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ASEAN Alternative Vehicle Technology Portal (A2VTP) and Outlook



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Economic Research Institute for ASEAN and East Asia

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Economic Research Institute for ASEAN and East Asia (ERIA)

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Preface

In accordance with the contract for the ASEAN Alternative Vehicle Technology Portal (A2VTP) and Outlook under ERIA Reference Number ERIA/DEA-1-4-2402/06/FY24 with the Civil and Environmental Engineering Research Center (UP2M), Faculty of Engineering, University of Indonesia (FTUI), this Final Report has been prepared. The report reflects the project's achievements and provides an overview of the activities undertaken throughout the project period.

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List of Abbreviations and Acronyms

ACFA	Asian Clean Fuels Association
ADB	Asian Development Bank
AEDP	Alternative Energy Development Plan (Thailand)
AFV	Alternative Fuel Vehicle
ASEAN	Association of Southeast Asian Nations
A2VTP	ASEAN Alternative Vehicle Technology Portal
BAU	Business as Usual
BBNKB	Bea Balik Nama Kendaraan Bermotor
BEV	Battery Electric Vehicle
BNEF	Bloomberg New Energy Finance
BOI	Board of Investment (Thailand)
CBU	Completely Built-Up
CKD	Completely Knocked Down
CO_2	Carbon Dioxide
COP21	21st Conference of the Parties (UNFCCC)
DAC	DAC Solution
DLT	Department of Land Transport (Thailand)
EEP	Energy Efficiency Plan (Thailand)
EGAT	Electricity Generating Authority of Thailand
ERIA	Economic Research Institute for ASEAN and East Asia
EST	Environmentally Sustainable Transport
EV	Electric Vehicle
EV 3.0/3.5	Thailand Electric Vehicle Incentive Schemes
FHEV	Full Hybrid Electric Vehicle
GAIKINDO	Gabungan Industri Kendaraan Bermotor Indonesia
GDP	Gross Domestic Product
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas

GTFS	Green Technology Financing Scheme (Malaysia)
HEV	Hybrid Electric Vehicle
ICE	Internal Combustion Engine
IEA	International Energy Agency
IMF	International Monetary Fund
INDC	Intended Nationally Determined Contribution
IREP	Institute of Renewable Energy Promotion (Lao PDR)
JETP	Just Energy Transition Partnership
LCGC	Low Cost Green Car
LCEV	Low Carbon Emission Vehicle
MAA	Malaysian Automotive Association
MEA	Metropolitan Electricity Authority (Thailand)
MGTC	Malaysian Green Technology and Climate Change Corporation
MITI	Ministry of International Trade and Industry (Malaysia)
MHEV	Mild Hybrid Electric Vehicle
NAP	National Automotive Policy (Malaysia)
NDC	Nationally Determined Contribution
NEP	National Energy Plan (Thailand)
NEV	New Energy Vehicle
NSEDP	National Socio-Economic Development Plan
PDP	Power Development Plan
PDP8	National Electricity Development Plan VIII (Viet Nam)
PEA	Provincial Electricity Authority (Thailand)
PHEV	Plug-in Hybrid Electric Vehicle
PKB	Pajak Kendaraan Bermotor
PMO	Prime Minister's Office
PPnBM	Pajak Penjualan atas Barang Mewah
PPP	Purchasing Power Parity
QD-TTg	Prime Minister's Decision (Viet Nam)
SDGs	Sustainable Development Goals
SMR	Small Modular Reactor

TAI	Thailand Automotive Institute
TAPMA	Thai Auto-Parts Manufacturers Association
TKDN	Tingkat Komponen Dalam Negeri
TTW	Tank-to-Wheel
UI	University of Indonesia
UN DESA	United Nations Department of Economic and Social Affairs
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
WEO	World Economic Outlook
WPP	World Population Prospects
xEV	Electrified Vehicle (including HEV, PHEV, BEV)
ZEV	Zero Emission Vehicle

Executive Summary

The ASEAN Alternative Vehicle Technology Portal (A2VTP) and Outlook Report provides a comprehensive assessment of vehicle market developments and the transition towards alternative and electrified vehicle technologies across selected ASEAN Member States. The report is designed as a companion document to the A2VTP web portal, enabling policymakers, researchers, industry stakeholders, and the general public to understand clearly how data are collected, how projections are generated, and how technology-specific forecasts are derived. A central objective of the report is to ensure methodological transparency and replicability so that the analytical approach can be applied by other countries or institutions using comparable datasets.

The analysis focuses on five ASEAN countries – Indonesia, Thailand, Malaysia, Viet Nam, and Lao PDR – which together represent a wide spectrum of automotive market sizes, income levels, industrial capacities, and stages of electrification. While these countries face common regional challenges related to emissions reduction, energy security, and sustainable mobility, their transition pathways differ substantially due to variations in market maturity, policy frameworks, and institutional capacity. The report situates national vehicle market developments within a broader ASEAN context, enabling both country-specific interpretation and regional comparison.

The analytical foundation of the report is a harmonised data framework developed through close collaboration between ERIA, the University of Indonesia, DAC Solution, and national experts from participating countries. Data collection covers 10 core categories, including vehicle sales and stock by propulsion type, energy prices, charging infrastructure, vehicle technology characteristics, and policy instruments. Although data availability varies across countries – particularly for cost, usage, and performance parameters – the report explicitly documents data gaps and limitations. Historical datasets for population and GDP per capita are generally robust across all countries and serve as the primary inputs for the projection framework, while vehicle market data show greater variation in completeness, with Indonesia and Thailand providing the most consistent historical series. Forecasting inputs under a business-as-usual (BAU) scenario are available for all five countries for the period up to 2032, enabling consistent cross-country comparison while acknowledging the absence of spatial indicators such as road network expansion.

To avoid black-box modelling and ensure replicability, the outlook applies a parsimonious macro-level projection approach. Total vehicle ownership and sales are estimated using a log-linear regression model with population and GDP per capita (in purchasing power parity terms) as explanatory variables, drawing on established literature in transport demand forecasting. The model is calibrated using harmonised historical data for the period 2011–2022 and projected forward to 2030 under BAU assumptions. Model performance differs across countries, reflecting structural differences in motorisation patterns and data quality. Thailand and Malaysia exhibit strong and economically intuitive relationships between

vehicle ownership and income growth, while Indonesia and Lao PDR show weaker statistical significance, indicating the influence of unobserved factors such as urbanisation, infrastructure constraints, and policy interventions. Viet Nam's results reflect transitional dynamics in a market characterised by strong two-wheeler dominance and evolving regulatory conditions. These variations highlight the need for country-specific interpretation when applying uniform macro-level models across heterogeneous economies.

Under BAU conditions, projected total vehicle sales trajectories diverge significantly across the five countries. Thailand and Malaysia are expected to experience sustained growth towards 2030, driven primarily by rising incomes and relatively mature automotive markets. Indonesia is projected to see slower but steady growth, reflecting a stabilising market in the absence of major policy or economic shocks. In contrast, Viet Nam and Lao PDR are projected to face stagnating or declining vehicle sales, suggesting structural constraints on car ownership growth and the presence of alternative mobility pathways. These projections serve as baseline references rather than policy-driven scenarios and provide a benchmark against which national targets and intervention strategies can be evaluated.

A key contribution of this report is the transparent decomposition of total vehicle sales into propulsion-specific categories, including ICE gasoline, ICE diesel, and electrified vehicles (xEVs). Recognising that macroeconomic ownership models do not directly explain technology choice, the report adopts an exogenous splitting approach based on regional technology adoption trajectories. Propulsion shares are derived from BloombergNEF regional outlook trends, which capture expected cost reductions, technology learning effects, infrastructure deployment, and global electrification dynamics. These trends are applied consistently across countries to allocate projected total vehicle sales into technology-specific categories. All intermediate results – including total sales, assumed technology shares, and resulting propulsion-specific sales – are explicitly presented in tables, ensuring full transparency and allowing readers to replicate the methodology using their own data.

At the ASEAN level, the results indicate a gradual decline in the dominance of internal combustion engine vehicles and a steady increase in electrified vehicle adoption towards 2030, with acceleration expected beyond the late 2020s. However, the pace and composition of this transition vary significantly across countries, reflecting differences in policy ambition, market readiness, industrial strategy, and supporting infrastructure. The findings underscore that, under BAU conditions, macroeconomic growth alone is insufficient to deliver rapid vehicle electrification. Instead, EV penetration outcomes are highly sensitive to policy design, incentive structures, and ecosystem readiness. These regional patterns are broadly consistent with global trends reported in the IEA's Global EV Outlook, which documents rapid growth in EV sales worldwide but also persistent gaps between frontrunner and emerging markets (International Energy Agency, 2023).

The report highlights several cross-cutting policy insights relevant to ASEAN countries. Consistency and predictability of incentives are critical for building long-term investor and consumer confidence. Technology-neutral or technology-inclusive policy frameworks – covering HEVs, PHEVs, and BEVs – can facilitate smoother transition pathways, particularly in markets where full electrification may not be immediately feasible. Aligning vehicle incentives with broader industrial policy objectives, such as local manufacturing and supply chain development, can enhance long-term economic benefits. Finally, strengthening data governance, harmonisation, and forecasting capacity across the transport sector will be essential for improving future modelling efforts and supporting evidence-based policymaking.

Together, the A2VTP web portal and this outlook report provide an integrated platform for understanding vehicle market transitions in ASEAN. While the portal offers interactive visualisations of key indicators and projections, this report documents the underlying data sources, assumptions, and methodologies. By making these processes explicit, the report supports informed policy dialogue, regional learning, and more effective decision-making towards a sustainable and low-emission mobility future in ASEAN.

Chapter 1
Introduction

1.1. Background

The road transport sector plays a critical role in shaping energy demand, economic activity, and environmental outcomes across the Association of Southeast Asian Nations (ASEAN). Over the past two decades, rapid economic growth, urbanisation, and rising household incomes have driven a steady increase in vehicle ownership and usage throughout the region. Empirical evidence consistently shows that motorisation follows economic development, particularly in emerging economies where income growth expands household purchasing power and access to private vehicles (Dargay et al., 2007; Liddle, 2009).

As a consequence, transport has emerged as one of the fastest-growing sources of final energy consumption and greenhouse gas emissions. In many ASEAN countries, road transport already accounts for a substantial share of total final energy demand, with passenger cars and motorcycles powered by internal combustion engines (ICEs) dominating the vehicle fleet. Without structural change, continued income and population growth are expected to reinforce this trend, increasing pressure on energy systems, fuel imports, and urban air quality (Brand et al., 2019). At the global level, energy-related CO_2 emissions rebounded strongly in 2021 as economic activity recovered from the COVID-19 pandemic, with transport emissions playing a major role in this increase (International Energy Agency, 2021). Recent global assessments underscore that deep and rapid emission reductions in the transport sector are essential to keep warming in line with the Paris Agreement temperature goals (Intergovernmental Panel on Climate Change, 2022). In the Indochina subregion, motorcycles and other two-wheelers are particularly pervasive, serving as the primary mode of transport for a large share of the population (Asian Clean Fuels Association, 2013).

In response to these challenges, ASEAN Member States have increasingly promoted alternative and low-emission vehicle technologies, including hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and battery electric vehicles (BEVs). However, the pace and structure of this transition vary significantly across countries due to differences in economic development, industrial capacity, infrastructure readiness, and policy frameworks. Studies on vehicle technology diffusion suggest that such transitions are rarely uniform and are strongly shaped by national context and market maturity (Meyer and Winebrake, 2009).

Against this backdrop, understanding future vehicle market dynamics requires transparent and replicable analytical frameworks. In particular, policymakers and stakeholders need projections that clearly explain how macroeconomic development translates into vehicle

ownership growth, vehicle sales, and changes in propulsion technology composition. Macro-level vehicle ownership models based on income and population have been widely applied in the literature to capture long-term trends, especially in contexts where detailed micro-level data are limited (Wang, 2011; Liddle, 2009).

This report is positioned as an analytical companion to the ASEAN Alternative Vehicle Technology Portal (A2VTP). It aims to document, in a transparent manner, how vehicle market projections are constructed, how alternative vehicle technologies are represented, and how resulting figures can be interpreted under a business-as-usual assumption, thereby avoiding black-box representations of forecast outcomes..

1.2. Purpose and Objective

The purpose of this report is to support evidence-based understanding of vehicle market developments and alternative vehicle technology transitions in selected ASEAN countries. Specifically, the report documents the methodological foundation underlying the ASEAN Alternative Vehicle Technology Portal (A2VTP) and ensures that all published projections can be traced through explicit assumptions, data sources, and calculation steps.

The objectives of this study are threefold:

a. To provide an up-to-date overview of road vehicle market conditions and trends in selected ASEAN countries, with particular attention to the evolving role of alternative and electrified vehicle technologies, as discussed in the broader literature on motorisation and energy transition (Dargay et al., 2007; Brand et al., 2019).
b. To establish a transparent and harmonised projection framework for vehicle ownership and vehicle sales based on population and GDP per capita, enabling consistent comparison across countries with heterogeneous data availability (Liddle, 2009; Wang, 2011).
c. To support the A2VTP web portal by clearly documenting the modelling approach, intermediate calculation steps, and assumptions used to generate baseline projections of total vehicle sales and propulsion technology splits, ensuring that the results are replicable by external users with access to similar data.

The report does not aim to forecast market outcomes under specific policy interventions. Instead, it provides a neutral, business-as-usual baseline that can serve as a reference for scenario analysis, policy evaluation, and regional comparison.

1.3. Methodology

1.3.1. General Precondition and Policy Context

The vehicle market projections in this study are developed under a business-as-usual (BAU) macroeconomic framework, while explicitly acknowledging the presence of national and regional policy targets that shape long-term technology adoption pathways. Across ASEAN,

government policies increasingly support vehicle electrification through a combination of sales targets, fiscal incentives, infrastructure deployment, and regulatory measures.

In Indonesia, national policy documents such as the National Energy Transition Roadmap set an indicative target of electric vehicles accounting for approximately 20% of new passenger car sales by 2030, supported by purchase incentives, import duty exemptions, and local content requirements under the Low Carbon Emission Vehicle (LCEV) framework. Similar policy signals are observed in Thailand, Malaysia, and Viet Nam, albeit with varying ambition and implementation timelines. These policy commitments provide an important contextual boundary for interpreting long-term projections, even though the core quantitative model does not endogenously simulate policy shocks or behavioural responses.

Indonesia's regulatory framework for low-carbon vehicles has evolved rapidly over the past few years. An initial decree on battery electric vehicles set technical specifications, a development roadmap, and local content requirements, signalling the government's intention to build a domestic EV manufacturing base (Ministry of Industry Indonesia, 2020). This was followed by the Low Carbon Emission Vehicle regulation, which broadened the scope of eligible technologies and linked industrial policy with emission-reduction objectives in the transport sector (Ministry of Industry Indonesia, 2021). More recently, an updated decree on battery electric vehicles has refined technical standards and localisation targets, aligning industrial incentives with the next phase of EV deployment and supply-chain development (Ministry of Industry Indonesia, 2023).

Accordingly, the projections presented in this report should be interpreted as policy-consistent baselines, rather than policy-optimised scenarios. Policy targets inform the interpretation of technology split trajectories but do not directly alter the underlying macroeconomic demand model. For Thailand, the latest dissemination of its NDC 3.0 outlines an enhanced, economy-wide greenhouse gas reduction target and sectoral mitigation guidelines that frame long-term transport decarbonisation pathways (Department of Climate Change and Environment, 2025). In Malaysia's case, transport-sector mitigation efforts are anchored in its Nationally Determined Contribution submitted to the UNFCCC, which sets out emission reduction commitments and highlights low-carbon transport as a key area for action (United Nations Framework Convention on Climate Change, 2021).

1.3.2. Estimation of Total Vehicle Sales

Total vehicle sales are derived through a two-step macro-level approach. First, total vehicle stock is estimated using a log-linear regression model based on population and GDP per capita. This approach is widely applied in national and regional vehicle ownership studies, particularly where long historical time series of detailed vehicle market data are limited (Dargay et al., 2007; Liddle, 2009). Early work on car ownership and use also demonstrated the usefulness of parsimonious income- and population-based models for long-term demand analysis (Khan and Willumsen, 1986).

The general form of the ownership model is:

$$\ln V_t = \alpha + \beta_1 \ln Pop_t + \beta_2 \ln GDP_t \quad (0.1)$$

where V_t denotes total vehicle stock in year t, Pop_t represents population, and GDP_t refers to GDP per capita in purchasing power parity (PPP) terms.

$$Sales_t = (V_t - V_{t-1}) + Scrappage_t \quad (0.2)$$

Vehicle sales are often derived by adjusting changes in vehicle stock with vehicle retirement based on an assumed average vehicle lifetime (Wang, 2011). However, this approach is not directly applicable in the ASEAN context, as registered vehicle data do not consistently reflect cumulative sales net of retirements. Vehicles are frequently not formally deregistered, and registration data are influenced by administrative practices rather than actual fleet turnover.

Therefore, this study estimates annual vehicle sales using a simplified identity-based formulation:

$$Sales_t = (V_t - V_{t-1}) \quad (0.3)$$

Annual vehicle sales are calculated from changes in vehicle full stock. This identity-based formulation avoids black-box estimation and ensures full traceability of results.

1.3.3. Technology Categorisation Framework (ICE, xEV, Diesel, Gasoline)

For the purpose of technology disaggregation, total vehicle sales are divided into four broad propulsion categories:

a. Gasoline ICE vehicles
b. Diesel ICE vehicles
c. xEV, comprising HEV, PHEV, and BEV
d. Other minor technologies, which are not modelled explicitly due to negligible market shares

This categorisation reflects both current market structure in ASEAN and the reporting format used in major global vehicle outlooks. Gasoline and diesel ICE vehicles are treated as separate categories to capture differences in fuel characteristics, regulatory treatment, and market dynamics across ASEAN countries.

In several ASEAN markets, including Thailand, diesel-powered vehicles account for a substantial share of light-duty vehicle sales, alongside their continued importance in commercial and freight segments. As such, distinguishing diesel ICE from gasoline ICE allows these structural differences across countries to be better reflected in the analysis, while maintaining consistency with international reporting practices.

1.3.4. Methodology for Splitting Total Vehicle Sales Using BloombergNEF Trends

The split of total vehicle sales by propulsion technology is conducted exogenously, using technology adoption trends from BloombergNEF (BNEF) as a reference trajectory. This approach is consistent with scenario-based outlook methodologies, where aggregate demand is estimated independently from technology diffusion assumptions to preserve transparency and replicability (Meyer and Winebrake, 2009).

BloombergNEF projections indicate a rapid acceleration of electric vehicle adoption in Southeast Asia after the mid-2020s, following a slower initial uptake compared to global averages. While ASEAN EV penetration lags global trends by approximately one-third until 2030, the region is expected to experience a steep increase in EV market share thereafter, driven by cost reductions, policy alignment, and infrastructure expansion (BloombergNEF, 2023). This projected adoption pathway is illustrated in Figure 1.1.

Figure 1.1. Market and xEV Adoption Ratio Simulation for ASEAN

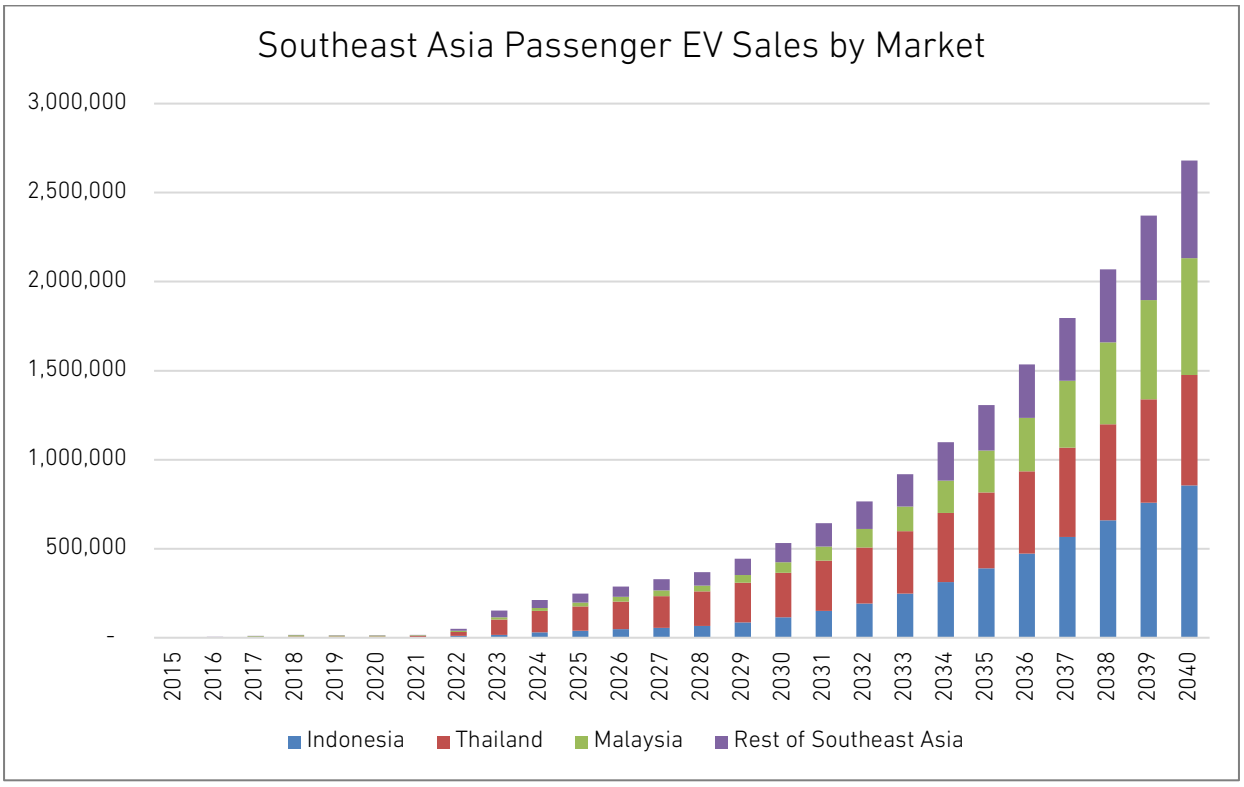
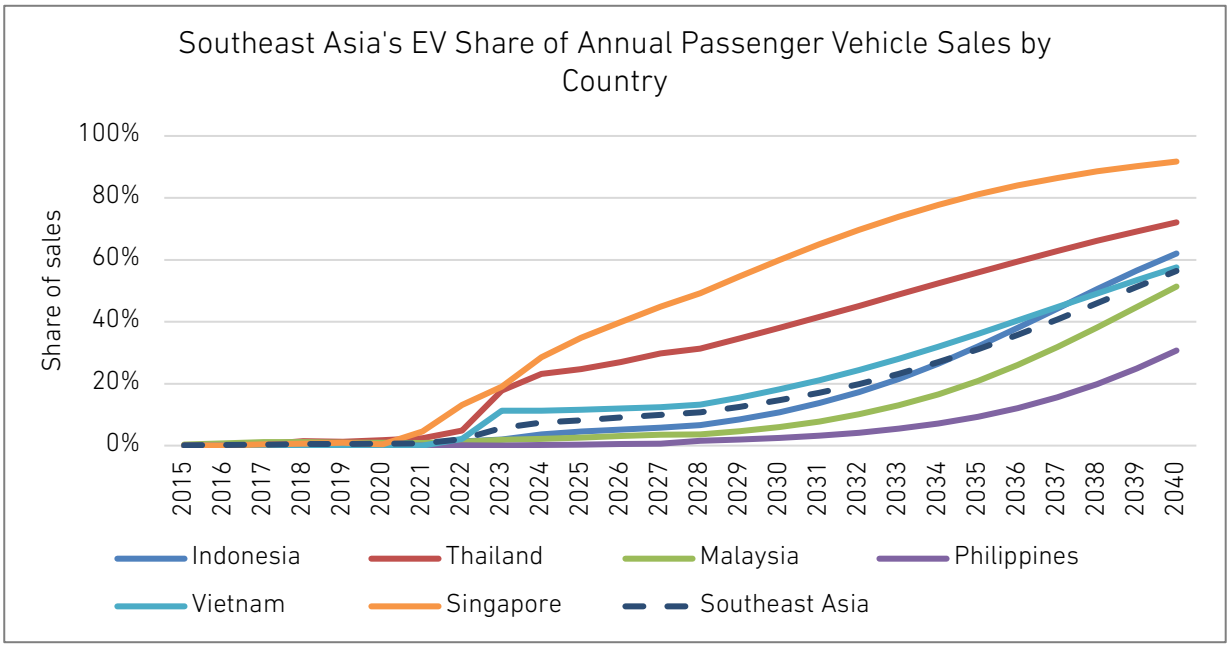


Figure 1.1. *Continued*



Source: Authors, based on data of BloombergNEF (2023).

Formally, total vehicle sales in year t are split as follows:

$$Sales_t^{tech} = Sales_t \times Share_t^{tech} \quad (0.4)$$

where $Share_t^{tech}$ represents the propulsion-specific sales share derived from BNEF regional outlook trends and adjusted for country context.

Table 1.1 presents the BloombergNEF database used as the basis for the regional technology adoption assumptions, including annual vehicle sales, cumulative vehicle fleets, and projected EV shares across Southeast Asia.

Table 1.1. Southeast Asia Vehicle Database

Southeast Asia's annual passenger vehicle sales by country

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
BEV	54	58	375	498	1,402	1,515	5,003	33,545	138,076	195,383	229,337	265,659	303,632
PHEV	2,275	4,198	8,168	13,994	11,499	10,676	10,923	16,866	15,250	16,426	19,190	22,084	24,712
HEV	13,297	15,554	25,531	34,615	40,277	41,227	59,766	112,629	190,696	275,818	373,153	466,674	585,184
ICE	2,237,013	2,364,270	2,473,059	2,546,568	2,524,292	1,758,777	1,992,004	2,302,484	2,341,751	2,376,425	2,420,141	2,425,609	2,384,566
Total	**2,252,639**	**2,384,080**	**2,507,133**	**2,595,675**	**2,577,470**	**1,812,195**	**2,067,696**	**2,465,524**	**2,685,773**	**2,864,052**	**3,041,821**	**3,180,027**	**3,298,094**

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
BEV	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036	2,037	2,038	2,039	2,040
PHEV	334,643	406,979	486,736	601,088	730,733	896,956	1,089,836	1,306,715	1,534,601	1,795,948	2,068,256	2,371,498	2,680,324
HEV	33,276	36,298	46,064	41,788	34,175	22,302	9,132	-	-	-	-	-	-
ICE	731,102	877,723	1,009,986	1,119,354	1,178,890	1,217,092	1,221,886	1,200,242	1,151,570	1,093,596	1,018,844	945,241	867,058
Total	**2,315,775**	**2,212,381**	**2,100,139**	**2,005,485**	**1,899,239**	**1,828,033**	**1,758,739**	**1,687,883**	**1,602,221**	**1,516,536**	**1,413,218**	**1,312,466**	**1,203,761**

Table 1.1. *Continued*

Southeast Asia's cumulative passenger vehicle fleet by country

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
BEV	134	192	567	1,065	2,467	3,982	8,985	42,528	180,595	375,970	605,277	870,905	1,174,483
PHEV	4,451	8,649	16,817	30,811	42,310	52,986	63,909	80,772	95,894	111,972	130,512	151,549	173,987
HEV	135,536	150,375	185,943	218,608	258,070	292,232	345,021	433,002	615,836	870,862	1,211,958	1,643,261	2,206,666
ICE	32,141,687	34,020,004	35,979,134	37,972,042	39,918,243	40,985,153	42,165,179	43,971,395	44,569,387	45,157,924	45,249,798	45,207,404	45,313,501
Total	**32,281,808**	**34,179,220**	**36,182,461**	**38,222,526**	**40,221,090**	**41,334,353**	**42,583,094**	**44,527,697**	**45,461,712**	**46,516,727**	**47,197,545**	**47,873,119**	**48,868,636**

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
BEV	1,509,067	1,915,672	2,401,910	3,001,596	3,730,814	4,622,767	5,679,059	6,847,698	8,186,916	9,753,527	11,556,123	13,623,990	15,969,671
PHEV	203,065	231,195	263,265	293,554	317,053	328,432	320,698	305,448	289,022	269,831	247,747	223,035	189,759
HEV	2,924,471	3,786,640	4,771,095	5,855,833	6,994,446	8,170,311	9,332,430	10,420,044	11,380,918	12,198,695	12,844,387	13,322,954	13,604,828
ICE	45,392,263	45,240,374	44,867,454	44,326,371	43,701,317	43,770,574	43,537,310	42,924,542	42,195,638	41,343,710	40,342,540	39,233,388	38,054,909
Total	**50,028,866**	**51,173,880**	**52,303,723**	**53,477,354**	**54,743,630**	**56,892,084**	**58,869,497**	**60,497,731**	**62,052,493**	**63,565,764**	**64,990,798**	**66,403,367**	**67,819,168**

Table 1.1. *Continued*

Southeast Asia's EV share of annual passenger vehicle sales by country

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Indonesia	0%	0%	0%	0%	0%	0%	0%	1%	2%	4%	5%	5%	6%
Thailand	0%	0%	0%	1%	1%	2%	2%	5%	18%	23%	25%	27%	30%
Malaysia	0%	1%	1%	1%	1%	1%	1%	1%	2%	2%	3%	3%	4%
Philippines	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
Viet Nam	0%	0%	0%	0%	0%	0%	0%	2%	11%	11%	12%	12%	12%
Singapore	0%	0%	0%	1%	1%	0%	5%	13%	19%	29%	35%	40%	45%
Southeast Asia	**0%**	**0%**	**0%**	**1%**	**1%**	**1%**	**1%**	**2%**	**6%**	**7%**	**8%**	**9%**	**10%**

Southeast Asia's EV share of annual passenger vehicle sales by country

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Indonesia	7%	8%	11%	14%	17%	22%	26%	32%	38%	44%	51%	57%	62%
Thailand	31%	35%	38%	42%	45%	49%	52%	56%	59%	63%	66%	69%	72%
Malaysia	4%	5%	6%	8%	10%	13%	17%	21%	26%	32%	38%	45%	51%
Philippines	2%	2%	3%	3%	4%	5%	7%	9%	12%	16%	20%	25%	31%
Viet Nam	13%	16%	18%	21%	24%	28%	32%	36%	40%	45%	49%	53%	58%
Singapore	49%	55%	60%	65%	70%	74%	78%	81%	84%	86%	89%	90%	92%
Southeast Asia	**11%**	**13%**	**15%**	**17%**	**20%**	**23%**	**27%**	**31%**	**36%**	**41%**	**46%**	**51%**	**56%**

Hybrid share of annual passenger vehicles sales in Southeast Asia

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Indonesia	0%	0%	1%	7%	12%	17%	21%	25%	30%	34%	37%
Thailand	6%	9%	15%	17%	20%	24%	28%	33%	39%	43%	46%
Others	2%	2%	3%	4%	5%	6%	7%	9%	11%	14%	16%
Southeast Asia	**2%**	**3%**	**5%**	**7%**	**10%**	**12%**	**15%**	**18%**	**21%**	**25%**	**28%**

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Indonesia	39%	40%	40%	39%	37%	34%	31%	28%	24%	21%
Thailand	47%	47%	45%	43%	40%	37%	34%	31%	28%	26%
Singapore	18%	20%	21%	21%	20%	19%	18%	17%	16%	14%
Southeast Asia	**30%**	**31%**	**31%**	**30%**	**29%**	**27%**	**25%**	**23%**	**20%**	**18%**

Source: BloombergNEF (2023).

1.3.5. Treatment of xEV Adoption

In cases where differences arise between national EV targets and BloombergNEF (BNEF) estimates, the modelling framework prioritises BNEF projections as the primary quantitative baseline, while national policy targets are used as qualitative boundary checks. This approach ensures internal consistency across countries and avoids embedding aspirational or normative policy targets directly into the demand model.

Country-specific EV policies – such as Indonesia's LCEV incentives, Malaysia's NAP and Low Carbon Mobility Blueprint, Thailand's 30-by-30 target, Viet Nam's green transport roadmap, and Lao PDR's EV targets under its NDC – inform the relative composition of xEV technologies (HEV, PHEV, BEV) rather than overriding the overall adoption trajectory. As a result, xEV splitting reflects observed policy emphasis and market readiness in each country, while remaining anchored to harmonised regional outlooks provided by BNEF.

1.3.6. Diesel Vehicle Trajectory

Diesel engines are expected to continue playing an important role in ASEAN vehicle markets through 2030, reflecting the structural characteristics of several national vehicle markets. In a number of ASEAN countries, diesel-powered vehicles account for a substantial share of both commercial and light-duty vehicle sales, although the magnitude and composition of this share vary by country.

Thailand represents a notable example, where diesel-fuelled vehicles have historically dominated the light-duty segment, particularly in pickup trucks and utility vehicles, which form a large proportion of total passenger vehicle sales. Studies on Thailand's vehicle market indicate that diesel-powered light-duty vehicles have, for many years, accounted for a higher share of the vehicle stock and new registrations than gasoline-powered counterparts, reflecting fuel pricing policies, vehicle taxation structures, and consumer preferences (Thai–German Cooperation Programme, 2024).

Similar patterns, though to varying degrees, are also observed in other ASEAN countries where diesel fuel plays an important rola beyond heavy-duty and freight applications. These market characteristics support the treatment of diesel ICE vehicles as a distinct category in the analysis, separate from gasoline ICE vehicles, in order to capture fuel-specific trends and policy impacts.

Despite their current significance, the share of diesel vehicles in new sales is projected to decline gradually across ASEAN. This decline is driven by increasingly stringent emission standards, rising concerns over local air pollution, and the expansion of electrified alternatives across multiple vehicle segments (Brand et al., 2019). Policy instruments promoting low-carbon and low-emission vehicles have accelerated the uptake of hybrid and electric vehicles, particularly in passenger and light commercial segments where diesel has traditionally been strong.

BloombergNEF projects that diesel and gasoline trucks in ASEAN will decline from nearly 100% of new sales in 2022 to approximately 45% by 2040, implying a gradual but

accelerating reduction beginning in the latter half of the 2020s (BloombergNEF, 2023). This declining trend is incorporated into the sales split by progressively reducing diesel shares in new vehicle sales, while recognising their continued importance in the existing vehicle stock.

1.3.7. Gasoline ICE Phase-Down

Gasoline ICE vehicle sales are assumed to peak around or before 2030 in Indonesia and several other ASEAN countries, followed by a sustained decline as xEV adoption accelerates. This assumption aligns with global projections indicating that total ICE vehicle stock will peak by 2030, with transport-related fuel demand declining by approximately 20% by 2040 relative to 2019 levels (BloombergNEF, 2023).

Although Southeast Asia is expected to lag advanced economies in EV adoption prior to 2030, post-2030 acceleration is anticipated as market conditions converge with global trends. Gasoline ICE vehicles therefore play a diminishing role in new sales beyond 2030, even as they continue to dominate the legacy fleet.

1.3.8. Methodological Implications and Limitations

By separating total vehicle demand estimation from technology splitting, this methodology ensures that all published results can be traced through explicit and replicable steps. However, the approach does not capture endogenous consumer choice, price feedback effects, or short-term policy shocks. As highlighted in previous studies, such factors can significantly influence observed market outcomes, particularly during periods of rapid policy change (Brand et al., 2019).

Accordingly, the projections should be interpreted as baseline, trend-consistent trajectories, suitable for regional comparison and policy dialogue rather than precise forecasts of realised sales outcomes.

Chapter 2
Analysis Dataset

2.1. Data Collection and Dataset Availability

This section presents a comprehensive description of the data collection process and dataset availability underpinning the analytical and projection components of the A2VTP study. Given the multi-country scope of the project and the heterogeneity of statistical systems, institutional arrangements, and data governance practices across ASEAN Member States, data compilation was designed to ensure analytical robustness while remaining sensitive to national contexts and practical constraints.

As this report will be published on the ERIA website, all information included in this section is intended for public dissemination. Any information collected for internal co-ordination purposes has therefore been excluded. To ensure accessibility for a broad audience, including policymakers, researchers, and practitioners, data availability is communicated using clear and intuitive indicators, such as the ✓ symbol, rather than detailed internal timelines or administrative references.

2.1.1. Collaboration Working Group and Data Governance

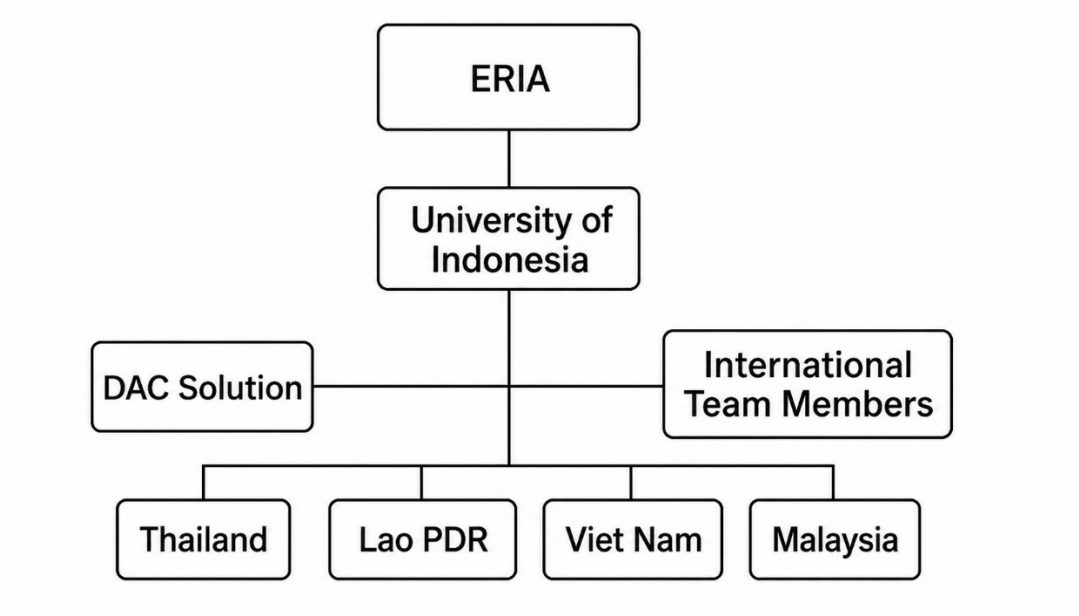
Data collection for this project is carried out through structured collaboration amongst multiple institutions, each contributing distinct expertise essential for achieving the project's objectives. The overall co-ordination structure comprises ERIA as the supervising institution, the University of Indonesia (UI) as the main research consultant, DAC Solution as the IT consultant, and international team members from Indonesia, Thailand, Malaysia, Viet Nam, and Lao PDR.

ERIA provides strategic oversight and ensures that the project aligns with regional policy priorities and reporting standards. The University of Indonesia leads the analytical and methodological aspects of the study, including transport planning analysis, vehicle market assessment, policy interpretation, and the integration of country-level inputs into a harmonised regional framework. DAC Solution supports the project by developing and maintaining the technological infrastructure required for data management, real-time collaboration, and integration with the A2VTP web portal.

International country experts play a critical role in compiling, validating, and contextualising national datasets. These experts contribute data on transportation systems, vehicle technologies, policy frameworks, and market conditions specific to their respective countries. Their involvement ensures that national submissions accurately reflect local regulatory environments, statistical conventions, and practical realities, thereby enhancing the credibility and relevance of cross-country comparisons.

Rather than presenting lengthy narrative descriptions of individual roles, the organisational structure of the project is illustrated through an organogram in Figure 2.1. This visual representation highlights the relationships between ERIA, the UI core team, DAC Solution, and international experts, and clarifies co-ordination flows, communication channels, and institutional responsibilities across all participating entities. The organogram supports transparency in project governance and facilitates a clear understanding of collaborative workflows throughout the data collection and analysis process.

Figure 2.1. Organogram of Project Team Structure



Source: Authors' analysis (2025).

The collaborative mechanism established through this structure ensures that data collection covers all key analytical dimensions required for the study, while also enabling continuous feedback and validation amongst technical experts, analysts, and institutional partners.

2.1.2. Dataset Requirements for the Project

The dataset requirements for this project are defined to support a comprehensive assessment of vehicle markets and alternative vehicle technologies across ASEAN, while recognising differences in national data availability, institutional capacity, and reporting practices. The data framework is designed to capture both current conditions and long-term trends relevant to transport demand, energy consumption, and technology transition.

In total, ten core data categories were identified as essential for the analysis. These categories span policy, vehicle market structure, technology characteristics, cost

parameters, energy prices, and infrastructure availability. Together, they form the minimum dataset required to support the analytical and projection components of the A2VTP study.

A key principle guiding data collection is contextual relevance. Not all indicators apply uniformly across countries, and imposing identical data requirements would risk misrepresenting national realities. For example, variables related to vehicle production, export, or domestic manufacturing capacity are highly relevant for countries with established automotive industries but less applicable for countries that rely primarily on vehicle imports. Similarly, national differences in transport infrastructure, energy mix, EV policy support, and economic structure necessitate flexibility in data submission.

Within this framework, particular attention is given to the following vehicle technology categories:

a. Internal Combustion Engine (ICE) vehicle data
   For countries where ICE vehicles remain dominant – namely Indonesia, Thailand, Malaysia, Viet Nam, and Lao PDR – data collection focuses on disaggregating vehicle sales, production, imports, exports, and stock by fuel type, particularly gasoline and diesel. This disaggregation provides critical insights into national fuel dependence, baseline emissions profiles, and the structure of existing vehicle fleets.

b. Electric Vehicle (EV) data
   For countries experiencing growing EV adoption, particularly Indonesia, Thailand, Malaysia, and Viet Nam, EV data are further disaggregated into Battery Electric Vehicles (BEV), Hybrid Electric Vehicles (HEV), and Plug-in Hybrid Electric Vehicles (PHEV). This level of detail supports analysis of electrification pathways, market maturity, and technology diffusion patterns across countries.

2.1.3. Dataset Availability Across Countries

Data collection was conducted for five Southeast Asian countries – Indonesia, Malaysia, Thailand, Viet Nam, and Lao PDR – with varying levels of completeness across the ten defined data categories. Table 2.1 presents a summary of dataset availability using a simple checklist format.

Indonesia has provided the most extensive dataset, covering all ten required categories. The submitted data include comprehensive ICE and New Energy Vehicle (NEV) statistics, detailed vehicle technology characteristics, cost-related parameters, energy prices, and infrastructure indicators. These submissions form a strong empirical foundation for the regional analysis and reflect Indonesia's consistent commitment to supporting the A2VTP initiative.

Malaysia, Thailand, Viet Nam, and Lao PDR have also contributed substantial datasets, particularly in core areas such as vehicle sales and stock, fuel prices, and charging infrastructure. However, gaps remain in several categories, especially those related to cost parameters, usage patterns, and vehicle performance characteristics. These differences

reflect broader variations in national data collection systems, institutional mandates, and resource availability.

Table 2.1. Data Collection Checklist

No	Data Category	Indonesia	Malaysia	Thailand	Viet Nam	Lao PDR
1	List of energy and transport policies related to alternative and new vehicle technologies	✓	✓	✓	✓	✗
2	Yearly data (up to 2023) on sales, production, export, import, and stock of conventional ICE vehicles, categorised by fuel type, engine size, and emission standards	✓	✓	✓	✓	✓
3	Yearly data (up to 2023) on sales, production, export, import, and stock of new and alternative energy vehicles (BEV, HEV, PHEV, etc.), categorised by battery size	✓	✓	✓	✓	✓
4	Estimates of average yearly new vehicle purchase prices, including tax components	✓	✓	✓	✓	✗
5	Yearly data on the number of charging stations, categorised by speed (regular, fast) and accessibility (semi-public, public)	✓	✓	✓	✓	✓
6	Estimates of average yearly mileage for conventional and alternative vehicles	✓	✓	✓	✗	✗
7	Estimates of fuel economy and battery efficiency for new vehicle entries	✓	✓	✓	✗	✗
8	Estimates of yearly average fuel prices (diesel, gasoline, CNG, LPG, etc.) and electricity tariffs	✓	✓	✓	✓	✓
9	Estimates of yearly average vehicle repair and maintenance costs	✓	✗	✓	✗	✗
10	Paper on alternative vehicles policy	✓	✓	✓	✗	✓

Source: Authors, 2025.

2.1.4. Historical Data Availability

Historical data availability is generally sufficient for key socioeconomic indicators that form the backbone of the analytical framework. Indicators such as population, gross domestic product (GDP) per capita, and, where available, total road length are consistently reported over multiple years and provide a stable empirical basis for examining long-term development trajectories and their implications for transport demand.

In contrast, the availability of historical data on Internal Combustion Engine (ICE) vehicle sales is uneven across countries. Indonesia maintains a relatively complete and continuous time series of ICE vehicle sales data spanning the period from 2011 to 2022, enabling detailed analysis of market dynamics and long-term trends. Thailand also provides historical ICE vehicle sales data, although the available series covers a shorter period from 2011 to 2019.

For Malaysia, Viet Nam, and Lao PDR, comparable historical ICE vehicle sales datasets are either incomplete, available only for limited years, or reported in aggregated form without disaggregation by fuel type or vehicle category. These limitations constrain the use of such data for rigorous longitudinal modelling and reflect broader challenges related to institutional capacity, data governance, and reporting priorities.

Where historical vehicle sales data are insufficient, the analysis relies on alternative approaches, including the use of vehicle stock proxies, macroeconomic indicators, and descriptive trend assessment. This ensures analytical consistency across countries while explicitly acknowledging data gaps and limitations.

2.1.5. Forecasting Data Availability

Forecasting data availability across the five countries remains uneven but has improved in recent years. For Indonesia, Malaysia, Thailand, Viet Nam, and Lao PDR, projections are now available for the period 2023–2032 under a Business-as-Usual (BAU) scenario. These forecasts include population and GDP per capita, as well as projections of vehicle sales and vehicle stock disaggregated by propulsion type, including ICE gasoline, ICE diesel, HEV, BEV, and PHEV.

The availability of harmonised BAU projections provides a valuable foundation for comparative analysis and scenario development. It enables consistent modelling of future vehicle market growth, electrification pathways, and energy demand across countries. The integration of propulsion-specific projections also supports more detailed assessment of decarbonisation trajectories and infrastructure needs.

However, a significant gap remains: none of the five countries provide forecasting data for total road length or road network expansion. This limitation restricts the ability to conduct spatially explicit analysis of transport infrastructure development, EV charging deployment, and geographic accessibility. As a result, the projections presented in this report focus on aggregate national-level trends rather than spatial dynamics.

2.1.6. Difficult-to-Obtain Data and Use of Alternative Sources

Several data points required for comprehensive vehicle market analysis are difficult to obtain due to the absence of systematic data collection and reporting mechanisms in many ASEAN countries. These variables often depend on private-sector information or individual behaviour and fall outside the scope of official statistical systems.

Examples include vehicle purchase prices, repair and maintenance costs, annual average mileage, real-world fuel economy, and battery efficiency for electric vehicles. These data are rarely collected by government agencies and, where available, exhibit substantial variation across regions, vehicle models, and usage conditions.

When such data cannot be obtained from primary sources, experts are encouraged to refer to reputable secondary sources, including academic literature, institutional research reports, international studies, and well-documented industry publications. The use of secondary data helps fill information gaps and ensures analytical continuity, provided that all assumptions and sources are clearly documented.

2.1.7. Implications of Data Limitations

The observed limitations in both historical and forecasting datasets highlight the importance of strengthening data governance frameworks within the transport sector across ASEAN. Improving the consistency, coverage, and granularity of vehicle market data would significantly enhance the robustness of future modelling efforts and policy evaluations.

Within the A2VTP framework, continued regional collaboration and harmonisation of data collection practices are therefore essential. While the current dataset provides a strong foundation for baseline analysis and regional comparison, further improvements – such as enhanced temporal continuity, greater spatial detail, and integration with behavioural data – would support more advanced modelling and more targeted policy analysis in future iterations of the portal and outlook report.

2.2. Projection Simulation Outlook

2.2.1. Introduction

This section presents the projection simulation results developed under the A2VTP analytical framework, with the objective of illustrating future vehicle market trajectories across selected ASEAN countries under a business-as-usual (BAU) scenario. The simulation is designed not only to generate forward-looking estimates but also to explain, in a transparent and replicable manner, how aggregate vehicle demand and technology composition evolve over time.

At the regional level, ASEAN countries are navigating heterogeneous pathways toward low-emission and sustainable mobility. These pathways are shaped by global electrification trends, international climate commitments, technological progress, and national policy priorities. While Thailand, Indonesia, Viet Nam, and Malaysia are emerging as key EV

markets and production bases, other ASEAN Member States are progressing more gradually through pilot initiatives, regulatory preparation, and infrastructure development.

Within this regional landscape, Indonesia occupies a strategically important position. As the largest vehicle market in ASEAN and a country with ambitious long-term climate commitments – including net-zero emissions by 2060 – Indonesia's transition toward electrified mobility is closely linked to both domestic industrial policy and regional competitiveness. Accordingly, this section analyses Indonesia's projected vehicle market development in parallel with other ASEAN countries, allowing for both national interpretation and regional benchmarking.

The projections presented here serve two purposes. First, they provide a baseline reference against which national EV targets and policy ambitions can be evaluated. Second, they underpin the A2VTP web portal by explaining how total vehicle sales and propulsion-specific figures are derived, thereby avoiding black-box representations of forecast results.

2.2.2. Current Conditions and Strategic Comparison

This subsection provides a comparative assessment of current vehicle market conditions and EV development across the ASEAN countries covered under the A2VTP framework. To ensure systematic comparison, each country is discussed using a consistent analytical structure:

a. Dominance and characteristics of the internal combustion engine (ice) vehicle market,
b. Current EV market development,
c. Government policies and regulatory interventions, and
d. Qualitative assessment of policy effectiveness and market readiness.

2.2.2.1. Indonesia

Indonesia's passenger vehicle market remains dominated by ICE vehicles, supported by a well-established manufacturing base, relatively affordable vehicle prices, and extensive fuel distribution infrastructure. Conventional gasoline-powered vehicles continue to account for the majority of annual sales.

Despite this dominance, EV adoption in Indonesia has accelerated rapidly in recent years. In 2024, EV sales increased by 153% year-on-year to 43,188 units, while hybrid electric vehicle (HEV) sales reached 59,903 units. Combined electrified vehicle sales accounted for approximately 12% of total passenger car sales. Although this penetration level remains below that of Thailand, the growth trajectory indicates an early-stage but fast-expanding market.

Indonesia's policy framework has focused heavily on fiscal incentives for BEVs, including the removal of luxury sales tax (PPnBM), import duty exemptions, and reduced value-added tax (VAT) rates. On the supply side, local content requirements (TKDN) are being phased in

to support domestic manufacturing and align EV development with Indonesia's strategic objective of leveraging its nickel resources for battery production. While effective in stimulating short-term demand, the EV ecosystem remains highly dependent on fiscal support and faces challenges related to charging infrastructure availability and regulatory co-ordination.

2.2.2.2. Thailand

Thailand's long-term commitment to industrial upgrading, infrastructure development, and environmental sustainability is anchored in the Thirteenth National Economic and Social Development Plan for 2023–2027. The plan emphasises productivity enhancement, green growth, and innovation, providing an overarching framework within which policies on electric vehicles, clean energy, and transport decarbonisation are designed and implemented (Office of the National Economic and Social Development Council, 2022).

Thailand has long functioned as ASEAN's primary automotive manufacturing hub, with a strong export-oriented ICE industry supported by deep supplier networks and consistent industrial policy. This industrial base has enabled a structured and relatively smooth transition toward vehicle electrification. Data from the Thai Auto-Parts Manufacturers Association indicate that a large and diversified domestic parts industry underpins this position and is now gradually adapting to supply components for electrified vehicles (Thai Auto-Parts Manufacturers Association, 2024).

By 2024, EVs accounted for approximately 23% of total passenger car sales, making Thailand the most mature EV market in ASEAN. Adoption spans multiple electrified powertrain technologies, including BEVs and full hybrid electric vehicles (FHEVs), indicating higher consumer acceptance and market readiness. Contemporary media coverage has described 2023 as a 'BEV boom' year in Thailand, reflecting a sharp increase in battery electric vehicle sales and heightened public interest in EVs (The Nation, 2023). Automotive production and export volumes reported by the Federation of Thai Industries further illustrate Thailand's role as a regional manufacturing centre, even as the industry navigates structural shifts toward electrified vehicles (Federation of Thai Industries, 2024). Dedicated incentive packages for the electric vehicle industry, including tax breaks and investment promotion measures, have been introduced to attract both global and regional manufacturers to Thailand (Thailand Board of Investment, 2023). Detailed statistics compiled by the Electric Vehicle Association of Thailand provide further evidence of this trend, documenting rapid growth in BEV registrations, expanding model availability, and rising EV market shares in recent years (Electric Vehicle Association of Thailand, 2024). Recent economy update presentations from the Department of Alternative Energy Development and Efficiency highlight Thailand's integrated clean energy and EV strategy, including energy intensity reduction targets and specific EV production goals under the Energy Efficiency Plan 2022 (Department of Alternative Energy Development and Efficiency, 2024).

Thailand's EV strategy is characterised by a technology-inclusive incentive framework. The BEV 3.5 programme (2024–2027) provides excise tax reductions, import duty exemptions, and direct subsidies, while incentives for HEVs and PHEVs are linked to local production and investment commitments. Compared to Indonesia's BEV-centric approach, Thailand's balanced strategy supports multiple transition pathways and has resulted in broader and earlier EV penetration.

2.2.2.3. Malaysia

Malaysia's push toward cleaner and more efficient transport is embedded in a broader sustainability agenda. Green transport initiatives led by the Ministry of Energy and Natural Resources and periodic energy–environment reviews have highlighted the need to curb emissions from the road sector and improve overall energy efficiency (Ministry of Energy and Natural Resources Malaysia, 2021; Ministry of Environment and Water Malaysia, 2020). Fiscal policy has also played a central role, with Budget 2022 introducing targeted incentives and tax measures to encourage investment in low-emission vehicles and supporting infrastructure (Ministry of Finance Malaysia, 2022). On the industrial side, the National Automotive Policy 2014 laid the foundation for developing an energy-efficient vehicle and EV ecosystem, while the 2020 update sharpened the focus on next-generation vehicles, mobility as a service, and connected technologies (Ministry of International Trade and Industry Malaysia, 2014; Ministry of International Trade and Industry Malaysia, 2020). Complementary initiatives in 5G and smart transport, together with the National Transport Policy 2019–2030 and detailed transport statistics, provide a framework for integrating digitalisation, safety, and low-carbon objectives into Malaysia's long-term transport planning (Ministry of Science, Technology and Innovation Malaysia, 2021; Ministry of Transport Malaysia, 2019; Ministry of Transport Malaysia, 2022).

Malaysia's automotive market is characterised by strong domestic ICE production and relatively high levels of market protection. Conventional vehicles continue to dominate sales, supported by established consumer preferences and fuel subsidies.

EV adoption remains modest, with penetration below regional leaders. However, interest in BEVs and HEVs has increased in urban areas, supported by premium and mid-range offerings. Policy measures include import and excise duty exemptions and road tax incentives, with a strong emphasis on charging infrastructure development. This cautious, infrastructure-first approach has resulted in stable but gradual EV uptake. Malaysia's EV Charging Infrastructure Development Plan, led by the Malaysian Green Technology and Climate Change Corporation, sets out staged deployment targets for public charging stations to support the emerging EV market (Malaysian Green Technology and Climate Change Corporation, 2022). Recent market statistics compiled by the Malaysian Automotive Association confirm that ICE vehicles still account for the overwhelming majority of new passenger car registrations, with electrified vehicles only beginning to gain market share (Malaysian Automotive Association, 2023).

2.2.2.4. Viet Nam

Viet Nam's vehicle market remains ICE-dominated but is undergoing structural transformation driven by rapid urbanisation, rising incomes, and expanding domestic manufacturing capacity. EV adoption has accelerated, particularly in major cities, led by domestic manufacturers. Policy support includes registration fee exemptions, reduced excise taxes, and preferential treatment for local EV producers. Viet Nam's manufacturer-led transition has enabled faster EV adoption relative to income levels, although growth remains concentrated in urban centres and dependent on continued state support. These developments are aligned with the National Green Growth Strategy 2021–2030, which identifies green and low-carbon transport as a key pillar of Viet Nam's long-term development vision (Viet Nam Government, 2021).

At the same time, a dedicated decision on transition to green energy and emission mitigation in transportation specifies objectives and measures for shifting road transport toward cleaner fuels and vehicle technologies (Viet Nam Government, 2022). The National Climate Change Strategy to 2050 provides the overarching framework for achieving net-zero emissions and guides the development of sectoral mitigation plans, including those for transport and energy (Viet Nam Government, 2022). The National Electricity Development Plan (PDP8) complements these strategies by outlining power sector investments and generation mixes that are consistent with rising electrification and Viet Nam's climate commitments (Viet Nam Government, 2023). The National Energy Master Plan further integrates these objectives by defining long-term directions for the country's energy mix, infrastructure development, and investment priorities across all fuels and technologies (Viet Nam Government, 2023). The decision on implementing the Just Energy Transition Partnership operationalises these ambitions by mobilising international finance and technical support for a fair and orderly shift away from fossil fuels, with implications for both the power and transport sectors (Viet Nam Government, 2023). Within the transport sector, Decision No. 1191/QD-GTVT sets specific greenhouse gas mitigation targets to 2030 and outlines measures such as promoting EVs, enhancing public transport, and improving logistics efficiency (Viet Nam Ministry of Transport, 2024).

2.2.2.5. Lao PDR

Lao PDR's vehicle market is small and dominated by imported used ICE vehicles. EV adoption remains at an early stage, largely confined to pilot projects and government fleets. While the country has strong renewable electricity potential, limited institutional capacity and fiscal space constrain large-scale EV deployment. EV development is therefore expected to remain incremental in the medium term. Recent technical work led by the Global Green Growth Institute has nevertheless supported the development of EV policies, technical standards, and incentive mechanisms, providing a foundational framework for scaling up electric mobility in Lao PDR over time (Global Green Growth Institute, 2023). Nonetheless, Lao PDR has signalled its commitment to environmentally sustainable transport by

participating in the Aichi 2030 Declaration process, as reflected in its country profile under the Asian Transport Outlook (Asian Transport Outlook, 2024). In parallel, the national Renewable Energy Development Strategy sets targets for increasing the share of renewable energy and promoting alternative transport fuels, indicating a broader policy interest in reducing dependence on conventional fossil fuels (Government of Lao PDR, 2011). These directions are consistent with the country's Intended Nationally Determined Contribution submitted to the UNFCCC, which outlines mitigation actions across energy, transport, and land-use sectors subject to international support (Government of Lao PDR, 2015). More broadly, the National Green Growth Strategy to 2030 frames sustainable transport, renewable energy and resource efficiency as integral components of Lao PDR's long-term development pathway (Government of Lao PDR, 2018). The updated Nationally Determined Contribution further refines these commitments, strengthening emission reduction targets and explicitly covering the transport sector in Lao PDR's mitigation portfolio (Government of Lao PDR, 2021).

2.2.3. Simulation Basis

The projection model is built on two macroeconomic indicators -- population and GDP per capita (PPP) which serve as the primary drivers of long-term vehicle ownership and sales. These indicators are selected due to their strong empirical linkage with household purchasing power, infrastructure demand, and economic development.

The simulation adopts a business-as-usual (BAU) assumption, under which population and economic growth follow baseline trajectories without explicit modelling of future fiscal incentives, regulatory changes, or policy shocks. Demographic projections are sourced from the United Nations World Population Prospects 2024, while GDP per capita projections are obtained from the IMF World Economic Outlook database.

Extensive population and GDP tables (Tables 2.2 and 2.3) provide the quantitative foundation for the simulation and ensure transparency in all subsequent projection steps. The use of harmonised GDP per capita projections from the World Economic Outlook database ensures consistency of macroeconomic assumptions across all countries in the analysis (International Monetary Fund, 2024). For Malaysia, recent economic indicator releases from the national statistics office provide additional context on income dynamics and consumption trends that shape medium-term vehicle demand projections (Department of Statistics Malaysia, 2023).

Table 2.2. Population Data

Year	Indonesia	Lao PDR	Malaysia	Thailand	Viet Nam
2011	252,698,525	6,518,978	29,662,831	69,436,098	89,510,356
2012	255,852,467	6,611,385	30,174,265	69,845,115	90,573,104
2013	258,877,399	6,703,172	30,696,137	70,216,367	91,679,578
2014	261,799,249	6,801,646	31,232,798	70,540,796	92,823,254
2015	264,627,418	6,908,803	31,789,686	70,859,842	94,000,117
2016	267,346,658	7,018,147	32,355,645	71,160,187	95,176,977
2017	269,951,847	7,128,045	32,910,967	71,376,079	96,237,320
2018	272,489,381	7,237,636	33,440,596	71,522,271	97,173,776
2019	274,814,866	7,346,533	33,889,559	71,641,484	98,079,191
2020	276,758,053	7,453,194	34,282,399	71,727,332	98,935,099
2021	278,830,529	7,559,008	34,695,493	71,735,329	99,680,655
2022	281,190,067	7,664,993	35,126,298	71,702,435	100,352,192
2023	283,487,931	7,769,819	35,557,674	71,668,011	100,987,687
2024	285,721,236	7,873,046	35,977,838	71,619,863	101,598,527
2025	287,886,783	7,974,018	36,385,115	71,559,615	102,177,431
2026	289,986,522	8,072,922	36,785,087	71,488,157	102,727,396
2027	292,016,779	8,169,793	37,182,770	71,406,994	103,255,744
2028	293,978,109	8,264,401	37,574,288	71,316,193	103,761,157
2029	295,876,648	8,357,023	37,961,719	71,215,022	104,254,903
2030	295,876,648	8,357,023	37,961,719	71,215,022	104,254,903

Source: United Nations, Department of Economic and Social Affairs, Population Division (2024).

Table 2.3. GDP per Capita Data (Current Prices, US$/Capita)

Year	Indonesia	Lao PDR	Malaysia	Thailand	Viet Nam
2011	3,690.10	1,397.00	10,397.90	5,492.12	1,949.83
2012	3,739.92	1,566.20	10,806.82	5,860.58	2,197.62
2013	3,667.44	1,813.80	10,851.66	6,168.27	2,369.97
2014	3,532.67	1,982.52	11,165.25	5,951.88	2,566.85
2015	3,373.49	2,124.26	9,663.12	5,840.05	2,581.91
2016	3,604.99	2,307.84	9,523.32	5,993.31	2,720.17
2017	3,885.97	2,437.13	9,965.12	6,593.82	2,957.90
2018	3,945.58	2,551.83	11,079.62	7,298.94	3,216.25

Year	Indonesia	Lao PDR	Malaysia	Thailand	Viet Nam
2019	4,192.77	2,602.62	11,228.29	7,812.89	3,439.10
2020	3,919.47	2,529.00	10,400.22	7,169.94	3,548.89
2021	4,351.30	2,495.96	11,474.23	7,236.43	3,756.89
2022	4,784.21	2,022.38	12,483.32	7,072.75	4,132.93
2023	4,919.94	1,975.53	12,090.60	7,350.89	4,316.74
2024	4,958.39	2,066.02	12,540.71	7,491.69	4,535.76
2025	5,026.54	2,095.81	13,144.98	7,766.70	4,805.84
2026	5,344.93	2,123.64	13,878.99	7,911.66	5,041.89
2027	5,689.77	2,171.65	14,561.83	8,152.06	5,334.30
2028	6,082.49	2,217.77	15,288.65	8,434.40	5,640.99
2029	6,497.23	2,267.99	16,008.55	8,750.87	5,957.56
2030	6,944.52	2,317.61	16,817.19	9,097.93	6,289.51

Source: International Monetary Fund (2024).

2.2.4. Vehicle Ownership Model and Regression Results

In line with existing research on vehicle ownership forecasting, this study adopts a log-linear regression approach to estimate total vehicle stock using population size and GDP per capita as the key explanatory factors. The relationship between total vehicle stock, population, and GDP per capita is formally represented in Equation 1.1.

Regression results for the period 2011–2022 reveal substantial cross-country variation in model performance and explanatory power (Table 2.4). While Thailand and Malaysia exhibit statistically robust relationships consistent with economic theory, Indonesia and Lao PDR show weak or insignificant coefficients, reflecting data limitations and the influence of unobserved structural factors. Viet Nam's model displays strong statistical fit but with coefficients that suggest transitional dynamics rather than stable long-term relationships.

Table 2.4. Regression Coefficients for Vehicle Ownership Model in 5 Countries (2011–2022)

Country	Constant	Population Coefficient	GDP Coefficient	Statistically Significant Variables (5%)	Model Interpretation
Indonesia	30.821	-3.163 (ns)	0.507 (ns)	None	Weak macro-level explanatory power; suitable only as a baseline simulation
Thailand	148.63	-19.040 **	1.784 **	Population, GDP	Strong income-driven model with structural demographic effects
Malaysia	4.589	-0.279 (ns)	0.966 **	GDP	Economically robust, GDP-led motorisation
Viet Nam	-317.702	42.672 **	-4.978 **	Population, GDP	Demographically driven growth with structural income effects
Lao PDR	6.961	-0.119 (ns)	-0.309 (ns)	None	Exploratory model with limited predictive strength

Source: Authors' analysis (2025).

Country-specific interpretations are therefore essential when applying macro-level models across heterogeneous economies, and the projections should be interpreted as indicative baseline trajectories rather than precise forecasts.

2.2.5. Vehicle Sales Projections by Country (2023–2030)

Total vehicle sales projections for the five countries are derived from changes in projected vehicle stock and assumed scrappage rates. The results reveal divergent motorisation pathways across ASEAN, reflecting differences in income growth, demographic trends, and market maturity.

Annual vehicle sales and vehicle stock projections provide complementary insights into the evolution of motorisation across ASEAN. While vehicle stock reflects the cumulative outcome of long-term ownership dynamics, annual sales capture short- to medium-term market responses to income growth, demographic change, and policy conditions.

The projected vehicle sales and stock trends reflect country-specific policy orientations and market structures across ASEAN. Indonesia, Malaysia, and Thailand exhibit stable to strong growth in both sales and vehicle stocks, reflecting larger market sizes, higher income levels, and well-established automotive ecosystems. In these countries, continued demand growth

is supported by replacement cycles and expanding vehicle ownership, resulting in sustained increases in annual sales toward 2030. For Malaysia, recent sales and production data reported by the Malaysian Automotive Association provide early confirmation of these trends, showing growing overall volumes alongside the gradual emergence of electrified models within total output (Malaysian Automotive Association, 2025).

By contrast, Viet Nam and Lao PDR show flatter or declining total sales trajectories despite continued growth in vehicle stocks. This pattern indicates a structural transition rather than a contraction in demand. In Viet Nam, growth in electrified vehicle sales increasingly offsets declining ICE sales, leading to relatively stable aggregate sales volumes. In Lao PDR, vehicle growth is driven more by gradual fleet accumulation under constrained market conditions, resulting in limited expansion of annual sales. Together, these results underscore the heterogeneous motorisation pathways across ASEAN, shaped by differences in market maturity and structural conditions rather than uniform regional trends.

The detailed annual vehicle sales projections for each country under the BAU scenario are presented in Table 2.5 and the corresponding projections of total vehicle stocks by country are summarised in Table 2.6.

Table 2.5. Annual Vehicle Sales Projection

Country	2023	2024	2025	2026	2027	2028	2029	2030
Indonesia	938,199	917,975	901,698	908,293	916,269	927,149	938,626	951,314
Lao PDR	133,350	131,308	130,524	129,797	128,716	127,703	126,650	125,640
Malaysia	2,687,999	2,775,162	2,894,759	3,041,227	3,175,978	3,319,045	3,459,804	3,618,150
Thailand	848,160	947,725	1,023,697	1,075,123	1,155,875	1,255,118	1,373,234	1,512,230
Viet Nam	444,074	454,415	440,728	442,397	420,162	395,946	371,610	347,415

Source: Authors' analysis (2025).

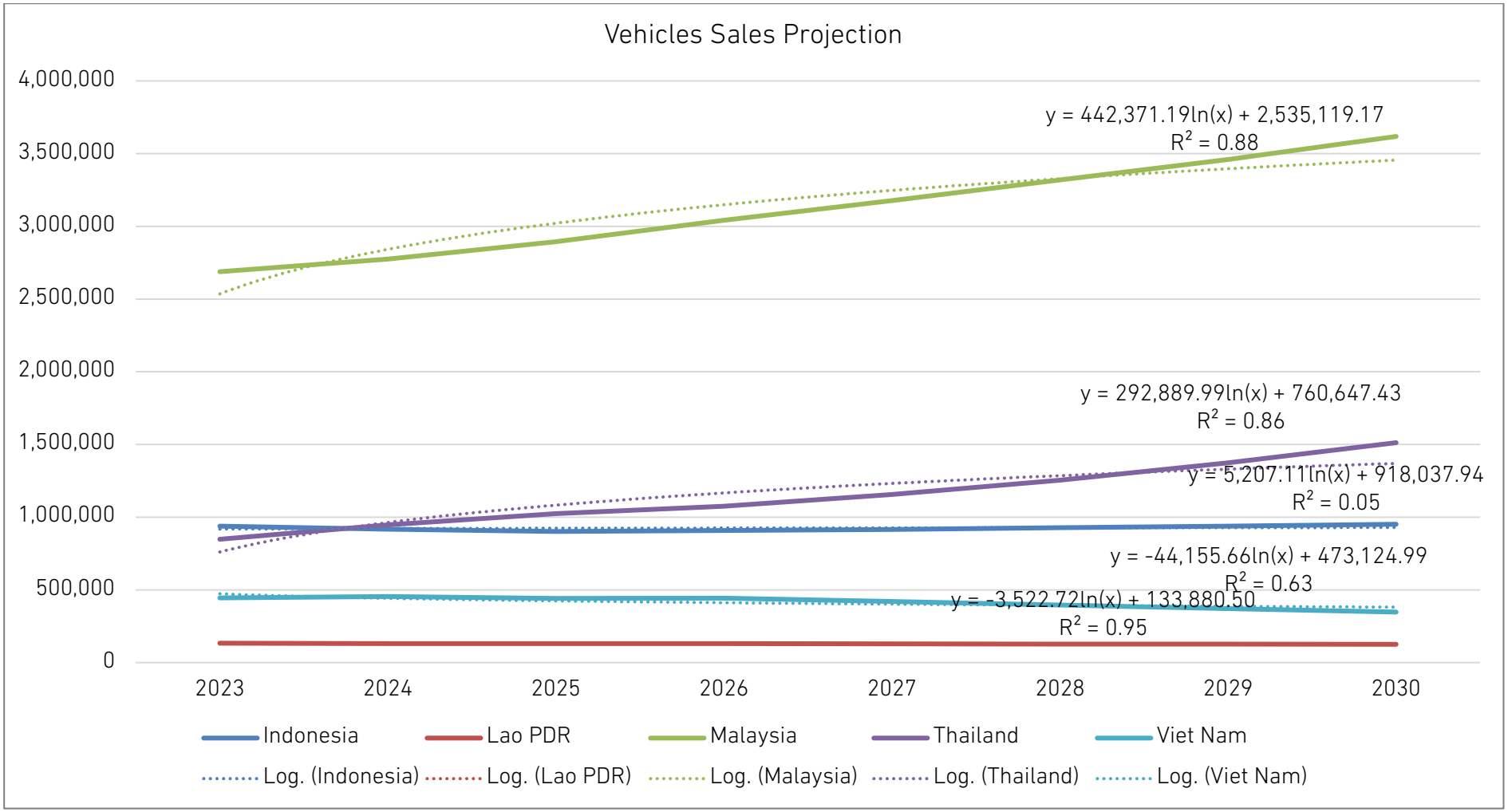
Table 2.6. Annual Vehicle Stocks Projection

Country	2023	2024	2025	2026	2027	2028	2029	2030
Indonesia	13,189,091	14,107,066	15,008,764	15,917,057	16,833,326	17,760,475	18,699,101	19,650,415
Lao PDR	1,726,981	1,858,289	1,988,813	2,118,610	2,247,326	2,375,028	2,501,678	2,627,318
Malaysia	27,295,671	30,070,833	32,965,592	36,006,819	39,182,797	42,501,842	45,961,646	49,579,796
Thailand	12,300,127	13,247,852	14,271,549	15,346,672	16,502,547	17,757,664	19,130,898	20,643,129
Viet Nam	3,678,057	4,132,472	4,573,200	5,015,596	5,435,759	5,831,705	6,203,315	6,550,730

Source: Authors' analysis (2025).

The projected sales trajectories and associated trendlines for the five countries are illustrated in Figure 2.2.

Figure 2.2. Vehicle Sales Projections and Trendlines (2023–2030)



Source: Authors' analysis (2025).

Indonesia is projected to experience slow and steady growth, reaching approximately 951,000 vehicle sales by 2030. Malaysia and Thailand exhibit strong growth trajectories, reflecting higher income levels and mature automotive markets. In contrast, Viet Nam and Lao PDR show stagnating or declining trends, highlighting structural constraints and alternative mobility patterns.

2.2.6. Splitting Total Vehicle Sales by Propulsion Technology

2.2.6.1. Rationale and Key Challenges

While total vehicle sales projections provide an aggregate view of market growth, policy relevance requires disaggregation by propulsion technology. A key challenge is that macroeconomic ownership models do not inherently explain technology choice. Directly embedding propulsion choice into the demand model would introduce significant data and behavioural uncertainty, particularly in data-constrained environments.

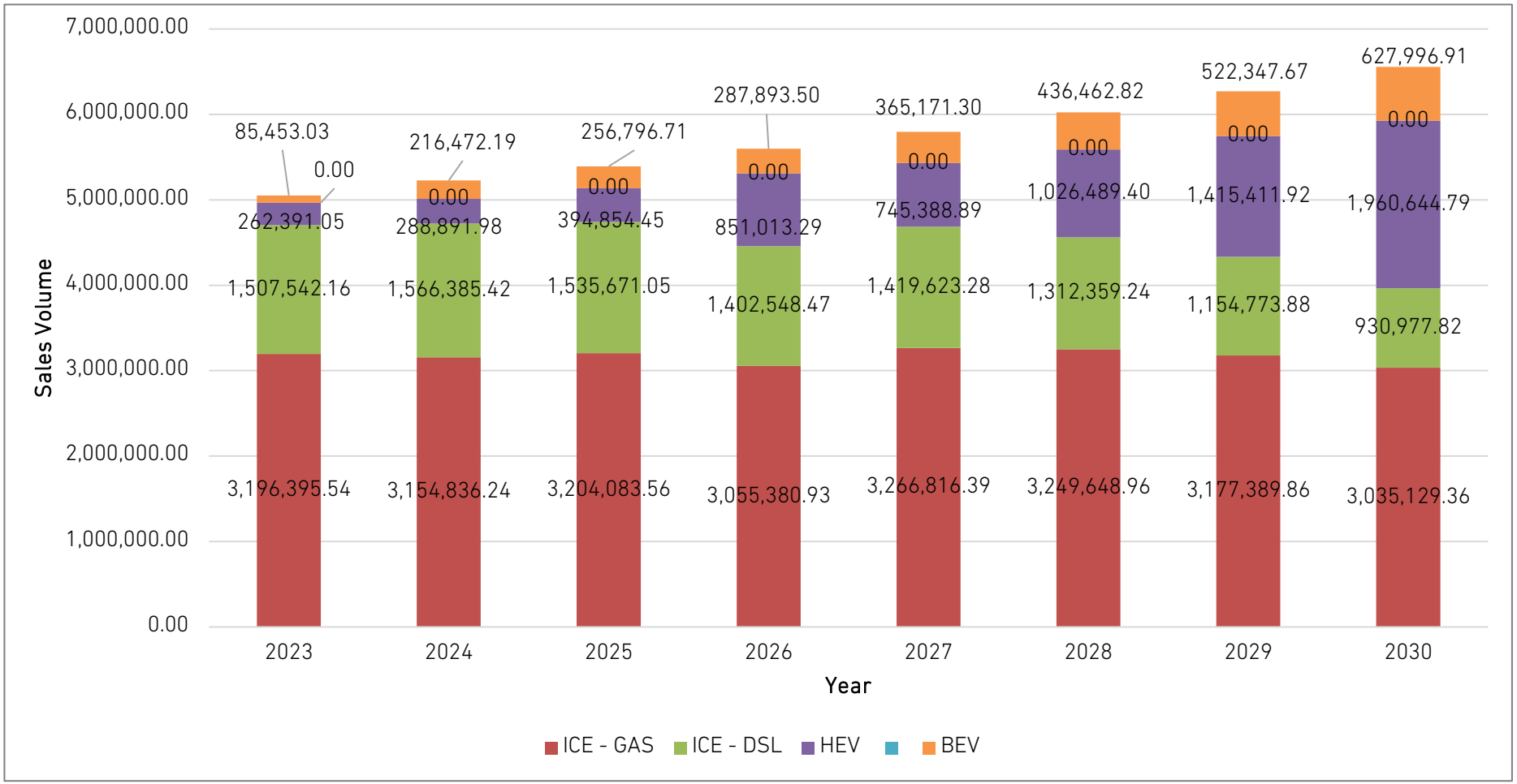
Accordingly, this study adopts an exogenous technology splitting approach, whereby total vehicle sales are allocated across propulsion types using externally derived trend trajectories.

2.2.6.2. BloombergNEF-Based Splitting Methodology

Technology shares are based on regional outlooks published by BloombergNEF, which describe the projected development of internal combustion engine and electrified vehicle adoption in Southeast Asia. These projections incorporate the effects of declining technology costs, policy direction, infrastructure development, and the diffusion of vehicle technologies at the global level. In addition, the outlooks implicitly account for learning effects and economies of scale that influence the relative competitiveness of different propulsion technologies over time. Accordingly, total vehicle sales for each country and year are allocated across propulsion technologies following the formulation presented in Equation (1.3), with time-varying technology shares applied uniformly across countries to maintain cross-country comparability and methodological consistency.

Figure 2.3. illustrates the declining share of ICE vehicles and the accelerating penetration of xEVs at the ASEAN level, particularly after 2030. The observed transition reflects a structural shift in the regional vehicle market driven by long-term decarbonisation objectives and technology maturation. Country-level xEV sales are subsequently obtained by applying these ratios to each country's projected total vehicle sales, ensuring that national projections remain aligned with the overarching regional transition pathway.

Figure 2.3. Market and xEV Ratio Simulation – Total ASEAN



Source: Authors' analysis (2025).

2.2.7. Splitting Total Vehicle Sales by Propulsion Technology

Simulation results indicate that, under BAU conditions, vehicle ownership and sales will continue to grow toward 2030, albeit with substantial variation across countries. EV penetration outcomes are therefore highly sensitive to policy design rather than macroeconomic growth alone.

Fiscal incentives, regulatory certainty, technology-neutral frameworks, and alignment with industrial policy emerge as key determinants of successful EV transition. While fiscal incentives have proven effective as entry mechanisms, long-term success will depend on how well they are integrated with broader transport, energy, and industrial strategies.

Table 2.7 illustrates the projected split of vehicle sales by propulsion type across selected ASEAN countries under BAU conditions. Across all cases, gasoline and diesel ICE vehicles continue to account for the majority of new sales in the near term, although both segments show a declining trend toward 2030. The reduction is generally more pronounced for diesel ICE vehicles, reflecting increasing regulatory pressure and the gradual shift away from diesel in passenger and light-duty segments.

Electrification in the BAU scenario is driven primarily by hybrid electric vehicles (HEVs), which consistently exhibit faster growth than battery electric vehicles (BEVs). This pattern suggests that HEVs function as a transitional technology in ASEAN markets, offering incremental emission reductions without requiring extensive charging infrastructure. BEV sales increase steadily over the projection period but remain secondary to HEVs, indicating that full electrification progresses more gradually in the absence of stronger policy intervention.

Plug-in hybrid electric vehicles (PHEVs) remain absent across the countries analysed. This reflects the limited market penetration and lack of consistently documented sales data for PHEVs in several ASEAN markets, as well as the tendency for electrification policies to prioritise either conventional hybrids or fully electric vehicles.

Overall, ASEAN's transition toward electrified mobility is underway but uneven. Co-ordinated regional learning, rather than uniform policy adoption, offers the most promising pathway toward a balanced and resilient low-emission mobility transition.

Table 2.7. Vehicle Sales Split Data

Indonesia								
Year	2023	2024	2025	2026	2027	2028	2029	2030
ICE - GAS	593,623.16	554,102.04	535,874.26	495,847.94	516,350.37	500,071.35	475,664.53	440,499.00
ICE - DSL	279,975.35	275,113.28	256,836.81	227,615.08	224,384.51	201,952.05	172,873.02	135,116.09
HEV	48,730.33	50,739.76	66,038.33	138,108.21	117,815.57	157,961.04	211,891.29	284,555.28
PHEV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEV	15,870.03	38,020.26	42,948.55	46,721.31	57,718.68	67,164.96	78,196.97	91,143.40

Lao PDR								
Year	2023	2024	2025	2026	2027	2028	2029	2030
ICE - GAS	84,374.23	79,259.23	77,569.75	70,857.70	72,535.90	68,878.19	64,181.82	58,176.68
ICE - DSL	39,794.11	39,352.44	37,178.06	32,526.67	31,521.10	27,816.21	23,325.90	17,844.77
HEV	6,926.25	7,257.86	9,559.29	19,735.95	16,550.50	21,757.04	28,590.67	37,581.20
PHEV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEV	2,255.68	5,438.45	6,216.96	6,676.57	8,108.21	9,251.08	10,551.18	12,037.30

Malaysia								
Year	2023	2024	2025	2026	2027	2028	2029	2030
ICE - GAS	1,700,767.63	1,675,124.60	1,720,339.87	1,660,242.94	1,789,777.04	1,790,174.44	1,753,314.10	1,675,358.51
ICE - DSL	802,146.94	831,704.26	824,534.10	762,121.40	777,763.08	722,955.62	637,215.26	513,889.66

HEV	139,615.45	153,393.09	212,005.66	462,426.40	408,373.10	565,474.95	781,037.83	1,082,254.68
PHEV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEV	45,468.63	114,940.32	137,879.56	156,436.52	200,064.88	240,439.69	288,236.44	346,647.49

Thailand

Year	2023	2024	2025	2026	2027	2028	2029	2030
ICE - GAS	536,653.20	572,059.36	608,377.59	586,922.65	651,376.73	676,965.79	695,909.62	700,227.25
ICE - DSL	253,106.13	284,029.14	291,586.61	269,422.20	283,061.38	273,390.24	252,917.73	214,783.61
HEV	44,053.68	52,384.13	74,973.26	163,475.19	148,624.51	213,837.93	310,002.49	452,335.55
PHEV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEV	14,346.99	39,252.42	48,759.45	55,302.83	72,812.20	90,923.79	114,404.21	144,883.63

Viet Nam

Year	2023	2024	2025	2026	2027	2028	2029	2030
ICE - GAS	280,977.33	274,291.01	261,922.08	241,509.69	236,776.35	213,559.19	188,319.80	160,867.91
ICE - DSL	132,519.63	136,186.29	125,535.48	110,863.11	102,893.21	86,245.12	68,441.96	49,343.68
HEV	23,065.34	25,117.14	32,277.90	67,267.54	54,025.22	67,458.44	83,889.64	103,918.08
PHEV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEV	7,511.70	18,820.75	20,992.19	22,756.27	26,467.34	28,683.30	30,958.87	33,285.09

Source: Authors' analysis (2025).

2.3. Policy Implementation

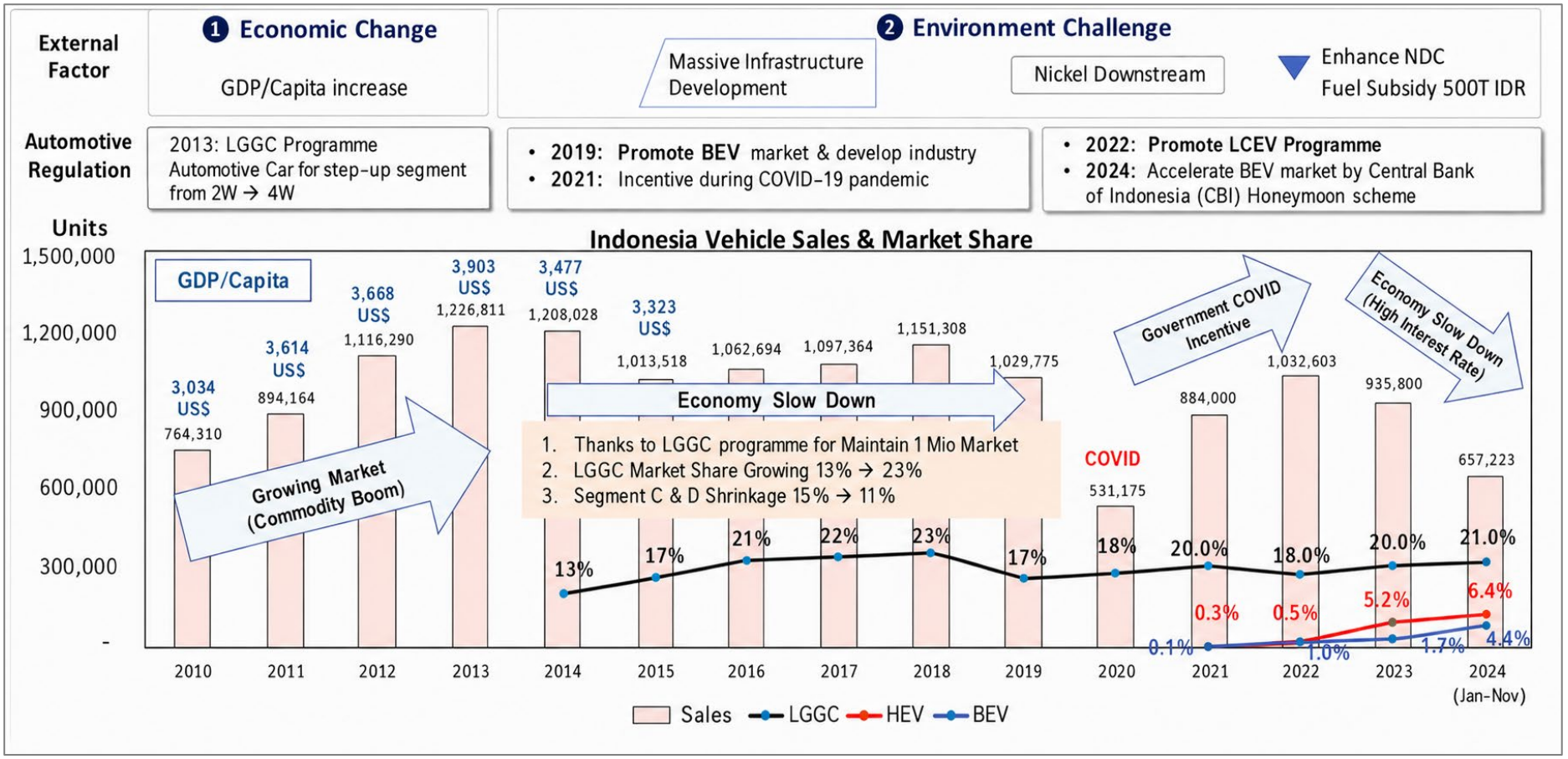
2.3.1. Indonesia's Policy

Indonesia's automotive sector has long played a strategic role in the national economy; however, policy attention in recent years has increasingly shifted toward aligning the sector with climate change mitigation and transport decarbonisation objectives. In line with Indonesia's commitments under the Paris Agreement, the government has identified the transport sector as a major contributor to greenhouse gas emissions and a priority area for policy intervention. Consequently, automotive and mobility policies are no longer framed solely around industrial growth and market expansion, but also around emission reduction, energy efficiency, and the gradual transition toward low-carbon mobility systems. Transport decarbonisation is a key pillar in achieving Indonesia's nationally determined contribution, which targets a 29 percent reduction in emissions by 2030 through domestic efforts, or up to 41 percent with international support.

Several external factors have influenced the trajectory of Indonesia's automotive market and its transition toward lower-emission vehicles. These include macroeconomic growth, rising income levels, large-scale toll road and urban infrastructure development, fuel price dynamics, and evolving government policies related to taxation and incentives. Economic growth has historically shown a strong correlation with vehicle sales, as rising GDP per capita increases household purchasing power and vehicle affordability. However, this relationship has not been linear over time, as demonstrated by the sharp decline in vehicle sales during the COVID-19 pandemic in 2020, followed by a gradual recovery beginning in 2021. These dynamics highlight the sensitivity of the automotive market to external shocks, while also underscoring the importance of policy support in stabilising demand and guiding longer-term structural transformation.

Key external factors influencing automotive market growth between 2010 and 2024 are summarised in Figure 2.4.

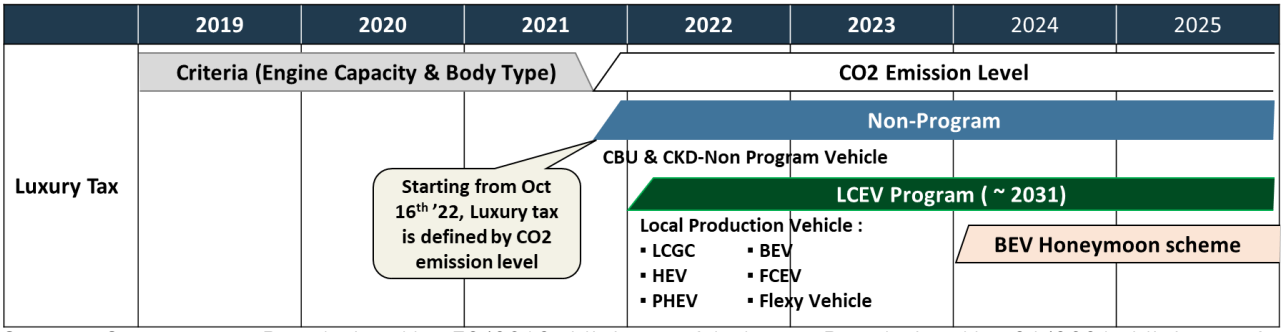
Figure 2.4. External Factor in affecting Automotive Market growth, 2010–2024



Source: Authors' analysis of ID market movements (2025).

The Indonesian government has introduced a range of incentive programmes to stimulate the industry. Started with Low-Cost Green Car (LCGC) programme launched in 2013, programme was designed to offer affordable cars for the mass market while reducing fuel subsidies and stimulating domestic production. The programme has attracted major investments from global manufacturers such as Toyota, Daihatsu, Nissan, Suzuki, and Honda. The evolution of the vehicle taxation framework is illustrated in Figure 2.5.

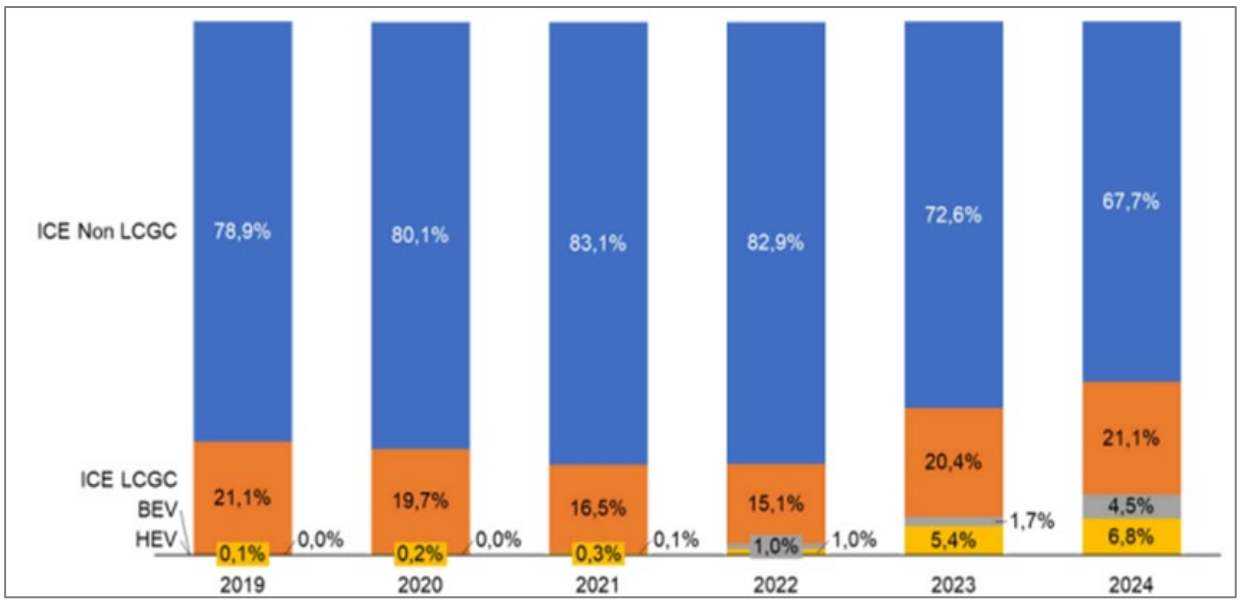
Figure 2.5. Shifting of Luxury Tax based on CO_2 Emission



Source: Government Regulation No. 73/2019, Minister of Industry Regulation No. 36/2021, Minister of Finance Regulation No. 141/PMK.010/2021, compiled by the authors.

The more recent Low Carbon Emission Vehicle (LCEV) programme, which offers tax incentives for vehicles such as HEVs and BEVs. This regulation has shifted Luxury Tax from engine capacity to CO_2 emission base. The LCEV initiative marks a broader move toward cleaner transportation. It includes hybrid electric vehicles (HEVs), plug-in hybrids (PHEVs), and battery electric vehicles (BEVs). In line with its COP21 climate commitments, Indonesia aims to reduce CO_2 emissions by 29% independently and by 41% with international support by 2030wd. Recent developments in Indonesia's vehicle market are presented in Figure 2.6.

Figure 2.6. Recent Market Trend in Indonesia



Source: Authors, based on GAIKINDO (2025).

Over the past five years, Indonesia's automotive market has undergone a major shift. Internal combustion engine (ICE) vehicles still dominate, but their market share is gradually declining in favor of alternative fuel vehicles. BEV sales have surged from just 125 units in 2020 to nearly 32,000 units in 2024 (reaching a 4.5% market share). Meanwhile, HEV sales have grown from 787 units in 2019 to over 54,000 units in 2023, making up 6.8% of the market in 2024.

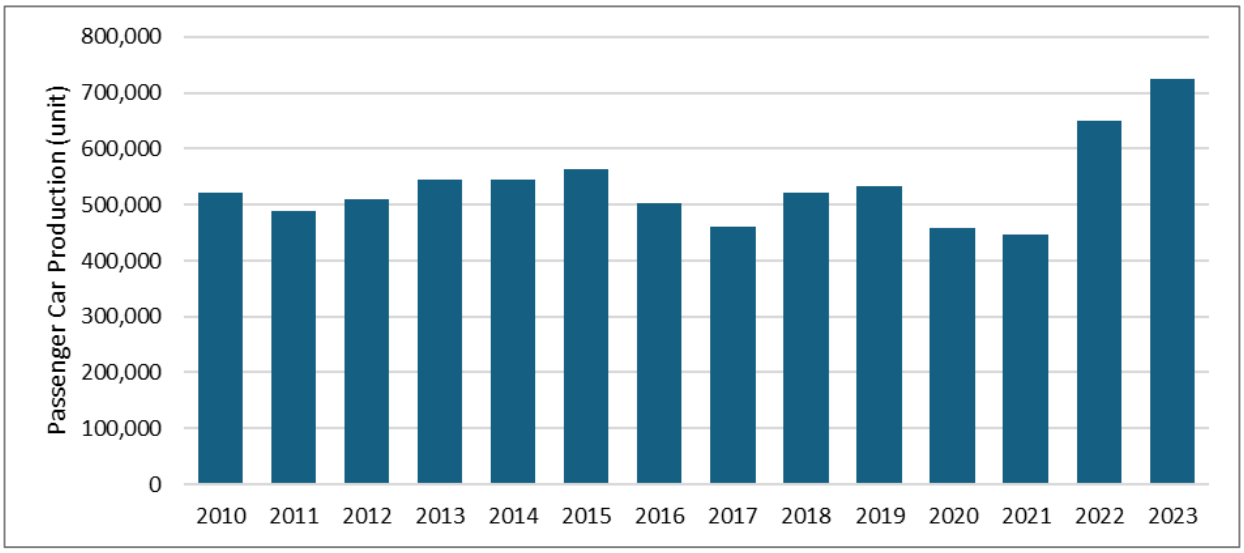
HEVs are increasingly seen as a practical bridge between ICE vehicles and full electrification, offering better fuel efficiency and lower emissions without dependence on charging infrastructure. This transition reflects growing consumer interest in sustainability, as well as government efforts to build a more diversified and climate-resilient automotive industry.

In summary, Indonesia's automotive industry is undergoing a strategic transformation toward low-emission mobility. Through a mix of regulation, fiscal incentives, and infrastructure development, the government is laying the groundwork for a more sustainable transport future. As the country moves toward its 2030 emission targets and 2050 net-zero vision, the development of the LCEV ecosystem will be crucial in securing Indonesia's place in the global green mobility transition.

2.3.2. Malaysia's Policy

The document outlines Malaysia's strategic policy direction to transition towards sustainable transport systems, particularly through the development and adoption of alternative and new vehicle technologies such as electric vehicles (EVs), hybrid systems, and hydrogen-powered vehicles. This transition is motivated by Malaysia's commitments under the Paris Agreement to reduce greenhouse gas emissions and is seen as essential to both environmental sustainability and economic resilience. Malaysia's historical passenger car production trend is shown in Figure 2.7.

Figure 2.7. Annual Passenger Cars Production in Malaysia



Source: Authors, based on Malaysian Automotive Association (2025).

Malaysia's automotive industry has long been a significant contributor to the national economy, accounting for about 4% of GDP and employing over 700,000 workers across manufacturers and suppliers. The country is the third-largest vehicle producer in Southeast Asia, trailing only Thailand and Indonesia. However, with growing urbanisation and vehicle ownership, Malaysia faces challenges such as traffic congestion, air pollution, and increasing emissions – transport alone accounts for nearly 29% of the nation's fossil fuel-related emissions. These concerns have accelerated policy efforts to reduce carbon intensity and promote green technologies in the transport sector.

To support this transition, Malaysia has adopted a comprehensive set of policies and strategies. Key amongst these is the National Automotive Policy (NAP), first launched in 2006 and most recently revised in 2020. NAP 2020 promotes next-generation vehicles (NxGV), electric vehicles, hybrid electric vehicles (HEVs), and digital integration like vehicle-to-infrastructure connectivity. The policy seeks to establish Malaysia as a regional hub for sustainable and smart automotive manufacturing.

In parallel, the National Transport Policy (NTP) 2019–2030 aims to develop an efficient, safe, and low-carbon transport system by improving connectivity, encouraging public transportation, supporting digital solutions, and reducing transport-related emissions. It advocates for integrated urban mobility, smart traffic systems, and public-private collaboration in green technology deployment.

The Low Carbon Mobility Blueprint 2021–2030 further strengthens Malaysia's policy mix by focusing on EV adoption, development of charging infrastructure, regulatory support, and fiscal incentives. Meanwhile, the Green Technology Master Plan (GTMP) 2017–2030 offers a broader framework for integrating green technologies across sectors. In transport, it supports research and innovation in energy-efficient vehicles, charging infrastructure, and alternative fuels like hydrogen and biofuels.

Malaysia also promotes its green transition through the Green Technology Financing Scheme (GTFS), which provides soft loans and incentives for EV and green mobility projects, and the National Renewable Energy Policy and Action Plan (NREPAP), which indirectly supports transport electrification by pushing clean energy generation for EV charging.

Additionally, annual budget incentives such as import and excise duty exemptions, road tax waivers, and personal income tax relief for EV-related expenses are used to encourage consumer adoption. These policies collectively aim to reduce the cost barriers of EV ownership and build public confidence in green vehicles.

Despite these strong policy foundations, challenges remain. As of the end of 2024, Malaysia had 4,299 EV charging stations – far below the 10,000-unit target set for 2025. Infrastructure gaps, high EV purchase costs, and lingering consumer skepticism (regarding charging time, range, and maintenance) hinder broader adoption. The government must address these barriers through continued investment, public awareness campaigns, and private-sector engagement.

The long-term vision includes not just EVs, but a digitally connected, low-carbon transport ecosystem. Intelligent transport systems, real-time traffic management, and integration with renewable energy sources are part of this broader strategy. Malaysia's success in this area will depend on maintaining policy consistency, enhancing collaboration with global partners, and fostering innovation through research and development.

In conclusion, Malaysia has established a robust policy framework for green transportation through a combination of regulatory, fiscal, and strategic instruments. With continued commitment and implementation, Malaysia is well-positioned to become a regional leader in alternative vehicle technologies while meeting its climate and economic development goals.

2.3.3. Viet Nam's Policy

Viet Nam is charting an ambitious course toward decarbonisation, with energy and transport policy frameworks increasingly aligned with the country's long-term environmental, economic, and international climate goals. A series of high-level government decisions and strategies signal a co-ordinated national effort to advance energy transition, green mobility, and low-emission transport systems. Together, these policies aim to modernise Viet Nam's infrastructure while enhancing energy security, reducing greenhouse gas (GHG) emissions, and driving green economic growth.

At the core of Viet Nam's clean energy transition is Prime Minister's Decision No. 500/QD-TTg (May 2023), which approved the National Electricity Development Plan for 2021–2030 with a vision to 2050 (PDP8). This document sets the direction for renewable energy integration, phasing down coal use, and preparing the grid for increasing electrification – including the future growth of electric vehicles (EVs). Complementing PDP8 is Decision No. 893/QĐ-TTg (July 2023), which provides a National Energy Master Plan for the same period.

The plan outlines energy supply diversification and increased renewable shares, which are foundational for a sustainable EV ecosystem.

These energy strategies are part of a broader development vision. Government Resolution No. 136/NQ-CP (2020) on sustainable development sets targets aligned with the United Nations Sustainable Development Goals (SDGs), while Decision No. 896/QD-TTg (2022) on the National Strategy for Climate Change to 2050 articulates the nation's pathway to net-zero emissions, with the transport and energy sectors identified as transformation priorities.

Viet Nam's Nationally Determined Contribution (NDC) 2022 update reinforces this commitment by increasing emission reduction targets, conditional on international support, and focusing on sectors such as transport, energy, agriculture, and waste. In line with this, Decision No. 1658/QD-TTg (2021) approves the National Green Growth Strategy for 2021–2030, with goals to green production, lifestyle, and infrastructure – including clean transport and energy efficiency.

A critical recent milestone is Decision No. 1009/QD-TTg (August 2023), which outlines Viet Nam's roadmap to implement the Just Energy Transition Partnership (JETP). This international political declaration commits Viet Nam to a fair, inclusive, and accelerated energy transition. It emphasises workforce development, renewable energy investments, and environmental justice – key enablers of electrified transportation and a sustainable energy economy.

In parallel with its energy reforms, Viet Nam is actively developing a greener transport system. Decision No. 876/QD-TTg (July 2022) approved an Action Program for the Transition to Green Energy and Carbon and Methane Emissions Reduction in Transportation. This strategy recognises the transport sector as a high-emission domain and outlines specific pathways to decarbonise it through alternative fuel vehicles, electric mobility, modal shift to rail and inland waterway, and infrastructure investment.

Building on this, Ministry of Transport's Decision No. 1191/QD-GTVT (September 2024) sets a concrete plan to reduce greenhouse gas emissions in the transport sector by 2030. It lays out key actions such as promoting EVs and hydrogen vehicles, improving fuel economy standards, enhancing public transport, and integrating climate considerations into infrastructure development.

Together, these two transport-specific policies reflect Viet Nam's multi-tiered approach to climate mitigation: regulatory reforms, technological adoption, infrastructure upgrades, and fiscal incentives for green mobility are intended to reshape how people and goods move across the country.

Viet Nam's energy and transport policy landscape reveals a holistic and forward-thinking approach to climate and economic development. By embedding clean mobility into its national energy planning, climate strategy, and green growth vision, Viet Nam is setting the stage for a transition to low-emission, energy-efficient transportation.

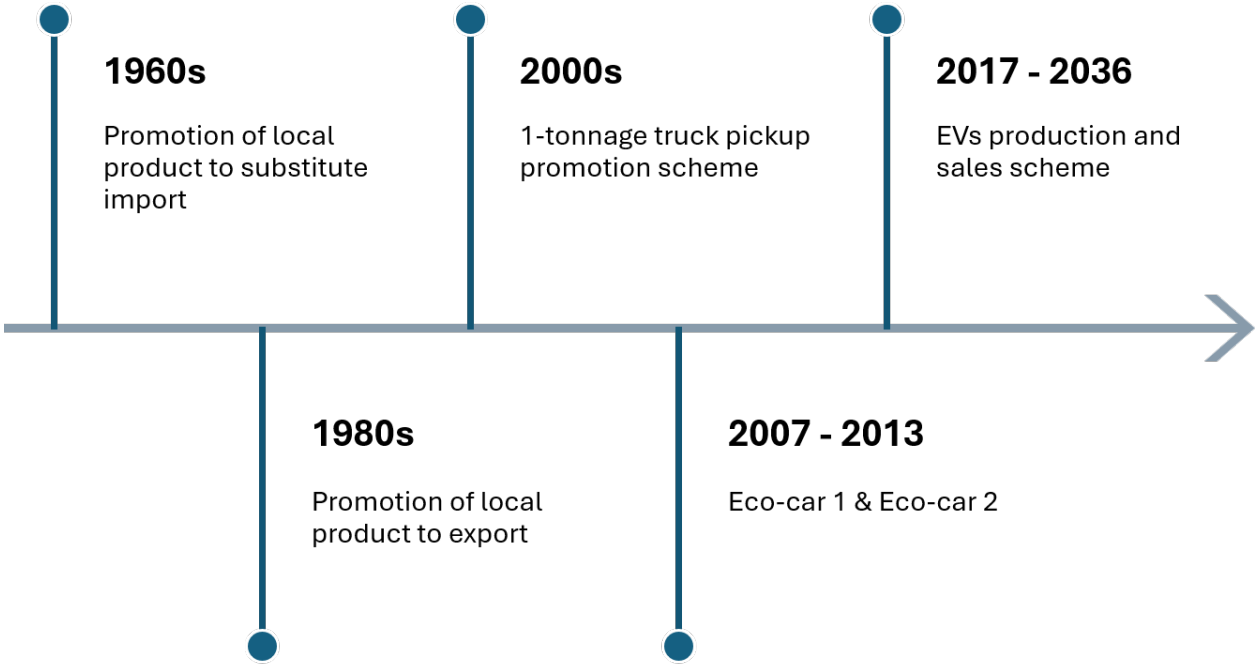
The convergence of decisions ranging from electricity planning to vehicle emissions mitigation – suggests strong political will and strategic clarity. While challenges such as financing, infrastructure, and consumer adoption remain, Viet Nam's engagement in global platforms like JETP and its updated NDCs indicate a growing commitment to partnerships and innovation. If effectively implemented, these interlinked policies could position Viet Nam as a regional leader in green mobility and clean energy integration, enhancing national resilience and global competitiveness in the sustainability era.

2.3.4. Thailand's Policy

This document discusses Thailand's energy and transport policy with a focus on the development of alternative and zero-emission vehicle (ZEV) technologies, particularly electric vehicles (EVs). The Thai government considers the transition to next-generation vehicles and ZEVs as a strategic priority in its national development plan. This transition aligns with global environmental trends and the need to reduce emissions. As one of the world's major automotive production hubs, Thailand has set an ambitious target for 30% of all new vehicle registrations to be electric by 2030 – a goal known as the 30-by-30 policy. This effort is integrated into the 13th National Economic and Social Development Plan (2023–2027) and supports Thailand's long-term commitments to carbon neutrality by 2050 and net-zero emissions by 2065.

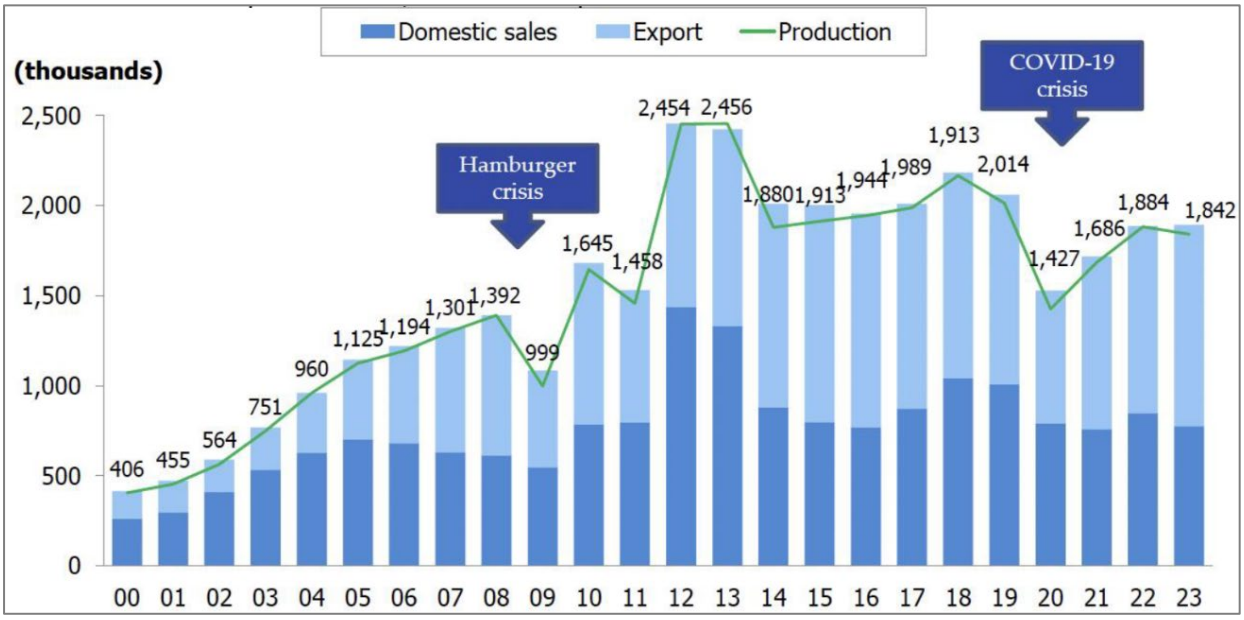
The policy is driven by the rising energy demand in the transport sector and its significant contribution to greenhouse gas emissions. Since the 1960s, Thailand has built a strong automotive industry and is now facing both challenges and opportunities in adapting to global shifts toward low-emission mobility. In recent years, Thailand's EV market has grown, especially with a surge in Battery Electric Vehicle (BEV) sales in 2023. This growth is supported by an expanding charging infrastructure, which includes 944 charging stations and over 2,500 plugs nationwide – 46% of which are DC fast chargers. Additionally, the adoption of home charging devices (wall-boxes) is increasing, either through manufacturer incentives, real estate developer support, or individual purchases. The evolution of Thailand's automotive industry promotion policies is summarised in Figure 2.8 and the h istorical trends in Thailand's vehicle production, sales, and exports are presented in Figure 2.9. Furthermore, Figure 2.10 shows the trend in passenger car registrations in Thailand together with the increasing share of low-emission vehicles (LEVs), including HEVs, PHEVs, and BEVs.

Figure 2.8. History of Thailand Promotion for Automotive Industry



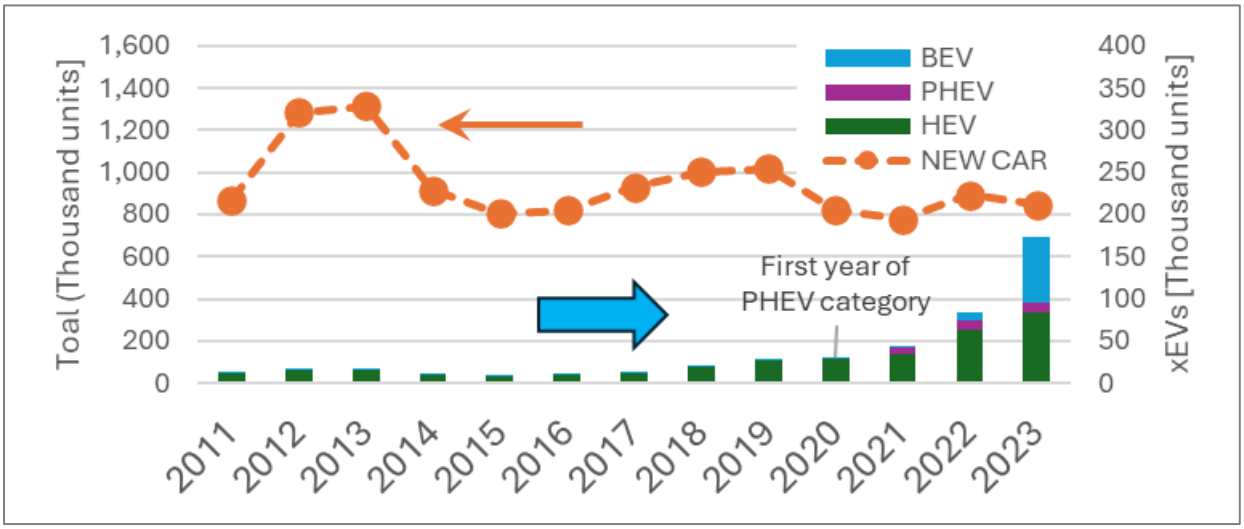
Source: Authors, based on data from Thailand Automotive Institute (2024).

Figure 2.9. Thailand Vehicle Production (line), Sale and Export



Source: Authors, based on data from Thailand Automotive Institute (2024).

Figure 2.10. Number of Passenger Car Registrations in Thailand and Proportion of LEVs (HEVs, PHEVs, and BEVs)



Source: Authors, based on data from Department of Land Transport (DLT).

EV development is integrated into Thailand's broader strategic plans. The 13th National Economic and Social Development Plan identifies EVs as part of the country's shift toward an innovation-driven economy and sustainable consumption. Within this framework, Thailand aspires to become a global EV production hub. Furthermore, the Nationally Determined Contributions (NDC 3.0) outline emission reduction pathways for the energy and transport sectors. These plans are being co-ordinated under the ongoing draft of the National Energy Plan (NEP), which consolidates other key policies such as the Power Development Plan (PDP), the Alternative Energy Development Plan (AEDP), and the Energy Efficiency Plan (EEP).

The Power Development Plan (PDP 2024–2037) focuses on ensuring a stable, affordable, and environmentally friendly electricity supply, which is essential for EV expansion. It includes the development of renewable energy sources like solar, hydropower, and wind, as well as the eventual incorporation of Small Modular Reactors (SMRs). The Energy Efficiency Plan (EEP) highlights the transformative role of EVs in shifting energy use from fossil fuels to electricity, and supports infrastructure development such as charging stations, grid upgrades, and smart microgrid projects.

Key stakeholders are also contributing to EV ecosystem development. Thailand's three electricity authorities – MEA, PEA, and EGAT – have implemented various EV-related research and pilot projects over the past decade. National oil and gas company PTT has joined the transition through its startup 'Swap and Go,' which offers battery-swapping services for delivery riders and motorcycle taxis. PTT has also shown growing interest in hydrogen infrastructure for future fuel-cell vehicles.

The latest policy initiative, known as EV 3.5, builds upon the previous EV 3.0 framework. It was developed by the Electric Vehicle Association of Thailand (EVAT), the Federation of Thai Industries (FTI), and the Thai Auto Parts Manufacturers Association (TAPMA). EV 3.5 introduces enhanced incentives, stronger support for local component manufacturing, investment in human resource development, and more structured research and development initiatives. It also addresses key challenges identified during the implementation of earlier policies.

Overall, Thailand's approach to alternative and zero-emission vehicle development is comprehensive, integrating national policies, infrastructure support, and cross-sector collaboration. The country's goal is to establish a sustainable, competitive transportation system that contributes meaningfully to national and global emission reduction efforts.

2.3.5. Lao PDR's Policy

Lao PDR is steadily emerging as a proactive player in Southeast Asia's transition toward clean energy and sustainable transport. Since 2010, the Lao People's Democratic Republic (Lao PDR) has gradually built a comprehensive policy framework promoting alternative vehicle technologies including biofuels, electric vehicles (EVs), and, to a lesser extent, hydrogen and hybrid vehicles as part of a broader strategy to enhance energy security and achieve low-carbon growth. Recent renewable energy agreements with Thai companies further underscore Lao PDR's role in regional clean energy cooperation and its efforts to leverage cross-border power trade as part of this transition (Krisanaraj, 2024).

At the core of this transformation is Lao PDR strategic vision to reduce reliance on imported fossil fuels, curb greenhouse gas emissions, and capitalise on its abundant hydropower potential. These goals are anchored in several national strategies and international climate commitments, such as the National Green Growth Strategy to 2030, Nationally Determined Contributions (NDCs), and the Renewable Energy Development Strategy (2011).

Initial efforts focused on biofuels, with the 2011 Renewable Energy Development Strategy setting a target for biofuels to meet 10% of transport energy demand by 2025. This direction was reinforced by the 2016 Decree on Biofuels (No. 410/GO), which outlined regulatory mechanisms and feedstock criteria for biofuel development. However, limited industry capacity and market uptake led policymakers to recalibrate focus toward electric mobility, especially after 2020. Early technical assessments of Lao PDR's biofuel potential, including feedstock availability and sustainability considerations, helped inform these initial policy choices and highlighted both opportunities and constraints for large-scale deployment (Lao Institute for Renewable Energy, 2009).

This shift gained momentum with the Updated NDC (2021), which introduced an ambitious target of 30% EVs (cars and two-wheelers) by 2030 and extended the 10% biofuel target to that year. These goals are now central to national transport and energy planning and are embedded in the 9th National Socio-Economic Development Plan (2021–2025).

2.3.6. Strengthening EV Ecosystems through Policy and Incentives

A series of reforms and strategies have established an enabling environment for EV adoption. The 2022 EV Promotion Policy Package offers one of the region's most generous tax regimes for electric vehicles, including 0% import tariffs, 3% excise taxes, and 7% VAT. These measures are designed to make EVs financially competitive with conventional vehicles and stimulate consumer demand.

Additionally, the government is actively supporting infrastructure development. The 9th NSEDP targets 100+ EV charging and biofuel stations nationwide by 2025, while recent initiatives encourage public and private investment in urban charging networks. Collaboration with international partners further supports infrastructure and EV market development. In parallel, recent adjustments to excise tax rates on selected products illustrate how fiscal instruments are being reshaped in Lao PDR, with implications for the relative pricing of fuels and other goods relevant to the transport sector (Santaniello and Xaechao, 2023).

To institutionalise these efforts, the government is finalising the Draft Strategy on Green Energy for Transport (2021–2030). Led by the Ministry of Energy and Mines through the Institute of Renewable Energy Promotion (IREP), this strategy includes an action plan covering incentives, technical standards, emissions regulations, and public awareness campaigns. It emphasises electric two-wheelers, which dominate Lao PDR's vehicle fleet.

What distinguishes Lao PDR's approach is the integration of EV and clean transport policies into broader national development and environmental frameworks. The National Green Growth Strategy 2030, the Pollution Control Strategy 2030 (Draft), and the Energy Security White Paper all highlight clean transportation as a core element of Lao PDR's transition to a net-zero economy by 2050.

Through the Prime Minister's Order No. 829/PMO.DE (2016) and emerging pollution control policies, the government has also taken steps to address EV battery waste and ensure safe disposal practices – anticipating the environmental risks of rapid e-mobility growth.

Meanwhile, institutional alignment across the Ministry of Energy and Mines, Ministry of Natural Resources and Environment, Ministry of Planning and Investment, and Ministry of Public Works and Transport ensures co-ordinated implementation. These linkages are reinforced through Lao PDR's participation in regional climate and transport initiatives under ASEAN and the Paris Agreement.

Lao PDR has moved from exploratory policies on alternative fuels to a more structured and ambitious clean transport agenda. While challenges remain – such as limited charging infrastructure, early-stage biofuel production, and fiscal trade-offs from reduced fuel tax revenues – the country has shown adaptability and foresight. By embedding EV promotion within broader goals of energy security, economic diversification, and environmental stewardship, Lao PDR is laying a robust foundation for its transport sector transformation.

The continued success of this transition will depend on sustained investment, international co-operation, and capacity building – especially in battery management, vehicle standards, and rural electrification. Nevertheless, Lao PDR is positioning itself as a regional model in leveraging domestic renewable energy for cleaner mobility, in line with its ambition to become the 'Battery of Asia'.

Chapter 3
Conclusion

This report has examined the evolution of vehicle markets and the transition toward alternative and electrified vehicle technologies across selected ASEAN Member States through a transparent, data-driven, and replicable analytical framework. By integrating harmonised datasets, parsimonious macro-level modelling, and clearly documented technology-splitting assumptions, the study provides a robust baseline outlook against which national policies, market developments, and future transition strategies can be assessed. Importantly, the report is designed not only to present results, but also to clarify how those results are generated, thereby supporting informed interpretation and reuse by policymakers, researchers, and practitioners.

Across the five countries analysed – Indonesia, Thailand, Malaysia, Viet Nam, and Lao PDR – the findings highlight substantial heterogeneity in vehicle market dynamics and electrification pathways. Differences in income levels, demographic trends, industrial structures, and policy frameworks translate into divergent trajectories of vehicle ownership, total sales, and technology composition. Thailand and Malaysia emerge as markets with strong income-driven growth and relatively advanced electrification readiness, while Indonesia shows a stabilising but slower-growing vehicle market under business-as-usual conditions. Viet Nam and Lao PDR, by contrast, face structural constraints that limit conventional car market expansion, reflecting alternative mobility patterns, institutional capacity, and market size. These variations underscore the limitations of one-size-fits-all policy prescriptions and the importance of country-specific interpretation within a regional analytical framework.

A key contribution of this report is its explicit treatment of the relationship between aggregate vehicle demand and propulsion technology choice. Rather than embedding technology adoption within the macroeconomic ownership model – an approach that would require extensive behavioural and cost data – the study adopts an exogenous splitting methodology informed by BloombergNEF regional outlook trends. This approach acknowledges current data constraints while ensuring methodological clarity. By presenting intermediate results, including total vehicle sales, assumed technology shares, and resulting propulsion-specific sales, the report avoids black-box forecasting and enables replication by other analysts using comparable data. The results suggest a gradual decline in the dominance of internal combustion engine vehicles and a steady increase in electrified vehicle adoption across ASEAN toward 2030, with the pace and composition of this transition varying significantly by country.

The analysis also demonstrates that, under business-as-usual conditions, macroeconomic growth alone is unlikely to deliver rapid or uniform electrification of vehicle fleets across ASEAN. While income growth and population dynamics continue to drive overall vehicle

demand, the penetration of electrified vehicles is highly sensitive to policy design, incentive structures, and ecosystem readiness. Countries that have implemented consistent, predictable, and technology-inclusive policy frameworks – often linked to broader industrial strategies – exhibit more advanced and balanced electrification outcomes. Conversely, markets that rely heavily on narrow or short-term fiscal incentives face greater uncertainty regarding the sustainability of adoption trends.

From a policy perspective, several implications emerge. First, fiscal incentives remain an effective entry mechanism for accelerating early-stage EV adoption, but their long-term impact depends on alignment with infrastructure development, regulatory clarity, and industrial policy objectives. Second, technology-neutral or technology-inclusive approaches encompassing HEVs, PHEVs, and BEVs can facilitate smoother transition pathways, particularly in markets where affordability, infrastructure constraints, or energy system characteristics limit immediate full electrification. Third, strengthening data governance – especially for vehicle sales, stock, usage, and cost parameters – is critical to improving the accuracy and policy relevance of future modelling efforts. Enhanced data availability would enable more refined scenario analysis, including policy-driven and accelerated transition pathways beyond the business-as-usual baseline presented in this report.

The A2VTP web portal, supported by this outlook report, represents an important step towards greater transparency and regional learning in ASEAN's vehicle transition. By coupling interactive visualisations with detailed methodological documentation, the platform allows users not only to explore projected outcomes but also to understand the assumptions and processes that generate them. This integrated approach supports evidence-based policy dialogue and facilitates knowledge sharing across countries at different stages of the mobility transition.

Looking ahead, the findings of this report should be interpreted as a baseline rather than a definitive forecast. Future iterations of the A2VTP outlook would benefit from incorporating policy-driven scenarios, greater spatial granularity, and more explicit treatment of behavioural and cost factors as data availability improves. As ASEAN countries continue to refine their transport, energy, and industrial strategies, transparent and harmonised analytical tools such as those presented in this report will be essential for guiding co-ordinated, context-sensitive, and sustainable mobility transitions across the region.

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This study examines developments in the vehicle market and the transition towards vehicle electrification in five ASEAN Member States: Indonesia, Thailand, Malaysia, Viet Nam, and Lao PDR. Drawing on a harmonised dataset, the study identifies a regional shift away from internal combustion engine vehicles, with electric vehicle (EV) adoption expected to accelerate significantly from the late 2020s onwards.

However, the pace of this transition varies across countries, reflecting differences in policy ambitions, industrial strategies, and infrastructure readiness. The findings indicate that macroeconomic growth alone is insufficient to drive rapid electrification under business-as-usual conditions. Rather, the pace of EV adoption depends heavily on well-targeted policies and appropriately designed incentives.

To facilitate stakeholder engagement and improve access to data, the study combines this outlook report with an interactive web portal. While the report presents the underlying methodologies, assumptions, and findings, the portal provides users with interactive visualisations and access to the supporting datasets.

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