https://sphweb.bumc.bu.edu/otlt/mph-modules/sb/behavioralchangetheories/behavioralchangetheories4.html>

Figure 39. Diffusion of Innovation Theory According to E.M. Rogers



Source: Boston University, 2022

In application to EV technology, the implementation of EV was more or less started in 1990s when Hybrid (fuel engine + electrified engine) car was sold to public market. During this period there were countries that are open to risks to adopt the idea, which are considered as Innovators. Following from there are Early Adopter category which defined as society that is interested in trying new technologies and establishing their utility; and Early Majority category which is defined as one who pave the way for the use of an innovation within mainstream society and are part of the general population.

Indonesia started rolling out EV in the market in the early 2000s. Within a couple of decades from there Hybrid Vehicle evolving to pure electric car. In this case, arguably it can be assumed that Indonesia can be classified to be in between Early Adopter and Early Majority. It embraces new idea of Hybrid, characterizing the Early Adopters, and also continue along with the technology evolution characterizing the Early Majority. This draws the possibility that the trend of EV in Indonesia may still continue to incline towards the future, along with advancement of all other technologies to support the EV technology.

## 4.2 Implementation Target Setting

To elucidate the potential future situation-, different goals and implementation targets (milestones) for the share of EVs and the amount of charging infrastructure for Bali Province for Short and Medium terms were set based on visions set in Bali EV RAD, SUMP Sarbagita, RPJMNs for up to 2029, Draft RPJPN 2025-2045, as well as presidential statement of EV target implementation. The long-term expectation target is set based on benchmarking with selected countries, including Norway, Denmark, and South Korea. This is to understand how fast EV adoption has grown in these countries, considering the normalization factor would apply to correspond with the population of vehicle ownership.

Different targets/milestones for short-term (2025), medium-term (2030), and long-term (2040) plans will be set as part of the development of the following scenarios:

1. BAU (Business-As-Usual) - scenario developed using the projections of the Bali EV RAD and benchmarking with selected major countries for trend of EV adoption in long-term.
2. Moderate scenario based on a considering of the findings from following, and with assuming 5% increase from BAU due to limited policies implementations.
  - the current situation in Bali

- international experience gathering
  - dialogue with stakeholders
3. Ambitious scenario based on the government vision for 15 million units EV by 2030 of Draft Final RPJPN 2025-2045 and assuming 20% increase from BAU, due to aggressive policies implementation by both central and provincial governments.

The following Table 40 summarize different assumptions used in setting the target for different scenarios for short-term, medium-term and long-term.

**Table 40. Summary of Basis of Target Setting for the Scenarios**

Scenario	Short-term (2025)	Medium-term (2030)	Long-term (2040)
BAU (Business-As-Usual)	<ul style="list-style-type: none"> <li>• EV Bali RAD projection for 2026 that is between 'Pessimistic' and 'Moderate'.</li> <li>• EV population share is 0.5-1% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>• Alignment between short- and long-term in considering exponential growth pattern.</li> <li>• EV population share is 1-3% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>• Benchmarking with selected major countries.</li> <li>• EV population share is 20% for E4W &amp; E2W.</li> </ul>
Moderate	<ul style="list-style-type: none"> <li>• EV Bali RAD projection for 2026 that is between 'Pessimistic' and 'Moderate' that are slightly higher from BAU.</li> <li>• EV population share is 1-1.5% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>• Alignment between short- and long-term in considering exponential growth pattern.</li> <li>• EV population share is 3-4% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>• 5% increase of EV population share from BAU, which to be reflected as resulted from range and amount of policies implemented in Section 5.</li> <li>• EV population share is 25% for E4W &amp; E2W.</li> </ul>
Ambitious	<ul style="list-style-type: none"> <li>• EV Bali RAD projection for 2026 that is between 'Pessimistic' and 'Moderate' that are slightly higher than Moderate.</li> <li>• EV population share is 2% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>• Government target setting of 15 million EV by 2030.</li> <li>• EV population share is 6-10% for E4W &amp; E2W.</li> </ul>	<ul style="list-style-type: none"> <li>• 15-20% increase of EV population share from BAU, which to be reflected as resulted from range and amount of policies implemented in Section 5.</li> <li>• EV population share is 35-40% for E4W &amp; E2W.</li> </ul>

### 4.2.1 BAU-Scenario

The BAU target scenario for EV Bali Province assumes that no significant new policy will be introduced in Bali and Indonesia, and no considerable technology change will disrupt the EV market, which would either positively or negatively influence future implementation. In this case, the trend of EVs in Bali will continue along with where it is in the Bali EV Regional Action Plan (*Rencana Aksi Daerah*). In addition, the long-term setting of the BAU scenario will look at how other major cities like Norway, Denmark and South Korea have grown their sales over 20 years and longer and apply it to a normalized context of Bali.

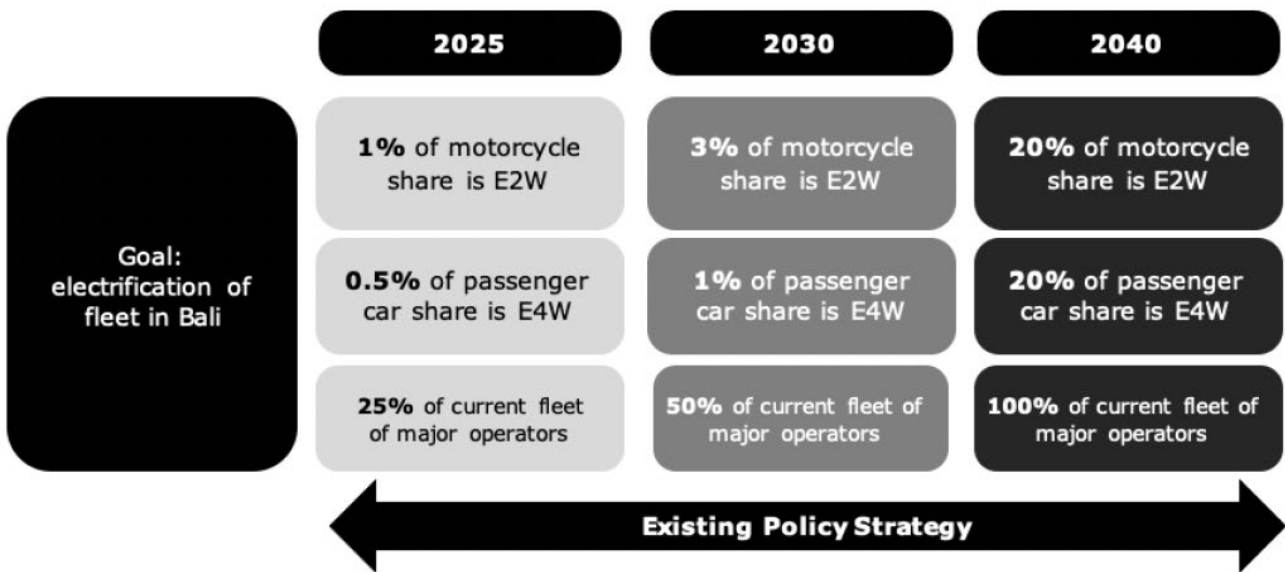
### Target Setting for E2W and E4W

For setting the targets for short-term and medium-term, the growth will continue to align with Bali EV RAD. In observing the current progression of the EV ecosystem in Bali, the current achievement of the EV population for EVs in 2022 and 2023 appears to be in between the 'Pessimistic' scenario and 'Moderate' scenario set in the planning document. Towards the end of projection in Bali EV RAD, E2W for 2026 is expected to be between 10,000-145,000 units, and E4W is expected to be between 600-6,000 units. Accordingly, the target setting of EV population for 2025 and 2030 for this roadmap are set to be within that range. From the perspective of population share in 2025 and 2030, E2W share are set to be 1% and 3%, and E4W share are set to be 0.5% and 1%. This to continue from the current population share which approximately to be 0.12% in 2023 for each E2W and E4W.

For setting the target for long-term, 2040, benchmarking is considered to be associated with EV trends of selected major countries including Norway, Denmark, and South Korea. The approximate considers how quickly the growth EV population in such countries within 20-30 years since the implementation of its first initiative. A normalization factor is applied to adjust with the characteristic of vehicle ownership between these countries, against in Bali. As an approximate of population share, the target setting for long-term for BAU scenario is set to be 20% EV population sales for each E2W and E4W.

The following Figure 40 illustrates the target expectation set for the BAU scenario for EV in Bali Province, assuming no further interventions are needed at the national and regional levels.

Figure 40. Target Setting For E-Mobility In Bali For BAU Scenario For 2025, 2030 and 2040



Source: Consultant analysis

As for the BAU Scenario, the percentage of EVs in the motorcycle category is expected to be 1% in 2025, 3% in 2030, and 20% in 2040. The rate of EVs in the passenger car category is expected to be 0.5% in 2025, 1% in 2030, and 20% in 2040.

### Target setting for E-Bus

As for E-bus, the target electrified fleet is expected to increase from the current total fleet operated by the two major public bus operators, Trans Metro Dewata and Trans Sarbagita, estimated to be 120 units in 2023. The target electrified fleet is expected to be 25% of the current fleet size in 2025, 50% of the current fleet size in 2030, and 100% of the current fleet size in 2040. This aligns with the current setting in the Bali EV RAD.

### 4.2.2 Moderate Scenario

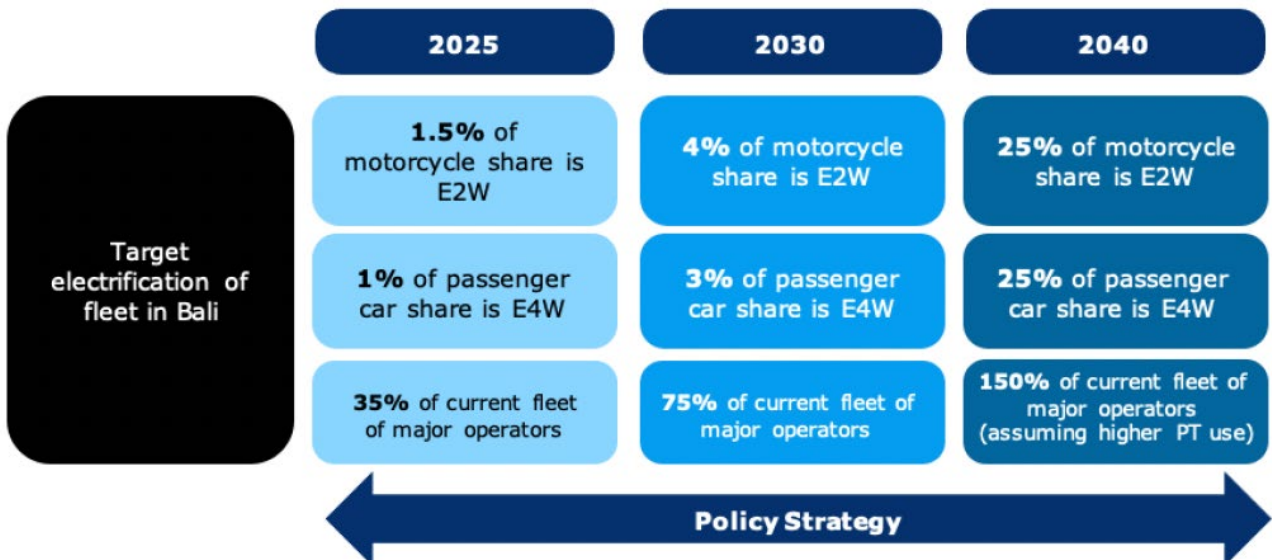
The Moderate scenario assumes that only provincial government pushes for EV through regional policies. Hence there will be very limited result expected, however such policies will still result in some effects. Significant fiscal policies may be inactive as they will need to be initiated by central government.

For setting the target for short-term, 2025, EV population is assumed to be just in between similar targets for BAU and Ambitious scenario. In this case E2W population share is expected to be 1.5% and E4W population share is expected to be 1%.

Now, for long-term, similar to setting the target such term in Ambitious scenario, it assumes that there will be only 5% increase of EV population share, compared to it is in BAU Scenario. This is due to the limited range of policies to be implemented to reflect this increase, which to be discussed in Section 5. In this case target setting for 2040 for Moderate scenario assumes that EV population share for E2W and E4W will be 25%.

In setting the target for medium-term, 2030, alignment of trend between short- and long-term is considered. Accordingly, target setting for 2030 for Moderate scenario assumes that EV population share for E2W and E4W will be 4% and 3% respectively.

Figure 41. Target Setting for E-Mobility in Bali for Moderate Scenario for 2025, 2030 and 2040



Source: Consultant analysis

### 4.2.3 Ambitious Scenario

The ambitious scenario for EVs in Bali Province is set based on alignment with the Draft Final RPJPN 2025-2045, where the period of 2025-2029 will expect a vision of several milestones, including a significant increase

for E-mobility, significant transition of subsidy to renewable energy and development of electricity grid capacity and technology. In addition, this scenario is expected to address the presidential vision, as stated by the Ministry of Energy and Mineral Resource, of an expectation of 15 million units of EVs by 2030.<sup>83</sup> These targets for Indonesia-wide are then translated to be applicable in Bali Province.

The Ambitious scenario assumes that government will push for EV through aggressive enforcement of policies. This will include a range of fiscal and non-fiscal policies implemented by both Central and Provincial governments, over the short, medium, and long term.

### Target setting for E2W and E4W

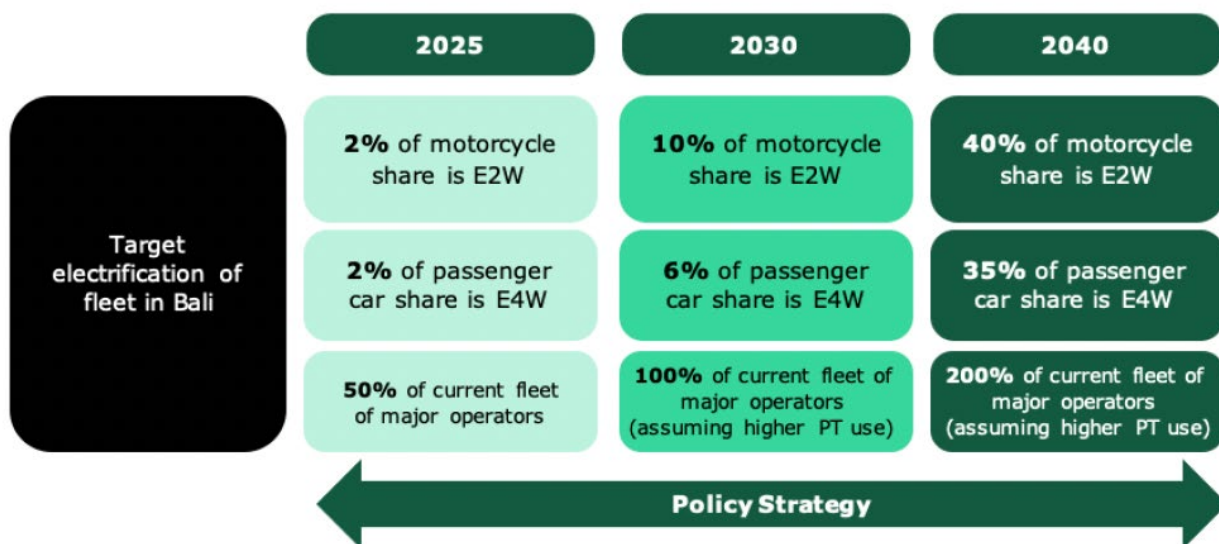
For setting the target for short-term 2025, similarly it assumes that EV growth will be still within the Bali EV RAD projection for 2026 that associated with figures within the range of its ‘Moderate’ and ‘Pessimistic’ scenario. However, it will expect quicker grow than it is for BAU Scenario. In terms of EV population share, 2% is assumed to be associated with each E2W and E4W.

Accordingly, in considering the 15 million EVs over Indonesia in 2030, this is translated to be population share of 10% of E2W and 6% of E4W in considering the expectation of total vehicle population in Bali in the year.

For setting the target for long-term 2040, it assumes that there will be 15-20% increase of EV population share, compared to it is in BAU Scenario. Where the later section of policy implementation discussed in Section 5 will reflect the amount of effort to achieve such targets. In this case target setting for 2040 assumes that EV population share for E2W and E4W will be 40% and 35% respectively.

The following Figure 42 illustrates the target expectation set for the Ambitious scenario for EV in Bali Province, assuming no further interventions are needed at the national and regional levels.

Figure 42. Target setting for E-Mobility in Bali for Ambitious Scenario for 2025, 2030 and 2040



Source: Consultant analysis

83 AntaraNews, 2022. <https://bali.antaranews.com/berita/334728/target-pemerintah-2030-15-juta-kendaraan-listrik-mengaspal-di-indonesia#:~:text=Kementerian%20Koordinator%20Bidang%20Kemaritiman%20dan,dapat%20mencapai%2015%20juta%20unit.>

## Target setting for E-bus

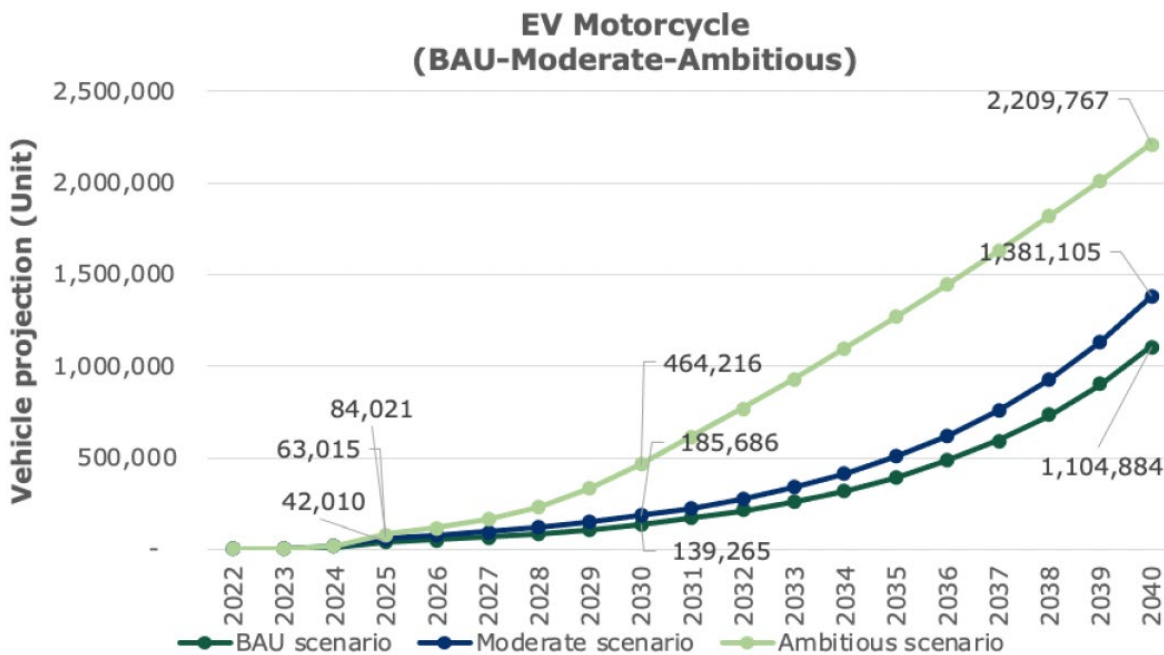
As for E-bus, the target electrified fleet is expected to increase from the current total fleet operated by the two major public bus operators, namely Trans Metro Dewata and Trans Sarbagita, which are estimated to be 120 units. The target electrified fleet is expected to be 50% of the current fleet size in 2025, 100% of the current fleet size in 2030, and 200% of the current fleet size in 2040. This would assume there is higher public transport use due to the improvement of the public transport system in Bali.

## 4.3 Scenarios for Future Vehicle Fleet and Charging Infrastructure in Bali, Indonesia

### 4.3.1 E-Motorcycles

The different scenarios for projecting the number of e-motorcycles are illustrated in Figure 43 discussed in the previous paragraph, the development of electric vehicles is generally expected to increase exponentially, with milestones in terms of shares of EVs in 2025, 2030, and 2040.

Figure 43. Scenarios for Development in Numbers of E-Motorcycles in Bali, Indonesia.



Source: Consultant analysis

Table 41. E2W Projection for Bali

E2W Scenario	EV Population share (%)			EV projection (units)		
	2025	2030	2040	2025	2030	2040
BAU	1%	3%	20%	42,000	139,200	1,105,000
Moderate	1.5%	4%	25%	63,000	186,000	1,381,000
Ambitious	2%	10%	40%	84,000	464,200	2,210,000

Source: Consultant analysis

## Technical Specifications for E-Motorcycles

As discussed earlier on in Section 2.3.1, the market currently prefers plug-ins over battery swap motorcycles. However, this technology has drawbacks, such as the cost and time of recharging batteries.

An alternative is battery swapping, which could be more cost- and time-effective if standardized batteries were introduced. Studies indicate that when electricity prices rise, as is expected, battery swap bikes may become more popular and would be the preferable technology in the long run. However, the battery-swapping industry faces operational complexity, demand management, standardization, and infrastructure investment issues.

Policies that increase the number of battery swap motorcycles, such as incentivizing initial purchase costs and early adoption of battery technology, lead to increased revenue for battery swapping stations. Electricity subsidies to charge cheaper may slightly increase the number of E-Motorcycles but, at the same time, decrease the accumulated cash flow of battery-swapping stations, consequently counteracting the development of a profitable battery-swapping industry.

Hence, the government could prioritize policies that target the supply side of battery swap electric motorcycle adoption to address key adoption barriers effectively.<sup>84</sup>

### 4.3.1.1 Potential Future Charging Infrastructure for E-Motorcycles

For the calculation of the demand for charging infrastructure for E-Motorcycles in this Roadmap, it is assumed that 100% of the E-Motorcycles will adopt battery swap to power up E2Ws. The use of home charging will be optional as battery swapping at stations will be much quicker. However, a more detailed analysis will be required if implementation of charging infrastructure will adopt plug-in charger for E2W.

The following Box 3 tabulates all assumptions used in calculating demand for charging infrastructures for E2W based on current practice in Bali and market adoption as elaborated in Section 2.

#### Box 3. Assumptions in the Calculations of Demand for Charging Infrastructure for E-Motorcycles

##### Scenario Assumptions on E-Motorcycles\*

- Average distance driven per day per motorcycle: 20 km
- Average battery size for an E-Motorcycle: 1.42 kWh
- Average distance per kWh for an E-Motorcycle: 20 km/kWh
- Range (100%-0% SoC): 28 km
- Calculated Days between charging: 1.42 day
- Calculated Consumption of kWh per day per fleet: 1 kWh/day

##### Assumptions on Battery Swapping Stations\*\*

- Total effect of cabinet: 5.6 kW
- Number of battery slots per cabinet: 7 units
- Utilization rate equalling to 10 hours per day: 0.42
- Duration of charging session of one battery: 1.78 hours
- No. of batteries charged per cabinet in a day: 39.32 units

\*) Based on average data of E-motorcycle fleet available in Indonesia reviewed in Section 2.3.1

\*\*\*) Based on Battery Swap Station specification of Swap.Id

84 How battery swapping can accelerate e-motorbikes, source: <https://360info.org/how-battery-swapping-can-accelerate-e-motorbikes/>

Considering the significant demand for motorcycles, the battery swapping station units in Bali were calculated for each scenario.

**Table 42.** Proposed Provision for Battery Swap Units (SPBKLU) in 2025, 2030, and 2040 for the Three Scenarios.

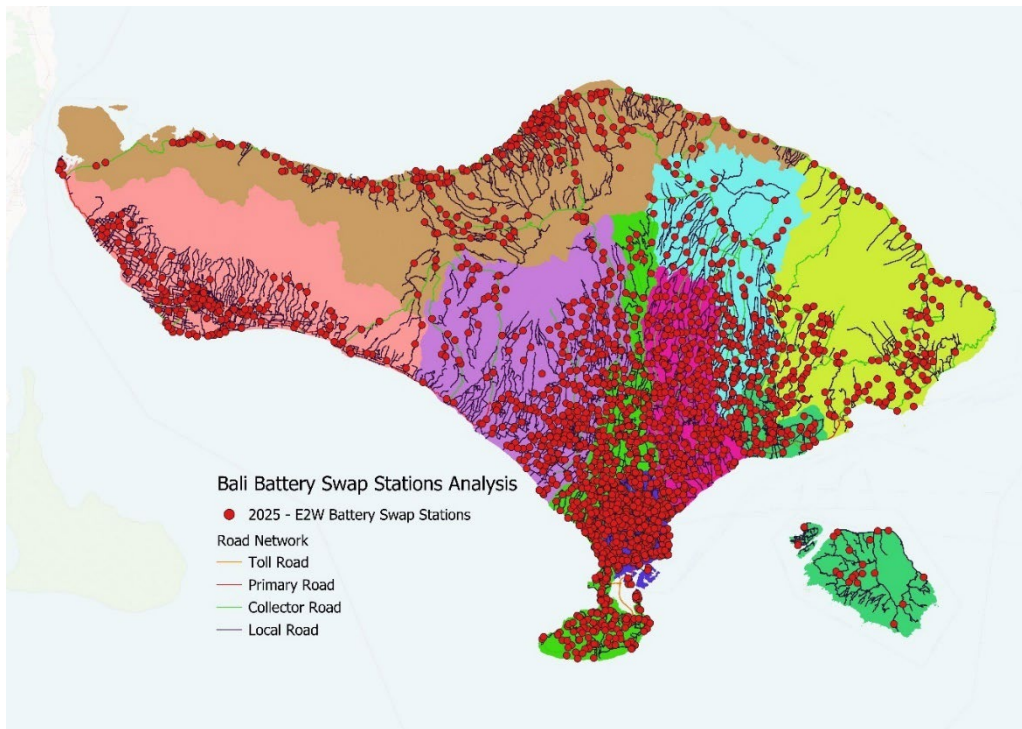
Scenario	2025	2030	2040
BAU	750	2,500	19,800
Moderate	1,200	3,400	24,700
Ambitious	1,500	8,300	39,500

*\*) Figures are rounded to the nearest 500; Source: Consultant analysis*

As for 2025, in considering the outreach capability of motorcycles that extend to local road networks, the illustration below proposes a total of more than 2,000 units of battery swap stations (moderate scenario) to be deployed across local, collector, and arterial roads in Bali. These figures will increase to 6,500 for demand in 2030 and to 34,500 units for demand in 2040 for the moderate scenario. Note that when distributing the locations for battery swapping stations, one facility may consist of more than a single unit with seven assumed battery slots. Instead, more units will be provided within one facility in areas with higher traffic volume, such as city areas.

The distribution of the battery swap stations should be all over Bali, with a higher density of charging infrastructure in areas of higher population density. This means that the battery swapping stations should be placed in every neighborhood and near local roads, not only on the roads of higher hierarchy. Mapping the geographical distribution of battery swap stations according to the population density leads to a map of charging infrastructure for E-Motorcycles, as illustrated by Figure 44.

**Figure 44.** Proposed Deployment of Battery Swap Stations (SPKBLU) in Bali for 2025 for a Moderate Scenario



*Source: Consultant analysis*

**Table 43.** Proposed Number of Location Points for E2W Battery Swap Station by Region – Moderate Scenario

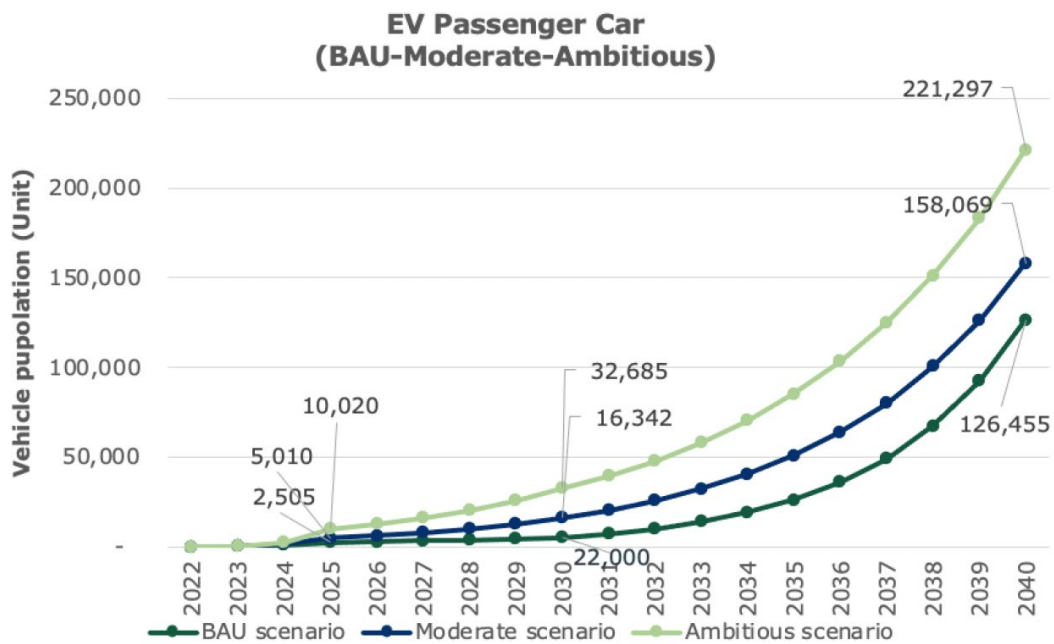
District	GIS distribution estimate	2025	2030	2040
Jembrana	7.0%	79	232	1,726
Buleleng	11.4%	128	378	2,814
Gianyar	14.1%	159	467	3,475
Karangasem	7.6%	86	253	1,883
Klungkung	4.8%	54	158	1,177
Tabanan	14.3%	161	473	3,520
Badung	19.7%	222	654	4,865
Bangli	6.4%	72	213	1,581
Denpasar	14.7%	165	487	3,621
Total	100%	1,125	3,316	24,663

Source: Consultant analysis

### 4.3.2 E-Passenger Cars

The different scenarios for forecasting the number of e-passenger cars are illustrated by Figure 45. As discussed previously, the development of electric vehicles is generally expected to increase exponentially, with milestones in terms of shares of EVs in 2025, 2030, and 2040.

**Figure 45.** Scenarios for Development in Numbers of E-Passenger Cars in Bali, Indonesia



Source: Consultant analysis

**Table 44. E4W Projection for Bali**

E4W	EV Population share (%)			EV projection (units)		
Scenario	2025	2030	2040	2025	2030	2040
BAU	0.5%	1%	20%	2,500	5,500	126,500
Moderate	1%	3%	25%	5,000	16,300	158,100
Ambitious	2%	6%	35%	10,000	32,700	221,300

Source: Consultant analysis

### Technical Specifications for E-Passenger Cars

Standardization of the connectors at the charging stations is necessary so that different vehicle models can use them. Under current legislation, several connector types must be available at the charger: AC Type 2 plug, DC charging CHAdeMO, and DC charging CCS. However, it would be beneficial to operate with different charger types that fit the end user’s needs.

This means that slower chargers (<22 kW AC chargers) where the charging takes several hours should be placed where the parking time typically is several hours, i.e., at offices/workplaces and near homes with no opportunity for home charging.

Fast charging (typically around 50 kW per outlet) (CHAdeMO and DC charging CCS) should be placed where people only have a short time, i.e., near retail. Ultra-fast charging (150 kW per outlet) should be placed where people just want to charge as fast as possible and be on their way, i.e., near the arterial and connector roads.

For the CHAdeMO connector, it should be noticed that the use of this connector type is declining, and it is not necessarily a future-proof approach to implement this charging technology. This should be discussed further with OEMs to understand their views on connector technology.

It is also essential to notice that the duration of the charging session does not rely only on the charger’s effect (kW). The vehicle may not be able to receive the impact provided by the charger. This especially applies to DC chargers where the conversion from DC to AC happens in the vehicle’s on-board charger. The average effect of the electricity provided to the EVs from the chargers should then not be expected to be as high as the effect of the chargers. However, the trend is that the charging speed is increasing while the range is not likely to go much higher than 600 km. This is because the driver is expected and recommended to have a break now and then where charging can be performed. Moreover, a bigger battery is generally heavier and much extra weight to move around in everyday life, where the distances traveled are much lower than to justify a big and heavy battery, resulting in a lower km/kWh.

#### 4.3.2.1 Potential Future Charging Infrastructure for E-Passenger Cars

To ensure enough charging stations and achieve a fine-meshed grid of charging infrastructure, it is recommended to set up more charging infrastructure for the E-passenger cars than the calculated demand in the given year:

- By 2025, the charging infrastructure for expected demand in 2030 should be deployed
- By 2030, the charging infrastructure for expected demand in 2040 should be deployed

This is based on the argument that charging infrastructure is a prerequisite for electric vehicles. This means that the charging infrastructure needs to be sufficient beyond the demand in the initial phases of the transition, and the ratio between chargers and EVs increases over the period up to 2040 and beyond. This is more important for passenger cars, as the network of battery swap stations will already be fine-meshed when deploying the necessary numbers for 2025.

In general, a higher density of charging networks should be provided in areas with higher population density because there is more traffic. More traffic is also found on roads of higher hierarchy, and thus, the demand for charging infrastructure along these roads is expected to be higher.

As principles for deploying the charging infrastructure for E-passenger cars, a distance requirement between chargers depending on the hierarchy of road network is recommended applied:

1. Toll road: max 5 km between ultra-fast charging stations
2. Arteria Road: max 5 km between ultra-fast charging stations
3. Collector Road: max 10 km between ultra-fast charging stations
4. Local road servicing neighborhoods: slow chargers are proposed on these roads depending on population density.

Note that when distributing the locations for charging stations, one facility may consist of more than a single charging unit with 2-3 outlets. Instead, in areas with higher traffic volume, such as the city area, more units are to be provided within one facility.

The following Box 4 tabulates all assumptions used in calculation of demand for charging infrastructure for E4W in this roadmap based on current practice in Bali and market adoption.

#### Box 4. Assumptions in the Calculations of Demand for Charging Infrastructure for E-Passenger Cars

##### Assumptions on E-Passenger cars\*

- Average distance driven per day per passenger car: 19 km
- Average battery size for an E-passenger car: 46.15 kWh
- Average distance per kWh for an E-passenger car: 5.6 km/kWh
- Range (100%-0% SoC): 258 km
- Typical charging session (industry practice): 20-80%
- Days between charging (general assumption): 14 days
- Consumption of kWh per day per E-passenger cars (calculated): 3.39 kWh/day

##### Assumptions on Charging Infrastructure

- Types of chargers in effect (kW) per outlet\*\*:
  - Home chargers: 7 kW AC
  - Publicly available slow chargers: 11 kW AC
  - Publicly available fast chargers: 50 kW DC
  - Publicly available ultra-fast chargers: 150 kW DC
- Utilization rate of all publicly available chargers: 15% (industry practice)
- Effect (kW) reduction of DC chargers due to limitations of vehicles: 25% (calculated)
- Share of E-passenger cars with possibility to charge at home: 80% (PLN's assumption)
- Share of E-passenger cars with no possibility to charge at home: 20% (PLN's assumption)
- Share of kWh demand provided by charger type: (consultant assumption)
  - Slow chargers incl. home chargers: 75%
  - Fast chargers: 5%

The following Table 45 summarizes the numbers for public chargers (SPKLU) for all three scenarios for 2025, 2030, and 2040.

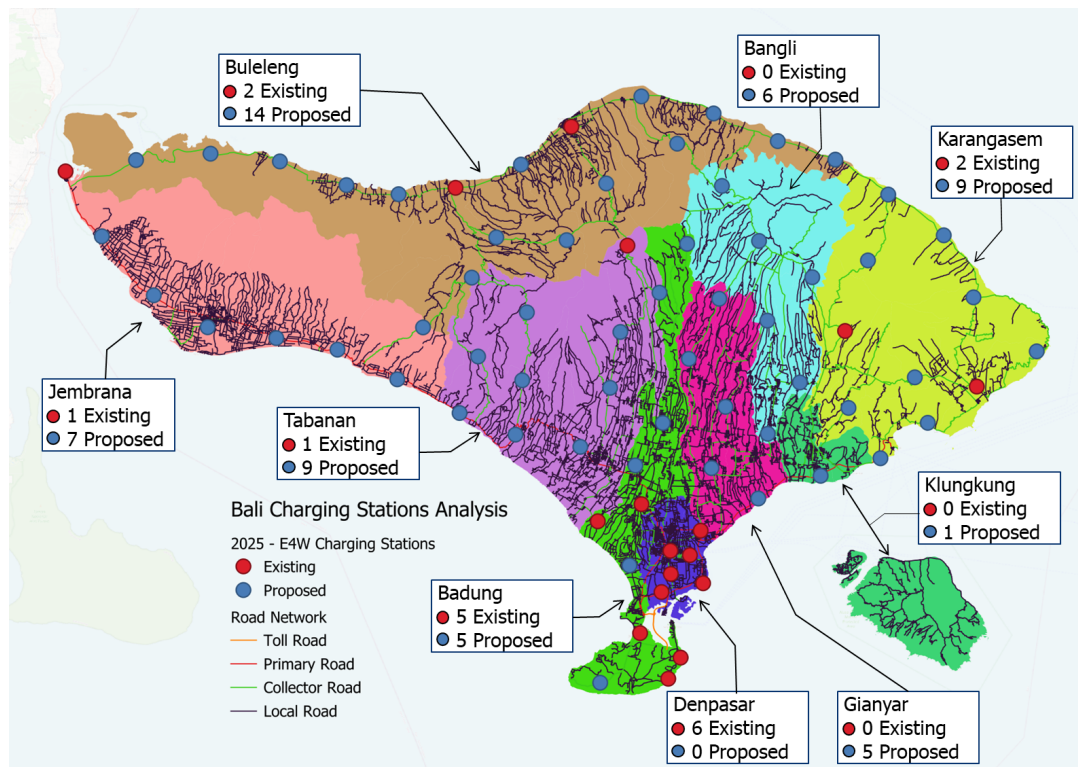
**Table 45. Proposed Provision for Public Chargers’ Units (SPKLUs) in 2025, 2030, and 2040 for the Three Scenarios**

Scenario	2025*	2030*	2040
BAU	18	210	414
Moderate	54	260	518
Ambitious	108	360	726

*\*) Figures are based on the assumption that provision for 2025 to consider for demand in 2030; Source: Consultant analysis*

Considering the geographical requirement above, the following map in Figure 46 shows the proposed deployment locations of SPKLU in Bali for 2025 for the moderate scenario. These may include a combination of slow, fast, and ultra-fast chargers. In this illustration, approximately 100 SPKLU are proposed to be deployed in 2025, to address the need for E4W for the Ambitious scenario. Such deployment is expected to address the issue of public reluctance to shift to EVs due to the limited availability of charging points.

**Figure 46. Proposed Deployment of Public Charging Stations (SPKLU) in Bali for 2025**



Source: Consultant analysis

**Table 46.** Proposed Number of Location Points for Public Charging Stations (SKPLUs) by Region – Moderate Scenario

District	GIS distribution estimate	2025	2030	2040
Jembrana	11.0%	6	28	57
Buleleng	21.9%	12	57	114
Gianyar	6.8%	4	18	35
Karangasem	15.1%	8	39	78
Klungkung	1.4%	1	4	7
Tabanan	13.7%	7	36	71
Badung	13.7%	7	36	71
Bangli	8.2%	4	21	43
Denpasar	8.2%	4	21	43
Total	100%	54	260	518

Source: Consultant analysis

### Home Charging Units for E-Passenger Car

Under the assumption that 80% of EV users will install their own home charging units, the numbers for home charging provision for all three scenarios for 2025, 2030, and 2040 are summarized in the following Table 47.

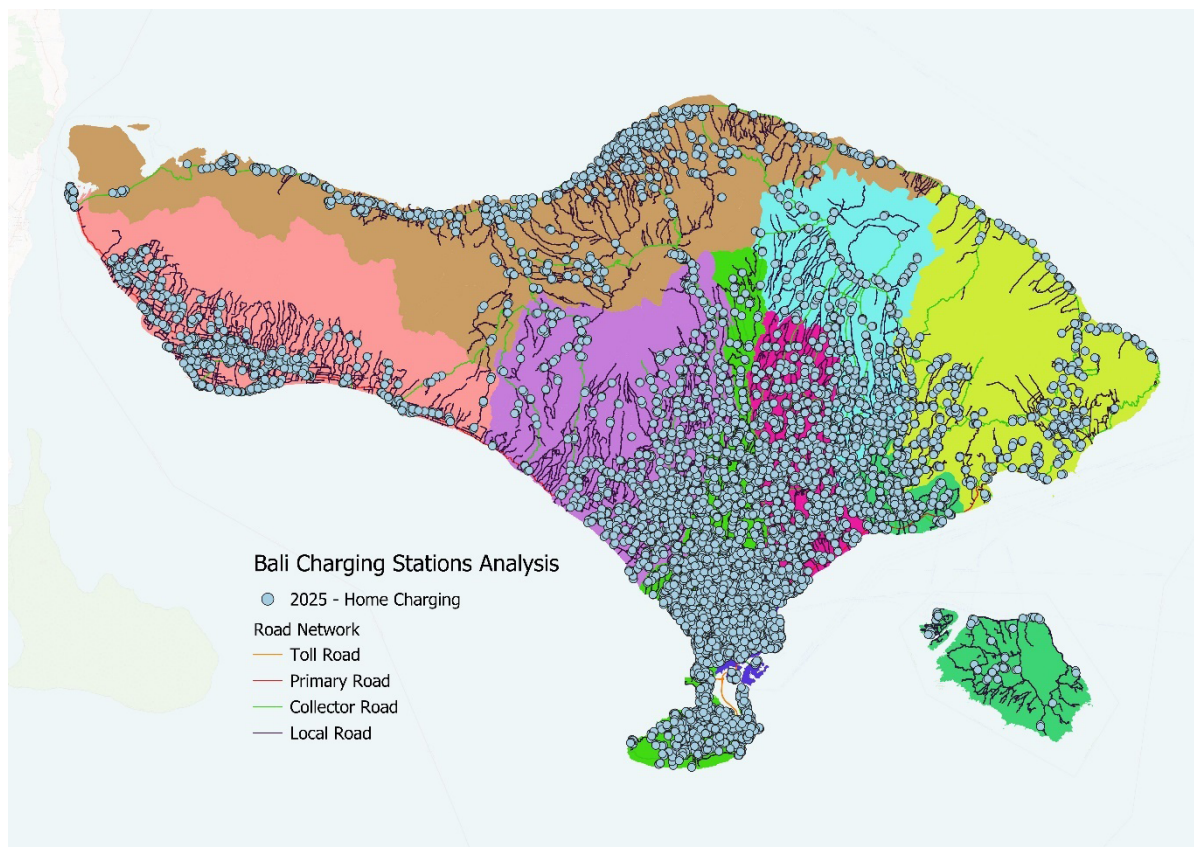
**Table 47.** Proposed Provision for Home Charging Units for E-Passenger Cars in 2025, 2030, and 2040 for the Three Scenarios

Scenario	2025	2030	2040
BAU	2,000	4,400	101,200
Moderate	4,000	13,100	126,500
Ambitious	12,000	43,600	177,000

\*) Figures are rounded to the nearest 100; Source: Consultant analysis

As for the moderate scenario for 2025, the following Figure 47 illustrates the proposed provision of home charging as distributed across the residential population in Bali. In this illustration, there are approximately a total of 13,000 units of home charging to address the demand in 2025 for overnight charging.

Figure 47. Proposed Deployment of Home Charging stations in Bali for 2025



Source: Consultant analysis

Table 48. Proposed Geographical Distribution for Home Charging Units by Region – Moderate Scenario

District	GIS distribution estimate	2025	2030	2040
Jembrana	7.2%	290	948	9,155
Buleleng	11.0%	442	1,446	13,962
Gianyar	14.3%	570	1,867	18,026
Karangasem	6.1%	243	796	7,685
Klungkung	4.2%	168	549	5,297
Tabanan	12.4%	496	1,623	15,670
Badung	22.7%	907	2,969	28,668
Bangli	5.3%	211	691	6,673
Denpasar	16.9%	676	2,212	21,363
Total		4,000	13,100	126,500

Source: Consultant analysis

The total number demanded of each charger type for each scenario in 2025, 2030, and 2040 is indicated in Table 49.

**Table 49.** In the Scenarios for 2025, 2030, and 2040, Several Outlets From The Different Charger Types are Expected to Meet the Demand for Charging Infrastructure from E-Passenger Cars

Scenario	7 kW AC Home (no. of outlets)	11 kW AC Public (no. of outlets)	50 kW DC (no. of outlets)	150 kW DC (no. of outlets)
<b>2025</b>				
BAU	2,000	7	1	1
Moderate	4,000	14	1	2
Ambitious	8,000	27	2	3
<b>2030</b>				
BAU	4,400	15	1	2
Moderate	13,100	45	3	5
Ambitious	26,100	90	7	11
<b>2040</b>				
BAU	101,200	347	25	42
Moderate	126,500	433	32	53
Ambitious	177,000	607	44	74

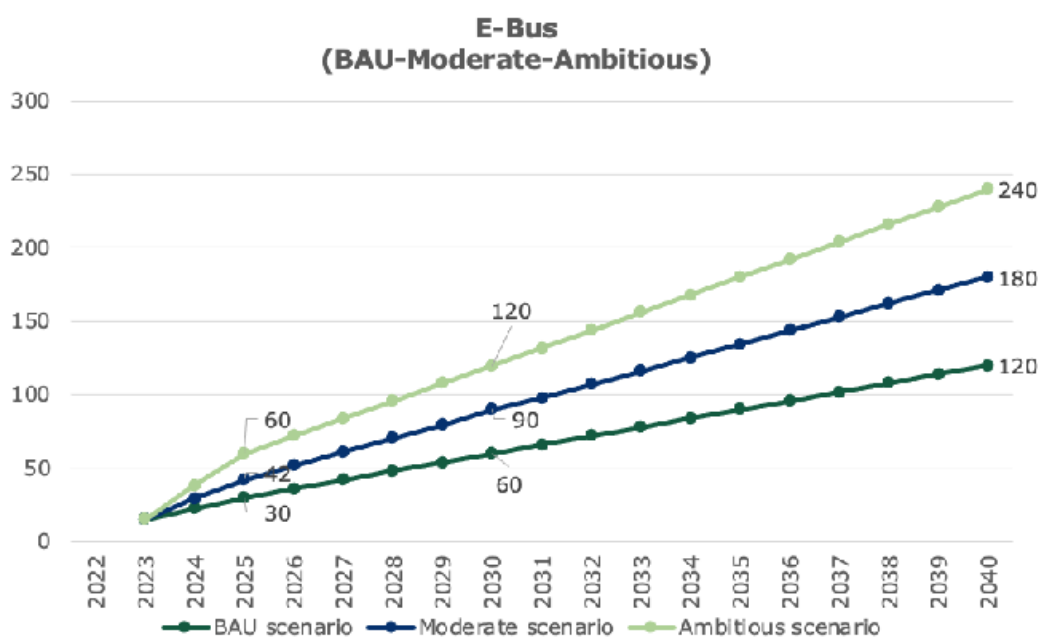
Source: Consultant analysis

### 4.3.3 E-Buses

The different scenarios for forecasting the number of e-buses are illustrated in the following Figure 48 and Table 50. As discussed previously, the development of electric buses is generally to increase linearly with milestones in terms of shares of EVs in 2025, 2030, and 2040. The development is by far determined by the ambitions of relatively few stakeholders and the government funding to promote E-buses and, more importantly, to promote higher utilization of public buses through strategic measures under its transport master plan.

The potential number of e-buses depends on the number of vehicles in the current fleet and the modal split expected in the future.

**Figure 48.** Scenarios for Development in Numbers of e-Bus in Bali, Indonesia



Source: Consultant analysis

**Table 50. E-Bus Projection and Demand for Charging Infrastructure for E-bus for Bali**

E-Bus Scenario	EV Population share compared to today's fleet (%)			EV projection (units)			No. of 180 kW DC Charger (units)		
	2025	2030	2040	2025	2030	2040	2025	2030	2040
BAU	25%	50%	100%	30	60	120	6	9	13
Moderate	25%	75%	150%	42	90	180	12	19	25
Ambitious	50%	100%	200%	60	120	240	25	38	42

Source: Consultant analysis

### Technology requirements to consider for transition to E-bus

Several considerations should be made when transitioning a fleet of buses to electric buses.

#### Infrastructure

**Charging strategy.** Analyses need to be performed on when and where to charge. A charging strategy ensures that vehicles are charged and ready for use when needed, minimizing downtime and maintaining consistent service levels. Proper scheduling of charging sessions helps avoid operational disruptions.

**Charging Stations.** Establishing sufficient and strategically located charging stations is crucial. This includes both depots charging and on-route charging (terminals etc.). To ensure safe and reliable operation, the charging infrastructure must provide the power that vehicles require. It is also advisable to ensure this by having a few additional charging points that offer extra power. If one charging point goes down, it is wise to have some in reserve.

**Charging technology.** There are currently three types of technologies used to charge buses:

1. Plug-in Charging is a simple, reliable, and often familiar technology. This is often used for overnight depot charging. The downside is that this requires a physical connection to the bus, limiting flexibility.
2. Pantograph Charging ensures faster charging than plug-in, especially for high-power applications. It offers overhead connections at designated stops. The downside is that it requires infrastructure installation along routes, which can be expensive.
3. Wireless Induction Charging offers a contactless and convenient charging experience. No physical connection is needed. However, this method is currently less common and can be more expensive than other methods. Its efficiency can be lower than that of plug-ins or pantographs.

**Grid Capacity.** It is crucial that the local grid can handle the additional load from multiple buses charging simultaneously. In case of brownouts or blackouts, it can be a good idea to have the option to connect to a generator. Generators can provide a backup power source for EVs during a power outage. This can be especially helpful if you rely on your EV for everyday transportation. This may require grid upgrades or the integration of energy storage systems.

**Maintenance Facilities.** Adapting or building maintenance facilities equipped to handle electric buses with different requirements than traditional diesel buses is necessary. Electric buses require less frequent and generally less complex maintenance than diesel buses. This can translate to significant cost savings for EV owners in the long run. There are some additional points to consider:

- EV Battery Degradation: While EV batteries are built to last many years, they degrade over time. However, significant degradation typically happens over a long period of ownership.
- EV-Specific Maintenance: Some EV components, like the battery cooling system, might require periodic checks as the manufacturer recommends.

## Vehicle Selection

**Range and Capacity.** Buses should be acquired with a range that meets or exceeds daily operational requirements and has sufficient passenger capacity. The rapid development of electric buses is expanding the availability of buses across various segments. However, for smaller buses (typically mini-buses or 8-meter buses), battery size is often constrained due to space limitations, affecting passenger capacity. Therefore, a robust charging strategy is crucial for these vehicles.

**Battery Technology.** Buses with the latest battery technologies offer better energy density and longevity. When purchasing/leasing an electric bus, it is crucial to ensure the supplier provides a warranty for battery capacity over time. This warranty is not just a formality but a guarantee that the battery will maintain a certain level of performance throughout the bus's lifespan, ensuring the bus's operational efficiency.

**Total Cost of Ownership (TCO).** The TCO should include purchase price, maintenance costs, energy costs, labour costs, potential subsidies or incentives, downtime costs, support and training costs, and disposal cost and so forth.

## Operational Planning versus Fleet Types

**Route Analysis.** The bus routes should be thoroughly analysed to determine the best fit for electric buses. This analysis is not just a step, but a crucial process that ensures efficient deployment and operational planning. Routes with predictable patterns and shorter distances are ideal for initial deployment.

**Scheduling.** Charging schedules should be developed to minimize downtime and ensure buses are charged during off-peak hours to reduce energy costs.

**Selection of fleet types.** Geographic assessment versus fleet type selection is important to address the considerations in deploying suitable fleet types on specific corridors.

- Low-floor buses:
  - These buses have no steps between the entry and exits and at least part of the passenger cabin. They are designed for easy access, particularly for the elderly, disabled, or those with strollers. This is the standard city bus with no steps into the bus and a flat floor.
  - High-floor buses: These are the opposite, with storage space below the passenger area. They are typical long-distance and airport express buses.
  - Low-entry buses (low-entry) / semi-low-floor:
    - These buses combine features of both high-floor and low-floor designs. The area near the front door is a low floor for easy entry, but the back part of the bus has a higher floor to accommodate the engine and accommodate more seating.

**Fleet Management Software.** Implement software to monitor and manage the fleet's performance, including battery health, energy consumption, and maintenance needs.

## Economic Considerations

**Initial Investment.** Electric buses typically have a higher upfront cost than diesel buses. Plan for the initial capital expenditure and explore financing options, grants, and incentives.

**Operational Savings.** Electric buses offer lower operating costs due to reduced fuel and maintenance expenses. Calculate the payback period and long-term savings.

**Incentives and Subsidies.** Any government incentives and subsidies for electric vehicles and charging infrastructure should be mapped and utilized.

## Environmental Impact

**Emission Reduction.** Transitioning to electric buses would reduce greenhouse gas emissions and other pollutants, and this should be quantified.

**Energy Source.** The electricity used for charging should be sourced from renewable energy to maximize environmental benefits.

**Battery Disposal and Recycling.** The end-of-life disposal and/or recycling of batteries to mitigate environmental impact should be considered and handled. Old batteries still have a life in other applications, such as in energy storage units, other vehicles or machinery, home energy systems, or grid-level storage.

## Stakeholder Engagement

**Community and Passenger Education.** The community and passengers should be informed about and engaged in the benefits and changes associated with electric buses. These build trust and transparency about electric buses' environmental and operational benefits, fostering support for the transition.

**Driver Training.** Comprehensive training for drivers to handle electric buses should be provided, focusing on energy-efficient driving techniques and safety protocols. While many aspects of driving remain the same as with a diesel bus, electric buses introduce unique characteristics that benefit from proper training. It is important to train the drivers in handling the vehicles, understanding regenerative braking, removing any range anxiety drives can have, understanding how to use the charging infrastructure, and any safety considerations that might occur.

**Collaboration with Utility Companies.** Utility companies like PLN should be engaged and informed of the project to ensure reliable energy supply and explore options for demand response programs.

## Regulatory Compliance

**Safety Standards.** All buses should meet safety standards and regulations for electric vehicles.

**Data Reporting.** Systems for reporting and monitoring should be implemented to comply with regulatory requirements and to optimize fleet performance.

## Strategy to Promote Higher Public Transport Take-up

Further assessment of the ages of vehicles, ridership demand and routes, and other operational and maintenance aspects of charging infrastructure should be conducted before further establishing the transition's recommended speed and associated costs.

Along with planning the implementation of the E-bus, strategy, and mitigation measures to promote higher take-up of public transport need to be considered. A higher transition to public transport use by utilizing E-bus means more carbon reduction due to conventional diesel buses.

For example, in the case of feeder services, TransJakarta provides Mikrotrans services with minibuses with an 11-seater capacity. TransJakarta carries out this service in partnership with cooperative companies. The minibuses are assigned as feeders to connect to the local area in Jakarta. These services can be introduced in Bali to support better accessibility to existing Trans Metro Dewata and Trans Sarbagita.

## 4.4 The Potential Future of Electric Vehicles in the Electricity Grid in Bali, Indonesia

### 4.4.1 Demand for Electricity for E-Mobility

- Overall energy demand due to transportation electrification
- Aggregated daily consumption profiles based on scenarios
- Need for additional power generation capacity requirements based on scenarios

### 4.4.2 Charging Impact on the Electricity Grid

Connecting electric vehicle (EV) charging infrastructure to the electrical network comes with various advantages and disadvantages from the electricity grid perspective. Depending on the total amount of MW of charging power needed, connecting the charging infrastructure to different voltage levels can be more beneficial.

Connection to lower voltage levels, where most of the consumption is connected, can provide advantages such as:

- **Distributed Energy Resources (DER) Integration:** EV charging infrastructure can be integrated with other distributed energy resources, such as solar panels and energy storage systems, creating a more resilient and flexible grid.
- **Increased Grid Utilization:** EV charging infrastructure can improve the utilization of the existing distribution grid infrastructure by spreading the load and demand more evenly throughout the day.
- **Grid Stability:** Smart charging technologies can help manage the demand on the grid, reducing the likelihood of overloads and contributing to overall grid stability.

When the charging infrastructure is connected to higher voltage levels, some advantages could be:

- **High Power Capacity:** The transmission grid operates at higher voltage levels, allowing more significant amounts of power to transfer over longer distances. This enables high-power charging stations, potentially reducing charging times for electric vehicles.
- **Reduced Localized Grid Upgrades:** Focusing on the transmission grid may reduce the need for upgrades to the local distribution grid, especially in areas with high concentrations of EVs. This can result in cost savings and faster implementation.
- **Integration with Renewable Energy Sources:** If many renewables are connected to the transmission grid, e.g., offshore wind farms, EV charging infrastructure could leverage renewable sources more effectively, contributing to a cleaner and more sustainable transportation system.

Disadvantages of the electric vehicle infrastructure at the distribution level can be:

- **Grid Congestion:** A more extensive adoption of EVs in some grid areas than others without proper planning and infrastructure upgrades can lead to grid congestion, especially during peak demand periods. This could then result in costly grid upgrades to handle the additional load.
- **Voltage Fluctuations:** EV charging at different voltage levels and locations can lead to voltage fluctuations and power quality issues, potentially causing disruptions to the electricity supply for other consumers on the same grid.

- **Infrastructure Costs:** Building and maintaining EV charging infrastructure at the distribution grid level means that the costs are more distributed and can be more expensive if not properly investigated.
- **Land Use:** The physical space required for charging stations, especially in urban areas, can raise concerns related to land use, aesthetics, and the visual impact of additional infrastructure.

Disadvantages of the electric vehicle infrastructure at the transmission level can be:

- **Building New Transmission Infrastructure:** The potential need to upgrade and expand the transmission grid to support widespread EV charging can be expensive, and there are challenges related to land use, environmental concerns, and permitting processes.
- **Energy Losses:** Transmitting electricity over long distances incurs some energy losses. These are reduced at the transmission grid level but should still be considered when planning large-scale EV charging infrastructure.
- **Limited Local Control:** EVs are centralized in a few locations, which limits the possibility of managing and optimizing the charging infrastructure and smart charging to support the overall electrical grid.
- **Dependence on Centralized Infrastructure:** Relying solely on the transmission grid for EV charging infrastructure may limit the deployment of charging stations in remote or less densely populated areas, where transmission infrastructure might not be as extensive.

In summary, incorporating EV charging infrastructure at the transmission and distribution grid levels offers advantages and disadvantages. In general, a balanced approach that considers all grid levels and advancements in smart grid technologies may be necessary to create an effective and resilient EV charging infrastructure system. This can be achieved by coordinating between stakeholders, including utilities, government agencies, and private entities. For instance, PLN as the main electricity power provider in the Island, it should be given an aligned understanding with provincial government of the expectation of power grid supply to support for EV for short, medium and long term. Therefore, it can maintain the overall power capacity and plan for distribution of grid across the island over the years.

### 4.4.3 Investment Requirements for the Electrical Infrastructure

The calculation on the demand for charging infrastructure in Section 4.4.1 further allows calculations on the impacts on the electricity grid – see Table 51.

These analyses are done for the moderate scenario and the expected number of EVs in 2025, 2030, and 2040, with studies on the extra kW demand at each of the substations on Bali using a simultaneous index of 60%.

PLN provides the available capacities in the substations and comparing this data with the extra kW demand from the charging of the electric vehicles (especially motorcycles and passenger cars), problems start to occur when an electric fleet of the expected size in 2030 is realized. In 2040, almost every substation will have problems, and more than 4,000 MW will be needed. The issues may be even more significant as sectors other than the transport sector may face an electrification process. This indicates that long-term plans and substantial funding for the grid upgrade will be necessary. The plans should also consider the possibilities electric vehicles pose as assets in the electricity system.

**Table 51. Present kW Demand vs Available Reserve (+) / Short of Additional (-) kW Demand Due to Charging Infrastructure for Moderate Scenario**

Region	Present substations	% of Bali population	Available capacity for EV charging infrastructure [kW] with a power factor of 1	Available reserve (+) / short of additional (-) kW demand for the moderate scenario in 2025	Available reserve (+) / short of additional (-) kW demand for the moderate scenario in 2030	Available reserve (+) / short of additional (-) kW demand for the moderate scenario in 2040
Denpasar	GI PBIAN	8%	80,913	68,660	42,018	(-) 274,957
	GI PSGRN	6%	82,391	73,333	53,636	(-) 180,712
	GI Sanur	9%	101,340	88,308	59,972	(-) 277,161
Badung	GIS Pecatu	5%	77,979	70,610	54,588	(-) 136,041
	GI NSDUA	4%	98,900	93,004	80,186	(-) 72,316
	GIS BNDRA	4%	80,577	74,682	61,864	(-) 90,639
	GI Kuta/ Pemecutan	6%	74,102	65,128	45,616	(-) 186,537
	GI Kapal	6%	111,396	102,554	83,327	(-) 145,428
Gianyar	GI Gianyar	8%	60,679	48,889	23,253	(-) 281,753
	GI Payangan	8%	59,028	46,946	20,677	(-) 291,865
Tabanan	GI Antosari	2%	105,838	103,478	98,345	37,282
	GI Baturiri	2%	74,773	71,825	65,416	(-) 10,835
	GIS Tanah Lot	4%	86,270	81,038	69,663	(-) 65,672
Karangasem	GI Amlapura	10%	82,678	67,940	35,895	(-) 345,362
Buleleng	GIS CLKBW	3%	44,099	39,004	27,923	(-) 103,903
	GI Pamaron	7%	74,325	64,009	41,577	(-) 225,303
Jembrana	GI Negara	6%	91,576	83,172	64,899	(-) 152,509
	GI Gilimanuk	2%	79,348	76,500	70,306	(-) 3,388
Bangli	No data	-	-	-	-	-
Klungkung	No data	-	-	-	-	-
Total		100%	1,466,212	1,319,080	999,160	(-) 2,807,097

Source: Consultant analysis

#### 4.4.4 Grid Services Using Electric Vehicles

EVs, with their innovative potential to offer various grid services, leveraging their energy storage capabilities and bidirectional power flow, can help improve grid stability, reliability, and efficiency. Here are some potential grid services that EVs can provide:

- **Peak Shaving:** EVs can stop charging or discharge stored energy if bidirectional chargers are used during periods of high demand, helping to reduce peak loads on the grid. Additionally, by strategically redistributing stored energy back to the grid, EVs can help balance the overall electricity demand, especially during peak hours.
- **Frequency Regulation:** EVs, with their rapid response capabilities, can adapt to grid frequency fluctuations by adjusting their charging or discharging rates, thereby contributing to grid stability.
- **Demand Response:** EVs can participate in demand response programs, adjusting their charging schedules based on signals from the grid operator to match electricity supply and demand.
- **Ancillary Services:** EVs can help provide services, such as voltage support or reactive power control, to the

overall grid. With voltage support, they contribute to maintaining proper grid voltage levels by injecting or absorbing power as needed. With reactive power control, EVs can support grid voltage and improve power factor.

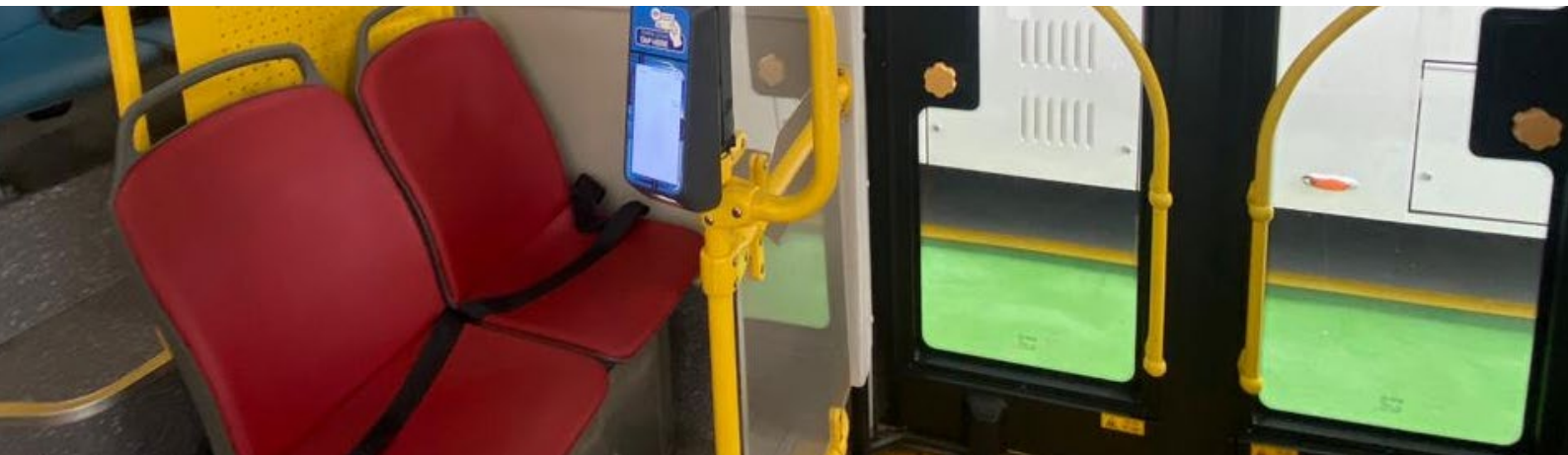
- **Renewable Energy Integration:** EVs can absorb excess renewable energy during periods of high generation and release it when renewable generation is low, helping to smooth out intermittent power production.
- **Grid Backup and Resilience:** In the event of grid outages or emergencies, EVs with bidirectional capabilities can serve as mobile power sources, supplying electricity to homes or critical infrastructure.
- **Energy Arbitrage:** EVs can be programmed to charge during periods of low electricity prices and discharge during peak demand hours, allowing for cost savings for both EV owners and the grid operator.
- **Carbon Reduction:** Coordinating EV charging with periods of high renewable energy generation can significantly reduce carbon emissions associated with electricity generation, promoting a more sustainable environment.

Realizing the full potential of grid services requires developing and implementing smart charging infrastructure, advanced communication protocols, and regulatory frameworks. The last one (regulatory frameworks) is still uncertain, especially for bidirectional chargers. However, as technology evolves and the adoption of EVs increases, the role of EVs in providing grid services is likely to become more significant and speed up the technology and regulation developments.

While there are numerous advantages to using EVs for grid services, addressing their obstacles requires collaboration among stakeholders, technological advancements, regulatory support, and effective communication strategies to encourage user participation and system integration.

Some of the significant challenges are summarized below:

- Incentives, education, and the development of user-friendly charging management systems may be required to encourage users to adopt flexible charging patterns.
- Variable renewable energy output and unpredictable EV charging behavior make coordination challenging, requiring sophisticated algorithms and real-time data analysis.
- The environmental benefits depend on the energy sources used for charging, and ensuring a net positive impact may require a transition to renewable energy sources.
- Rapid technological advancements and standardization efforts are needed to ensure interoperability and compatibility among diverse charging infrastructure and vehicle models. Advanced communication and control systems are also required for the grid to perform the services as discussed.



# 5. DEVELOPMENT OF POLICY STRATEGY AND IMPLEMENTATION PLAN

## 5.1 Overview

This section elaborates on developing policy strategy recommendations to support the target set for future scenarios, especially to achieve EV implementation beyond the BAU Scenario, which includes Moderate and Ambitious Scenarios.

The development and planning for policy strategy and its implementation are not only based on local insights but also heavily influenced by inputs gathered during stakeholder engagement and insights from the international adoption carried out within this study. This comprehensive approach ensures that the policy strategy is not only locally relevant but also globally competitive.

With the point of departure in the key recommendations and assessment of the contribution of each of the policy/ regulatory framework/subsidy schemes to achieve the objectives of the EV Roadmap, the following approaches are considered for developing the policy strategy set in this study.

- Understanding the determinants of policies, regulatory frameworks, and subsidy schemes with higher chances of success.
- Evaluating the effectiveness of different policies, regulatory frameworks, and subsidy schemes and suggesting adopting these.

In other words, the policy strategy developed for this study is based on how specific policies have successfully boosted the use of EVs elsewhere. However, it should be noted that a wide range of factors drive the effectiveness of different policies for different regions. For instance, these factors may include the purchasing power of society, national fiscal capacity, preceding regulations (such as current tax, subsidy, age of vehicle limit, etc.),

and other relevant factors. Hence, implementing the policy strategy developed for this roadmap is not intended to directly influence the target setting of EV implementation. Instead, it is the intent to consider these policy strategies to be key drivers that need regular monitoring to see the effectiveness of maintaining the expected trajectory of future trends of implementation of EVs in Bali and Indonesia.

This section will also present the implementation plan for the identified range of policy measures, from fiscal and non-fiscal categories, and for the short-term (by 2025), medium-term (by 2030), and long-term (2040).

## 5.2 Development of Policy Strategy Recommendations

### 5.2.1 Strategy Recommendations

At present, in tackling the concern of overall EV cost, the policy applied in Bali and Indonesia in accelerating the implementation of E-Mobility has been focused on relieving VAT tax (PPn) and Sales Tax on luxurious goods (PPnBM) since 2019-2021. The exemption of vehicle ownership tax (PKB) and transfer title fee (BBNKB) have only been introduced recently, which has had more impact on the E4W sales from 2022/2023 than the previous yearly sales. Nevertheless, in understanding the cost structure of EV purchase and operation, these policies are yet to make EV prices competitive with fuel-fossil prices.

Based on understanding the overall cost structure of purchasing and operating an EV unit, it becomes more apparent that the high initial cost to purchase an EV is the main decision point for users to choose in shifting from fossil-fuel vehicles. This is even knowing that the operational cost for EVs over the years is lower than fossil-fuel vehicles. In the EISR study for Indonesia EV Outlook 2023, the initial Capex dominates 70% of the cost structure of purchasing and operating an E4W. Vehicle ownership tax (PKB) and ownership transfer tax (BBNKB), which refer to fossil-fuel cars, may only take up a small portion of the overall cost structure.

As for motorcycles, the policy intervention of the IDR 7 million subsidy, implemented in early 2023, has significantly increased E2W use over 2023.

From the perspective of reliability, the high availability of charging infrastructure enables a higher confidence level for users, hence for consumers to decide to shift from fossil-fuel vehicles to EVs. Yet ensuring the high availability of charging infrastructure will depend on several factors, including:

- Feasibility for consumers to install home charging facilities
- Feasibility for the government to deploy significant numbers of public charging facilities for better accessibility to EV users

By understanding the underlying strategic issues of implementing EVs in Bali and Indonesia, some key strategy recommendations have been developed to support the E-Mobility Roadmap for Bali. Such Strategy Recommendations are derived from the findings from:

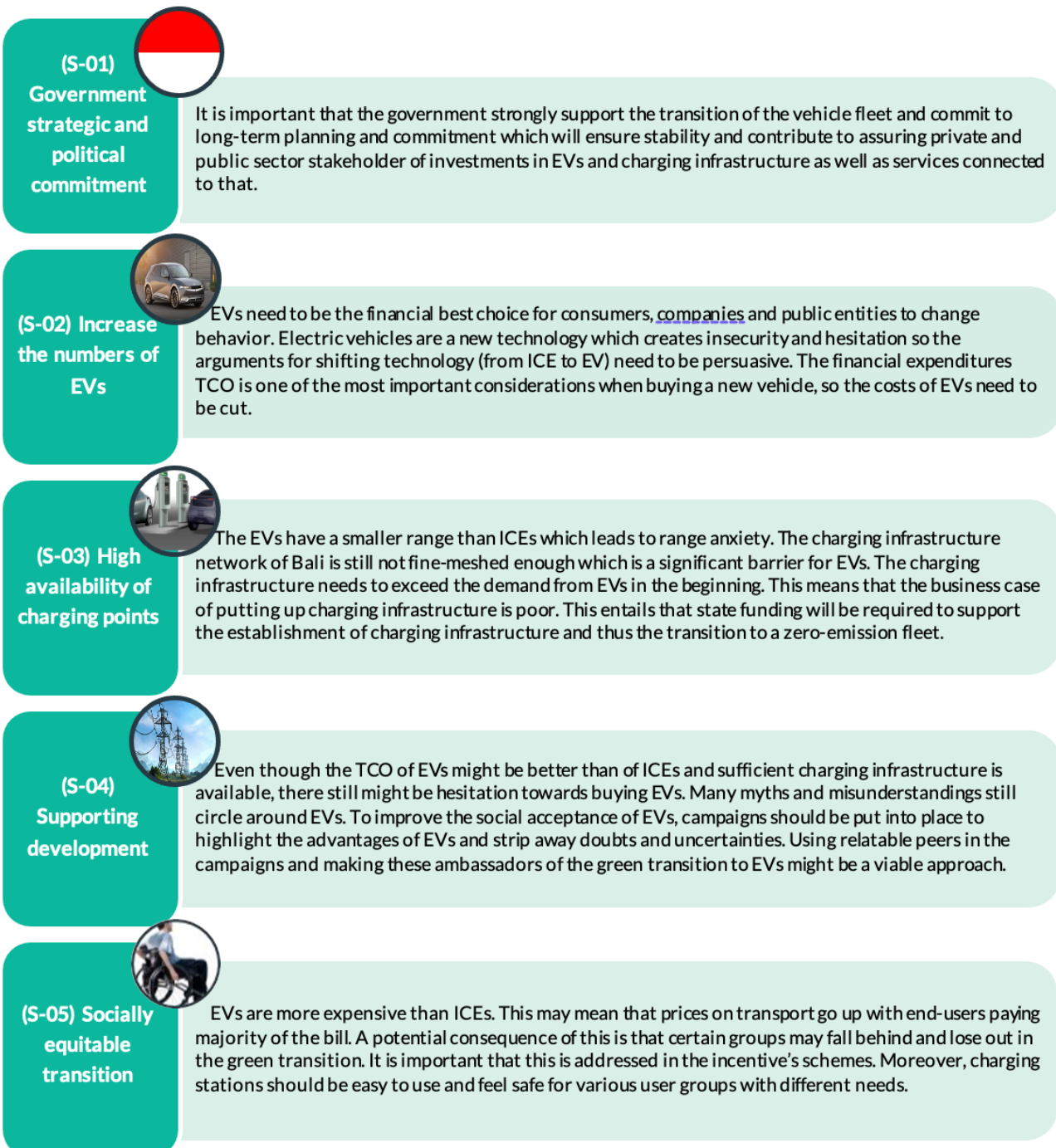
1. The Baseline Assessment for Bali as described in Section 2. During this mapping and analyses of the current policies and incentives, it has been highlighted what has been done so far, as well as the development in the numbers of EVs and charging infrastructure up until now.
2. International Experience Gathering in Section 3. Learning from other countries around the globe has made it possible to determine common denominators for the incentives put in place to support the transition to electrical vehicle fleets. These incentives can be profitable in Bali (and Indonesia) as well, but they must be adjusted to the specific conditions in Bali. The level of ambition in the action point under each Key

Recommendation then needs to be aligned with the goals/targets as described in the different scenarios in Section 4.3 (this section).

- 3. Dialogue with Stakeholders. To best understand the current condition and potential future development and what the roadmap should address, stakeholders provide invaluable insights. Such insights were gathered during a stakeholder engagement session in Bali in May 2024. Where essential information gathered includes a range of preferred policy measures that can be reasonable from the perspective of both effectiveness and efficiency (from the standpoint of ease and cost of implementation), these insights contribute to the final Roadmap and the action points under each recommendation.

The following Figure 49 illustrates the key recommendations to address the five main strategic themes to improve EV implementation in Bali and Indonesia.

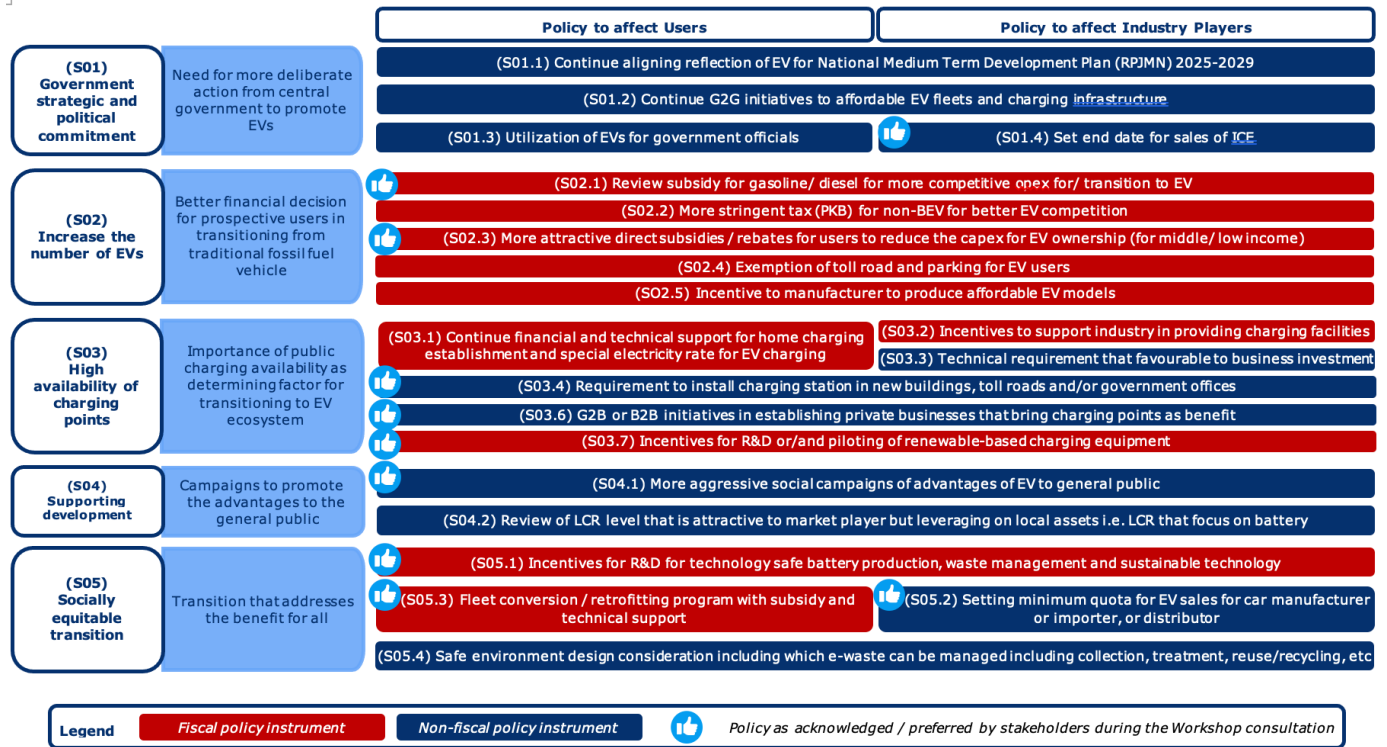
Figure 49. Key Recommendations of the Roadmap



## 5.2.2 Range of Available Policy Strategy As Identified From Baseline Assessment And International Adoption

This section identifies a range of policy instruments to support the Strategy Recommendations and possible measures to achieve the target implementation settings. The Figure 50 below presents some possible fiscal or non-fiscal policy instruments and measures concerning the strategy recommendations developed. Fiscal policy instruments are in dark red, while non-fiscal instruments are in dark blue.

Figure 50. Range of Applicable Policies Strategy



Source: Consultant Analysis

## 5.3 Stakeholder Consultation Inputs to Policy Strategy Development

A stakeholder consultation was undertaken on 15 May 2024, where part of the objective was to gain inputs from various stakeholder participants to validate the challenges faced in implementing EVs in Bali and Indonesia. In addition, the two-way interaction is conducted to understand the most reasonable strategic policy that can be effective and economical enough to support the EV implementation. Lastly, the interaction also facilitated knowledge sharing from international adoptions of how other regions have successfully set their target and strategic policy to support the target implementation of EVs in the future.

### 5.3.1 Understanding Key Challenges From Stakeholders' Perspectives

During this session, participants were asked to select up to four potential challenges they perceived Bali is facing in implementing the EV from the perspective of E2W, E4W, and E-bus.

From the perspective of E-Motorcycle, the following challenges were identified during the workshop interaction.

**Table 52. Key Challenges Associated with the Implementation of E2W as Identified by Stakeholders**

Rank	Category	Challenge identified
#1	Commercial	High price
#2	Charger	Charging point accessibility/compatibility
#3	Commercial	Limited incentives or access to incentives
#4	Regulatory	Limited policy implementation to push EV usage
#5	Political	Challenging institutional coordination regarding policies
#6	User experience	Limited understanding of EV health and environmental benefits
#7	Charger	Undesirable/unsafe locations for users (women, disabled, etc.)
#8	User experience	Limited understanding of EV cost savings

From the perspective of EVs for Passenger Cars, the following challenges were identified during the workshop interaction.

**Table 53. Key Challenges Associated with the Implementation of E4W as Identified by Stakeholders**

Rank	Category	Challenge identified
#1	Commercial	High capital of vehicles and limited subsidies available
#2	Regulatory	Limited policy implementation to push EV usage
#3	User experience	Limited choice of categories/class of E4W
#4	Technical	Challenging technical/technological capabilities for ICE to Electric vehicle conversion
#5	Political	Challenging institutional coordination regarding policies
#6	Charger	Significant investments are needed compared to the low interest of investors in providing charging stations
#7	Regulatory	Limited environmentally friendly battery options
#8	Charger	Limited charging points/battery swap stations
#9	User experience	Limited understanding of EV health and environmental benefits
#10	Technical	Limited local EV human resources/experts
#11	Charger	Undesirable/unsafe locations for users (women, disabled, etc.)

Participants were also asked to suggest other perceived challenges not on the list.

**Table 54. Key Challenges Associated with the Implementation of EV in General as Identified by Stakeholders**

Rank	Other challenges	Votes
#1	Social awareness of EV benefits, public interest in transitioning to EVs	5
#2	Battery lifetime	2
#3	Long duration of charging	1
#3	Diversification of battery swap EVs	1
#3	Untested technology	1

From the perspective of E-bus implementation, the following are some challenges identified by participants.

**Table 55. Key Challenges Associated with the Implementation of E-Bus as Identified by Stakeholders**

Rank	Answers	Votes
#1	Low demand / low interest to use public transport	9
#2	Accessibility constraint/need for first- or last-mile connectivity	8
#3	Road infrastructure constraint (too narrow, connectivity, etc.)	6

#4	High OPEX and CAPEX vs. limited investments	5
#5	Limited charging infrastructure, depot, and terminals	3
#6	Operational consideration	2

Understanding key policy strategy to address challenges in implementing EV

During this session, participants were presented with several policy measures identified as initial findings of the study. These policy measures include both fiscal and non-fiscal categories of policy. Participants then were asked to select up to four most preferred policies when considering the following conditions:

Condition 1 - the most effective fiscal policy

Condition 2 – the most economic fiscal policy

Condition 3 – the most effective non-fiscal policy

Condition 4 – the easiest to implement of non-fiscal policy

Through this process, the top 5 most applicable policies for each fiscal and non-fiscal category were identified, and they are summarized below.

**Table 56. Top 10 of Most Selected Policies Through Prioritization With Stakeholders**

Category	Rank	Policy
Fiscal	#1	Subsidy to purchase EVs for specific EV models for low- and middle-income groups
	#2	Review of subsidy to petrol to support EV transition
	#3	Incentive for R&D and technical support for retrofitting of E-passenger car
	#4	Subsidy to compensate for free parking and free toll road
	#5	Incentives for environmentally friendly EV R&D
Non-Fiscal	#1	More aggressive social campaigns for public awareness of using EV
	#2	Setting end date of fossil-fuelled vehicle sale
	#3	Mandating charging point installations at new developments/toll roads/government offices
	#4	Setting a minimum quota for EV sales for producers/importers
	#5	G2B or B2B initiatives in establishing private businesses that bring charging stations/battery swap stations as the benefit

Besides the above policy, participants were also openly asked to introduce other potential policies, which are listed as follows.

- ICE to EV trade-in policy
- Subsidy for government staff for EVs
- Free public EV parking/ battery swaps
- R&D incentive for very Ultra-Fast Charging

### 5.3.2 In-Depth Understanding of Policy Implementation

During this session, participants were split into four groups, each consisting of up to 8 participants, to form a round table focus group discussion:

- Group 1: Dishub, Bappeda
- Group 2: MTI, Puspadi, Dishub, Bappeda
- Group 3: WRI, Dishub, Bappenas, IESR
- Group 4: Academia - Bali Land Transportation Polytechnic

Each group was assigned to select the two most preferred policies from the list of top 10 policies identified in the previous session, then to identify the likelihood implementation plan of the policy from the perspective of the following:

- Who is the key enabler(s) of such policy
- Where is the source of funding for such a policy
- What could be the implementation timeline: i.e., short-, medium- or long-term, and at once or gradually

The following summarizes the policies selected and discussed by the focus groups in order of the most chosen policies among the four groups.

**Table 57. Top 5 Most Selected Policies Through Focus Group Discussion With Stakeholders**

Policy	Explanation
<b>Policy #1: More aggressive social campaigns for public awareness of using EV</b>	<p>Three (3) groups were recorded to opt for this policy as the most preferred policy to accelerate EV implementation. When discussed in the previous session, this policy appeared to be the most economical and effective action. This is seen from the perspective of ease of implementation, the investment required to implement the policy, and addressing the current key driver issue of EV implementation.</p> <p>Such social campaigns were discussed to address public awareness of the actual benefits of EVs from an operational saving perspective, potential promotional or subsidy packages from the government or industry players, other information related to the progress of implementing the charging ecosystem, and so forth.</p>
<b>Policy #2: Reviewing petrol subsidy amount to support for transition to EV</b>	<p>Two (2) groups were recorded to opt for this policy as the most preferred policy to accelerate EV implementation. When discussed in the previous session, this policy appeared to be the most economical and effective action. This is viewed from the perspective of ease of implementation, the investment required to implement the policy, and addressing the current key driver issue of EV implementation.</p>
<b>Policy #3: Setting end date of fossil-fuelled vehicle sale</b>	<p>This policy is meant to regulate the sale of fossil-fuelled (ICE) vehicle sales to end within a specific timeline. In global practice, some cities/ countries have committed to ending ICE vehicle sales by 2030 or 2040. This means that by such a year, no new ICE will be sold on the market. This policy does not intend to dismiss all ICEs on the roads so that ICEs may remain in operation. In a more stringent case, implementing the operational age of the vehicles (for example, LTA Singapore limits the age of cars using higher taxes for cars beyond ten years old) may help control the number of (old) vehicles running on the roads. Hence, the regeneration of car models and technology on the roads.</p>

Policy	Explanation
<b>Policy #4: Subsidy to purchase EVs for specific models and low- and middle-income groups</b>	Whilst this policy is meant to address the issue of the high capex required for users to purchase a new EV, it is also meant to target a specific category of vehicles and support certain users who are low- and middle-income groups. Setting such a strategy for this policy may maintain the effectiveness of the policy to overcome the high price of EVs while limiting the subsidy recipients to certain groups.
<b>Policy #5: Subsidy to compensate for free parking / free toll road for EV users</b>	This policy is meant to allow higher benefits for EV users, hence increasing the attractiveness of purchasing an EV. EV users will have the advantage of free parking at certain developments and free toll road charges. This policy will require a subsidy to the development and toll road operator to compensate for the operational cost of parking facilities and toll road infrastructures.

## 5.4 Implementation Plan For Selected Policy

### 5.4.1 Qualitative Assessment of Selected Policy

Based on the screening process of the most preferred policy to identify the most suitable one from the stakeholder perspective, the top 10 policy priorities are selected and assessed in terms of what, how, who, where, and when they are to be implemented.

To begin with, the following Table 58 summarizes the list of the top 10 policies, and with indicating the category (Fiscal or Non-Fiscal) and the priority of implementation (#1-10).

Identification of priority level #1-5 (top-5 priority) is based on the feedback received along with the stakeholder consultation, while of priority level #6-10 is based on considering the following initial assessment to understand:

- complexity of the implementation (low/moderate/high), and
- potential cost of implementation (negligible/low/moderate/high)

A policy with 'Low' complexity and 'Negligible' cost will be prioritized more than one with 'Moderate' complexity or cost.

The complexity and cost of implementation are based on the common understanding of how difficult the effort is to implement or how much cost is needed to implement the policy. However, defining inputs to these contexts is subject to further discussion and the purpose is mainly to guide policymakers in setting the priority level of these policies.

**Table 58.** Initial Assessment of the Top 10 Priorities of Policy Introduced to Support the EV Implementation

Strategic theme	Policy description	Type	Priority (1-10)	Complexity in implementation*	Cost of implementation*
<b>(S-01) Government strategic and political commitment</b>	Setting end date of fossil-fuelled vehicle sale	NF (non-fiscal)	#3	Moderate	Negligible

<b>(S-02) Financially viable EV investment</b>	Reviewing petrol subsidy amount to support for transition to EV	F (Fiscal)	#2	High	Negligible
	Subsidy to purchase EVs for specific models and low- and middle-income groups	F	#4	Moderate	Significant
	Subsidy to compensate for free parking/ free toll road for EV users	F	#5	Low	Moderate
<b>(S-03) High availability of charging points</b>	Mandating charging point installations at new developments/ toll roads/ government offices/ public facilities	NF	#6	Low	Significant
	Initiatives in establishing private businesses that bring charging stations/ battery swap stations as the benefit	NF	#7	Low	Negligible
<b>(S-04) Campaigns and awareness</b>	More aggressive social campaigns for public awareness of using EV	NF	#1	Low	Low
<b>(S05) Socially equitable transition</b>	Incentive and technical support for R&D in retrofitting of E-passenger car	F	#9	Moderate	Moderate
	Incentives for R&D for environmentally friendly EVs, technology for cheaper battery cost, safe production, and sustainable	F	#10	Moderate	Moderate
	Setting a minimum quota for EV sales for producers/importers	NF	#8	Moderate	Negligible

\*) Definitions

- Negligible is the least cost implication. Any cost involved may be due to administrative purpose to support this.
- Low is the second least cost implication, where the implementation may need certain amount of budget. E.g. social campaign.
- Moderate may consider meaningful amount of cost implication, but not significant. Example of this can be small subsidy amount.
- High / Significant may consider very meaningful amount of cost implication such as more aggressive subsidy to purchase E4W.

### 5.4.1 Policy Implementation Details and Plan

Careful consideration must be given to designing the details, mechanisms, and timeline for implementing the identified policies.

This section provides a more descriptive definition of the policies set above, including potential key enablers, source of funds, target nominal/ amount/ quantum affected by the policies, and the proposed implementation timeline.

Nominal/ quantum introduced for each of following policies is based on how the Cost-Benefit Ratio expect to increase for Moderate- and Ambitious-Scenario, compared to the BAU scenario, which reflect the impact of increase EV projection for 2040 for both scenarios.

It is important to note that, in principle, implementation of these policies is expected to be in place before the effect of the target setting of EV deployment is set in the previous chapter for 2025, 2030, and 2040.

<b>Priority Policy #1: More aggressive social campaigns for public awareness of using EV</b>	
<p>Social campaigns for public awareness of using EVs are meant to enable public access to several pieces of information, including:</p> <ul style="list-style-type: none"> <li>• understanding the actual benefit of EV from an operational saving perspective</li> <li>• potential promotional or subsidy packages from government or industry player</li> <li>• other information related to the progress of implementation of the EV ecosystem, such as charging stations and so forth.</li> </ul> <p>Media involved in such social campaigns can vary from digital to analog.</p>	
Key enabler(s)	<p>The central government, local government, and private.</p> <p>The Ministry of Energy and Mineral Resources (ESDM) and PLN will drive this at the national level. Nonetheless, local government involvement is pivotal in boosting such campaigns to the downstream district level, where, in this case, the roles of the Bali Transport Agency (Dishub), Bali Regency Government (Bappeda), and PLN Bali are pivotal.</p> <p>In addition, private participation to enable this policy can be done by APMs (Vehicle Distributor Companies) and other CSR efforts of various private industry players associated with EV / charging components products.</p>
Source of fund (if applicable)	Sources of funds for implementing this include the Regional Government Budget (APBD) and the National Government Budget (APBN)
Target nominal	<p>2024-2035: IDR 50 million / year</p> <p>2036-2040: reduce by half</p>
Implementation Timeline	Policy for the social campaign was identified to be urgent; hence, it is expected to be executed as immediately as possible and to continue in the medium-term (2035) and long-term (2040).

<b>Priority Policy #2: Reviewing petrol subsidy amount to support for transition to EV</b>	
<p>A policy to review the amount of subsidies applied to petrol is expected to affect the increase in fuel prices. Hence, the gain from reducing the subsidy can be used to address the need to transition to EVs. The positive effects of this policy on the EV ecosystem include the following:</p> <ul style="list-style-type: none"> <li>• Enabling a subsidy amount to be shifted to support EVs, e.g., to enable charging points, subsidy for free parking/ free toll road for EVs, etc</li> <li>• Higher price of gasoline means higher opex of fossil-fuelled vehicles, hence higher savings if users shift to using EV</li> <li>• Alignment with the expectation to reduce GHG emissions at the national and regional levels.</li> </ul> <p>However, as this will affect the broader economic environment, this policy should be implemented gradually and carefully.</p>	

### Priority Policy #2: Reviewing petrol subsidy amount to support for transition to EV

Key enabler(s)	<p>Central government and local government.</p> <p>At the national level, the Ministry of Finance, Ministry of Energy and Mineral Resources, Bappenas, and Pertamina are notably the most influential institutions associated with enabling this policy.</p> <p>The Bali Provincial Government (Bappeda) also has a potential influence at the regional level on enabling such a policy.</p>
Source of fund (if applicable)	The fund activity associated with such subsidy review is suggested to be regulated along with the National Government Budget (APBN), but it may also be controlled through Regional Revenue (APBD)
Target nominal	<p>By 2024: Fuel price to increase by 15% (to drive the effect in 2025)</p> <p>By 2028: Fuel price to increase by 35% (to drive the impact in 2030)</p> <p>By 2038: Fuel price to increase by 75% (to drive the effect in 2045)</p>
Implementation Time-line	The policy for subsidy review of gasoline is one of the key driving factors for a successful transition to EVs. Hence, implementation of this policy should be as immediate as possible. However, in considering the broader impact on the economy, the implementation can be applied gradually at the suggested amount and period above.

### Policy #3: Setting end date of fossil-fueled vehicle sale

This policy regulates the sale of fossil-fueled (ICE) vehicle sales to end within a specific timeline. In global practice, some cities/ countries have committed to ending the sale of ICE vehicles by 2030 or 2040 (see figure below). This means no new ICE will be sold on the market by a year.

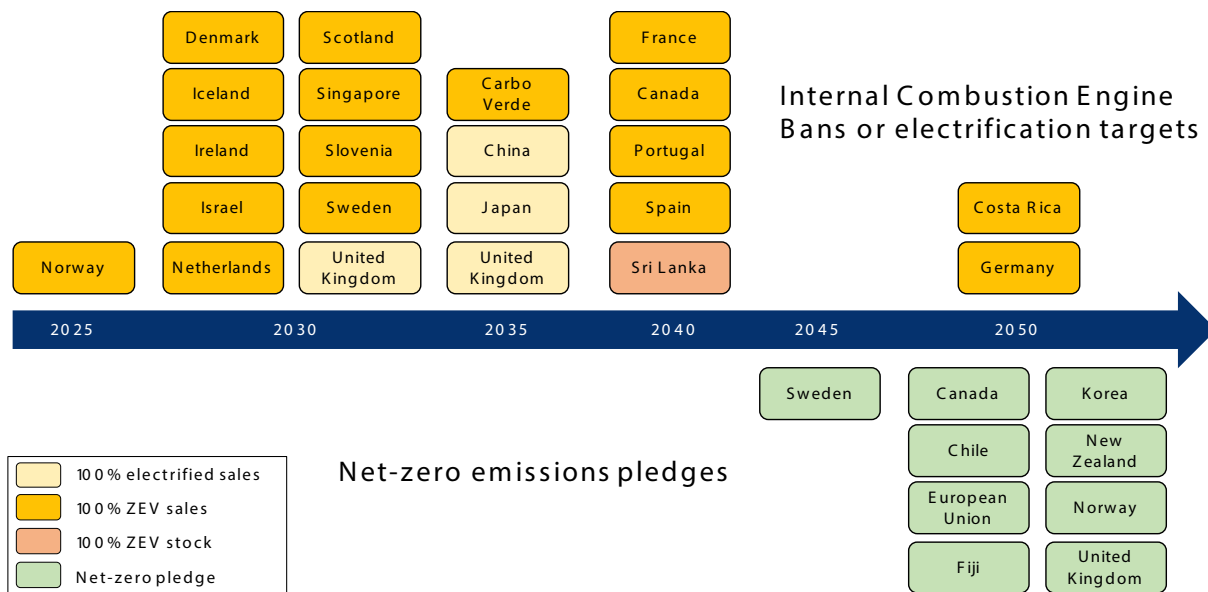


Illustration of the end date of ICE sales / 100% BEV sales set in other countries

Source: GIZ, 2022. Climate Finance for Carbon Neutrality in Thailand

This policy does not intend to dismiss all ICEs on the roads so that ICEs may remain in operation. In a more stringent case, implementing the operational age of the vehicles (for example, LTA Singapore restricts the age of cars using higher taxes for cars beyond ten years old) may help control the number of (old) vehicles running on the roads. Hence, the regeneration of car models and technology on the roads.

### Policy #3: Setting end date of fossil-fueled vehicle sale

Key enabler(s)	<p>Central government</p> <p>This policy was perceived to be influenced by the central government, which may include the Ministry of Energy and Mineral Resources (ESDM) and the Ministry of Industry.</p>
Source of fund (if applicable)	<p>Implementing this policy does not require budgeting. However, it may require specific commitment from policymakers and industry players, including the Ministry of Industry, the Ministry of Transport (General Directorate of Road Transport), and car manufacturers and their associations.</p>
Target figure	<p>By 2040, the target is 100% sales of BEV for passenger cars and buses.</p>
Implementation Timeline	<p>This policy is essential to ensure the government and society's commitment to future net zero and carbon reduction. Careful consideration is needed to set the proper timeline when Indonesia is ready for the 100% sale of BEVs for passenger cars and buses.</p> <p>Then, gradual implementation can ensure the trajectory of the targeted timeline.</p>

### Priority Policy #4: Subsidy to purchase EVs for specific models and low- and middle-income groups

While this policy is meant to address the issue of the high capex required for users to purchase a new EV, it is also meant to target a specific category of vehicles and support certain users who are low- and middle-income groups. Regarding other mechanisms, such a subsidy could also consider specific EV models where the manufacturer cost is reasonably cheaper than the average model.

Such mechanisms are expected to effectively address the objective of overcoming the high purchase cost of EVs while limiting the subsidy recipients to specific groups and particular models.

Key enabler(s)	<p>Central government</p> <p>This policy was suggested to be driven by the central government, which may include the Ministry of Finance and the Ministry of Industry. This is due to a certain amount of fiscal capability that needs to be considered in determining the appropriate amount and detailed implementation mechanisms of this policy.</p> <p>In addition, implementing this policy may require particular collaboration with EV manufacturers or distributor companies (G2B), which mainly aligns with the expectation of making specific models available in the market.</p>
Source of fund (if applicable)	<p>The National Government Budget (APBN) plays a pivotal role in the success of this policy's implementation. The amount of the subsidy required for this policy relies heavily on the fiscal capability of the central government budget.</p>

Target figure	<p>Identifying the appropriate figure for this subsidy amount should also be looked at from the fiscal availability perspective. However, setting the right amount could also be seen from the proportion of the total purchase cost of EVs. In a few countries, the subsidy amount (or could be in the form of a tax rebate) ranges from 15-30% of the total purchase amount of the car.</p> <p>In the case of Indonesia, we could assume 5% of the total initial cost. Assuming an EV model has a market price of IDR 500 million, such a subsidy amount would be IDR 25 million. In the longer term, this subsidy would reduce along with the growing market of EVs.</p> <p>By 2024: Subsidy of IDR 25 million (to drive the effect in 2025), limited to 10% of E4W sales</p> <p>By 2028: Subsidy of IDR 20 million (to drive the impact in 2030), limited to 10% of E4W sales</p> <p>By 2038: Subsidy of IDR 10 million (to drive the effect in 2040), limited to 10% of E4W sales</p>
Implementation Timeline	It was suggested that this policy be executed gradually and considered along with the subsidy shift from gasoline to support the transition to EVs.

### Priority Policy #5: Subsidy to compensate for free parking / free toll road for EV users

This policy is meant to provide higher benefits for EV users and, hence, increase the attractiveness of purchasing EVs. EV users will benefit from free parking at certain developments and free toll road charges, for example, throughout the working days. This policy will require subsidies to development and toll road operators to compensate for the cost associated with the operational cost of parking facilities and toll road infrastructures.

Key enabler(s)	<p>Local government</p> <p>Free Parking: Province government plays the role as enabler &amp; providing recommendation to enable free parking. Then Regency / Municipal Government under Gead of Regency / Head of Municipality hold the decesion role in executing such recommendation to parking however the decision level is in each head of Regencies/ city.</p> <p>Free Toll Raod: National government through the Toll Road Regulator Body (BPJT) plays the key enabler role providing recommendation of free toll road charge.</p> <p>At central government, key enabler for this policy can also consider Ministry of Public Work and Housing.</p>
Source of fund (if applicable)	Regarding the source of funds for this policy, the Regional Government Budget (APBD) plays a pivotal role in the success of the implementation of this policy.
Target figure	<p>When setting the target figure for this policy, some assumptions about toll roads and parking expenses in Bali must be made.</p> <p>Generally, the following toll road and parking expenses are assumed to apply for daily commuting trips during working days. In this instance, it is assumed that each EV unit considers making two-way daily trips with multiple parking activities for budgeting purposes.</p> <p>Compensation for free toll road and free parking: IDR 6,000 / day (E4W); IDR 3,000 / day (for E2W)</p>
Implementation Timeline	It was suggested that this policy be executed gradually in stages, from short to medium to long term, with regular review to monitor its effectiveness.

### Priority Policy #6: Mandating charging point installations at new developments/toll roads/government offices/public facilities

Ensuring the availability of charging infrastructure requires broad effort from public and private entities, including central government, municipalities, agencies, operators, and private developers. To govern the EV ecosystem, mandating the installation of charging stations in public facilities, including toll road rest areas and government offices, is seen to be the critical step in initiating the broader use of EVs, hence the more comprehensive implementation of charging stations.

Key enabler(s)	<p>Local government and private developer (for new building)</p> <p>This policy requires strong support from the Bali province government (Bappeda Bali), the Bali Transport Agency (Dishub Bali), Public Works Agency (Dinas PUPR), Labour Energy and Mineral Resources Agency (Dinas Naker ESDM, for implementation in public areas. At execution level, this may require strong decision under Provincial Government (Pemda), Regencial and City Government (Pemkab and Pemkot).</p> <p>This policy will initiate private developer participation by mandating the installation of charging stations for new public buildings such as hotels, apartments, condos, malls, and certain-scale shopping centers.</p>
Source of fund (if applicable)	<p>There is no specific fund associated with this policy. However, this policy may require the participation of toll road operator(s) and government office, which, in this case, the fund is to tap into the Regional Government Budget (APBN). As for the new development, a private developer must consider the additional costs to enable the charging feature at a new development.</p>
Target figure	<p>Cost per SPKLU (ultrafast 180kW): IDR 1.5 billion per unit</p> <p>Cost per SPKLU (fast 50kW): IDR 800 million per unit</p> <p>Cost per SPBKLU (7 slots): IDR 190 million per unit</p>
Implementation Time-line	<p>Implementation of this policy is best, along with the effort to make EV cars more affordable and the subsidy to purchase EVs for specific groups and particular models. In this case, it is seen that implementation of this may start immediately from 2024.</p>

### Priority Policy #7: Initiatives in establishing private businesses that bring charging stations/battery swap stations as a benefit

This policy is to be seen as another form of effort to support the success of the implementation of PP#6 above. The policy requires the establishment of a range of potential business models accounting for the following options:

- PPP for procurement of massive charging deployment
- Franchising for charging installation and O&M
- Contractual term for charging station O&M
- Through grant as G2G collaboration

Key enabler(s)	<p>This policy requires private sector participation, including from developers, charger vendors, and operators. This can be done through various business models, including PPP, franchise, contractual-term, or other forms.</p>
Source of fund (if applicable)	<p>Private and partly public.</p>
Target figure	<p>This is subject to further Feasibility Study to analyze potential forms of business model, and opportunity cost and benefit can be achieved in establishing collaboration with private sector.</p>
Implementation Time-line	<p>This effort should be implemented immediately until the EV ecosystem is widely growing.</p>

### Priority Policy #8: Setting a minimum quota for EV sales for producers/importers

This policy addresses the vision of having a higher market sale share of E2W and E4W. In Indonesia, by the end of 2023, Gaikindo Wholesale data of sales of passenger cars (Sedans, Vans, and SUVs) indicates that the market sale share of EVs was nearly 3%. In the future, along with all other efforts to contribute to Net Zero Emissions (NZE) by 2060, this policy expects to set the minimum proportion of sales of BEVs by car producers and importers.

This policy works in conjunction with PP#3 and PP#4, as described previously.

Key enabler(s)	It was suggested that the central government, which may include the Ministry of Energy and Mineral Resources (ESDM) and the Ministry of Industry, influence this policy.  In the implementation, this policy will impact vehicle producers, importers, and their associations.
Source of fund (if applicable)	Implementing this policy does not require budgeting. However, it may require specific commitment from policymakers and industry players, including the Ministry of Industry, the Ministry of Transport (General Directorate of Road Transport), and car manufacturers and their associations.
Target figure	By 2025: 10% market sales share for EV  By 2028: 25% market sales share for EV  By 2038: 90% market sales share for EV
Implementation Timeline	Similar to PP#4, this policy will reflect the government and society's commitment to future net zero and carbon reduction. Careful consideration is needed to set the proper timeline for when the industry is ready to commit to a specific target.  Gradual implementation can be applied to ensure the trajectory towards the targeted timeline.

### Priority Policy #9: Incentive and technical support for retrofitting of E-passenger car

This policy is intended to enable an alternative solution for more affordable EVs, hence better accessibility for certain economic groups to purchase EVs. In addition, this policy is also expected to promote wider home industries for EV retrofitting, thus increasing the utilization of human resources and local mineral sources in building a cheaper EV product.

From the technical and safety perspective, in addition to a number of incentives, this policy will require the establishment of guidelines and standards to produce safe and high-quality EVs.

Key enabler(s)	At the national level this includes the Ministry of Energy and Mineral Resources (ESDM), the Ministry of Industry, the Ministry of Transport, Coordinating Ministry for Maritime and Investment Affairs (Kemenkomarves), Ministry of Research and Technology and Ministry of Finance.  This will also require participation from home industry players, academia, and potentially transport operators in the application.
Source of fund (if applicable)	This policy will rely on the National Government Budget (APBN) and the Regional Government Budget (APBD).
Target figure	IDR 50 million per E4W unit for producing an affordable retrofitted E4W  By 2025: Subsidy budget for 2,000 units of retrofitted E4Ws  By 2030: Subsidy budget for 5,000 units of retrofitted E4Ws  By 2038: Subsidy budget for 20,000 units of retrofitted E4Ws
Implementation Timeline	This policy should be implemented immediately to enable an alternative solution for more affordable EVs until the technology is well-established in the global market. This will be reflected in more affordable EV pricing in the markets.

### Priority Policy #10: Incentives for R&D for environmentally friendly EVs, technology for cheaper battery cost, safe production, and sustainable

This policy is expected to support better technology for the EV ecosystem. Incentives allow industry players, including home industries, academia, local battery manufacturers, and local charging station vendors, to research and develop more sustainable EV and charging technology.

Key enabler(s)	At the national level, this includes the Ministry of Energy and Mineral Resources (ESDM), the Ministry of Industry, the Ministry of Transport, Coordinating Ministry for Maritime and Investment Affairs (Kemenkomarves), Ministry of Research and Technology and Ministry of Finance.  This will also require participation from home industry players, academia, and potentially transport operators in the application.
Source of fund (if applicable)	This policy will rely on the National Government Budget (APBN) and the Regional Government Budget (APBD).
Target figure	By 2024: R&D budget for sustainable EV ecosystem of IDR 1 billion/year  By 2026: R&D budget for sustainable EV ecosystem of IDR 500 million/year  By 2036: R&D budget for sustainable EV ecosystem of IDR 200 million ear
Implementation Timeline	To promote the better growth of the EV ecosystem, this policy should be implemented immediately until the technology is well established in the global market, which will be reflected through more affordable EVs in the markets and higher availability of charging on the roads.

#### 5.4.2.1 Other soft policy measures for consideration

- Continue aligning reflection of EV for National Medium Term Development Plan (RPJMN) 2025-2029 through incorporating target setting and policy in such planning document.
- Review the technical standard requirements for charging facilities favorable to business investment (e.g., adopt the most relevant plug-in).
- Safe environment design consideration at the charging point.
- Review of Local Component Requirement (TKDN) rate for tax rebate.

## 5.5 Summary of Policy Implementation Plan

This section outlays the implementation plan of the priority policies over the short, medium, and long term, respectively, for the Moderate and Ambitious scenarios. For the Moderate scenarios only policies at Bali Provincial level to be implemented. For Ambitious Scenario all policies at both Central and Bali Provincial Governments levels are assumed to be implemented.

## 5.5.1 Implementation Plan for Moderate Scenario – Implementation of Policies that Bali Provincial Government is Able to Initiate Without Influence From Central Government

Timeline*	Short-term (2025) Policy to be in effect by 2024	Medium-term (2030) Policy to be in effect by 2028	Long-term (2040) Policy to be in effect by 2038	Category: F - Fiscal NF - Non-Fiscal	Remarks
Target  Priority Policy (PP#)	<ul style="list-style-type: none"> <li>E2W pop. share of 3%</li> <li>E4W pop. share of 2%</li> <li>E-Bus deployment 40 units</li> <li>Charging points ratio of 1:30</li> <li>GHG reduction target by 38.6%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 8%</li> <li>E4W pop. share of 6%</li> <li>E-Bus deployment of 90 units</li> <li>Charging points ratio of 1:35</li> <li>GHG reduction target by 50%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 30%</li> <li>E4W pop. share of 30%</li> <li>E-Bus deployment of 180 units</li> <li>Charging points ratio of 1:50</li> <li>GHG reduction target by 90%</li> </ul>		
<b>PP#1: More aggressive social campaigns for public awareness of using EV</b>	Utilization of IDR 50 million/ year for massive social campaigns associated with EV use	Utilization of IDR 50 million/ year for massive social campaigns associated with EV use <i>(subject to review from past year implementation)</i>	By 2039, utilization of IDR 25 million/ year for massive social campaigns associated with EV use <i>(subject to review from past year implementation)</i>	<b>F</b>	<b>Key enablers:</b> at the National level, the Ministry of Energy and Mineral Resources (ESDM) and PLN are pivotal; at the regional level, the Bali Transport Agency (Dishub Bali), the Bali Regency Government (Bappeda), and PLN Bali are pivotal; and in the private sector, automobile associations (APM) and CSR functions for vehicle manufacturers and importers may be involved.
<b>PP#2: Reviewing petrol subsidy amount to support for transition to EV</b>	Not applicable for Moderate Scenario as this will be initiated at Central Government level	Not applicable for Moderate Scenario as this will be initiated at Central Government level	Not applicable for Moderate Scenario as this will be initiated at Central Government level	<b>F</b>	<b>Key enablers:</b> At the national level, the Ministry of Finance, the Ministry of National Development (Bappenas), and the National Oil and Gas Corporation (Pertamina) have potential influence in enabling such a policy. At the regional level, the Bali Provincial Government (Bappeda) also has potential influence. <b>Other Policy enablers:</b> PP#3 and PP#4 work in conjunction with this policy
<b>PP#3: Setting end date of fossil-fueled vehicle sale</b>	Not applicable for Moderate Scenario as this will be initiated at Central Government level	Not applicable for Moderate Scenario as this will be initiated at Central Government level	Not applicable for Moderate Scenario as this will be initiated at Central Government level	<b>NF</b>	<b>Key enablers:</b> Central government, which may include the Ministry of Energy and Mineral Resources (ESDM) and Ministry of Industry. <b>Other Policy enablers:</b> PP#4 and PP#8 work in conjunction with this policy

Timeline*	Short-term (2025) Policy to be in effect by 2024	Medium-term (2030) Policy to be in effect by 2028	Long-term (2040) Policy to be in effect by 2038	Category: F - Fiscal NF - Non-Fiscal	Remarks
Target  Priority Policy (PP#)	<ul style="list-style-type: none"> <li>E2W pop. share of 3%</li> <li>E4W pop. share of 2%</li> <li>E-Bus deployment 40 units</li> <li>Charging points ratio of 1:30</li> <li>GHG reduction target by 38.6%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 8%</li> <li>E4W pop. share of 6%</li> <li>E-Bus deployment of 90 units</li> <li>Charging points ratio of 1:35</li> <li>GHG reduction target by 50%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 30%</li> <li>E4W pop. share of 30%</li> <li>E-Bus deployment of 180 units</li> <li>Charging points ratio of 1:50</li> <li>GHG reduction target by 90%</li> </ul>		
<b>PP#4: Subsidy to purchase E4W for specific models and low- and middle-income groups</b>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<b>F</b>	<p><b>Key enablers:</b> At the national level, this includes the Ministry of Finance and the Ministry of Industry. In addition, it requires collaboration with EV manufacturers or importers to align the expectations for certain models available in the market.</p> <p><b>Other Policy enablers:</b> PP#3 and PP#8 work in conjunction with this policy</p>
<b>PP#5: Subsidy to compensate for free parking/ free toll road for EV users</b>	<p>In 2023-2025: Compensation for free toll road + free parking of:</p> <ul style="list-style-type: none"> <li>- IDR 6,000/day/E4W unit;</li> <li>- IDR 3,000/day/ E2W unit</li> </ul>	<p>In 2026-2030: Similar compensations for subsidy to continue, with the amount subject to evaluation of effectiveness and alignment with the applicable toll road and parking tariffs</p>	<p><b>In 2030 onwards:</b> Implementation of this subject to evaluate the effectiveness</p>	<b>F</b>	<p><b>Key enablers:</b> at the local government level, including the Bali transport agency (Dishub Bali), and with collaboration with developers and associated toll road operators.</p>

Timeline*	Short-term (2025) Policy to be in effect by 2024	Medium-term (2030) Policy to be in effect by 2028	Long-term (2040) Policy to be in effect by 2038	Category: F - Fiscal NF - Non-Fiscal	Remarks
Target  Priority Policy (PP#)	<ul style="list-style-type: none"> <li>E2W pop. share of 3%</li> <li>E4W pop. share of 2%</li> <li>E-Bus deployment 40 units</li> <li>Charging points ratio of 1:30</li> <li>GHG reduction target by 38.6%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 8%</li> <li>E4W pop. share of 6%</li> <li>E-Bus deployment of 90 units</li> <li>Charging points ratio of 1:35</li> <li>GHG reduction target by 50%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 30%</li> <li>E4W pop. share of 30%</li> <li>E-Bus deployment of 180 units</li> <li>Charging points ratio of 1:50</li> <li>GHG reduction target by 90%</li> </ul>		
<b>PP#6: Mandating charging point installations at new developments/toll roads/government offices</b>	<p>By 2024:</p> <p>Implementation of:</p> <ul style="list-style-type: none"> <li>- total up to 54 SPKLU for Medium (22kW) to Ultrafast (150kW) type; and</li> <li>- up to 6,500 units of SPBKLU (Assuming 60-80% of EV users also rely on home charging)</li> </ul>	<p>By 2028:</p> <p>Implementation of:</p> <ul style="list-style-type: none"> <li>- total up to 260 SPKLU for Medium (22kW) to Ultrafast (150kW) type; and</li> <li>- up to 15,000 units of SPBKLU (Assuming 60-80% of EV users also rely on home charging)</li> </ul>	<p>By 2038:</p> <p>Implementation of:</p> <ul style="list-style-type: none"> <li>- total up to 520 SPKLU for Medium (22kW) to Ultrafast (150kW) type; and</li> <li>- up to 35,000 units of SPBKLU (Assuming 60-80% of EV users also rely on home charging)</li> </ul>	NF	<p><b>Key enablers:</b> At the local government level, the Bali province government (Bappeda Bali) and the Bali transport agency (Dishub Bali) should be included in implementing those in public areas. From the private sector to mandate private developer participation in relevancy with new public buildings such as hotels, apartments, condos, malls, particular scale of shopping centers).</p> <p><b>Other policy enablers:</b> This policy may work better in conjunction with effort in PP#7</p> <p><b>Other information - Estimated price of charging stations:</b>  SPKLU (ultrafast 180kW): IDR 1.5 billion per unit  SPKLU (fast 50kW): IDR 810 million per unit  SPBKLU (7-battery slot): IDR 190 million per unit</p>
<b>PP#7: Initiatives in establishing private businesses that bring charging infrastructures as a benefit</b>	<p><i>Further benefit to investment cost impact to be calculated in a separate Feasibility Study of Business Model for public charging procurement</i></p>	<p><i>Further benefit to investment cost impact to be calculated in a separate Feasibility Study of Business Model for public charging procurement</i></p>	<p><i>Further benefit to investment cost impact to be calculated in a separate Feasibility Study of Business Model for public charging procurement</i></p>	NF	<p><b>Key enablers:</b> private sectors, including developers, charger vendors, and operators, which can be done through various business models, including PPP, franchise, contractual-term, or other forms of models.</p> <p><b>Other policy enablers:</b> This policy works to support efforts in PP#6</p>

Timeline*	Short-term (2025) Policy to be in effect by 2024	Medium-term (2030) Policy to be in effect by 2028	Long-term (2040) Policy to be in effect by 2038	Category:	Remarks
Target	<ul style="list-style-type: none"> <li>E2W pop. share of 3%</li> <li>E4W pop. share of 2%</li> <li>E-Bus deployment 40 units</li> <li>Charging points ratio of 1:30</li> <li>GHG reduction target by 38.6%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 8%</li> <li>E4W pop. share of 6%</li> <li>E-Bus deployment of 90 units</li> <li>Charging points ratio of 1:35</li> <li>GHG reduction target by 50%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 30%</li> <li>E4W pop. share of 30%</li> <li>E-Bus deployment of 180 units</li> <li>Charging points ratio of 1:50</li> <li>GHG reduction target by 90%</li> </ul>	F - Fiscal NF - Non-Fiscal	
Priority Policy (PP#)					
PP#8: Setting a minimum quota for EV sales for producers/importers	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	NF	<p><b>Key enabler(s):</b> It was suggested that this policy be influenced by the central government, which may include the Ministry of Energy and Mineral Resources (ESDM) and the Ministry of Industry. The policy also requires the readiness of vehicle producers and importers, as well as their associations, to commit to the target setting.</p> <p><b>Other policy enablers:</b> This policy works in conjunction with <b>PP#3</b> and <b>PP#4</b>, as described previously.</p>
PP#9: Incentive and technical support for R&D in retrofitting of E-passenger car	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	F	<p><b>Key enabler(s):</b> at the national level, this includes the Ministry of Energy and Mineral Resources (ESDM), the Ministry of Industry, and the Ministry of Transport.</p> <p>In application, this will also require participation ranging from home industry players, academia, and potentially transport operators.</p> <p><b>Other information</b> – Estimated budget for R&amp;D for retrofitting E4W: IDR 50 million per E4W unit for producing an affordable retrofitted E4W</p>
PP#10: Incentives for R&D for environmentally friendly EVs, technology for cheaper battery cost, safe production, and sustainable	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	<i>Not applicable for Moderate Scenario as this will be initiated at Central Government level</i>	F	<p><b>Key enabler(s):</b> at the national level, this includes the Ministry of Energy and Mineral Resources (ESDM), the Ministry of Industry, and the Ministry of Transport.</p> <p>In application, this will also require participation from home industry players, academia, and transport operators.</p>

\*) Short-term (<5 years), Medium-term (5-10 years), long-term (> 10 years)

## 5.5.2 Implementation Plan for Ambitious Scenario – A More Aggressive Policies Implementation That Will Be Initiated By Both Bali Provincial Government and Central Government

Timeline*	Short-term (2025) Policy to be in effect by 2024	Medium-term (2030) Policy to be in effect by 2028	Long-term (2040) Policy to be in effect by 2038	Category: F - Fiscal NF - Non-Fiscal	Remarks
<b>Target</b> <b>Priority Policy</b> <b>(PP#)</b>	<ul style="list-style-type: none"> <li>E2W pop. share of 5%</li> <li>E4W pop. share of 3%</li> <li>E-Bus deployment 60 units</li> <li>Charging points ratio of 1:25</li> <li>GHG reduction target by 38.6%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 10%</li> <li>E4W pop. share of 10%</li> <li>E-Bus deployment of 120units</li> <li>Charging points ratio of 1:30</li> <li>GHG reduction target by 50%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 40%</li> <li>E4W pop. share of 305%</li> <li>E-Bus deployment of 240 units</li> <li>Charging points ratio of 1:40</li> <li>GHG reduction target by 90%</li> </ul>		
<b>PP#1: More aggressive social campaigns for public awareness of using EV</b>	Utilization of IDR 100 million/ year for massive social campaigns associated with EV use	Utilization of IDR 100 million/ year for massive social campaigns associated with EV use <i>(subject to review from past year implementation)</i>	By 2036 utilization of IDR 50 million/ year for massive social campaigns associated with EV use <i>(subject to review from past year implementation)</i>	<b>F</b>	<i>(See Moderate scenario)</i>
<b>PP#2: Reviewing petrol subsidy amount to support for transition to EV</b>	By 2025: Fuel price to increase by 30% (to drive the effect in 2026)	By 2028: Fuel price to increase by 50% (to drive the effect in 2030)	By 2038: Fuel price to increase by 80% (to drive the effect in 2045)	<b>F</b>	<i>(See Moderate scenario)</i>
<b>PP#3: Setting end date of fossil-fueled vehicle sale</b>	By 2025: 80% market sale cap on new fossil-fueled vehicle	By 2040: 50% market sale cap on new fossil-fueled vehicle	By 2040: 0% market sale cap on new fossil-fueled vehicles / 100% market sales of new BEV	<b>NF</b>	<i>(See Moderate scenario)</i>
<b>PP#4: Subsidy to purchase E4W for specific models and low- and middle-income groups</b>	By 2024: Subsidy of IDR 50 million, limited to 10% of E4W sales (to drive the effect in 2025)	By 2028: Subsidy of IDR 40 million, limited to 10% of E4W sales (to drive the effect in 2030)	By 2038: Subsidy of IDR 20 million, limited to 10% of E4W sales (to drive the effect in 2030)	<b>F</b>	<i>(See Moderate scenario)</i>
<b>PP#5: Subsidy to compensate for free parking/ free toll road for EV users</b>	In 2023-2025: Compensation for free toll road + free parking of: IDR 17,000/day/E4W unit; IDR 6,500/day/E2W unit	In 2026-2030: Similar compensations for subsidy to continue, with the amount subject to evaluation of effectiveness and alignment with the applicable toll road and parking tariffs	<b>In 2030 onwards:</b> Implementation of this subject to evaluate the effectiveness	<b>F</b>	<i>(See Moderate scenario)</i>

Timeline*	Short-term (2025) Policy to be in effect by 2024	Medium-term (2030) Policy to be in effect by 2028	Long-term (2040) Policy to be in effect by 2038	Category: F - Fiscal NF - Non-Fiscal	Remarks
<b>Target</b> <b>Priority Policy</b> <b>(PP#)</b>	<ul style="list-style-type: none"> <li>E2W pop. share of 5%</li> <li>E4W pop. share of 3%</li> <li>E-Bus deployment 60 units</li> <li>Charging points ratio of 1:25</li> <li>GHG reduction target by 38.6%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 10%</li> <li>E4W pop. share of 10%</li> <li>E-Bus deployment of 120units</li> <li>Charging points ratio of 1:30</li> <li>GHG reduction target by 50%</li> </ul>	<ul style="list-style-type: none"> <li>E2W pop. share of 40%</li> <li>E4W pop. share of 305%</li> <li>E-Bus deployment of 240 units</li> <li>Charging points ratio of 1:40</li> <li>GHG reduction target by 90%</li> </ul>		
<b>PP#6: Mandating charging point installations at new developments/toll roads/government offices</b>	<p>By 2024:</p> <p>Implementation of:</p> <ul style="list-style-type: none"> <li>total up to 107 SPKLU for Medium (22kW) to Ultrafast (150kW) type; and</li> <li>up to 1,500 units of SPBKLU</li> </ul> <p>(Assuming 60-80% of EV users also rely on home charging)</p>	<p>By 2028:</p> <p>Implementation of:</p> <ul style="list-style-type: none"> <li>total up to 360 SPKLU for Medium (22kW) to Ultrafast (150kW) type; and</li> <li>up to 8,290 units of SPBKLU</li> </ul> <p>(Assuming 60-80% of EV users also rely on home charging)</p>	<p>By 2038:</p> <p>Implementation of:</p> <ul style="list-style-type: none"> <li>total up to 725 SPKLU for Medium (22kW) to Ultrafast (150kW) type; and</li> <li>up to 39,500 units of SPBKLU</li> </ul> <p>(Assuming 60-80% of EV users also rely on home charging)</p>	NF	<i>(See Moderate scenario)</i>
<b>PP#7: Initiatives in establishing private businesses that bring charging infrastructures as a benefit</b>	<p>By 2024:</p> <p>To ensure private participation in enabling for investment cost saving for PP#6. The amount of saving to investment cost impact to be calculated in a separate Feasibility Study of Business Model for public charging procurement</p>	<p>By 2028:</p> <p>To ensure private participation in enabling for investment cost saving for PP#6. The amount of saving to investment cost impact to be calculated in a separate Feasibility Study of Business Model for public charging procurement</p>	<p>By 2038:</p> <p>To ensure private participation in enabling for investment cost saving for PP#6. The amount of saving to investment cost impact to be calculated in a separate Feasibility Study of Business Model for public charging procurement</p>	NF	<i>(See Moderate scenario)</i>
<b>PP#8: Setting a minimum quota for EV sales for producers/importers</b>	<p>By 2025:</p> <p>Minimum of 20% market sales share for EV</p>	<p>By 2028:</p> <p>50% market sales share for EV</p>	<p>By 2038:</p> <p>90% market sales share of EV</p>	NF	<i>(See Moderate scenario)</i>
<b>PP#9: Incentive and technical support for R&amp;D in retrofitting of E-passenger car</b>	<p>By 2025:</p> <p>R&amp;D budget for 2,000 units of retrofitted E4Ws</p>	<p>By 2030:</p> <p>R&amp;D budget for 5,000 units of retrofitted E4Ws</p> <p><i>(subject to evaluation and achievement of target E4W in the previous year)</i></p>	<p>By 2038:</p> <p>R&amp;D budget for 20,000 units of retrofitted E4Ws</p> <p><i>(subject to evaluation and achievement of target E4W in the previous year)</i></p>	<b>F</b>	<i>(See Moderate scenario)</i>
<b>PP#10: Incentives for R&amp;D for environmentally friendly EVs, technology for cheaper battery cost, safe production, and sustainable</b>	<p>In 2024-2025:</p> <p>R&amp;D budget for sustainable EV ecosystem of IDR 1 billion/year</p>	<p>By 2030:</p> <p>In 2026-2029:</p> <p>R&amp;D budget for sustainable EV ecosystem of IDR 500 million/year</p>	<p>By 2038:</p> <p>In 2036-2040:</p> <p>R&amp;D budget for sustainable EV ecosystem of IDR 200 million/year</p>	<b>F</b>	<i>(See Moderate scenario)</i>

\*) Short-term (<5 years), Medium-term (5-10 years), long-term (> 10 years)



## 6. HIGH-LEVEL ECONOMIC AND ENVIRONMENTAL ASSESSMENT

### 6.1 High-Level Economic Assessment

#### 6.1.1 Overview

A high-level economic assessment is performed to confirm the economic benefits of the E-Mobility Roadmap using cost-benefit analysis (CBA). The CBA calculates the potential total benefits expected from a situation or action and subtracts it from the total costs associated with that action.<sup>85</sup> In principle, CBA measures a change's efficiency or resource allocation effects. It calculates the monetized value of the gains and losses for all people affected. If the sum is positive, the benefits exceed the costs, and the proposal would increase efficiency.<sup>86</sup>

#### 6.1.2 Limitation

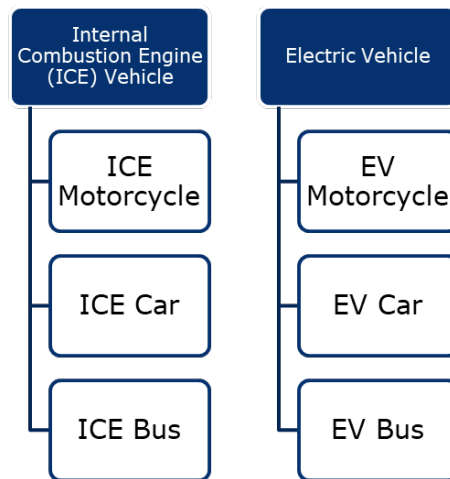
The economic assessment in this study is performed at a high level, assuming certain parameters. The extent of these parameters is highly dependent on the availability of the extent details of data. Such parameters used in this study include health data, number of vehicle data, etc.

In alignment with the extent of the E-Mobility roadmap, the economic Cost-Benefit Analysis for this study will cover three (3) modes of vehicles: motorcycles, cars, and buses. The total benefits will be observed in terms of the total benefits resulting from the change from a certain number of shifts from Internal Combustion Vehicle (ICE) use to Electric Vehicle (EV) use (see Figure 51 below).

<sup>85</sup> <https://www.investopedia.com/terms/c/cost-benefitanalysis.asp>

<sup>86</sup> The Office of Impact Analysis – Australia Government (2023). Guidance Note: Cost Benefit Analysis.

Figure 51. Vehicles Considered for CBA Calculation



Source: Consultant Analysis

Cost-benefit analysis must account for all Benefits and Costs of Direct and Indirect effects, including externalities, with valuation being as accurate as possible, reflecting the actual social costs and benefits.<sup>87</sup> Direct impacts result from factors directly associated with the industry’s production, operation, or administration under analysis. These impacts can affect consumers, producers, and regulatory bodies within the industry.

In this study, the Direct factor considered includes everything related to the purchase and use of the EV. In contrast, factors affecting the government and society, such as the health sector and the environment, are considered Indirect factors.

While the associated monetized value of implementing the roadmap encompasses both Benefits and Costs, the CBA calculation incorporates four main components: Direct Benefits, Indirect Benefits, Direct Costs, and Indirect Costs. All components will be calculated from the base year of 2023 until the projected year of 2040, adjusted with inflation. The number of vehicles projected will follow the BAU scenario.

For calculating the cost associated with the charging infrastructure, it is assumed that 80% of charging relies on Home Charging, and the remaining depends on public charging facilities (SPKLU, SPLU, and SPBKLU).

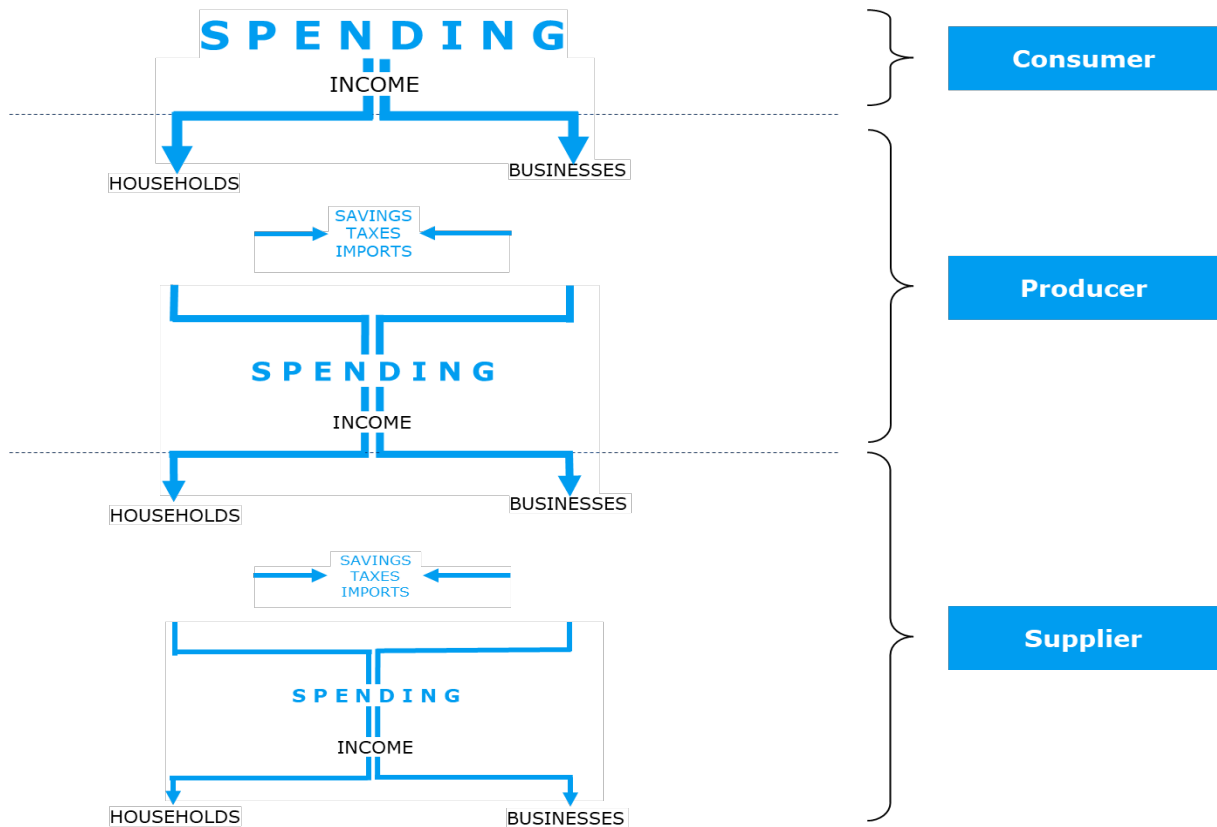
### 6.1.3 Methodology

#### Induced Economic Effect

To account for broader externalities, the induced economic impacts are calculated using the economic multiplier introduced by Keynes in 1936. A fundamental principle of Keynesian economic theory is that government policy can influence consumer behavior, leading to changes in business activity and increased spending. This, in turn, boosts aggregate output and generates more income for companies. Consequently, this process results in higher worker pay, increased supply, and greater aggregate demand. See Figure 52.

87 Quah, E. (2017) Using Cost-Benefit Analysis In Developed And Developing Countries: Is It The Same?. Macroeconomic Review, April 2017, 92-97. Singapore: Monetary Authority of Singapore

Figure 52. Illustration of the Interaction of Household Spending in the Industry Supply Chain



Source: Consultant Analysis

The shift in consumer preference from ICEVs to EVs will increase income for EV producers. As a result, EV producers will purchase more components from their suppliers and pay higher bonuses to their employees. To enhance their capacity, suppliers will invest more in machinery, raw materials, and wages, thereby increasing the income of machinery producers, raw material suppliers, and the suppliers' employees. This cycle will continue, creating a ripple effect throughout the economy. Additionally, the bonuses received by EV producers' employees will be spent on goods, services, and leisure activities, further boosting the income of the goods and services industry.

However, on the opposite of the above, decreasing sales in the EV industry would lead to a reduction in production. Hence, lower profits and diminished incomes for related businesses and their employees would further decrease consumption. This is why it is essential to calculate the induced economic impacts on both the benefit and cost sides of the Cost-Benefit Analysis (CBA).

The magnitude of the Economic Multiplier is directly related to the Marginal Propensity to Consume (MPC), which is defined as the proportion of an increase in income that gets spent on consumption. The formula for the Economic Multiplier is as follows:

$$\text{Economic Multiplier} = \frac{1}{1 - MPC}$$

Additionally, the calculation of the potential return on investing the savings from using EVs was incorporated, assuming these savings are deposited in a bank. The opportunity cost of higher spending associated with purchasing EVs increased electricity consumption, and the additional investment required for EV infrastructure are also considered.

### 6.1.4 General Economic Parameters

The following Table 59 show the general economic parameters used in the CBA calculation.

**Table 59. General Economic Parameters**

Parameter	Value (Base Year)	Source	Remarks
Inflation Rate	3.81%	BPS Bali	Average from 2013-2023
Gov Yield 15-yr	6.82%	<a href="#">Penilai Harga Efek Indonesia</a>	-
Investment rate of return	6.02%	Deposit Rate BI	Average from 2013-2023
Marginal Propensity to Consume (MPC)	0.73	Utama & Purbadharmaja (2014)	-
Economic Multiplier	3.69	Calculation	Econ Multiplier = $1/(1-MPC)$

Source: Consultant Analysis

### 6.1.5 General Component Parameters

Each of the CBA calculation components is explained in the following subsections.

#### 6.1.5.1 Direct Benefits

This subsection will identify and calculate the direct benefits of the CBA calculation. The direct benefits include:

- Decrease in Vehicle Operating Costs
- Change in Fuel Consumption Expenditures
- Change in Vehicle Tax and Administration Expenditures

#### Change in Vehicle Operation & Maintenance (OM) Expenditures

One of the direct benefits of owning an EV vehicle is the lower maintenance cost because EV vehicles have fewer moving parts than the ICE vehicle.<sup>88</sup> The formula for calculating the change in OM Expenditures is as follows:

$$\Delta \text{ Vehicle OM Expenditures} = (\text{ICE OM Expenditures} - \text{EV OM Expenditures}) \times \text{EV Population}$$

#### ***Example: for Motorcycle, BAU Scenario, Base Year 2023***

Change in Vehicle Motorcycle OM Expenditures (IDR 586,268,145) = [ICE Motorcycle OM Expenditure (IDR 291,250) – EV Motorcycle OM Expenditure (IDR 173,879)] \* EV Motorcycle Population (4,995 units)

- ICE OM Expenditure = IDR 291,250 per year
- EV OM Expenditure = IDR 173,879 per year
- EV Motorcycle Population = 4,995 units

88 <https://www.kia.com/id/discover-kia/ask/are-electric-cars-cheaper-to-maintain.html>

## Change in Fuel Consumption Expenditures

The adoption of EVs will reduce the number of ICE vehicles on the road. Subsequently, it will reduce the fuel consumption of ICE vehicles to equal the number of EVs. The formula for calculating the change in fuel consumption is as follows:

$$\Delta \text{ Fuel Consumption Expenditures} = (\text{ICE Average Fuel Efficiency} \times \text{Fuel Price and Subsidy}) \times \text{EV Population}$$

### **Example: for Motorcycle, BAU Scenario, Base Year 2023**

*Change in Fuel Consumption Expenditure (IDR 13,356,580,050) = ICE Average Fuel Efficiency (0.033 L/km) \* Vehicle Distance Travelled (7,300 km per year) \* Fuel price with subsidy considered (IDR 10,000 + IDR 1,100 per L) \* EV populations (4,995 units)*

- a. ICE Average fuel Efficiency = 0.033 L/km
- b. Vehicle Distance Travelled = 7,300 km per year
- c. Fuel Price (subsidy considered) = IDR 11,100 per L
- d. EV population = 4,995 units

## Change in Vehicle Tax and Administration Expenditures

One kind of subsidy that is being applied for EVs is vehicle tax and administration expenditures. By changing to EVs, people will save money normally spent on the more expensive ICE vehicle tax. The formula for calculating the change in vehicle tax and administration expenditures is as follows:

$$\Delta \text{ Vehicle Tax and Administration Expenditures} = [(\text{ICE Vehicle Tax} \times \text{Average ICE Vehicle Price}) - (\text{EV Tax} \times (\text{EV Price} - \text{EV Subsidy}))] \times \text{EV Population}$$

### **Example: for Motorcycle, BAU Scenario, Base Year 2023**

*Change Vehicle Tax and Administration Expenditures (IDR 895,054,050) = [(ICE Vehicle Tax (1.00%) \* Average ICE Vehicle Price (IDR 17,919,000)) - (EV Tax (0%) \* Average EV Price (IDR 24,184,286))] \* EV Population (4,995 units)*

- a. ICE Vehicle Tax = 1.00%
- b. Average ICE Vehicle Price = IDR 17,919,000
- c. EV Tax = 0%
- d. Average EV Price = IDR 24,184,286
- e. EV Population = 4.995 units

The parameters used for calculation associated with Direct Benefits above are summarized in the following Table 60.

**Table 60. Direct Benefit Parameters**

Parameter	Value (Base Year 2023)	Source	Remarks
Change in Vehicle OM Expenditures			
ICE OM Expenditures (Annual)	<ul style="list-style-type: none"> <li>ICE Motorcycles: IDR 291,250</li> <li>ICE Cars: IDR 4,330,000</li> <li>ICE Bus: IDR 12,315,421</li> </ul>	<ul style="list-style-type: none"> <li>ICE Motorcycles: ITDP 2Wheeler Study (2021); online research</li> <li>ICE Cars: online research</li> <li>ICE Buses: WB-ICCT-ITDP E-Bus Implementation in Medan &amp; Bandung (2021)</li> </ul>	Daily fuel cost, maintenance, replacement cost of various consumable and spare parts
EV OM Expenditures (Annual)	<ul style="list-style-type: none"> <li>EV Motorcycles: IDR 173,879</li> <li>EV Cars: IDR 2,585,054</li> <li>EV Buses: IDR 7,352,432</li> </ul>	<ul style="list-style-type: none"> <li>ICE Motorcycles: ITDP 2Wheeler Study (2021); online research</li> <li>ICE Cars: online research</li> <li>ICE Buses: WB-ICCT-ITDP E-Bus Implementation in Medan &amp; Bandung (2021)</li> </ul>	Daily electricity cost, system maintenance, replacement cost for tires and battery
Change in Fuel Consumption Expenditures			
ICE Average Fuel Efficiency	<ul style="list-style-type: none"> <li>ICE Motorcycles: 0.03 L/km</li> <li>ICE Cars: 0.08 L/km</li> <li>ICE Buses: 0.49 L/km</li> </ul>	Energy Transition in Indonesia and Future Mobility, Ministry of Energy and Mineral Resources Presentation 2023	
Vehicle Distance Travelled (Annual)	<ul style="list-style-type: none"> <li>Motorcycles: 7,300 km per year</li> <li>Cars: 18,250 km per year</li> <li>Buses: 87,600 km per year</li> </ul>	Energy Transition in Indonesia and Future Mobility, Ministry of Energy and Mineral Resources Presentation 2023; Bali Regional Action Plan 2023	
Fuel Price and Subsidy	<ul style="list-style-type: none"> <li>Motorcycles &amp; Cars: IDR 10,000 per L (Pertalite)</li> <li>Pertalite Subsidy: IDR 1100 per L</li> <li>Bus: IDR 6,800 per L (Subsidized Diesel)</li> <li>Diesel Subsidy: IDR 1,000 per L</li> </ul>	Pertamina <a href="https://ekonomi.bisnis.com/read/20240117/44/1732964/lengkap-daftar-harga-bbm-pertamina-shell-bp-per-17-januari-2024">https://ekonomi.bisnis.com/read/20240117/44/1732964/lengkap-daftar-harga-bbm-pertamina-shell-bp-per-17-januari-2024</a> ; <a href="https://moladin.com/blog/harga-pertalite-sebelum-subsidi-bikin-kaget/">https://moladin.com/blog/harga-pertalite-sebelum-subsidi-bikin-kaget/</a> ; <a href="https://www.cnbcindonesia.com/news/20230605164654-4-443134/subsidi-solar-2024-diusulkan-naik-hingga-rp-2000-per-liter">https://www.cnbcindonesia.com/news/20230605164654-4-443134/subsidi-solar-2024-diusulkan-naik-hingga-rp-2000-per-liter</a>	
EV Population	<ul style="list-style-type: none"> <li>EV Motorcycles: 4,995</li> <li>EV Cars: 601</li> <li>EV Buses: 10</li> </ul>	Bali Transportation Agency, Bali Regional Action Plan 2022-2026	Projection to the end of the year done by calculation for each scenario (BAU, Moderate, and Ambitious) as explained in subchapter 4.2
Change in Vehicle Tax and Administration Expenditures			

Parameter	Value (Base Year 2023)	Source	Remarks
ICE Vehicle Tax	<ul style="list-style-type: none"> <li>ICE Motorcycles: 1.00%</li> <li>ICE Cars: 1.00%</li> <li>ICE Buses: 0.30%</li> </ul>	Governor of Bali Regulation No.47/2022 about calculating the Basis for Imposition of Motor Vehicle Tax and Motor Vehicle Title Transfer Fee.	
Average ICE Vehicle Price	<ul style="list-style-type: none"> <li>ICE Motorcycles: IDR 17,919,000</li> <li>ICE Cars: IDR 278,350,000</li> <li>ICE Buses: IDR 1,500,000,000</li> </ul>	<ul style="list-style-type: none"> <li>ICE Motorcycles: ITDP 2Wheeler Study (2021); online research</li> <li>ICE Cars: online research</li> <li>ICE Buses: WB-ICCT-ITDP E-Bus Implementation in Medan &amp; Bandung (2021)</li> </ul>	
EV Tax	<ul style="list-style-type: none"> <li>EV Motorcycles: 0%</li> <li>EV Cars: 0%</li> <li>EV Buses: 0%</li> </ul>	Governor of Bali Regulation No. 47/2022 about calculating the Basis for Imposition of Motor Vehicle Tax and Motor Vehicle Title Transfer Fee.	
Average EV Price	<ul style="list-style-type: none"> <li>EV Motorcycles: IDR 24,184,286</li> <li>EV Cars: IDR 663,000,000</li> <li>EV Buses: IDR 3,599,570,000</li> </ul>	<ul style="list-style-type: none"> <li>EV Motorcycles: ITDP 2Wheeler Study (2021); online research</li> <li>EV Cars: online research</li> <li>EV Buses: World Bank-ICCT-ITDP E-Bus Implementation in Medan &amp; Bandung (2021)</li> </ul>	
EV Subsidy	<ul style="list-style-type: none"> <li>EV Motorcycles: IDR 7,000,000</li> <li>EV Cars: 10% VAT reduction</li> <li>EV Buses: n/a</li> </ul>	Ministry of Home Affairs Regulation No. 6/2023 about the Basis for Imposition of Motor Vehicle Tax, Motor Vehicle Title Transfer Fee, and Heavy Equipment Tax in 2023.	
EV Population	<ul style="list-style-type: none"> <li>EV Motorcycles: 4,995</li> <li>EV Cars: 601</li> <li>EV Buses: 10</li> </ul>	Bali Transportation Agency, Bali Regional Action Plan 2022-2026	Projection to the end of the year done by calculation for each scenario (BAU, Moderate, and Ambitious) as explained in subchapter 4.2

Source: Consultant Analysis

### 6.1.5.2 Indirect Benefits

In this subsection, the indirect benefits will be identified and calculated for the CBA calculation. The indirect benefits include:

- Pollution Cost Reduction
- Health Cost Saving
- Noise Cost Saving
- Induced Economic Benefit

## Carbon Reduction Project Revenue

The carbon reduction revenue comes from the carbon trading market now available in Indonesia, facilitated by the Indonesia Stock Exchange (IDX). Carbon trading involves buying and selling permits and credits for greenhouse gas emissions. IDX Carbon Trading Indonesia would be the platform or mechanism through which companies in Indonesia can participate in carbon trading activities to manage their emissions and comply with regulations or voluntary carbon reduction initiatives. As EVs will not emit CO<sub>2</sub> for their operation, the use of EVs will reduce the CO<sub>2</sub> emission that is supposedly produced by their ICE vehicle counterpart.

Currently in Indonesia, only EV Bus that can be accounted for the carbon trading since the current carbon market regulation dictates that the project owner (i.e. the government or corporations) must monitor diligently the carbon accounting. This can only be done to the EVs that are owned by the government, where they are listed as asset in its balance sheet. In this case the EV buses were the only vehicles that could be accounted for the carbon trading, since there are no information on how many EVs other than buses owned by the government. So to accommodate the potential carbon trading benefit that can be captured from the transition to EV motorcycle and EV cars, we assumed that 50% of EV cars and EV motorcycle sales are owned by corporations as their operational vehicles. The carbon reduction project revenue can be calculated by using the following formula:

**Carbon reduction project revenue = (Indonesia Carbon Price x ICE Buses Carbon Emission) x EV Population x Corporate Share (only for EV motorcycle and EV cars)**

### Example: for Motorcycle, BAU Scenario, Base Year 2023

Carbon reduction project revenue (IDR 70,001,474) = Indonesia Carbon Price (IDR 59,200) \* ICE Carbon Emission (0.69 tCO<sub>2</sub> per year) \* EV sales (3,463 units) \* Corporate Share (50%)

- a. Indonesia Carbon Price = IDR 59,500
- b. ICE Carbon Emission = 0.69 tCO<sub>2</sub> per year
- c. EV sales = 3,463 units
- d. Corporate Share = 50%

## Health Cost Saving

The reduction in CO<sub>2</sub> emissions due to the conversion to EV operation will decrease the health cost, causing indirect health cost savings. The Indonesian Ministry of Health focuses on collecting data on specific diseases of concern based on factors such as high incidence rates, severity, and other considerations. For diseases potentially caused by pollution, the only available data pertains to pneumonia and tuberculosis (TB).

The formula for calculating health cost savings is as follows:

**Health Cost Saving = [(Projected Reduced Number of Pneumonia Patient \* Pneumonia health cost) + (Projected Reduced Number of TB Patient \* TB health cost)]**

### Example: BAU Scenario, Base Year 2023

Health Cost Saving (IDR 5,968,680,186) = Projected Reduced Number of Pneumonia Patient (-1,426 persons) \* Pneumonia Health Cost (IDR 219,003 per person) + Projected Reduced Number of TBC Patient (2,665 persons) \* TBC Health Cost (IDR 2,351,690 per person)

- a. Projected Reduced Number of Pneumonia Patient = -1,426 person (reduction in patients according to model)
- b. Pneumonia Health Cost = IDR 219,003 per person

- c. *Projected Reduced Number of TBC Patient = 2,665 persons*
- d. *TBC Health Cost = IDR 2,351,690*

For the projected reduced number of pneumonia/TBC patients, a linear formula is regressed from the function of CO2 pollution in relation to historical patient data compiled by the Bali Statistics Bureau for several past years. After the linear formula has been obtained, the number of total reduced CO2 emissions will be plotted to the formula to obtain the number of patients that potentially will be saved from getting TBC/pneumonia. See Table 61 for the Indirect Benefit Parameters for the parameter details.

### Noise Cost Reduction

Noise Cost Reduction is calculated using reference from Ernest & Young report<sup>89</sup> where the noise cost value is estimated to be around 77,70% from the value of carbon reduction revenue.

### Induced Economic Benefit

As explained by Keynesian economics, the change in vehicle purchases, electricity consumption expenditures, and investment in EV infrastructure will create a positive economic multiplier effect. However, many components used in EV production and infrastructure development are imported. These imported components do not contribute to the Indonesian economy, as the benefits accrue to the exporting countries. Therefore, only locally sourced components are included, ensuring that the benefits circulate within the local economy by multiplying the purchase and infrastructure costs by the local content level mandated by the Indonesian government.

Additionally, the potential return on savings and additional revenues is calculated by multiplying the direct benefits, carbon reduction revenue, health cost savings, and noise cost reduction with the investment rate of return.

The formula for calculating the induced economic benefit is as follows:

**Induced Economic Benefit = Positive Economic Multiplier + Potential Return on Savings and Additional Revenues**

**Positive Economic Multiplier = Economic Multiplier x [(change in vehicle purchase + EV infrastructure cost + Battery replacement Cost) x Local Content Level + Change in Electricity Consumption Expenditures]**

**Potential Return on Savings and Additional Revenues = [(Direct benefits + Carbon Reduction Revenue + Health Cost Saving + Noise Cost Reduction) x Investment Rate of Return]**

#### Example: BAU Scenario, Base Year 2023

*Induced Economic Benefit (IDR 329,768,620,730) = [ Economic Multiplier (3.69) x (Change in vehicle purchase (IDR 196,664,684,429) + EV infrastructure cost (IDR 0) + Battery Replacement Cost (IDR 0)) x Local Content Level (40%) + Change in Electricity Consumption Expenditures (IDR 10,138,226,943)]*

*+ [ (Direct benefits (IDR 32,830,607,845) + Carbon Reduction Revenue (IDR 149,042,050) + Health Cost Saving (IDR 5,968,680,186) + Noise Cost Reduction (IDR 115,808,807)) x Investment Rate of Return (5.32%)]*

- a. *Economic Multiplier = 3.69*
- b. *Change in vehicle purchase = IDR 196,664,684,429*
- c. *EV infrastructure cost = IDR 0 (0 in 2023, started in 2024)*
- d. *Battery Replacement Cost = IDR 0 (0 in 2023, started in 2030)*
- e. *Local Content Level = 40%*
- f. *Change in Electricity Consumption Expenditures = IDR 10,138,226,943*
- g. *Direct benefits = IDR 32,830,607,845*

89 Ernst & Young (September 2020), Uncovering The Hidden Costs and Benefits from Electric Vehicles, page 6

- h. Carbon Reduction Revenue = IDR 149,042,050
- i. Health Cost Saving = IDR 5,968,680,186
- j. Noise Cost Reduction = IDR 115,808,807
- k. Investment Rate of Return = 5.32%

The parameters used for calculation associated with the Indirect Benefits above are summarized in the following Table 61.

**Table 61. Indirect Benefit Parameters**

Parameter	Value (Base Year)	Source	Remarks
Carbon Reduction Project Revenue			
Indonesia Carbon Price	IDR 59,200 per ton CO2	<a href="https://idxcarbon.co.id/id/data-daily">https://idxcarbon.co.id/id/data-daily</a>	Data from 4 <sup>th</sup> February 2024
Average ICE Carbon Emission	ICE Motorcycles: 0.69 ton CO2 per vehicle ICE Cars: 3.26 ton CO2 per vehicle ICE Buses: 47.33 ton CO2 per vehicle	ICE Motorcycles: ITDP 2Wheeler Study (2021); online research ICE Cars: online research ICE Buses: WB-ICCT-ITDP E-Bus Implementation in Medan & Bandung (2021)	
EV Sales	EV Motorcycles: 3,463 units EV Cars: 373 units EV Buses: 10 units	Calculation	Sales number is assumed from the differences in EV population from last year to current year
Reduced ICE Carbon Emission	ICE Motorcycles: 1,199 ton CO2 ICE Cars: 608 ton CO2 ICE Buses: 710 ton CO2	Calculation (Average ICE emission x EV Sales)	For carbon trading, the requirement is that carbon emissions must be measurable, which is only applicable to e-bus which owned by government. For EV motorcycles and cars, it is that 50% of EV cars and EV motorcycle sales are owned by corporations as their operational vehicles, so their emission can be measured.
Average Health Cost for TBC/ person (adjusted by inflation)	IDR 2,351,690	Iswari et al., 2019	
Number of People with TBC (for model regression)	3,052 people	Bali Statistics Bureau and Satu Data Bali <a href="https://balisatudata.baliprov.go.id/laporan/jumlah-penderita-tbc-paru-per-kabupatenkota?year=2021">https://balisatudata.baliprov.go.id/laporan/jumlah-penderita-tbc-paru-per-kabupatenkota?year=2021</a>	
Average Health Cost for Pneumonia/ person (adjusted by inflation)	IDR 219,003	Pranata et al. (2020)	
Number of People with Pneumonia (for model regression)	2,404 people	Bali Statistics Bureau	

Parameter	Value (Base Year)	Source	Remarks
Health Cost Model	TBC Model: $y = 0,0774x + 2664,7$ Pneumonia Model: $y = 0,7673x - 1430,9$	Modelling	$y$ = Number of People with Pneumonia/ TBC from  $x$ = Total Carbon Reduction
Average ICE Carbon Emission	ICE Motorcycles: 0.69 ton CO2 per vehicle ICE Cars: 3.26 ton CO2 per vehicle ICE Buses: 47.33 ton CO2 per vehicle	ICE Motorcycles: ITDP 2Wheeler Study (2021); online research ICE Cars: online research ICE Buses: WB-ICCT-ITDP E-Bus Implementation in Medan & Bandung (2021)	
Total Carbon Reduction	6,130 ton CO2	Calculation	EV population x Average ICE CO2 emission per vehicle (the CO2 emission that will be lost by EV adoption)
Noise Cost Reduction			
Noise Cost	IDR 198,957,838 per year	Uncovering The Hidden Costs and Benefits from Electric Vehicles, Ernst & Young Australia (September 2020)	Noise cost is estimated to be around 77,70% from Carbon reduction revenue
EV Population	EV Motorcycles: 4,995 EV Cars: 601 EV Buses: 10	Bali Transportation Agency, Bali Regional Action Plan 2022-2026	Projection to the end of the year done by calculation for each scenario (BAU, Moderate, and Ambitious) as explained in subchapter 4.2
Positive Induced Economic Benefit			
Positive Induced Economic Benefit Calculation	Benefits Components: Carbon Reduction Project Revenue Health Costs Saving Noise Cost Reduction  Cost Component: Change in Vehicle Purchases Change in Electricity Consumption Expenditures EV Infrastructure Investment Costs	Calculation	
Investment rate of return	5.32%	Deposit Rate BI	Average from 2013-2023
Economic Multiplier	3.69	Calculation	
Local Content Multiplier	40%	Presidential Regulation No.79 of 2023	

Source: Consultant Analysis

### 6.1.5.3 Direct Costs

In this subsection, the direct cost will be identified and calculated for the CBA calculation. The direct costs are

including:

- Change in Vehicle Purchase
- Change in Electricity Consumption Expenditures
- EV Infrastructure Investment Costs

### Change in Vehicle Purchase

The price of the EV is generally more expensive than their ICE vehicle counterpart. There will be an increase in vehicle purchase costs due to the price difference. The formula for calculating change in vehicle purchase are as follows:

$$\Delta = \text{EV Sales} \times (\text{EV Price} - \text{ICE Vehicle Price})$$

#### Example: for Motorcycle, BAU Scenario, Base Year 2023

Change in Vehicle Purchase (IDR 196,664,684,429) = EV Sales (3,463 units) \* (EV Price (IDR 24,184,286) - Average ICE Vehicle Price (IDR 17,919,000))

- . EV Sales = 3,463 units
- . Average ICE Vehicle Price = IDR 17,919,000
- . Average EV Price = IDR 24,184,286

### Change in Electricity Consumption Expenditures

The increase in EV usage will increase the demand of electricity for EV operation, thus increasing the expenditures for electricity consumption. The formula for calculating change in electricity consumption expenditures are as follows:

$$\Delta \text{ Electricity Consumption Expenditures} = \text{Average EV kWh/km} \times \text{Annual Distance Traveled} \times \text{Electricity Price} \times \text{Ev Population}$$

#### Example: for Motorcycle, BAU Scenario, Base Year 2023

Change in Electricity Consumption Expenditures (IDR 10,138,226,943) = Average EV kWh/km (0.045 kWh/km) \* Vehicle Distance Travelled (7,300 km per year) \* Electricity Price (IDR 1,700 per kWh) \* EV population (4,995 units)

- Average EV kWh/km = 0.045 kWh/km
- Vehicle Distance Travelled = 7,300 km per year
- Electricity Price = IDR 1,700 per kWh
- EV population = 4,995 units

### EV Infrastructure Investment Costs

The usage of the EV will also require the infrastructure for EV operation, which is the charging station, to be built. The formula for calculating change in vehicle purchase are as follows:

$$\text{EV Infrastructure Cost} = \text{Charger Price} \times \text{Unit Quantity}$$

#### Example: for Motorcycle, BAU Scenario, Year 2024

EV Infrastructure Cost (IDR 3,800,000,000) = EV Charger (battery swap station or SPBLU for motorcycle) Price (IDR

190,000,000) \* EV Charger Purchase (20 units in 2024)

- a. EV Charger (battery swap station or SPBLU for motorcycle) Price = IDR 190,000,000
- b. SPBLU Purchase = 20 units in year 2024

Parameters used for calculation associated with the Direct Costs above are summarized in the following Table 62.

**Table 62. Direct Cost Parameters**

Parameter	Value (Base Year)	Source	Remarks
Change in Vehicle Purchase			
Average ICE Vehicle Price	ICE Motorcycles: IDR 17,919,000 ICE Cars: IDR 278,350,000 ICE Buses: IDR 1,500,000,000	EV Motorcycles: ITDP 2Wheeler Study (2021); online research EV Cars: online research EV Buses: WB-ICCT-ITDP E-Bus Implementation in Medan & Bandung (2021)	
Average EV Price	EV Motorcycles: IDR 24,184,286 EV Cars: IDR 663,000,000 EV Buses: IDR 3,599,570,000	EV Motorcycles: ITDP 2Wheeler Study (2021); online research EV Cars: online research EV Buses: WB-ICCT-ITDP E-Bus Implementation in Medan & Bandung (2021)	
EV Sales	EV Motorcycles: 3,463 units EV Cars: 373 units EV Buses: 10 units	Calculation	Sales number is assumed from the differences in EV population from last year to current year
Change in Electricity Consumption Expenditures			
Annual Distance Travelled	Motorcycles: 7,300 km Cars: 18,250 km Buses: 87,600 km	Energy Transition in Indonesia and Future Mobility, MEMR Presentation 2023; Bali Regional Action Plan 2023	
Average EV km/kWh	EV Motorcycles: 24.09 EV Cars: 8.15 EV Buses: 0.80	EV Motorcycles: ITDP 2Wheeler Study (2021); online research EV Cars: online research EV Buses: WB-ICCT-ITDP E-Bus Implementation in Medan & Bandung (2021)	
EV electricity consumption	EV Motorcycles: 1,628,874 kWh EV Cars: 1,345,798 kWh EV Buses: 1,642,500 kWh	Calculation	Annual Distance Travelled divided by average EV km/kWh
Electricity Price	IDR 2,466 per kWh (for SPKLU) IDR 1,700 per kWh (for home)	ESDM Regulation No.1 of 2023, pln.co.id	
EV Infrastructure Investment Costs			

Parameter	Value (Base Year)	Source	Remarks
EV Infrastructure Addition	EV Motorcycles: 20 EV Cars: 30 EV Buses: 5	Ramboll EV Infrastructure Calculation	Battery Swap Station for EV Motorcycles, Public Charging Station / SPKLU for EV Cars and E-Buses
EV Sales	EV Sales	EV Motorcycles: 3,463 units EV Cars: 373 units EV Buses: 10 units	Calculation
Charging Station Price (adjusted by inflation)	SPKLU Price 11 kW : IDR 326,000,000 SPKLU Price 50 kW : IDR 815,000,000 SPKLU Price 150 kW : IDR 1,467,000,000 SPBLU Price : IDR 190,000,000	Market Research	

Source: Consultant Analysis

#### 6.1.5.4 Indirect Costs

In this subsection, the indirect cost will be identified and calculated for the CBA calculation. The indirect cost is including:

- Induced Economic Costs
- Policy costs

#### Induced Economic Cost

The growth of the EV industry will create opportunities and benefits for the economy. However, it will also inversely affect the ICE vehicle industry by reducing ICE vehicle sales and impacting related businesses. Unlike the positive economic multiplier associated with the EV industry, this will result in a negative economic multiplier for the ICE vehicle industry. Additionally, the extra expenses associated with EV purchase and operation may lead to opportunity losses in interest returns.

The formula for calculating the induced economic cost are as follows:

**Induced Economic Cost = Negative Economic Multiplier + Opportunity Loss in Interest Returns**

**Negative Economic Multiplier = Economic Multiplier x [(Change in Vehicle OM Expenditures x Local Content Level) + (Change in Fuel Consumption Expenditures + Health Cost Saving + Noise Cost Reduction)]**

**Opportunity Loss in Interest Returns = [(change in vehicle purchase + Change in Electricity Consumption Expenditures + EV Infrastructure Cost + Battery Replacement Cost) x Investment Rate of Return]**

#### Example: BAU Scenario, Base Year 2023

*Induced Economic Cost (IDR 141,090,494,088) = Economic Multiplier (3.69) x [(Change in Vehicle OM Expenditures (IDR 1,709,423,873) x Local Content Level (40%)) + Change in Fuel Consumption Expenditures (IDR 28,485,746,422) + Health Cost Saving (IDR 5,968,680,186) + Noise Cost Reduction (IDR 115,808,807)]*

*+ [ Change in vehicle purchase (IDR 196,664,684,429) + Change in Electricity Consumption Expenditures (IDR 10,138,226,943) + EV infrastructure cost (0) + Battery Replacement Cost (IDR 0)] x Investment Rate of Return*

(5.32%)

- a. Economic Multiplier = 3.69
- b. Change in Vehicle OM Expenditures = IDR 1,709,423,873
- c. Local Content Level = 40%
- d. Change in Fuel Consumption Expenditures = IDR 28,485,746,422
- e. Health Cost Saving = IDR 5,968,680,186
- f. Noise Cost Reduction = IDR 198,957,838
- g. Change in vehicle purchase = IDR 196,664,684,429
- h. EV infrastructure cost = IDR 0 (begins in 2024)
- i. Battery Replacement Cost = IDR 0 (begins in 2030)
- j. Change in Electricity Consumption Expenditures = IDR 10,138,226,943
- k. Investment Rate of Return = 5.32%

The parameters used for calculation associated with the indirect cost above are shown in the following Table 63.

**Table 63. Indirect Cost Parameters**

Parameter	Value (Base Year)	Source	Remarks
Negative Induced Economic Benefit			
Negative Induced Economic Cost Calculation	Cost Component: Change in Vehicle Purchases Change in Electricity Consumption Expenditures EV Infrastructure Investment Costs Benefits Components: Change in Vehicle OM Expenditures Change in Fuel Consumption Expenditures Health Costs Saving Noise Cost Reduction	Calculation	
Investment rate of return	5.32%	Deposit Rate BI	Average from 2013-2023
Economic Multiplier	3.69	Calculation	
Local Content Multiplier	40%	Presidential Regulation No.79 of 2023	

Source: Consultant Analysis

### Policy Cost

The Policy cost is introduced as a feature to reflect the effect of the policy on the EV projection in the Roadmap. The amount policy costs assumed in the model correspond with the additional 10 new policies as elaborated in Section 5.4.2. These policies are assumed to additional efforts to be introduced in Moderate- and Ambitious-Scenario, on top of all policies that have been implemented today considered in BAU scenario.

With this approach, it is assumed that policy cost for BAU is generally 0 (zero). The policy cost for Moderate- and Ambitious-Scenario are generally calculated based on the difference of target settings of EV projection, between BAU and the two other scenarios, and over the short-, medium-, and long- term implementation.

Calculation of policy costs is elaborated in **section 6.1.7**.

## 6.1.6 Cost-Benefit Analysis

After considering all the benefits and the cost described in the previous section, the Cost-Benefit Analysis is conducted by analyzing three parameters, i.e., Economic Net Present Value (ENPV), Economic Internal Rate of Return (EIRR), and Benefit-Cost Ratio (BCR). The ENPV is the difference between the present value of quantified benefits and the present value of quantified costs over a period of time. The ENPV is calculated by using following formula:

$$ENPV = \sum_{t=0}^T \frac{(B_t - C_t)}{(1 + sc)^t}$$

Where **B<sub>t</sub>** is the quantified benefits at time t, **C<sub>t</sub>** is the quantified costs at time t, and **sc** is the social discount rate. A project is said to bring greater benefits for society when the ENPV is greater than zero.

EIRR is a metric used to estimate the profitability of potential investments. EIRR is a discount rate that makes the present value of all net benefits equal to zero in a discounted cash flow analysis. In other words, it is the annual return that makes the ENPV equal to zero. A project is said to bring greater benefits for society when the EIRR is greater than the social discount rate. The EIRR can be calculated by using the following formula.

$$0 = \sum_{t=0}^T \frac{(B_t - C_t)}{(1 + EIRR)^t}$$

A benefit-cost ratio (BCR) is to summarize the overall relationship between the relative costs and benefits of a proposed project. BCR can be expressed in monetary or qualitative terms. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to society. The formula to calculate BCR is as follows.

$$BCR = \frac{\sum_{t=1}^T \frac{B_t}{(1 + sc)^t}}{\sum_{t=1}^T \frac{C_t}{(1 + sc)^t}}$$

As for the cost associated with social, a 15-year Government Bond Yield is considered to be at 6.82%.<sup>90</sup> This yield serves as a mark-to-market risk-free rate and provides a direct approach to calculating the social discount rate. This method is also utilized by the Congressional Budget Office and the General Accounting Office of the United States<sup>91</sup>.

Result of the Cost-Benefit Analysis performed for **BAU-, Moderate-, and Ambitious-Scenario** can be seen in following tables and figures. It is important to note that the result may be subject to further adjustment to make to assumptions, adoption of scenarios, as based on dialogue with stakeholders towards finalization of the final version of roadmap document.

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90 <https://www.phei.co.id/Data/HPW-dan-Imbal-Hasil>

91 Asian Development Bank (2013) Cost-benefit analysis for development: A practical guide. Mandaluyong City, Philippines: Asian Development Bank

**Table 64.** Result of Cost-Benefit Analysis of EV Implementation in Bali (In IDR Million) – BAU, Moderate, and Ambitious Scenario

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
<b>BENEFITS: DIRECT &amp; INDIRECT (IDR Million)</b>																		
<b>Direct Benefits</b>																		
<b>Ambitious</b>	<b>32,831</b>	<b>125,322</b>	<b>477,107</b>	<b>637,582</b>	<b>855,477</b>	<b>1,148,081</b>	<b>1,550,910</b>	<b>2,100,801</b>	<b>2,704,895</b>	<b>3,361,878</b>	<b>4,079,941</b>	<b>4,869,034</b>	<b>5,741,392</b>	<b>6,711,793</b>	<b>7,798,370</b>	<b>9,023,247</b>	<b>10,438,877</b>	<b>12,059,891</b>
<b>Moderate</b>	<b>32,831</b>	<b>100,248</b>	<b>311,799</b>	<b>392,161</b>	<b>492,044</b>	<b>616,930</b>	<b>773,636</b>	<b>969,965</b>	<b>1,202,787</b>	<b>1,492,501</b>	<b>1,852,737</b>	<b>2,300,959</b>	<b>2,859,343</b>	<b>3,554,474</b>	<b>4,420,832</b>	<b>5,501,120</b>	<b>6,848,796</b>	<b>8,530,811</b>
<b>BAU</b>	<b>32,831</b>	<b>77,532</b>	<b>190,456</b>	<b>237,106</b>	<b>295,080</b>	<b>367,330</b>	<b>457,566</b>	<b>570,494</b>	<b>721,451</b>	<b>914,661</b>	<b>1,162,826</b>	<b>1,482,650</b>	<b>1,896,299</b>	<b>2,433,168</b>	<b>3,132,399</b>	<b>4,046,237</b>	<b>5,244,753</b>	<b>6,821,989</b>
Change in Vehicle OM Expenditures																		
Ambitious	1,709	7,136	29,776	40,704	55,759	76,561	105,382	145,418	191,096	244,448	306,923	380,301	466,783	569,066	690,494	835,208	1,008,340	1,216,259
Moderate	1,709	5,454	17,608	22,947	29,879	38,888	50,605	65,835	84,780	109,179	140,594	181,042	233,132	300,195	386,548	497,741	640,919	825,285
BAU	1,709	4,106	10,184	12,930	16,432	20,905	26,629	33,963	45,161	60,205	80,475	107,857	144,956	195,356	264,008	357,761	486,117	662,266
Change in Fuel Consumption Expenditures																		
Ambitious	28,486	107,109	400,780	533,287	712,661	952,057	1,281,203	1,728,788	2,216,226	2,736,838	3,295,059	3,896,240	4,546,920	5,254,894	6,029,633	6,882,537	7,852,762	8,938,426
Moderate	28,486	86,345	266,805	333,511	415,652	517,465	644,152	801,446	985,678	1,212,795	1,492,410	1,836,795	2,261,425	2,784,305	3,428,811	4,223,365	5,203,035	6,411,083
BAU	28,486	67,078	164,501	204,168	253,237	314,110	389,793	484,074	606,413	761,139	957,404	1,207,054	1,525,549	1,933,043	2,455,912	3,128,732	3,997,041	5,120,821
Change in Vehicle Tax & Adm Expenditures																		
Ambitious	2,635	11,078	46,550	63,591	87,058	119,463	164,326	226,596	297,572	380,593	477,959	592,493	727,689	887,833	1,078,243	1,305,502	1,577,776	1,905,206
Moderate	2,635	8,449	27,387	35,703	46,514	60,578	78,879	102,684	132,329	170,527	219,733	283,122	364,786	469,974	605,473	780,014	1,004,842	1,294,443
BAU	2,635	6,348	15,771	20,008	25,411	32,314	41,144	52,457	69,877	93,317	124,947	167,739	225,794	304,769	412,479	559,744	761,595	1,038,901
<b>Indirect Benefits</b>																		
<b>Ambitious</b>	<b>335,988</b>	<b>2,150,624</b>	<b>7,893,599</b>	<b>4,828,904</b>	<b>7,953,032</b>	<b>10,593,546</b>	<b>14,197,609</b>	<b>23,648,304</b>	<b>26,466,493</b>	<b>33,747,619</b>	<b>39,701,095</b>	<b>49,686,278</b>	<b>66,597,461</b>	<b>72,625,599</b>	<b>88,504,029</b>	<b>109,435,223</b>	<b>132,617,585</b>	<b>156,725,362</b>
<b>Moderate</b>	<b>335,988</b>	<b>1,072,947</b>	<b>3,474,486</b>	<b>1,928,978</b>	<b>3,219,603</b>	<b>4,120,049</b>	<b>5,292,464</b>	<b>8,464,280</b>	<b>10,936,591</b>	<b>14,861,696</b>	<b>17,979,096</b>	<b>23,755,779</b>	<b>32,664,536</b>	<b>38,345,031</b>	<b>49,314,686</b>	<b>63,532,094</b>	<b>82,952,000</b>	<b>104,489,359</b>
<b>BAU</b>	<b>336,002</b>	<b>601,966</b>	<b>1,509,896</b>	<b>734,256</b>	<b>1,220,979</b>	<b>1,513,416</b>	<b>1,888,706</b>	<b>3,108,226</b>	<b>5,415,838</b>	<b>7,872,219</b>	<b>10,340,599</b>	<b>14,202,641</b>	<b>19,988,154</b>	<b>25,831,882</b>	<b>35,639,255</b>	<b>49,113,620</b>	<b>68,502,369</b>	<b>93,646,312</b>
Carbon Reduction Project Revenue																		
Ambitious	149	561	2,095	996	1,351	1,841	2,515	3,447	3,793	4,042	4,321	4,635	4,992	5,401	5,872	6,418	7,056	7,803
Moderate	149	410	1,281	470	577	713	886	1,097	1,279	1,574	1,933	2,375	2,923	3,591	4,417	5,435	6,687	8,230
BAU	149	278	707	292	362	450	560	699	874	1,098	1,384	1,748	2,213	2,811	3,580	4,571	5,853	7,516
Health Costs Saving																		
Ambitious	5,955	6,187	6,448	6,705	6,977	7,267	7,579	7,919	8,278	8,658	9,060	9,485	9,936	10,415	10,926	11,472	12,057	12,687
Moderate	5,955	6,186	6,436	6,685	6,946	7,219	7,505	7,806	8,122	8,455	8,808	9,183	9,585	10,016	10,483	10,992	11,551	12,171
BAU	5,969	6,199	6,444	6,693	6,953	7,224	7,507	7,803	8,114	8,441	8,786	9,151	9,541	9,958	10,408	10,899	11,440	12,043
Noise Cost Reduction																		
Ambitious	116	436	1,628	774	1,050	1,430	1,955	2,679	2,947	3,141	3,358	3,601	3,879	4,196	4,563	4,987	5,482	6,063
Moderate	116	319	995	366	448	554	688	853	994	1,223	1,502	1,846	2,271	2,790	3,432	4,223	5,196	6,395
BAU	116	216	550	227	281	349	435	543	679	853	1,075	1,358	1,720	2,184	2,782	3,552	4,548	5,840
Positive Induced Economic Effects																		
Ambitious	329,768	2,143,439	7,883,429	4,820,429	7,943,653	10,583,008	14,185,561	23,634,259	26,451,474	33,731,777	39,684,357	49,668,556	66,578,654	72,605,587	88,482,669	109,412,346	132,592,990	156,698,809
Moderate	329,768	1,066,033	3,465,774	1,921,457	3,211,631	4,111,563	5,283,384	8,454,524	10,926,196	14,850,445	17,966,853	23,742,375	32,649,757	38,328,633	49,296,354	63,511,444	82,928,566	104,462,564
BAU	329,769	595,273	1,502,195	727,044	1,213,384	1,505,394	1,880,204	3,099,180	5,406,170	7,861,826	10,329,355	14,190,384	19,974,680	25,816,929	35,622,485	49,094,598	68,480,528	93,620,913
<b>Total Benefits</b>																		
<b>Ambitious</b>	<b>368,819</b>	<b>2,275,946</b>	<b>8,370,706</b>	<b>5,466,486</b>	<b>8,808,509</b>	<b>11,741,627</b>	<b>15,748,520</b>	<b>25,749,105</b>	<b>29,171,388</b>	<b>37,109,497</b>	<b>43,781,036</b>	<b>54,555,312</b>	<b>72,338,853</b>	<b>79,337,392</b>	<b>96,302,399</b>	<b>118,458,470</b>	<b>143,056,462</b>	<b>168,785,252</b>
<b>Moderate</b>	<b>368,819</b>	<b>1,173,195</b>	<b>3,786,285</b>	<b>2,321,139</b>	<b>3,711,647</b>	<b>4,736,979</b>	<b>6,066,100</b>	<b>9,434,245</b>	<b>12,139,378</b>	<b>16,354,197</b>	<b>19,831,833</b>	<b>26,056,739</b>	<b>35,523,879</b>	<b>41,899,506</b>	<b>53,735,518</b>	<b>69,033,214</b>	<b>89,800,797</b>	<b>113,020,170</b>
<b>BAU</b>	<b>368,833</b>	<b>679,498</b>	<b>1,700,352</b>	<b>971,362</b>	<b>1,516,059</b>	<b>1,880,746</b>	<b>2,346,272</b>	<b>3,678,720</b>	<b>6,137,289</b>	<b>8,786,880</b>	<b>11,503,425</b>	<b>15,685,291</b>	<b>21,884,454</b>	<b>28,265,051</b>	<b>38,771,654</b>	<b>53,159,857</b>	<b>73,747,122</b>	<b>100,468,301</b>

**Table 64.** (cont'd) Result of Cost-Benefit Analysis of EV Implementation in Bali (In IDR Million) – BAU, Moderate, and Ambitious Scenario

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	
<b>COST: DIRECT &amp; INDIRECT (IDR Million)</b>																			
<b>Direct Costs</b>																			
<b>Ambitious</b>	206,803	952,078	4,102,571	1,758,941	2,344,415	3,138,817	4,217,148	5,685,799	5,904,165	7,137,140	8,636,227	10,469,556	12,720,637	15,482,924	18,892,071	23,102,182	28,307,632	34,762,008	
<b>Moderate</b>	206,803	618,782	2,024,018	897,535	1,153,602	1,487,837	1,927,370	2,451,599	3,092,986	3,913,805	5,025,282	6,458,933	8,307,009	10,684,673	13,755,407	17,716,713	22,825,825	29,421,192	
<b>BAU</b>	206,803	368,334	941,819	399,338	494,552	614,470	769,119	968,921	1,669,077	2,268,637	3,098,273	4,246,308	5,839,239	8,053,426	11,136,134	15,441,699	21,452,838	29,865,260	
<b>Change in Vehicle Purchases</b>																			
Ambitious	196,665	890,618	3,613,258	1,421,096	1,894,160	2,531,192	3,389,790	4,549,884	4,893,522	5,908,627	7,163,115	8,715,982	10,644,682	13,039,251	16,019,183	19,730,550	24,356,545	30,126,305	
Moderate	196,665	566,312	1,691,559	706,663	916,490	1,193,849	1,559,041	2,033,076	2,539,985	3,292,031	4,263,105	5,521,647	7,155,923	9,266,158	12,004,730	15,552,933	20,149,758	26,104,630	
BAU	196,665	329,139	731,358	276,150	340,304	420,722	521,193	647,407	1,337,926	1,856,038	2,581,258	3,596,127	5,020,146	7,019,137	9,827,623	13,776,129	19,333,483	27,157,422	
<b>Change in Electricity Consumption Expenditures</b>																			
Ambitious	10,138	35,172	118,111	155,187	203,936	268,537	354,695	470,239	595,309	731,366	880,086	1,043,493	1,224,053	1,424,710	1,649,042	1,901,363	2,186,873	2,511,846	
Moderate	10,138	27,252	73,940	92,504	114,792	142,076	175,876	217,485	265,805	325,385	398,566	488,580	599,696	736,324	904,857	1,112,874	1,369,757	1,687,112	
BAU	10,138	21,018	45,223	55,511	67,892		101,145	123,485	154,167	193,084	242,697	306,223	387,920	493,400	630,088	807,829	1,039,725	1,343,207	
<b>Battery Replacement Cost</b>																			
Ambitious	-	-	-	-	-	-	-	39,056	181,971	776,797	611,930	1,429,685	4,120,830	2,552,219	3,601,792	4,608,078	6,203,313	6,763,675	
Moderate	-	-	-	-	-	-	-	39,056	149,732	553,526	369,124	733,976	1,709,184	1,016,941	1,368,744	1,863,116	2,889,661	3,046,025	
BAU	-	-	-	-	-	-	-	38,233	108,808	327,415	316,172	453,634	791,247	518,770	709,222	904,212	1,377,577	1,373,344	
<b>EV Infrastructure Investment Costs</b>																			
Ambitious	-	26,289	371,202	182,658	246,318	339,089	472,663	665,677	415,334	497,147	593,025	710,081	851,902	1,018,963	1,223,846	1,470,269	1,764,215	2,123,857	
Moderate	-	25,218	258,519	98,367	122,319	151,912	192,453	201,038	287,195	296,389	363,611	448,706	551,390	682,191	845,826	1,050,906	1,306,311	1,629,449	
BAU	-	18,177	165,238	67,677	86,356	110,862	146,781	198,029	176,984	219,515	274,319	343,958	431,173	540,889	678,423	857,741	1,079,630	1,364,631	
<b>Policy Costs</b>																			
Ambitious	-	176,775	416,562	499,104	650,393	858,382	1,146,614	1,696,440	2,135,992	2,608,768	3,113,064	3,652,340	4,230,830	4,853,200	5,526,293	6,954,640	7,715,815	8,545,222	
Moderate	-	23,282	80,024	99,676	124,114	154,494	192,252	239,167	293,866	360,989	443,344	544,372	668,287	820,230	1,006,576	1,235,052	1,515,152	1,858,506	
BAU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Negative Induced Economic Effects</b>																			
Ambitious	141,041	498,186	1,824,776	2,191,501	2,963,158	3,955,431	5,319,177	7,294,569	9,278,622	11,497,846	13,855,124	16,484,706	19,476,172	22,502,863	26,032,405	30,010,565	34,561,168	39,657,918	
Moderate	141,041	389,330	1,164,630	1,350,608	1,704,150	2,123,145	2,646,860	3,348,049	4,134,066	5,124,022	6,311,666	7,818,906	9,720,103	11,961,672	14,816,250	18,363,296	22,792,980	28,228,939	
BAU	141,090	299,431	704,567	822,054	1,027,307	1,270,311	1,572,930	1,975,656	2,503,958	3,157,267	3,993,379	5,066,956	6,450,425	8,239,466	10,561,034	13,584,451	17,535,107	22,715,471	
<b>Total Costs</b>																			
<b>Ambitious</b>	347,844	1,450,264	5,927,348	3,950,442	5,307,573	7,094,248	9,536,326	12,980,368	15,182,787	18,634,986	22,491,351	26,954,262	32,196,809	37,985,787	44,924,476	53,112,747	62,868,801	74,419,926	
<b>Moderate</b>	347,844	1,008,112	3,188,647	2,248,142	2,857,752	3,610,982	4,574,230	5,799,648	7,227,051	9,037,827	11,336,949	14,277,840	18,027,111	22,646,346	28,571,657	36,080,009	45,618,805	57,650,131	
<b>BAU</b>	347,893	667,765	1,646,386	1,221,392	1,521,859	1,884,780	2,342,050	2,944,577	4,173,035	5,425,904	7,091,652	9,313,264	12,289,664	16,292,892	21,697,167	29,026,151	38,987,945	52,580,731	
<b>Net Benefits (IDR Million)</b>																			
<b>Ambitious</b>	20,975	825,682	2,443,358	1,516,043	3,500,936	4,647,379	6,212,194	12,768,737	13,988,601	18,474,511	21,289,685	27,601,050	40,142,044	41,351,605	51,377,923	65,345,723	80,187,661	94,365,326	
<b>Moderate</b>	20,975	165,083	597,638	72,997	853,895	1,125,997	1,491,870	3,634,597	4,912,327	7,316,370	8,494,884	11,778,899	17,496,767	19,253,160	25,163,861	32,953,205	44,181,992	55,370,039	
<b>BAU</b>	20,939	11,733	53,965	-250,030	-5,800	-4,034	4,223	734,143	1,964,254	3,360,975	4,411,773	6,372,027	9,594,790	11,972,159	17,074,486	24,133,706	34,759,177	47,887,570	
<b>PV Benefits</b>																			
<b>Ambitious</b>	368,819	2,130,613	7,335,795	4,484,725	6,765,075	8,441,916	10,599,735	16,224,076	17,206,695	20,491,229	22,631,405	26,400,069	32,770,434	33,645,814	38,232,507	44,025,504	49,772,361	54,974,059	
<b>Moderate</b>	368,819	1,098,279	3,318,168	1,904,271	2,850,603	3,405,761	4,082,863	5,944,359	7,160,392	9,030,507	10,251,522	12,609,216	16,092,775	17,768,960	21,333,254	25,656,435	31,243,592	36,811,140	
<b>BAU</b>	368,833	636,107	1,490,129	796,909	1,164,357	1,352,206	1,579,188	2,317,899	3,620,070	4,851,964	5,946,380	7,590,329	9,913,940	11,986,790	15,392,529	19,757,046	25,658,179	32,722,944	
<b>PV Costs</b>																			
<b>Ambitious</b>	347,844	1,357,656	5,194,521	3,240,958	4,076,300	5,100,575	6,418,542	8,178,711	8,955,542	10,289,920	11,626,287	13,043,540	14,585,570	16,109,210	17,835,229	19,739,538	21,873,382	24,238,880	
<b>Moderate</b>	347,844	943,738	2,794,419	1,844,384	2,194,799	2,596,200	3,078,742	3,654,260	4,262,864	4,990,533	5,860,324	6,909,244	8,166,514	9,603,980	11,343,083	13,409,261	15,871,745	18,776,888	
<b>BAU</b>	347,893	625,124	1,442,835	1,002,034	1,168,812	1,355,107	1,576,345	1,855,328	2,461,458	2,996,091	3,665,835	4,506,817	5,567,376	6,909,574	8,613,878	10,787,670	13,564,728	17,125,763	

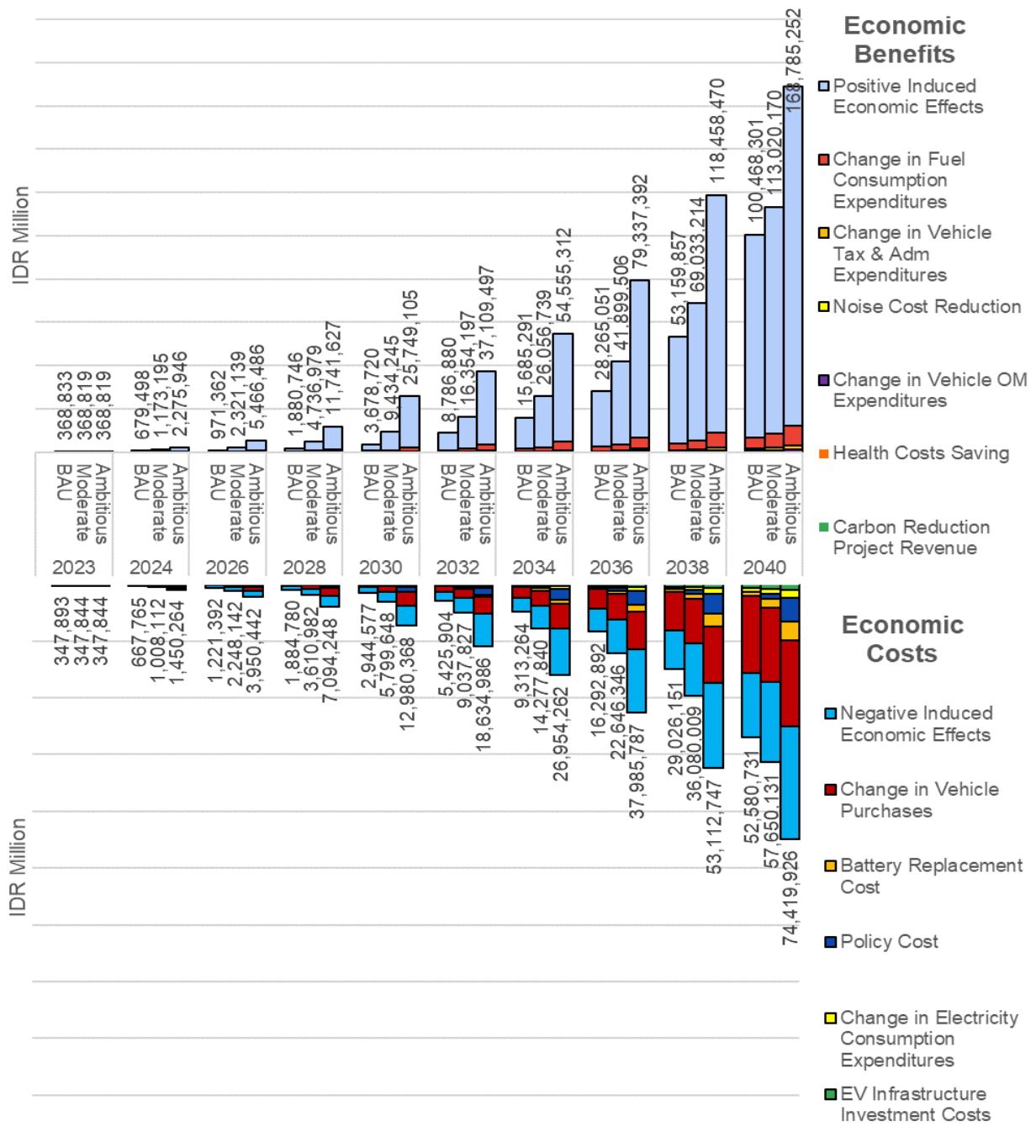


Figure 53. Cost-Benefit Analysis Result Graph – BAU, Moderate, and Ambitious Scenario

The CBA results showed that the project resulted in a positive net benefit from the beginning of the projection year 2023 until the end of the projection year 2040, except for the BAU in the years 2026-2028.

For the BAU-Scenario, the Benefit-Cost Ratio (BCR) values are 1.72, and the ENPV values are IDR 61,573,129 million. For the Moderate-Scenario, the Benefit-Cost Ratio (BCR) values are 1.81, and the ENPV values are IDR 94,282,095 million. For the Ambitious-Scenario, the Benefit-Cost Ratio (BCR) values are 2.06, and the ENPV values are IDR 204,288,628 million.

The EIRR for all scenarios is not calculated because this study's projection is not meant to reflect an investment, where profit—and loss—gain are usually calculated. Mathematically, the EIRR can't be justified with all positive

present values. Based on the current run of the Cost-Benefit Analysis, the electrification of the vehicle in Bali is economically feasible for all scenarios.

Several key findings from preliminary CBA calculation are as follows:

- The most significant component of the economic benefits comes from indirect benefits of positive induced economic benefits because when consumption increases (by purchasing of EV, etc.), the economic flywheel turns, resulting in a multiplier effect that maintains a positive Benefit-Cost Ratio.
- Meanwhile, the most significant component of the economic costs comes from the change in vehicle purchases. Adding EV capex costs is substantial; not even the savings from the shift in energy and OM expenditures can offset it.
- The factors influencing the changes and making the direct benefits more prominent over the years are mainly the number of EVs in the population. As the EV population grows, the greater the fuel consumption savings, OM expenditures, and vehicle tax (because EVs have tax incentives), the greater the direct benefits over the year.
- The health-saving cost is not too high in value because the level of respiratory health in Bali is excellent (it has the best rate of TB and pneumonia in Indonesia), while in some areas like Jakarta, the indirect benefit from the health-saving cost would be relatively large.

The several gaps of the preliminary CBA calculation are:

- In the current CBA calculation, the projection assumption uses existing data up to 2026 following the Bali Regional Action Plan document and up to 2040 according to the projection in subchapter 4.2.
- There is not yet sensitivity analysis to CBA components or parameters done in this current CBA calculation.
- The parameters currently used refer to various economic parameters for both Benefit and Cost parameters but are macro and high-level analysis in nature.

### 6.1.7 Policy Recommendation Cost Projection

As been discussed in **Section 5** of this report, policy strategies have been developed to support the target set for the future scenario especially in order to achieve the target set beyond the Business-as-Usual (BAU) scenario, which are the Moderate and Ambitious Scenario. From the development of the policy strategies done in Section 5, ten Priority Policies (PP) recommendation has been identified to support the implementation of EV ecosystem in Bali:

1. PP #1: More aggressive social campaigns for public awareness in using EV
2. PP #2: Reviewing petrol subsidy amount to support for transition to EV
3. PP #3: Setting end date of fossil-fueled vehicle sale
4. PP #4: Subsidy to purchase EV for certain models and for low- and middle-income groups
5. PP #5: Subsidy to compensate for free parking / free toll road for EV users
6. PP #6: Mandating charging point installations at new developments/ toll roads/ government offices/ public facilities
7. PP #7: Initiatives in establishing private businesses that bring charging stations/battery swap stations as a benefit

8. PP #8: Setting a minimum quota for EV sales for producers/importers
9. PP #9: Incentive and technical support for R&D in retrofitting of E4Ws
10. PP #10: Incentives for R&D for environmentally friendly EVs, technology for cheaper battery cost, safe production, and sustainability.

The Provincial Government of Bali will need to spend money on the incentives/policy costs required to implement the recommended policies. This section will identify the policy cost and the projection to indicate the budget the Government needs for this.

### 6.1.7.1 Policy Cost as Key Drivers for Projection

The policy amount for each of the above ten Priority Policies was set at a high level to model how it would drive the EV projection set as a target. In application, the selection of the policies and the amount of incentives reflect the potential efforts that can be implemented at the provincial and national levels with respect to the projection for the Moderate and Ambitious scenario.

In verifying the yearly policy amount implementation for both scenarios, the Benefit-Cost Ratio (BCR) of each scenario was set to reflect the increase as compared to it in the BAU scenario, for 2040. For instance, Moderate Scenario BCR is assumed to be 5% higher than BAU Scenario BCR, and Ambitious Scenario BCR is considered to be 20% higher than BAU Scenario BCR, where these increases reflect the increase of 2040 projections in comparing the two scenarios with the BAU. In setting these BCRs at such rates, the policies are recalculated.

Given the high-level nature of the assessment, the policy cost estimates in this study are indicative. The actual amount of policy cost will be subject to further studies, considering various aspects, including (not limited to) fiscal capacity, economic conducive level, and other potential considerations.

Following Table 65 summarizes the assumptions used in deriving the Policy Cost Parameter

**Table 65. Assumptions Applied for Policy Cost Parameter**

No.	Policy Recommendation	Policy making authority	Assumption for Moderate Scenario	Assumption for Ambitious Scenario	Remarks
1.	PP#1 More aggressive social campaigns for public awareness of using EV	Possible to be implemented at province level	IDR 50 million will be allocated until 2035; after that, IDR 25 million will be allocated until 2040	IDR 100 million will be allocated until 2035; after that, IDR 50 million will be allocated until 2040	Although this may not be considered fiscal policy, implementing it will require a large budget.  The amount of this budget is indicative and subject to parliament's decision for the budgeting exercise
2.	PP#2 Reviewing petrol subsidy amount to support for transition to EV	Need to be implemented by central government	<i>Not applicable to Moderate Scenario</i>	A review of subsidies will result in a fuel price increase progressively by 30% (2025), 50% (2030), and 80% (2040)	A decrease of fuel subsidy will result in EV to be more attractive from operational perspective. This policy has double impacts, which are expenditure saving, but also increase in social economy cost to users

No.	Policy Recommendation	Policy making authority	Assumption for Moderate Scenario	Assumption for Ambitious Scenario	Remarks
3.	PP#3: Setting end date of fossil-fuelled vehicle sale	Need to be implemented by central government	<i>Not applicable to Moderate Scenario</i>	Progressive cap of market sale on new fossil-fuelled vehicle at 80% (by 2025); 50% (by 2030); 0% (by 2040)	A directive strategy policy as national commitment to reduce CO2, in aligning with Paris Agreement and ASEAN Climate Mitigation Plages
4.	PP#4 Subsidy to purchase EV for certain models and for low- and middle-income groups	Need to be implemented by central government	<i>Not applicable to Moderate Scenario</i>	Progressive subsidy of IDR 50 million (2025-2025); IDR 40 million (2026-2030); IDR 20 million (2031-2040)	Amount of this policy is indicatively based on certain portion of Capex that may be attractive to recipient.  Amount of this budget is indicative and subject to parliament decision for budgeting exercise
5.	PP#5 Subsidy to compensate for free parking for EV users	For Parking to be implemented at province level; for Free Toll road to be implemented at Central government	Compensation for free toll road + free parking of:  - IDR 6,000/day/ E4W unit;  - IDR 3,000/day/ E2W unit	Compensation for free toll road + free parking of:  - IDR 17,000/day/ E4W unit.  - IDR 6,500/day/ E2W unit	Amount of this based on practical operational assumption.  Amount of this budget is indicative and subject to parliament decision for budgeting exercise.
6.	PP#6 Mandating charging point installations at new developments/toll roads/government offices/public facilities	Possible to be implemented at the province level	The calculation for EV Infrastructure cost has already been incorporated in the base CBA calculation	The calculation for EV Infrastructure cost has already been incorporated in the base CBA calculation.	Amount of this is based on a practical market price assumption exercise.  Amount of this budget is indicative and subject to parliament's decision for the budgeting exercise
7.	PP#7 Initiatives in establishing private businesses that bring charging stations / battery swap stations as benefit	Possible to be implemented at the province level	Participation from private entities is expected to reduce the implementation cost in PP#6	Participation from private entity is expected to reduce the implementation cost in PP#6	Amount of this policy will be subject to a Feasibility Study to analyze potential business model that can address the objective to reduce the cost for PP#6
8.	PP#8: Setting minimum quota for EV sale for producers/importers	Need to be implemented by central government	<i>Not applicable to Moderate Scenario</i>	Direction to progressively set minimum quota sales of EV of 20% (By 2025); 50% (By 2028); 90% (By 2038)	A directive policy to work in conjunction with PP#3 as national commitment to reduce CO2

No.	Policy Recommendation	Policy making authority	Assumption for Moderate Scenario	Assumption for Ambitious Scenario	Remarks
9.	PP#9 Incentive and technical support for R&D in retrofitting of E-passenger car	Need to be implemented by central government	<i>Not applicable to Moderate Scenario</i>	<p>IDR 50 million per E4W unit for producing for an affordable retrofitted E4W</p> <p>By 2025: R&amp;D budget for 1,500 units of retrofitted E4Ws (30% of EV)</p> <p>By 2030: R&amp;D budget for 5,000 units of retrofitted E4Ws (20% of EV)</p> <p>By 2038: R&amp;D budget for 20,000 units of retrofitted E4Ws (10% of EV)</p>	<p>Amount of this based on high-level estimate of a price of affordable BEV</p> <p>The amount of this budget is indicative and subject to parliament's decision for the budgeting exercise</p>
10.	PP#10 Incentives for R&D for environmentally friendly EVs, technology for cheaper battery cost, safe production, and sustainability	Need to be implemented by central government	<i>Not applicable to Moderate Scenario</i>	<p>IDR 1 bill/ year (up to 2025)</p> <p>IDR 500 mill/year (2026-2035)</p> <p>IDR 200 mill/year (2036-2040)</p>	<p>The amount of this is based on expectations to support the industry</p> <p>The amount of this budget is indicative and subject to parliament's decision for the budgeting exercise</p>

### 6.1.7.2 Cost Projection for Policy Implementation

The result of the cost projection for policy implementation are described in the following sections, which these figures are indicative and will be subject to further detailed studies.

#### Moderate Scenario

The Moderate Scenario assumes that the policy effort to push for EVs in Bali will be driven only by Bali Province alone, without significant change to current policies being in place (as per BAU Scenario). In this case, there are 3 priority policies Bali Province can still push forward without needing strong support from the central government. Such priority policies include PP#1 implementation of more aggressive social campaigns; PP#5 introduction of subsidy of free parking and toll roads for commuters using EVs; and PP#6 implementation of charging infrastructure as required to support the EV projection for the Moderate scenario. The remaining 7 priority policies are assumed not applicable to expect for the EV projection for the Moderate scenario.

Such policies are expected to increase the EV population share in 2040 by 5% compared to the BAU scenario. The total budgetary implication calculated to implement the priority policies can be seen in the policy cost projection for the Moderate Scenario is shown at Table 66 and Figure 54 below.

**Table 66. Policy Cost Projection for Moderate Scenario (IDR Million)**

Policy items	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
PP#1 Social Campaign	50	50	50	50	50	50	50	50	50	50	50	50	25	25	25	25	25
PP#5 Subsidy of free parking & toll road	23,232	79,974	99,626	124,064	154,444	192,202	239,117	293,816	360,939	443,294	544,322	668,237	820,205	1,006,551	1,235,027	1,515,127	1,858,481
PP#6 Charging points installation	7,042	240,342	80,191	104,143	133,736	174,276	182,861	269,019	278,213	345,435	430,529	533,213	664,015	827,643	1,032,730	1,288,134	1,611,273
<b>Total</b>	<b>30,324</b>	<b>320,366</b>	<b>179,867</b>	<b>228,257</b>	<b>288,230</b>	<b>366,528</b>	<b>422,028</b>	<b>562,884</b>	<b>639,202</b>	<b>788,779</b>	<b>974,901</b>	<b>1,201,500</b>	<b>1,484,244</b>	<b>1,834,220</b>	<b>2,267,782</b>	<b>2,803,286</b>	<b>3,469,779</b>

Source: Consultant Analysis

### **Ambitious Scenario**

The Ambitious Scenario assumes that the policy effort to push for EVs in Bali will be driven by both the Central government and Bali Province by introducing the ten additional policies compared to those in place today (as per the BAU scenario). Such 10 policies include PP#1 Social Campaign; PP#2 Review of petrol subsidy; PP#3 Setting end date of fuel vehicle sales; PP#4 Subsidy to purchase E4W; PP#5 Subsidy of free parking & toll road; PP#6 Charging points installation; PP#7 Establishing collaboration with private sector; PP#8 Setting minimum quota sales; PP#9 Subsidy for retrofitting E4W; PP#10 R&D incentives.

Such policies are expected to increase the EV population share in 2040 by 15-20% compared to the BAU scenario. The cost projection for the Ambitious Scenario is shown at following Table 67 and Figure 55.

**Table 67. Policy Cost Projection for Ambitious Scenario (IDR Million)**

Policy Items*	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
PP#1 Social Campaign	100	100	100	100	100	100	100	100	100	100	100	100	50	50	50	50	50
PP#2 Review of petrol subsidy	(107,109)	(400,780)	(533,287)	(712,661)	(952,057)	(1,281,203)	(1,728,788)	(2,216,226)	(2,736,838)	(3,295,059)	(3,896,240)	(4,546,920)	(5,254,894)	(6,029,633)	(6,882,537)	(7,852,762)	(8,938,426)
PP#3 Setting end date of fuel vehicle sales	No budgetary implication																
PP#4 Subsidy to purchase E4W	9,265	37,830	13,400	16,960	17,172	21,724	27,476	27,720	33,552	40,600	49,112	59,412	71,844	86,868	52,508	63,466	76,696
PP#5 Subsidy of free parking & toll road	64,738	265,171	364,248	501,135	690,485	952,678	1,316,093	1,719,239	2,144,525	2,593,945	3,069,905	3,575,341	4,113,757	4,689,409	5,307,427	5,974,000	6,696,593
PP#6 Charging points installation	8,113	353,026	164,481	228,141	320,912	454,486	647,500	397,157	478,971	574,849	691,904	833,726	1,000,787	1,205,669	1,452,093	1,746,038	2,105,681
PP#7 Private sector collaboration	Need for FS to analyze potential cost reduction in the implementation of PP#6																
PP#8 Setting minimum quota sales	No budgetary implication																
PP#9 Subsidy for retrofitting E4W	100,000	100,000	100,000	100,000	100,000	100,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	1,000,000	1,000,000	1,000,000
PP#10 R&D incentives	1,000	1,000	500	500	500	500	500	500	500	500	500	500	200	200	200	200	200
<b>Total Policy expenditures</b>	<b>183,215</b>	<b>757,127</b>	<b>642,729</b>	<b>846,836</b>	<b>1,129,169</b>	<b>1,529,489</b>	<b>2,241,669</b>	<b>2,394,717</b>	<b>2,907,648</b>	<b>3,459,993</b>	<b>4,061,521</b>	<b>4,719,079</b>	<b>5,436,637</b>	<b>6,232,196</b>	<b>7,812,278</b>	<b>8,783,754</b>	<b>9,879,220</b>

\*PP#3 & PP#8 may not be subject to policy cost calculation due to the nature of the policy that is assumed to involve a negligible amount of cost. Policy cost PP#7 will be subject to a more detailed Feasibility Analysis to understand the range of potential business models that can result in potential cost reduction in the implementation of PP#6; Source: Consultant Analysis

Figure 54. Component of Policy Cost Projection for Moderate Scenario

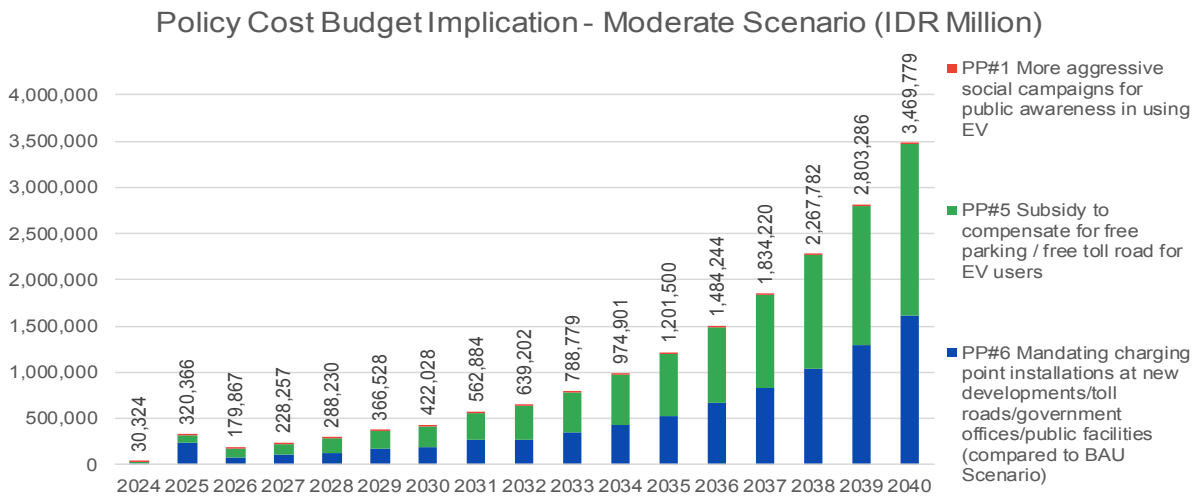
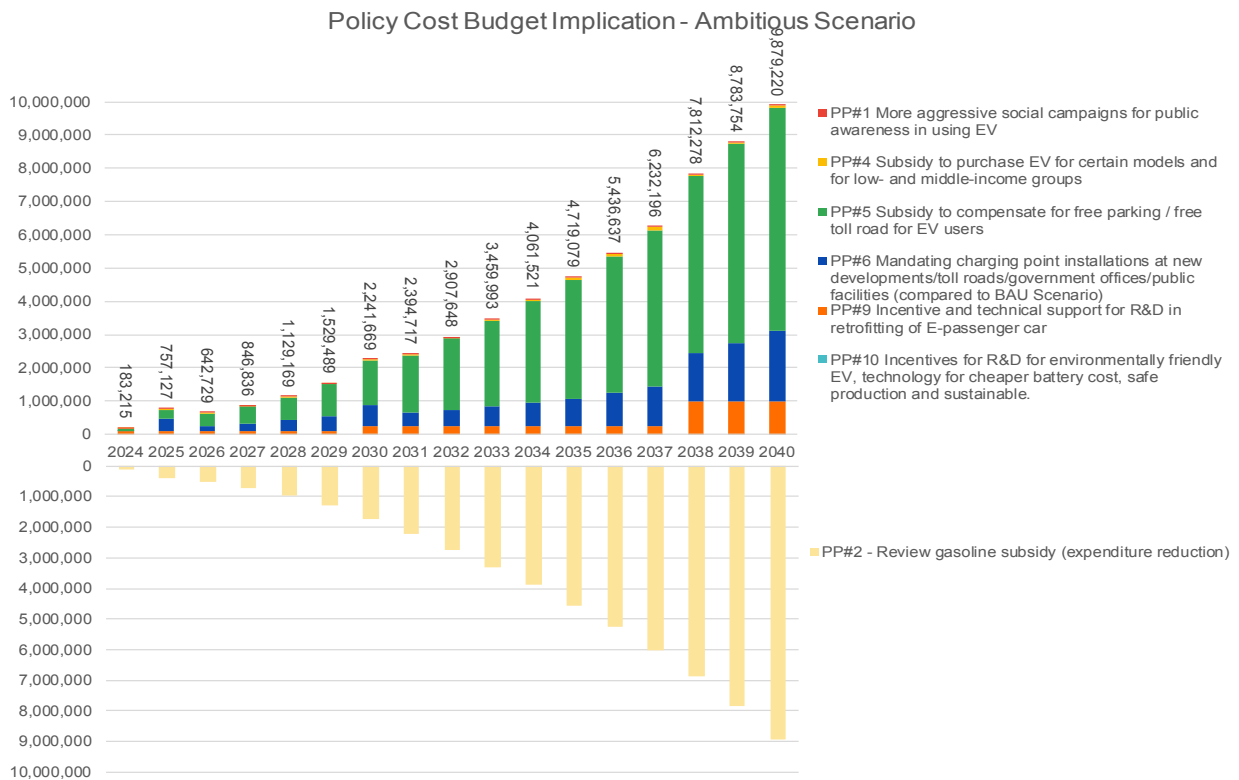


Figure 55. Component of Policy Cost Projection for Ambitious Scenario



The above illustrates the amount of investment the government(s) will need to consider over the years to achieve a certain increase in the target EV projection for the Moderate and Ambitious Scenarios, respectively.

For the Ambitious scenario, the policy cost projection shows that PP#2 is assumed to become an expenditure saving due to less subsidy amount to spend on fuel fossil vehicles in Bali. However, from the economic perspective, this can also be seen as an additional social cost to non-EV users. The effect of this particular policy is to make EVs more favourable from an operational cost perspective compared to fossil fuel vehicles.

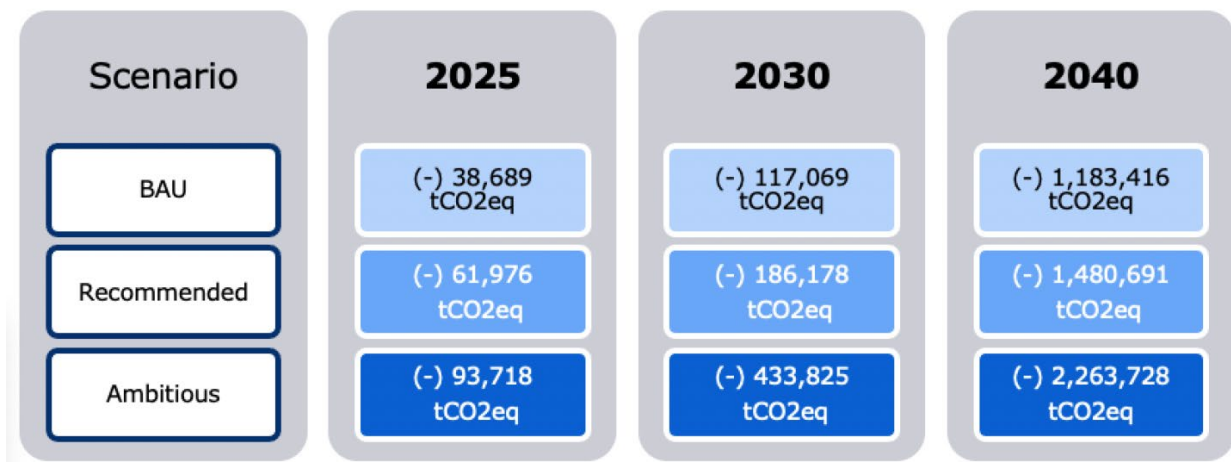
## 6.2 High-Level Environmental Assessment

### 6.2.1 Potential Reductions in Greenhouse-Gas Emissions

Potential reductions in GHG emissions resulting from the target EV transition in the roadmap are assessed at a high level from the perspective of how much the amount of carbon dioxide equivalent (CO<sub>2</sub>eq) will be reduced due to the number of EVs implemented in the projected years.

The following Figure 56 illustrates the potential CO<sub>2</sub>eq reductions (in tons) that would result from implementing EVs in Bali in 2025, 2030, and 2040.

**Figure 56.** Approximate amount of CO<sub>2</sub>eq reduction achieved for EV projection for BAU, Moderate, and Ambitious Scenario



### 6.2.2 Potential Reductions In Noise Impact

In order to understand potential noise reduction as impacted by the transition to EV, one needs to understand several factors of noise generated by the vehicle, including noise generated by the engine or electric motor, materials associated with tires and road surface, and traveling speed.

#### Noise Impact Due to E-Passenger Car

A study by the Danish Road Directorate<sup>92</sup> suggested that, at a constant speed, EV is 4-5 dB less noisy than similar ICE at low speed. At about a speed of 30 km/h and beyond, the difference in emitted noise between EV and ICE is not significant. This is because noise generated from tires and roads is found to be more dominant than the vehicles’ engine or electric motor. Overall, the study suggested that EVs can potentially reduce traffic noise veiling with speeds under 30 km/h within car parks or streets within urban areas.

#### Noise Impact due to E-Motorcycle

At present studies explaining findings on the impact of noise due to transition to E-Motorcycle from conventional fossil-fueled two-wheeler are still lacking. This is mainly due to the transition of EV in wider global countries mainly implemented in major cities or countries where motorcycle is not the dominant mode for transport.

<sup>92</sup> Danish Road Directorate, Measurement of noise from electrical vehicles and internal combustion engine vehicles under urban driving conditions. <https://www.toi.no/getfile.php/1340825-1434373783/mmarkiv/Forside%202015/compett-foredrag/Lykke%20-Silent%20Urban%20Driving.pdf>

A study of Commercialization of E-Motorcycle Conversion in Indonesia<sup>93</sup> suggests that electric motorcycle can reduce high traffic noise for up to 22.7% in a city with motorcycle as the dominant transport mode. This is based on study of Environmental impact of E-motorcycle<sup>94</sup>, where suggesting the proportion of noise levels above 75dB(A) decreased significantly from 82.6% to 59.9% due to replacement of fossil-fueled motorcycle to E-motorcycle.

### **High-level Noise Impact**

In the case of Bali, in considering the road network characteristic where restrict travel speed at moderate level, and vehicle ownership that is dominated by motorcycle, transition to e-mobility will be looking at potential noise reduction due to motorcycle. Now depending on the density and usage of motorcycle traffic flow, the above % of noise level decrease can potentially be expected, subject to a more detailed analysis.

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93 A Habibi, W. Sutopo, 2020. IOP Conf. Ser.: Mater. Sci. Eng 943012048. Source: <https://iopscience.iop.org/article/10.1088/1757-899X/943/1/012048/pdf>

94 Sheng N, Zhou X, Zhou Y, 2016. Environmental impact of electric motorcycles: Evidence from traffic noise assessment by a building-based data mining technique. Source: [https://www.researchgate.net/publication/297594345\\_Environmental\\_impact\\_of\\_electric\\_motorcycles\\_Evidence\\_from\\_traffic\\_noise\\_assessment\\_by\\_a\\_building-based\\_data\\_mining\\_technique](https://www.researchgate.net/publication/297594345_Environmental_impact_of_electric_motorcycles_Evidence_from_traffic_noise_assessment_by_a_building-based_data_mining_technique)

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