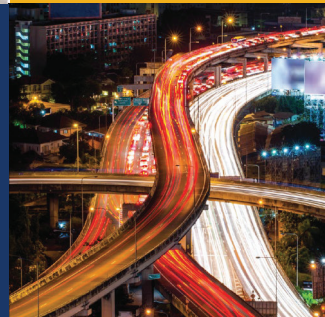
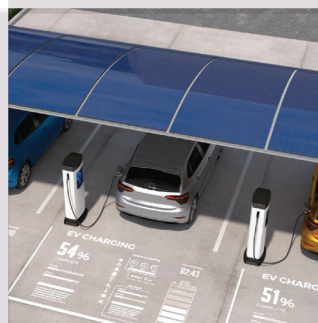


Thailand EV Outlook 2026

Insights on Electric Vehicles,
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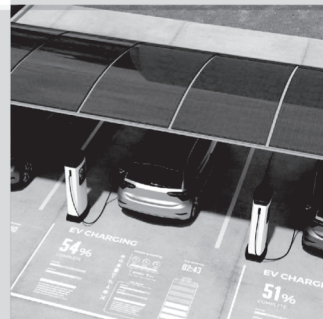
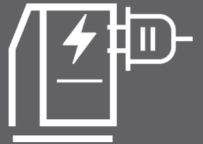
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Thailand EV Outlook 2026

Insights on Electric Vehicles,
Infrastructure, and Policy in
Thailand





Executive Summary

Thailand EV Outlook 2026 provides a comprehensive assessment of the status and prospects of electric vehicle (EV) development in Thailand. The report integrates evidence from technology trends, infrastructure readiness, policy analysis, and scenario-based projections to support coordinated and informed decision-making for Thailand's transition toward electric mobility. The report begins by examining recent trends and developments in electric mobility and supporting infrastructure. It reviews the status of EV adoption across major vehicle segments, including two- and three-wheelers, light-duty vehicles, and heavy-duty vehicles,

as well as the role of public transport and first- and last-mile services in advancing urban mobility transformation. The analysis highlights technological progress in EV systems, charging infrastructure development, and battery technologies, alongside an assessment of the domestic battery value chain. In parallel, the report maps Thailand's EV policy landscape, covering the national EV vision, existing policy measures and support mechanisms, battery-related regulations, and policies related to EV-grid integration. Drawing on inputs from multiple analytical components, this section synthesizes key successes, challenges, and barriers that

shape the pace and direction of EV ecosystem development in Thailand.

Building on the assessment of current conditions, the report presents forward-looking projections of EV deployment using scenario-based modeling, by applying three pathways:

a Business-as-Usual (BAU) scenario reflecting existing EV adoption rates by vehicle segment; a Stated Policies Scenario (STEPS) that incorporates implementation of the national 30@30 policy target to accelerate EV uptake across segments; and an Accelerated Zero-Emission Scenario (AZS) that combines the 30@30 policy with the achievement of full zero-emission vehicle adoption by 2035. The Thailand EV Outlook examines Thailand's transition to electric mobility by assessing

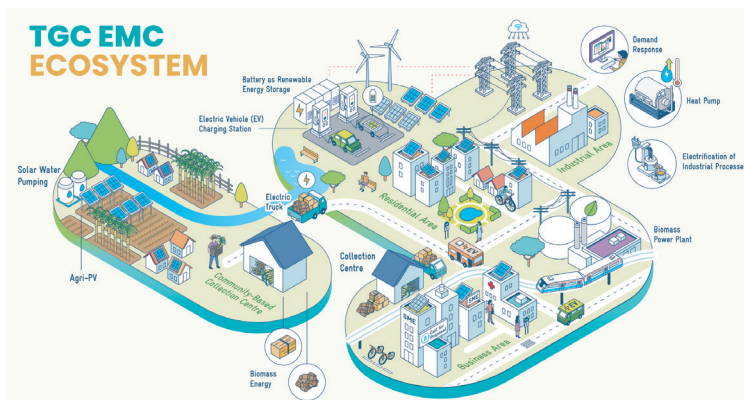
current market developments, future deployment trajectories, and policy implications. It integrates analysis of electric vehicle adoption, charging infrastructure development, the impacts on the power grid and battery systems, and the evolving policy framework guiding transport electrification. The report finds that electric vehicle adoption is expanding rapidly in the passenger car segment, while progress in public transport, motorcycles, heavy-duty vehicles and two- and three-wheelers remains comparatively limited. Through scenario-based analysis, the study shows that achieving a transition to zero-emission vehicles

by 2035 will require more targeted and coordinated policies beyond existing trends. In addition, the report quantifies the greenhouse gas mitigation potential of alternative EV deployment pathways using a tank-to-wheel (TTW) framework. The analysis shows that emissions under BAU rise until around 2030 and decline only modestly thereafter, while STEPS reduces annual CO₂ emissions by approximately 55–60% by 2050 relative to BAU. Under AZS, emissions peak earlier and decline rapidly, achieving a full transition toward zero-emission vehicle adoption by 2035 and near-zero tank-to-wheel CO₂ emissions by 2050.



THAI – GERMAN COOPERATION ON ENERGY, MOBILITY AND CLIMATE

At COP30, Thailand announced two ambitious targets: carbon neutrality by 2050 and net-zero emissions by 2050. To achieve these goals, Thailand needs to decarbonise its power, transport, and industrial sectors, which are still dominated by fossil fuels, and increase variable renewable energy (vRE) generation (e.g., wind and solar), which remains far below its full potential to support decarbonisation.

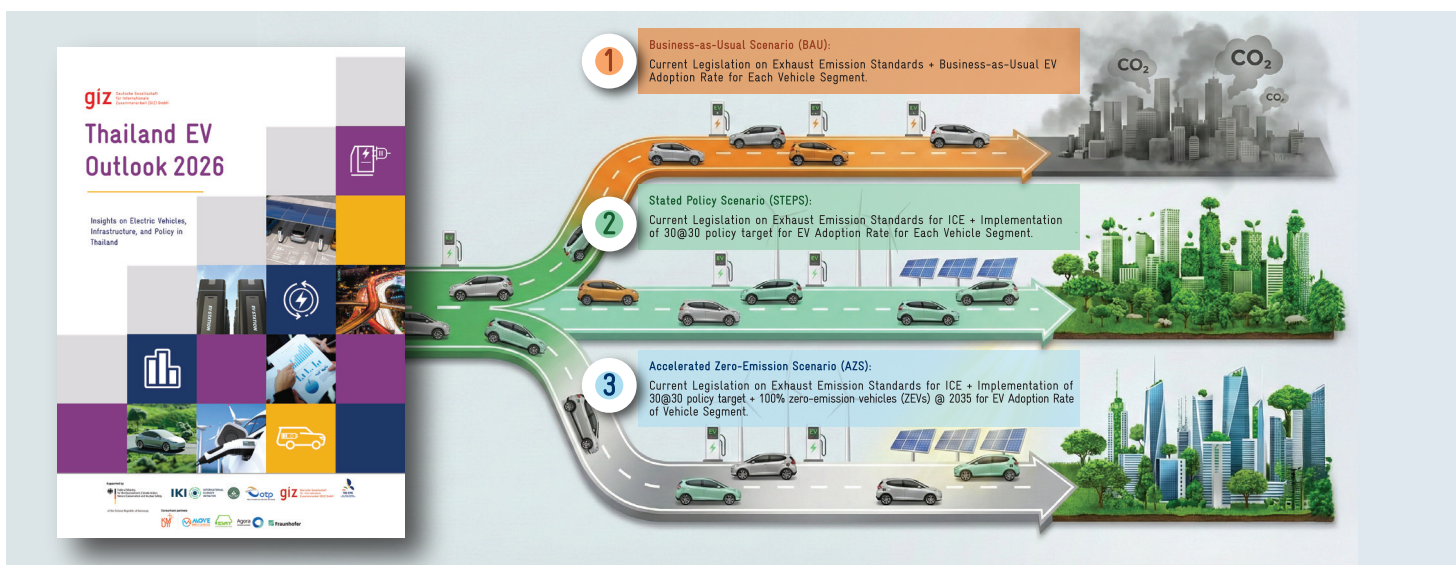


Thailand's potential for variable renewable energy (vRE) remains underutilized, while transport and industry sectors still rely heavily on fossil fuels. Barriers such as inflexible power-system planning, limited technological capacity, and weak regulatory support, all of which hinder vRE adoption and electrification. The absence of clear decarbonisation roadmaps, limited understanding of sector coupling, and poor cross-sector dialogue further constrain investment and limit the role of vRE in reducing emissions.

Objective

Key actors in Thailand are becoming empowered in the planning and implementation of transformative activities in the energy, transport and industry sectors in line with the Government's 2050 carbon neutrality objective.

THAILAND EV OUTLOOK



Chapter 1

Trends and Developments in Electric Mobility and Infrastructure

- This chapter provides a comprehensive snapshot of Thailand's current EV landscape.
- The analysis highlights areas where EV adoption is accelerating particularly in passenger cars, as well as in segments where progress remains limited, including public transport, motorcycle, Tuk Tuk, and heavy-duty vehicles.
- Readers gain a clear understanding of technology trends, infrastructure readiness, policy support, and key barriers shaping Thailand's EV transition.

Chapter 2

Prospects for Electric Vehicle Deployment

- This chapter explores future pathways for EV deployment in Thailand using scenario-based analysis.
- The analysis examines how national targets shape EV uptake, charging demand, grid impacts, battery requirements, and the electrification of public transport.
- Three scenarios are assessed: under the Business-as-Usual scenario, EV adoption continues to grow but remains insufficient to meet national decarbonization targets; the Stated Policies Scenario reflects accelerated uptake driven by implementation of the 30@30 policy target; and the Accelerated Zero-Emission Scenario assumes a full transition to zero-emission vehicles by 2035, resulting in the highest EV penetration.

Chapter 3

Key Findings and Recommendations EV Outlook

- This chapter synthesizes key insights into evidence-based findings and practical recommendations.
- The analysis identifies critical gaps in policy, infrastructure, and system readiness across EV adoption, charging infrastructure, grid integration, and battery management.
- Special attention is given to vehicle segments with high transformative potential, particularly motorcycles and public transport. While passenger cars currently represent the mass market, motorcycles are identified as a potential game changer for EV transformation in Thailand, offering significant opportunities for emissions reduction and domestic industry development.
- Policy-relevant conclusions are provided to support informed decision-making and guide Thailand's transition toward a low-carbon transport future.

THAILAND EV POLICY IMPACT ASSESSMENT

Thailand promotes electric vehicles through a sequenced mix of carbon neutrality commitments, fiscal incentives, industrial policies, and R&D support. Since 2016, EV development has been integrated into broader economic and sustainability strategies. Despite comprehensive measures to support the transition to electrified mobility, challenges remain in meeting the EV30@30 targets, highlighting the need for further policy refinement.

THAILAND EV POLICY LANDSCAPE

Phase 1 : Raise public awareness and attract FDI

Phase 2 : Local production of EV and parts

Phase 3 : Production hub of every EV types

2016

CO₂-based Excise Tax
The new excise tax structure based on CO₂ emissions has been implemented.

2021

EV 30@30
Achieving at least 30% Zero-emission vehicles (ZEVs) of country's total vehicle production by 2030.
COP26 Pledge
Achieving carbon neutrality by 2050 and reaching net-zero greenhouse gas emissions by 2065.

2023

EV 3.5 Package
Extension of EV 3.0 package with additional incentives.
EV R&D and Innovation Support
PMU-C and NIA have provided grants for R&D projects.

2025

Tax Incentive for Heavy-duty EV Purchases
Corporate income tax deduction for companies investing in large commercial EVs: 100% deduction of the investment cost for vehicles manufactured or assembled in Thailand, and 50% deduction for fully imported vehicles.

2016

2017

2021

2022

2023

2024

2025

2026

2017

EV Investment Promotion
Thailand's Board of Investment (BOI) launched EV investment promotion packages to attract investment in EV, EV important parts and related infrastructure.

2022

13th National Economic and Social Development Plan (2023–2027)
Milestone 3: transform Thailand into an EV production hub.
EV 3.0 Package
Subsidies and tax breaks for EV manufacturers that import BEVs between 2022 and 2023, with condition that they establish BEV assembly in Thailand by 2024 or 2025.

2024

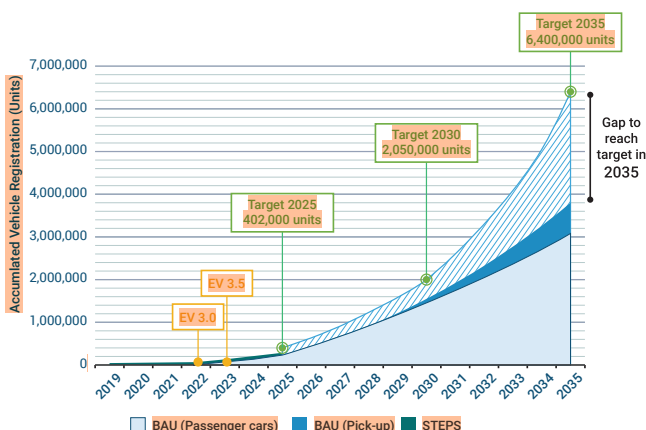
MHESI for EV
Focuses on 3 key initiatives: EV-transformation, EV-HRD, and EV-innovation.
E-bus and E-truck Support
Support from BOI. Companies can deduct expenses of CIT for purchasing E-buses and E-trucks.
Battery Cells Production
Incentives from BOI's Competitiveness Enhancement Fund for battery cell makers.

2026

New Excise Tax Structure for ICE and HEV
Excise tax rates gradually rise by 1-2% every two years until 2030.

■ Targets and Goals
■ Investment Support
■ Demand Stimulation Support
■ Research & Development Support

BRIDGING THE GAP



- There has been a significant increase in BEV passenger car uptake following the introduction of the EV 3.0 package.
- The 2025 and 2030 targets remain highly ambitious; therefore, additional policies and measures are needed to bridge the gap

POLICY GAP PRELIMINARY RESULTS



The adoption of electric motorcycle and electric Tuk Tuk and commercial vehicles remains low compared with passenger BEVs. Additional policies or measures are needed to support a complete ecosystem for these vehicle segments.



Charging infrastructure is increasingly moving toward high-power chargers and V2G technology. Thailand is currently lagging in preparing the electricity supply and EV-grid integration (EVGI) strategy needed to support these technologies.



Currently, there is no clear direction on how electric vehicles and their key components, especially batteries, will be managed and recycled at end-of-life. Thailand should introduce policies or measures to track and recycle these components

EV ADOPTION RATE DEFINED IN 30@30 POLICY

EV Usage

EV Production

Category	2025	2030	2035
PC / Pickup	225,000 (30%)	440,000 (50%)	1,154,000 (100%)
Motorcycle	360,000 (20%)	650,000 (40%)	1,800,000 (100%)
Bus / Truck	18,000 (20%)	33,000 (35%)	83,000 (100%)
Tuk Tuk	500 (85%)	2,200 (100%)	2,800 (100%)

Category	2025	2030	2035
PC / Pickup	225,000 (10%)	725,000 (30%)	1,350,000 (50%)
Motorcycle	360,000 (20%)	675,000 (30%)	1,850,000 (70%)
Bus / Truck	18,000 (20%)	34,000 (50%)	84,000 (100%)
Tuk Tuk	500 (85%)	2,200 (100%)	2,800 (100%)

POLICY RECOMMENDATIONS

- For Motorcycle and Tuk Tuk, there should be incentives for installing battery-swapping stations.
- For charging infrastructure, standardized guidelines for regular safety inspections of charging stations should be mandated.
- For EV batteries and components, end-of-life (EoL) regulations should be established.

THAILAND'S EV ADOPTION: STATUS QUO TO OUTLOOK AND PROSPECTS

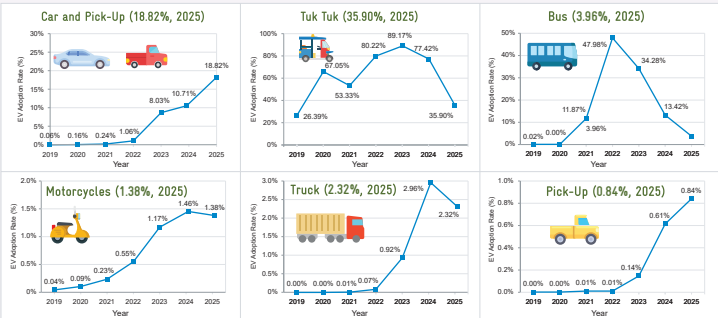
Abstract

Thailand is racing toward an electric future, backed by bold policies, expanding infrastructure, and growing consumer interest. Passenger cars are leading the charge, but motorcycles, pickups, and heavy-duty vehicles still face hurdles in technology, regulation, and market readiness. This poster explores three policy-driven scenarios—Business as Usual (BAU), Stated Policies (STEPS), and Accelerated Zero-Emission Scenario (AZS)—to map Thailand's EV adoption journey and its impact on CO₂ reduction. The results are clear: only decisive action and full implementation of pledges can put Thailand on track for carbon neutrality by 2050. To succeed, policies must go beyond targets—fostering local manufacturing, R&D, and strong incentives for producers and infrastructure providers. The road ahead is challenging, but with the right measures, Thailand can lead the region in sustainable transport.

Status Quo

In 2025, the EV adoption rate for all vehicles under the Motor Vehicle Act (RY.1 to RY.17) is 5.6%, while that for vehicles under the Land Transport Act (buses and trucks) is 0.9%.

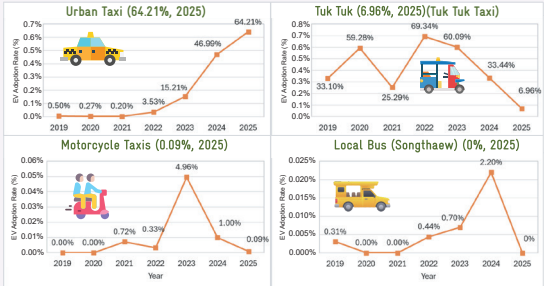
Trends of EV Adoption Rate of All Types of Registered Vehicles (2019-2025)



Adoption of the BEV-Passenger Cars is leading, both the EV Adoption Rate and the Cumulative Number.

Note: Car and Pick-Up (RY.1 2 3 5 6 7 9 10 11 13 14 15 16 18) Pick-Up (RY.3) Motor Tricycles (RY.4 and RY.8) Motorcycles (RY.12 and RY.17)

Trends of EV Adoption Rate of Public First- and Last-Mile Service Vehicles (2019-2025)



Urban Taxi is the only segment to show a continuing increase since 2023, similarly to BEV-Passenger Cars.

Note: Motorcycle Taxis (RY.17) Motor Tricycle Taxis (RY.8) Urban Taxis (RY.6) Local Bus (Songthaew) (Category.4)

Outlook and Prospects

Future Scenarios of Road Transport Development

Business As Usual Scenario (BAU):

- Current Legislation on Exhaust Emission Standards for ICE + Current EV Adoption Rate for Each Vehicle Segment

Stated Policy Scenario (STEPS):

- Current Legislation on Exhaust Emission Standards for ICE + Implementation of 30@30 policy target for EV Adoption Rate for Each Vehicle Segment

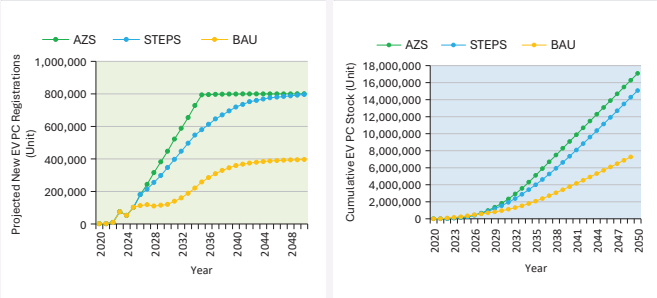
Accelerated Zero-Emission Scenario (AZS):

- Current Legislation on Exhaust Emission Standards for ICE + Implementation of 30@30 policy target + 100% Zero-Emission vehicles (ZEVs) @ 2035 for EV Adoption Rate of Vehicle Segment

Aspect	BAU	STEPS	AZS
Policy Basis	Historical trend + existing enforced policies only	Policies already announced and being implemented	STEPS + all national ZEV pledges
Future Policy Action	No new measures; continuation of current practices	Full implementation of announced measures	Assumes full achievement of ZEV commitments
EV (BEV) Growth	Slow, market-driven	Moderate, supported by current policies	Rapid, aligned with ZEV goals
ICE Phase-out	ICE remains dominant long term	ICE declines but not eliminated by 2035	ICE sales phase-out to 0% under ZEV targets
30@30 Target Consistency	May not achieve 30% ZEV production by 2030	Likely to achieve 30@30	Exceeds 30@30; moves toward 100% ZEV

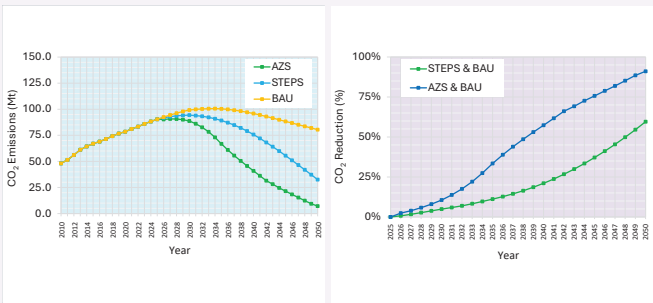
Projected EV Adoption Rate of Key Registered Vehicle Types Under BAU, STEPS, AZS (2020-2050)

Passenger cars



Comparison of projected EV adoption under the BAU, STEPS, and AZS scenarios indicates that stronger and more comprehensive policy measures are required to align Thailand with its 2050 zero-emission objective, particularly for pick-ups and motorcycles, which remain high-volume vehicle segments.

Trends of CO₂ Reduction Associated with EV Adoption in All Vehicle Types Under BAU, STEPS, AZS (2010-2050)



Projected CO₂ Emissions from Road Transport under BAU, STEPS, and AZS Scenarios (2010-2050)

Annual CO₂ Emission Reduction Relative to BAU under STEPS and AZS Scenarios (2010-2050).

Simulations to assess future CO₂ emission reduction using projected EV Adoption Rates under BAU, STEPS, and AZS show that the only Pathway to bring Thailand on track to Zero Carbon Emission in the road transport sector by 2050 is AZS.

THAILAND'S PUBLIC EV CHARGING INFRASTRUCTURE: PROGRESS AND CHALLENGES AHEAD.

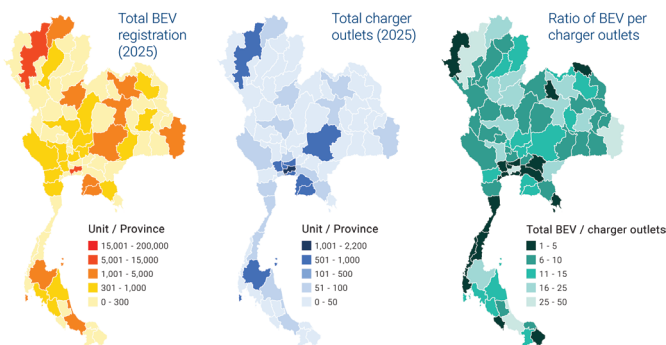
Thailand has achieved rapid growth in public EV charging, surpassing its 2025 target ahead of schedule. However, rising EV adoption, higher vehicle charging power, and uneven regional distribution create urgent challenges toward 2030.

Rapid Expansion of Public EV Charging Infrastructure

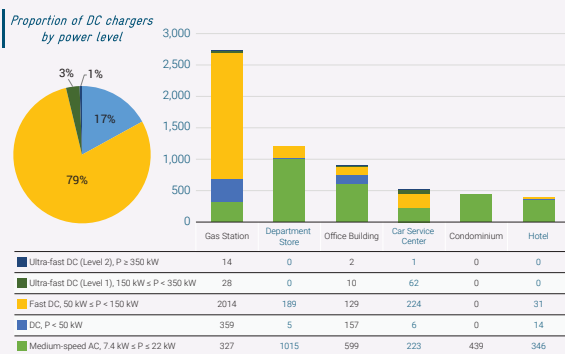
Thailand's public EV charging infrastructure expanded rapidly between 2020 and 2023, supported by strong EV adoption and EV3.0/EV3.5 policies. In 2023, charging outlets increased by more than 300% year-on-year, allowing Thailand to surpass its 2025 target of 4,000 outlets two years early. However, EV adoption continues to grow faster than charging deployment, as reflected in the rising BEV-to-charger ratio. Despite accelerated rollout since 2023, further expansion will be required to keep pace with EV growth toward 2030.

- ✓ Target for 2025 achieved ahead of schedule
- ✓ Strong private-sector participation
- ✓ Rapid increase aligned with EV sales growth
- ⚠ 2030 target requires 2–3 times further expansion

Uneven Spatial Distribution and Charging Adequacy

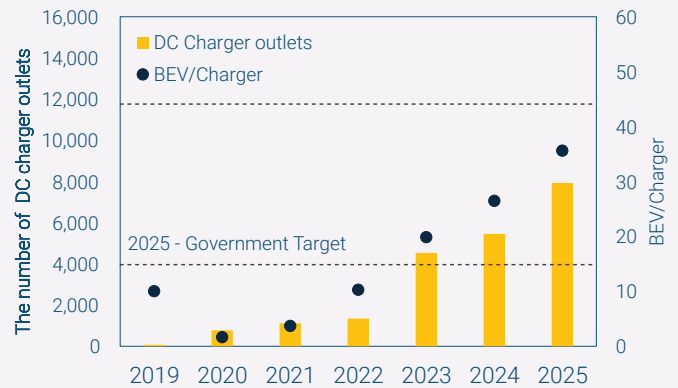


Structure of Thailand's Public EV Charging Network



Public EV charging in Thailand is dominated by DC fast chargers, which account for nearly 80% of all public charging outlets. This reflects strong demand for rapid, en-route, and opportunity charging—particularly in urban areas and along major travel corridors. Slower DC chargers and AC chargers play a smaller role, while ultra-fast chargers remain limited.

Charging demand also varies significantly by vehicle segment and use case. Passenger cars rely mainly on home and workplace charging, with public chargers used for trips and top-up charging. In contrast, taxis, ride-hailing vehicles, and commercial fleets depend more heavily on high-utilization public fast charging, contributing disproportionately to public charging demand.



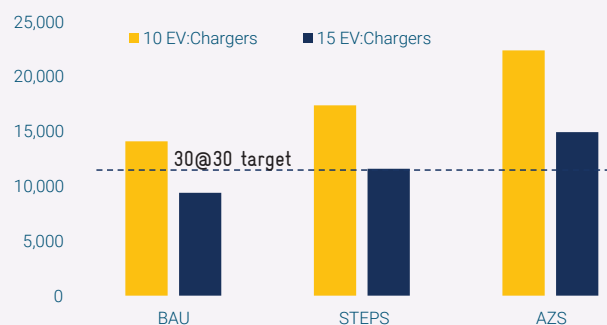
EV adoption and public charging infrastructure in Thailand are unevenly distributed across provinces. BEV registrations are concentrated in Bangkok and major economic centers, while charging outlets are more widely spread but remain insufficient in several regions. As a result, many provinces already show high BEV-to-charger ratios, indicating growing pressure on public charging infrastructure.

- Bangkok and major cities dominate BEV registrations
- Charging availability lags behind demand in several provinces
- High BEV-to-charger ratios signal rising congestion risks
- Urban and tourism-oriented regions are approaching or exceeding planning benchmarks

EV-to-Charger Ratios as a Planning Indicator

As Thailand moves beyond the early deployment phase, charger counts alone are no longer sufficient to assess infrastructure readiness. The EV-to-charger ratio provides a practical indicator of charging adequacy by reflecting the balance between EV adoption and public charging availability. Rapidly rising ratios signal increasing pressure on chargers and higher congestion risk.

- Thailand's EV-to-charger ratio has increased rapidly, exceeding levels in more mature EV markets
- By 2030, Thailand will require ~15,000–24,000 public chargers, depending on EV uptake and utilization
- Even under conservative assumptions (15 EVs per charger), faster in frastructure expansion is required



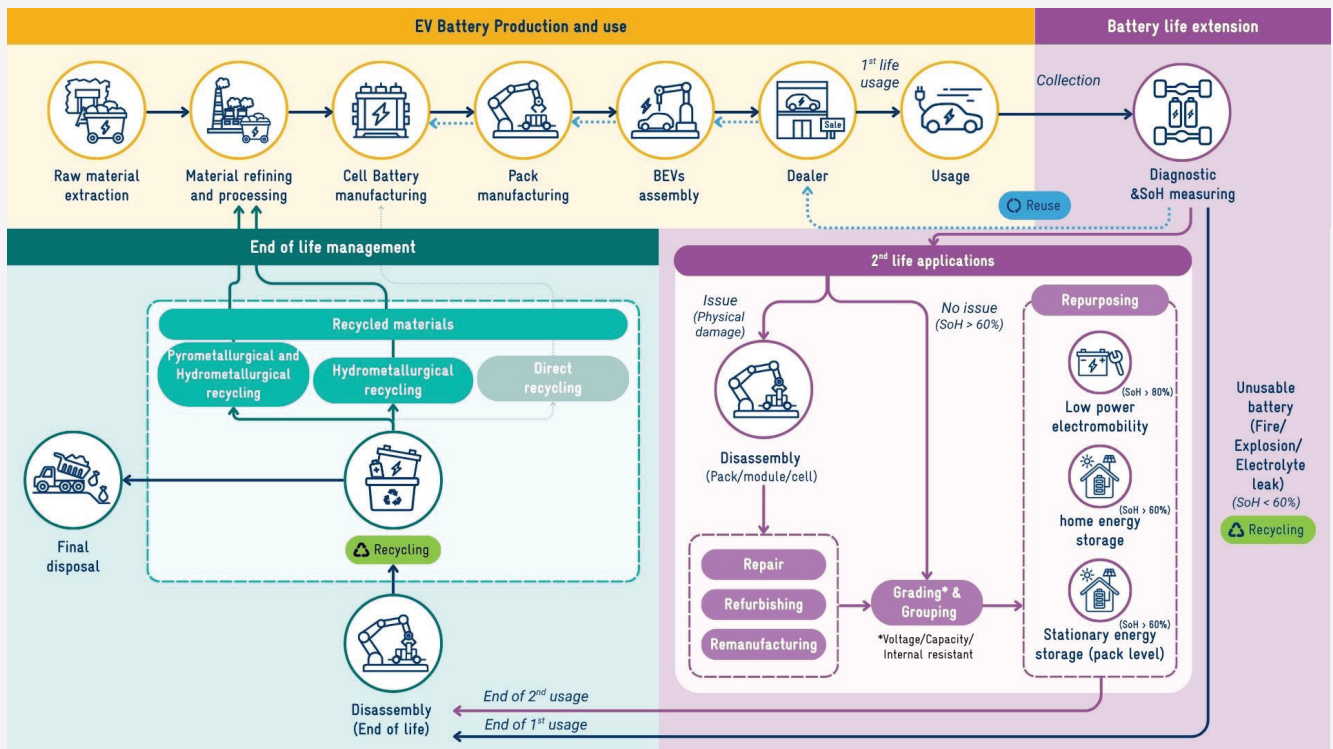
To sustain EV adoption toward 2030, charging infrastructure planning must evolve beyond near-term deployment targets. Based on current trends and scenario analysis, the following policy actions are recommended:

- Revise national charging targets to reflect updated EV adoption scenarios and realistic EV-to-charger utilization ratios
- Implement spatially differentiated incentives to address regional gaps and ensure nationwide accessibility
- Integrate infrastructure planning with EV technology trends, grid readiness, and long-term system efficiency

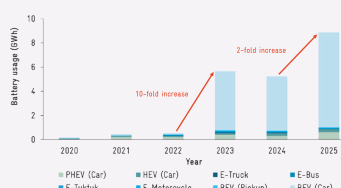
EV BATTERY VALUE CHAIN

Thailand moves toward widespread electric vehicle adoption, a proactive approach to electric vehicle (EV) battery lifecycle production and management will become an increasingly critical challenge. The expected rise in battery waste highlights the urgent need for comprehensive laws, policies, and regulations that support sustainable practices. By taking a holistic view of every stage in the EV battery lifecycle, Thailand can minimize environmental impact, conserve valuable resources, and ensure the long-term viability of its EV battery industry. Through these measures, the nation can pursue a path that is both environmentally responsible and economically sustainable.

A holistic consideration of all stages within the EV battery lifecycle



The need for a holistic approach: To maximize resource efficiency and reduce broad environmental impacts (beyond just GHGs), a full-lifecycle approach is crucial. This strategy ensures resource security by retaining critical materials within the country and ensures environmental protection by preventing illegal dumping and managing the massive influx of EoL batteries during the rapid rise in EV adoption.



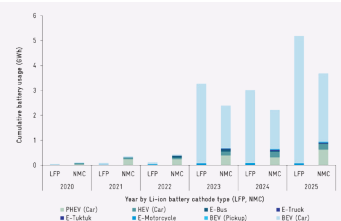
Battery usage for all EV types (2020-2025)

EV battery trends (2020-2025)

Rapid surge: Experienced a 10-fold increase (2022-2023) and a 2-fold increase (2024-2025).

2025 Peak: Reached nearly 9 GWh, driven primarily by passenger BEVs.

Emerging trend: Despite a minor fluctuation in 2024, the upward trend continues. PHEVs are emerging as a growing contributor, while passenger BEVs remain the primary driver.



Battery usage for all EV types (2020-2025) classified by battery chemistries

Battery chemistry trends (2020-2025)

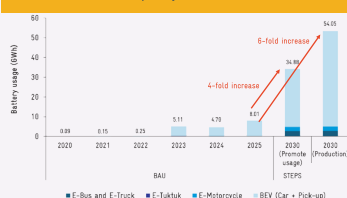
Market leaders: LFP and NMC are the primary battery chemistries.

2020-2022 (NMC era): NMC dominated, driven by PHEVs, HEVs, and E-Buses.

2023-2025 (LFP shift): LFP took the lead due to the rapid rise of passenger BEVs. Passenger BEVs remain the primary driver.

Cumulative usage: LFP reached ~12 GWh, surpassing NMC at ~9 GWh.

Battery production and usage: from past to future due to the Thailand 30@30 policy under the different scenarios



2030 Policy targets and growth

Target: Projected to reach 35 GWh (usage) and 54 GWh (production)

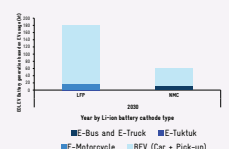
Primary driver: BEVs (cars and pickups) account for the majority (~29 GWh of usage / ~48 GWh of production).

Required scale-up: To meet these targets, battery demand must increase 4-fold (usage) and 6-fold (production) compared to 2025 levels.

2030 The emerging waste challenge

Projected EoL batteries: Meeting the BEV usage target (~29.3 GWh) will eventually generate over 210 kTon of End-of-Life (EoL) batteries (161 kTon LFP and 49 kTon NMC).

Urgent action: This massive influx highlights the critical need for comprehensive laws and regulations to govern sustainable battery production and disposal.



Key messages:

- Each stage of the EV battery value chain involves different key players.
- The challenge lies in connecting them under a shared vision of sustainable EV battery production and management.
- A holistic approach is the foundation for a successful transition toward sustainability.

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Abbreviation

A

AC	Alternating current
AZS	Announced Pledge on Zero Emission Vehicles Adoption Scenario

B

BAU	Business As Usual Scenario
BEV	Battery Electric Vehicle
BMR	Bangkok Metropolitan
BOI	Board of Investment

C

CAGR	Compound Annual Growth
CBU	Completely Built-Up
CIT	Corporate Income Tax
CO₂	Carbon Dioxide
COVID-19	Corona Virus Disease 2019

D

DC	Direct current
DIW	Department of Industrial
DLT	Department of Land

E

E2W	Two-wheelers
E3W	Three-wheelers
E4W	Four-wheelers
E-Buses	Electric Buses
EEC	Eastern Economic Corridor
EF	Emission Factors
EGAT	Electricity Generating Authority of Thailand
ELV	end-of-life vehicle
E-Motorcycle	Electric Motorcycle
EoL	End-of-Life
EPPO	Energy Policy and Planning
EPR	Extended Producer
ERC	Energy Regulatory Commission
E-TukTuk	Electric Tuk-Tuk
EV	Electric Vehicle
EV-HRD	EV-Human Resource Development

F

FU	Fuel Use
-----------	----------

G

GWh	Gigawatt hour
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H

HDV	Heavy-Duty Vehicle
HEV	Hybrid Electric Vehicle
HEV	hybrid electric vehicles

I

ICE	Internal Combustion Engine
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K

km	Kilometer
kTon	kiloTon
kW	kiloWatt

L

LCV	Light Commercial Vehicle
LDV	Light Duty Vehicle
LFP	Lithium Iron Phosphate
LV	Low-Voltage

M

MEA	Metropolitan Electricity Authority
MHESI	Ministry of Higher Education, Science, Research, and Innovation
MV	Medium-Voltage
MW	Megawatt

N

NIA	National Innovation Agency
NMC	Nickel Manganese Cobalt
NSTDA	National Science and Technology Development Agency

P

PEA	Provincial Electricity
PHEV	Plug-in-Hybrid Electric
PMUC	Program Management Unit for Competitiveness

R

R&D	Research & Development
RY.1	Passenger car (≤ 7 seats)
RY.2	Passenger car (> 7 seats)
RY.3	Pick-up
RY.4	Motor Tricycles
RY.6	Urban Taxis
RY.7	Fixed Route Taxi (Kra-Por)
RY.8	Motor Tricycles Taxi (Tuk Tuk)
RY.9	Hotel Taxi
RY.10	Tour Taxi
RY.11	Car For Hire
RY.12	Motorcycles
RY.17	Motorcycles Taxi
RY.18	Application-based Taxis

S

SMEs	Small and Medium Enterprises
SoH	State of health
STEPS	Stated Policy Scenario

T

TAI	Thailand Automotive Institute
TISI	Thai Industrial Standards
TTW	Tank-To-Wheel

U

UN	United Nations
USD	United States Dollar

V

V1G	Vehicle-One-Grid
V2G	Vehicle-to-Grid
V2X	Vehicle-to-Everything
VKT	Vehicle-Kilometres Traveled
vRE	variable Renewable Energy

W

WEEE	Waste Electrical and Electronic Equipment
WTT	well-to-tank
2W	Two - Wheeler
3W	Three - Wheeler
4W	Four - wheeler

Z

ZEV	Zero-Emission Vehicle
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Thai-German Cooperation on Energy, Mobility and Climate (TGC EMC)

TGC EMC project Background



Key actors in Thailand are empowered to plan and implement transformative activities in the energy, transport, and industry sectors in line with the Government's 2050 carbon neutrality objectives

TGC EMC project

Background

At COP30, Thailand announced target: net zero emissions by 2050. To achieve these goals, Thailand needs to decarbonise its power, transport, and industrial sectors, which are still dominated by fossil fuels, and increase variable renewable energy (vRE) generation (e.g., wind and solar), which remains far below its full potential.

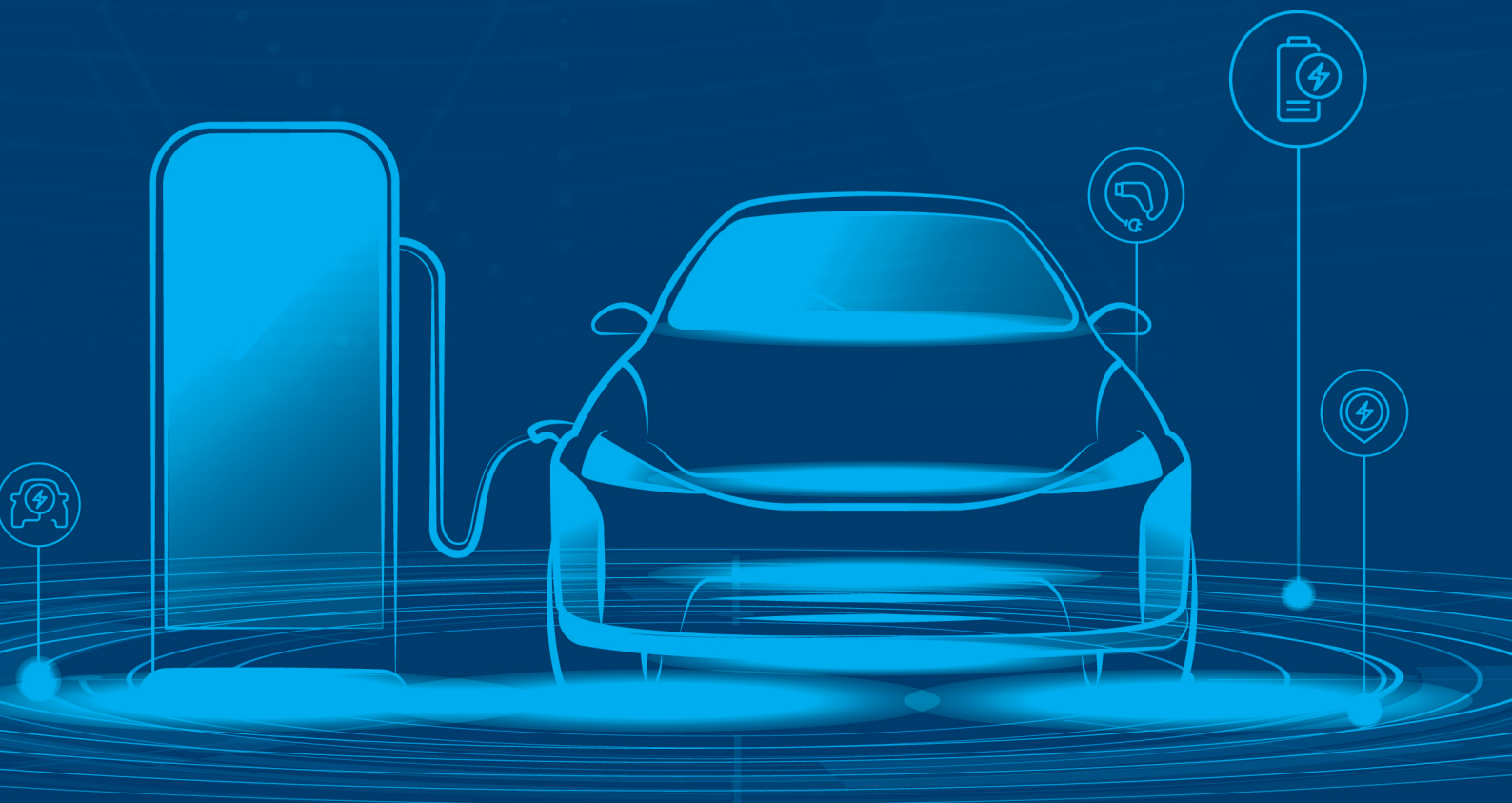
The potentials of vRE remains far below what is feasible in Thailand, while other energy-intensive sectors (i.e., transport, industry) are still dominated by fossil fuels. The market penetration of vRE and the electrification of end-use sectors are both limited by barriers inherent to the Thai power sector. These include inflexibility in power-system operation and planning but also limited technological resources and skills in integrated planning, which stand in the way of a renewable-based transformation of the energy system. Ambitious net zero emissions (by 2050) and sector-specific targets have not been pursued by the market and regulatory structures that could drive transformation. Other barriers to transition are a lack of concrete decarbonisation roadmaps and poor understanding of sector coupling, as well as insufficient cross-sectoral dialogue. These factors prevent investment and vRE ramp up and currently limit their role as decarbonisation options in the transport and industry sectors.

The project supports Thailand's efforts to reach net zero emissions by 2050, focusing on the two most important sectors in terms of emissions. It aims to reach its goals by:

- Supporting the transition in the power and transport sectors with technology and knowledge transfer.
- Developing policy, regulatory and business models with a clear focus on sector coupling to tackle cross-sector issues hampering the energy transition.
- Setting up city labs offering technical, regulatory and business support to local urban actors and integrating a scaling-up plan.
- Providing significant support in the field of climate finance, for example in the form of seed funding for local projects, as well as measures to increase the capabilities of both fund managers and potential recipients.

Trends and Developments

in Electric Mobility
and Infrastructure



1. Trends and Developments in Electric Mobility and Infrastructure

1.1 | Thailand Position in the Global EV Status

Thailand has emerged as one of the fastest-growing electric vehicle (EV) markets in Southeast Asia, supported by strong government policy interventions, expansion of charging infrastructure, and increasing consumer acceptance of electric mobility technologies. Although Thailand remains relatively small compared with major global EV markets in terms of cumulative vehicle stock, recent developments indicate that the country is transitioning from an early adoption phase toward a period of accelerated market expansion and industrial transformation.

Figure 1 presents the trajectory of Battery Electric Vehicle (BEV) light-duty vehicle adoption in Thailand relative to global benchmarks, including China, Europe, the United States, South Korea, and the global average. During the initial phase between 2019 and 2021, Thailand exhibited relatively low BEV market penetration compared with leading EV economies, reflecting the limited availability of EV models, insufficient charging infrastructure, and relatively weak market incentives. However, a significant shift became evident beginning in 2022, driven primarily by targeted policy mechanisms such as the EV 3.0 incentive package, fiscal support measures, tax reductions, and increasing participation from domestic and international automotive manufacturers.

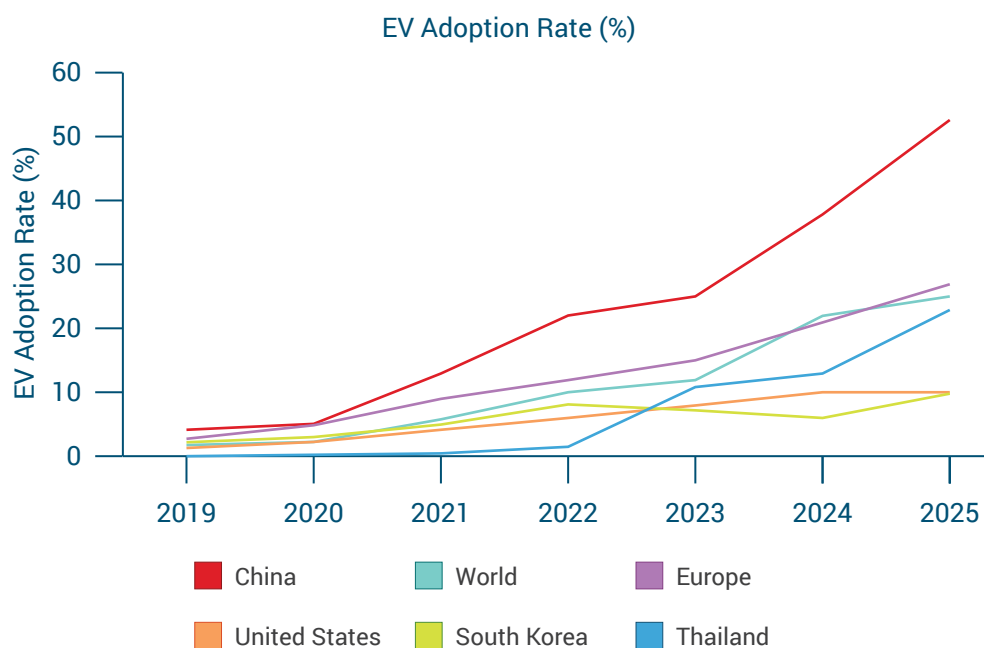


Figure 1 Battery Electric Vehicle (BEV) Light-Duty Vehicle Adoption: Thailand vs. Global Benchmarks (IEA, 2026)

Thailand's BEV adoption rate increased substantially from below 1% in 2019 to approximately 13% in 2024 and is projected to approach approximately 23% by 2025. This rapid increase represents one of the steepest growth trajectories among emerging EV markets. By 2023, Thailand had surpassed South Korea in BEV adoption and progressively narrowed the gap with the United States and the global average. Such developments suggest that Thailand has entered a period of accelerated market expansion characterized by stronger consumer confidence, broader vehicle model availability, and improved accessibility to charging facilities.

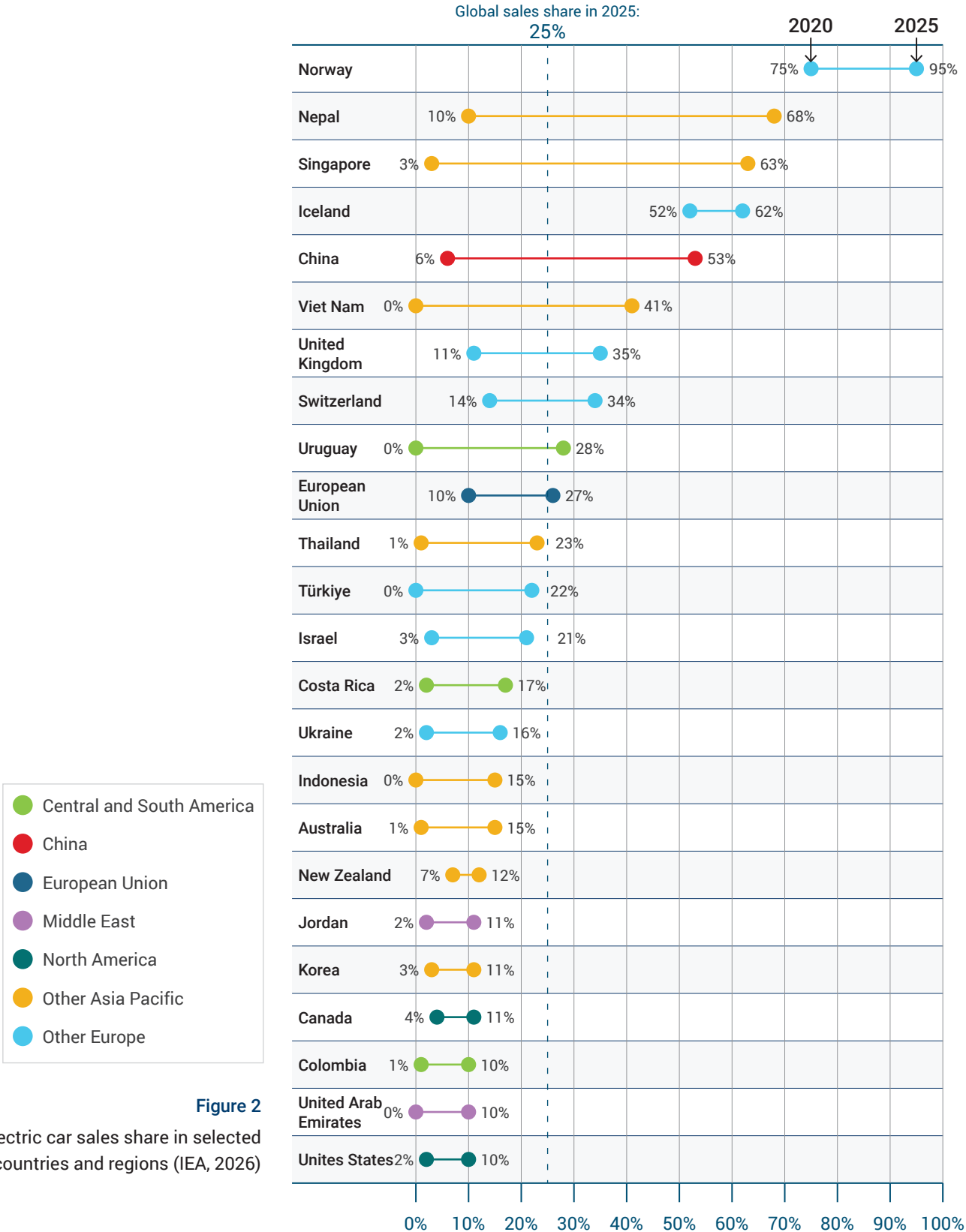


Figure 2

Electric car sales share in selected countries and regions (IEA, 2026)

While Figure 1 highlights Thailand's rapid progress in market penetration and adoption dynamics, Figure 2 provides a broader perspective on Thailand's position within the global EV landscape through a comparison of passenger EV stock across countries between 2019 and 2025. The figure illustrates considerable disparities in EV deployment worldwide, with China maintaining a dominant position in both cumulative vehicle stock and market scale, followed by major economies such as the United States and several European countries. Meanwhile, countries such as Norway exhibit exceptionally high penetration rates despite relatively smaller market sizes, demonstrating the influence of strong policy frameworks and mature charging ecosystems.

Against this global backdrop, Thailand remains comparatively modest in terms of absolute EV stock. Nevertheless, the country has demonstrated one of the most significant rates of market expansion among emerging economies. Figure 2 indicates that Thailand increased from almost negligible EV market penetration in 2020 to approximately 23% by 2025, reflecting substantial progress achieved within a relatively short period. Although Thailand's cumulative EV stock remains considerably lower than those of major markets such as China, the United States, and leading European countries, the pace of market growth suggests increasing competitiveness and a strengthening role in the regional EV transition.



Overall, the combined evidence from Figures 1 and 2 highlights two key characteristics of Thailand's EV transition. First, Thailand has demonstrated rapid progress in market adoption, with growth rates exceeding those observed in several advanced economies during comparable stages of market development. Second, despite this accelerated growth, a considerable gap remains between Thailand and global EV leaders in terms of cumulative market scale and long-term penetration. These findings suggest that sustained policy support, continued infrastructure investment, and strategic industrial development will remain essential for maintaining growth momentum and positioning Thailand as a regional hub for EV manufacturing and deployment in the coming decades.

1.2 Current EV Adoption

1.2.1

Light-Duty Vehicles (LDVs)

Thailand's LDV market—comprising passenger cars (RY.1), pickups (RY.3), and light commercial vehicles (RY.6, RY.9-11)—represents the most dynamic segment of the country's electric mobility transition. This category has moved from a nascent stage to a global leader in adoption speed within just a few years.

Passenger car registrations in Thailand showed fluctuating trends throughout the study period (Figure 3). Following a decline associated with the impacts of the COVID-19 pandemic and economic disruptions, the market experienced a temporary recovery before moderating again in the later years, reflecting changes in market conditions and consumer demand.

Despite fluctuations in annual sales, the total number of registered passenger cars grew steadily throughout the study period. The passenger car fleet increased from about 10.0 million vehicles in 2019 to nearly 12.5 million in 2025, showing sustained growth in the overall vehicle stock. This gap between volatile new registrations and the consistently rising total registrations highlights the long lifespan of passenger cars in Thailand and emphasizes the importance of fleet turnover when evaluating the pace and potential impact of EV adoption in LDV sector.

EV adoption in Thailand's passenger car segment remained marginal prior to 2022, with BEVs accounting for virtually no share of new registrations (Figure 3). A clear inflection point emerged in 2022, followed by rapid and sustained acceleration during 2023–2025. BEV adoption increased from approximately 2% in 2022 to 12% in 2023 and continued to rise to 23% by 2025, indicating a substantial shift in consumer preferences and signaling a structural transformation within Thailand's passenger car market.



Figure 3 New Registration and Cumulative Number of Passenger Car (RY.1) Pick-up (RY.3) and Taxi and For-Hire Vehicles (RY. 6, 9, 10, 11).

This rapid increase in adoption was accompanied by a surge in new EV passenger-car registrations, which grew by more than an order of magnitude over a few years. After remaining negligible up to 2021, annual EV registrations increased dramatically from 2022 onward, reaching historically high levels by 2025. Together, these trends highlight a transition from an early adoption phase to a rapid market expansion phase, underscoring the growing role of EVs in shaping the future composition of Thailand's passenger car fleet.

Pickup registrations showed a persistent downward trend over the same period. Following a decline after 2019, new registrations remained subdued during 2020–2022 and contracted sharply from 2023 onward, indicating a structural slowdown in this vehicle segment (Figure 3).

In contrast to passenger cars, the cumulative pickup fleet increased only modestly until 2023 and then began to decline slightly in 2024–2025. This pattern suggests a combination of reduced new sales and accelerated vehicle retirement or reclassification, pointing to a fundamentally different fleet evolution pathway compared with passenger cars—an important consideration for electrification strategies targeting Thailand's light-duty vehicle fleet.

Electric vehicle adoption in Thailand's pickup segment remained minimal through 2022, due to technological, cost, and infrastructure limitations inherent to utility-focused vehicles. A clear growth phase began in 2023, leading to further acceleration in 2024–2025. During this time, EV adoption surged from nearly zero to over 0.5% by 2024 and continued to rise in 2025, although from a still modest base compared to passenger cars (Figure 4).

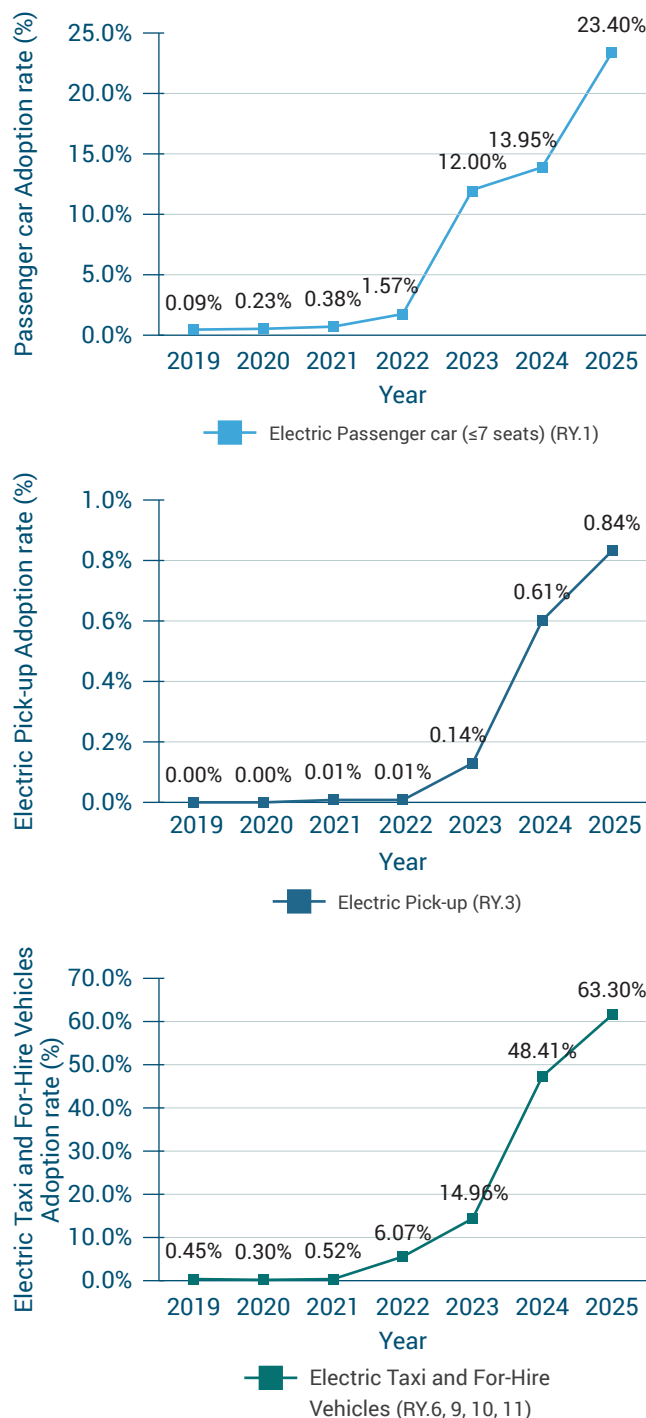
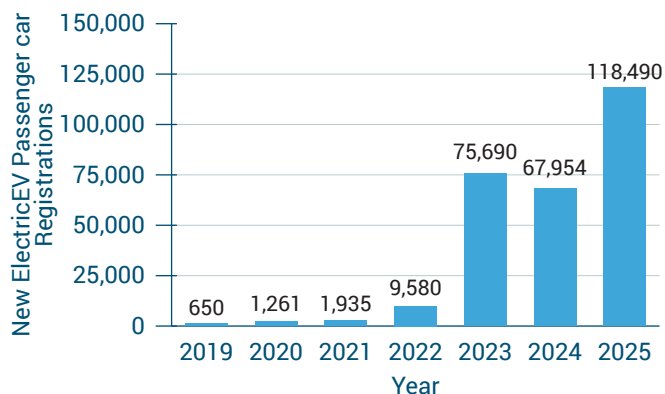
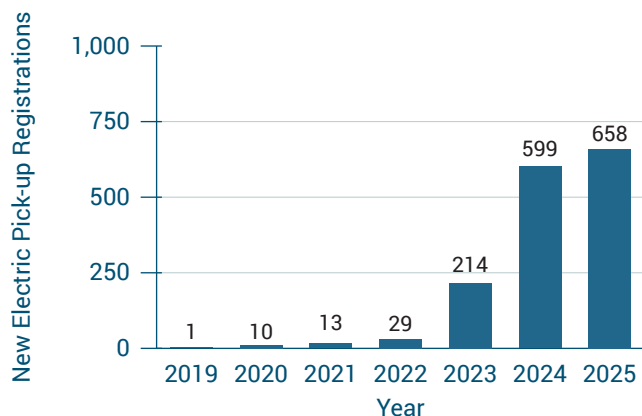


Figure 4

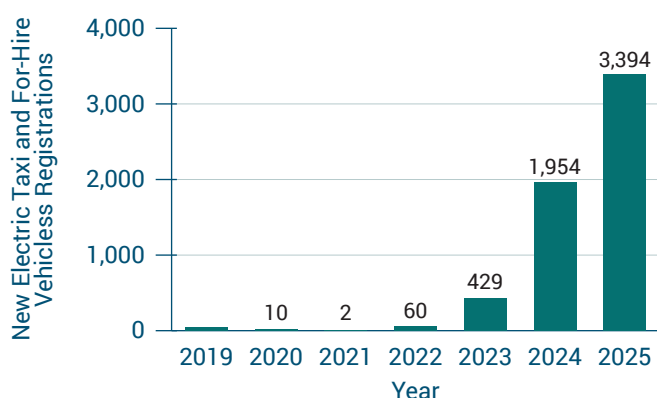
EV Adoption Rate & New EV Registration of Passenger Car (RY.1) Pick-up (RY.3) and Electric Taxi and For-Hire Vehicles (RY.6, 9, 10, 11)



■ Electric Passenger car (≤ 7 seats) (RY.1)



■ Electric Pick-up (RY.3)



■ Electric Taxi and For-Hire Vehicles (RY.6, 9, 10, 11)

Figure 4

EV Adoption Rate & New EV Registration of Passenger Car (RY.1) Pick-up (RY.3) and Electric Taxi and For-Hire Vehicles (RY.6, 9, 10, 11)

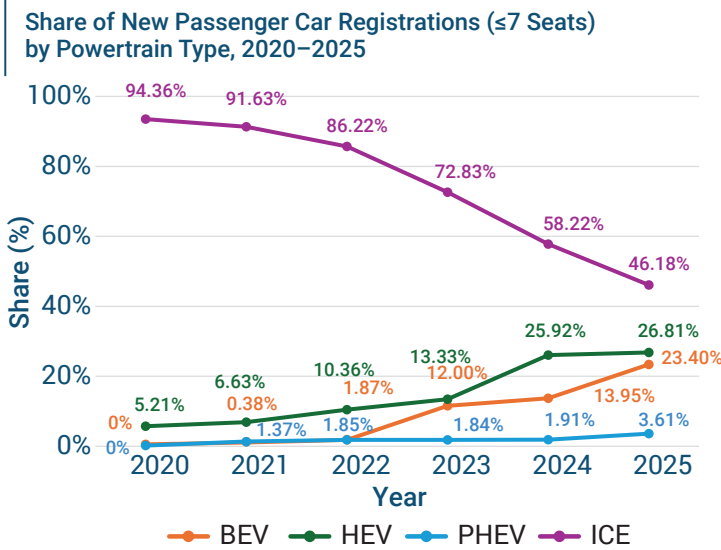
This acceleration was reflected in a swift rise in new electric pickup registrations. After staying at very low levels before 2022, annual registrations grew significantly from 2023 onward, signaling the beginning of commercial sales and market entry for electric pickup models. Although overall adoption remains limited, the growth trend indicates that the pickup segment has entered an early expansion stage, with strong potential for future electrification as vehicle availability, charging infrastructure, and policy support continue to improve.

Light commercial vehicle (LCV) registrations in Thailand dropped sharply during 2020–2021, then gradually recovered from 2022 onward (Figure 3). New registrations declined significantly after 2019, hit a low in 2021, and then steadily rebounded through 2023–2025. Although annual registrations recovered, volumes in later years remained below pre-pandemic levels, indicating only a partial return to pre-pandemic market activity.

In contrast, the total number of registered light commercial vehicles steadily declined throughout the study period. The overall registered fleet decreased consistently from 2019 to 2025, indicating that vehicle retirements regularly exceeded new registrations. This combination of increasing new registrations and a shrinking total fleet suggests faster fleet turnover and ongoing downsizing within the LCV segment—an important factor for electrification plans focused on commercial and service vehicles.

EV adoption in Thailand's LCV segment was very limited before 2022, due to market immaturity and a lack of suitable electric models (Figure 4). A clear turning point occurred in 2022, followed by a rapid increase from 2023 onwards. During this time, the EV adoption rate rose sharply, surpassing 10% in 2023 and reaching over 50% by 2025, marking a significant shift in new-vehicle purchases in this segment.

This surge in adoption was accompanied by a sharp increase in new electric LCV registrations, which grew from almost zero levels before 2022 to several thousand units annually by 2024–2025. The combination of quickly rising adoption rates and strong growth in new registrations indicates that the LCV segment has moved directly from early adoption to rapid market expansion, highlighting its substantial short-term potential for electrification, especially in urban delivery, service, and last-mile logistics.



The composition of new passenger car registrations in Thailand underwent a marked structural shift between 2020 and 2025 (Figure 5). The share of internal combustion engine (ICE) vehicles declined sharply, from over 90% in 2020 to around 40% by 2025, indicating a rapid erosion of ICE dominance in new vehicle sales. This decline was accompanied by a strong expansion of electrified powertrains, particularly BEVs and hybrid electric vehicles (HEVs). BEV market share increased rapidly after 2022, reaching more than one quarter of new registrations by 2025, while HEVs also showed sustained growth over the period. In contrast, plug-in hybrid electric vehicles (PHEVs) remained a niche option with a consistently small market share. Overall, these trends reflect a rapid electrification of Thailand's passenger car market, with new purchases increasingly shifting away from conventional ICE vehicles toward fully electric and hybrid technologies.

Figure 5
Passenger Car (RY.1) New Registration Share.

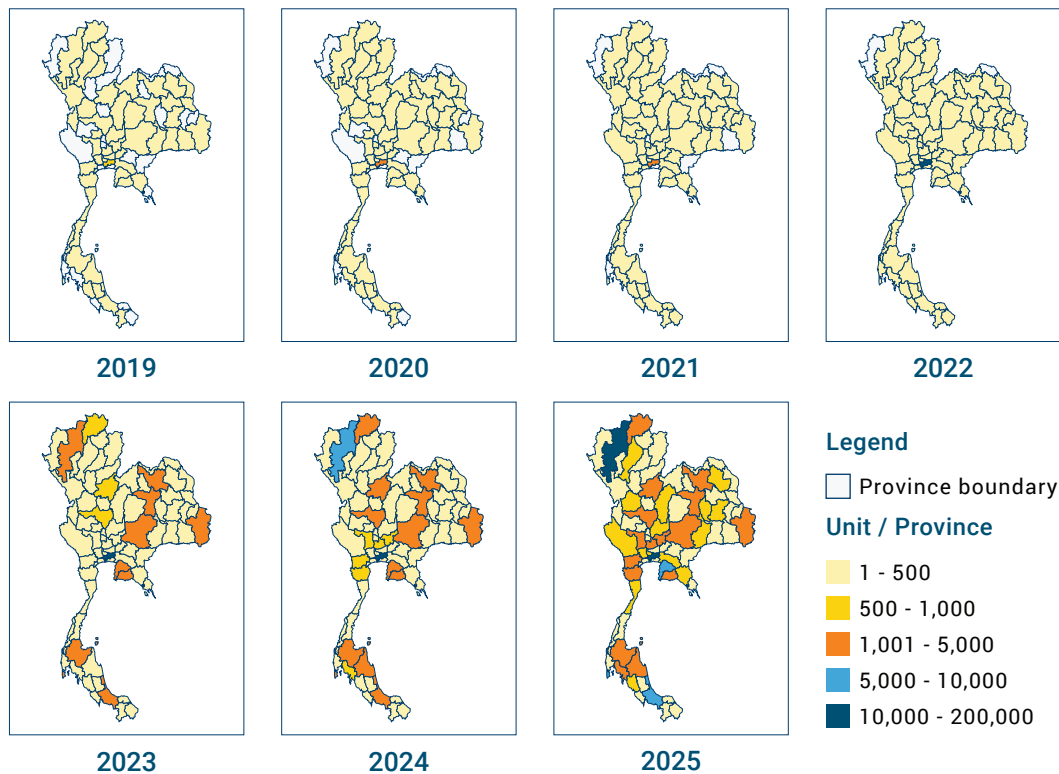


Figure 6 Map of Cumulative Electric Car and Pick-up by Province 2019 – 2025.

Figure 6 shows the spatial distribution of cumulative BEV registrations for passenger cars and pickups across Thai provinces from 2019 to 2025. The results indicate a highly uneven geographic pattern, with BEV adoption mainly concentrated in major economic and urban centers. Specifically, Bangkok, Chiang Mai, Chonburi, and Songkhla consistently have the highest cumulative numbers of BEVs throughout the study period. These provinces serve as key economic hubs in their regions, characterized by higher incomes, greater purchasing power, denser charging infrastructure, and greater exposure to EV-related policies and incentives.

The observed spatial pattern indicates that BEV adoption in Thailand has so far followed an urban- and economy-driven growth pattern, with early adoption concentrated in large cities and provinces with strong transport and energy infrastructure. Conversely, many rural or less populated provinces showed significantly lower cumulative BEV numbers, revealing ongoing regional gaps in EV usage. This spatial variation underscores the need for targeted regional policies and infrastructure development to foster a more equitable nationwide shift toward electric mobility.

Despite the potential for rapid electrification in Thailand's LDV fleet, several structural barriers still limit broader and more balanced adoption across passenger cars (RY.1), pickups (RY.3), and light commercial vehicles (RY.6, RY.9, RY.10, RY.11, and Category 4). First, market readiness varies across segments: passenger cars have shown the fastest growth, while pickups—despite their significant role in Thailand's vehicle stock and rural-commercial use—still face limited model options and higher technical demands (e.g., towing, payload, long-range driving), slowing their adoption. Second, overall costs and affordability remain critical issues, especially for commercial users and households outside major urban centers, where upfront vehicle prices, financing conditions, and residual-value uncertainty may outweigh fuel-cost savings. Third, charging infrastructure deployment and grid readiness remain concentrated in economic hubs, reinforcing the urban-led adoption trend and creating range and operational limitations for rural and interregional travel, commercial logistics, and fleet management. Finally, adoption is hindered by regulatory and operational gaps, such as fragmented standards and permitting processes, limited fast-charging coverage for high-utilization vehicles, and uncertainty about long-term policy continuity. Overcoming these barriers will be essential to translate the recent rapid growth in certain segments into a sustained, nationwide shift across Thailand's entire LDV fleet.



1.2.2 Motorcycle and Tuk Tuk

Motorcycles continue to be the main vehicle type in Thailand, both in annual new registrations and total fleet size. From 2019 to 2025, new motorcycle registrations showed moderate fluctuations, with a dip in 2020 followed by recovery and stabilization. Despite yearly changes, the total number of registered motorcycles grew consistently over the period, highlighting the key role that motorcycles play in daily travel, especially for commuting, informal transport, and last-mile journeys in urban and rural areas (Figure 7).

Compared with the overall market size, electric motorcycle adoption has grown rapidly from a very small base. New electric motorcycle registrations remained limited during 2020–2021 but increased substantially beginning in 2022, with strong growth observed in 2023–2024 and registrations remaining at relatively high levels in 2025 (Figure 8). Likewise, the EV adoption rate increased steadily, rising from approximately 0.1% in 2020 to around 1.4–1.5% during 2024–2025. Although the overall penetration rate remains modest relative to Thailand’s large motorcycle fleet, the trend suggests a transition from early demonstration and pilot activities toward initial market expansion, supported by declining vehicle costs, increasing availability of electric models, and the suitability of motorcycles for short-distance and high-frequency urban travel. These factors suggest that motorcycles represent one of the most promising near-term opportunities for transport electrification in Thailand. Tuk Tuks (motor tricycles) constitute a small but important component of Thailand’s transport system, particularly for informal passenger services, local freight activities, and short-distance urban travel. Between 2020 and 2025, new Tuk Tuk registrations fluctuated considerably, with a temporary decline around 2021, followed by a marked increase during 2022–2023 before slowing again during 2024–2025 (Figure 7). Meanwhile, the total number of registered Tuk Tuks steadily decreased during this period, showing that retirements consistently outnumbered new registrations. This decline indicates a gradual shrinking of the traditional motor tricycle fleet, likely due to aging vehicles, regulatory pressures, and competition from other transportation options. In terms of electrification, Tuk Tuks show a relatively high but fluctuating EV adoption rate. New electric tricycle registrations surged significantly in 2022–2023, pushing the EV adoption rate to over 50% of new registrations in certain years, far higher than in other vehicle categories (Figure 8). However, both new EV registrations and adoption rates fell after 2023 due to the small overall market size and sensitivity to policy support, pilot initiatives, and procurement cycles. Overall, the data suggests that although Tuk Tuks have proven to be technically and operationally suitable for electrification,

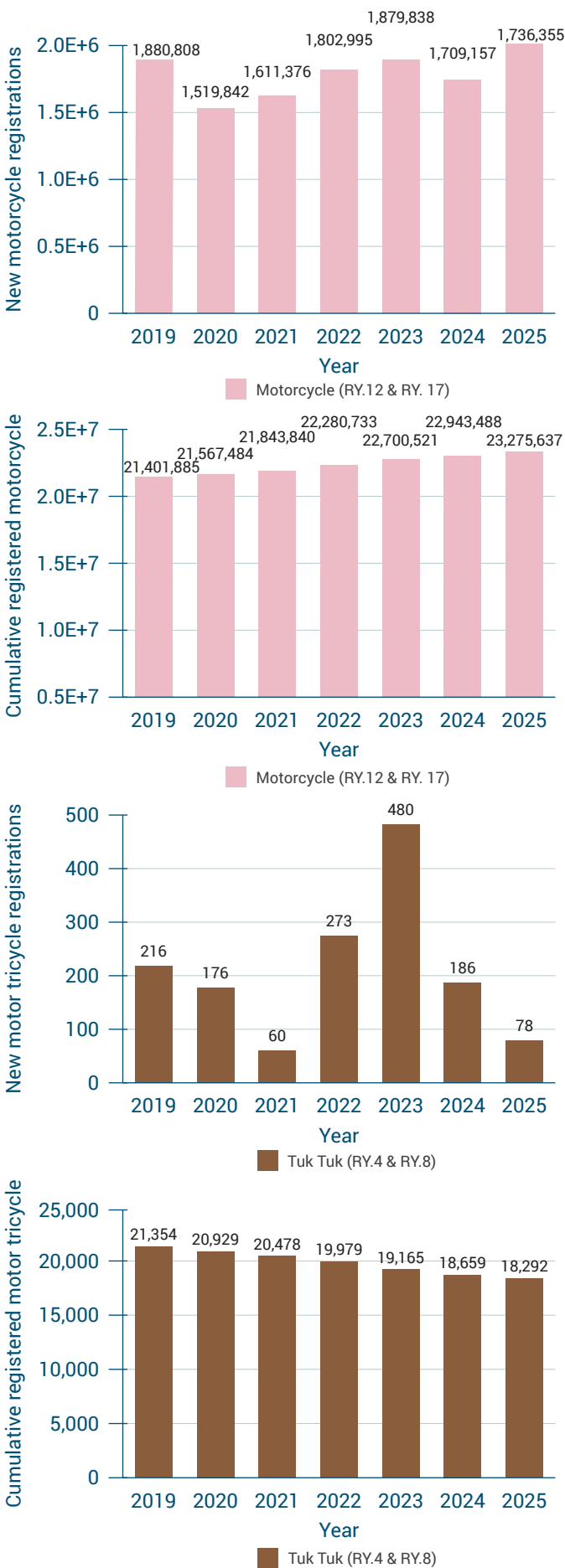


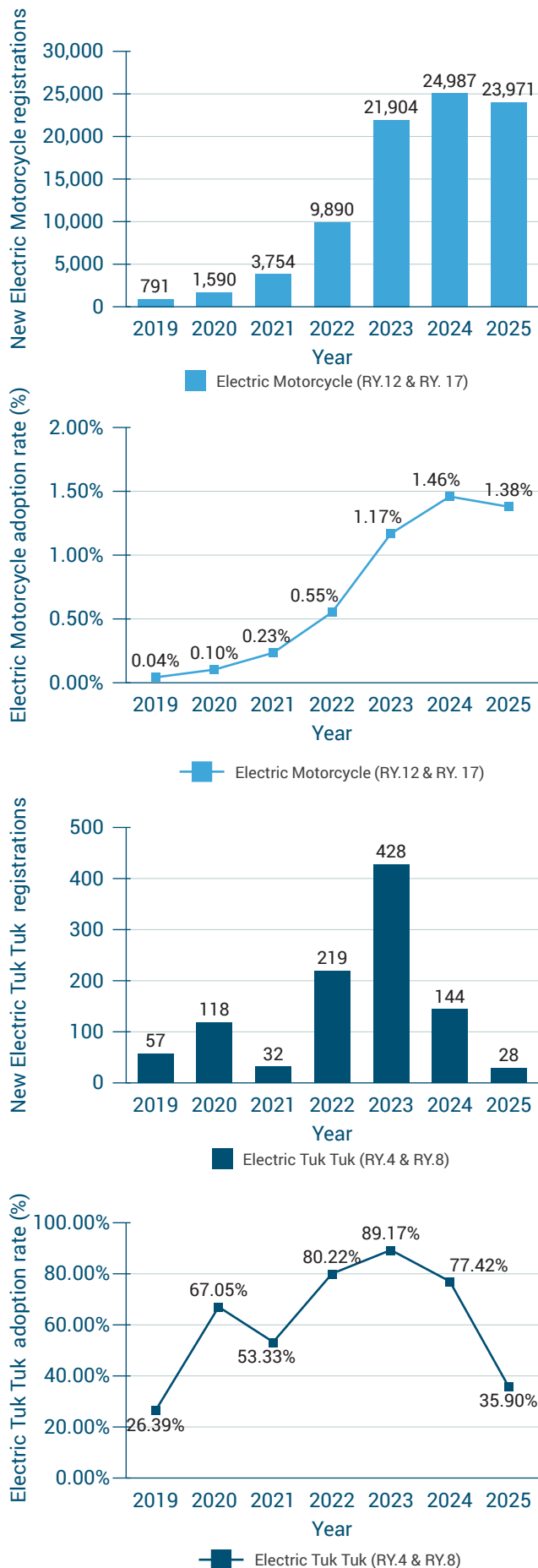
Figure 7
New Registration and Cumulative Number of Motorcycles (RY.12 and RY.17) and Tuk Tuks (RY.4 and RY.8)

continued adoption will likely depend on consistent policy incentives, targeted urban programs, and integration with public and informal transportation systems.

Despite the potential for rapid electrification of Thailand's two- and three-wheeler fleet, several barriers still limit broader and sustained adoption of motorcycles and Tuk Tuks. First, affordability and financing challenges remain key for many users, especially those in low- to middle-income households and informal-sector workers, as higher upfront EV costs limited access to credit and uncertainty about resale value can outweigh savings on operating costs. Second, limitations in charging and energy supply persist, particularly for users without secure private parking or access to home charging, whereas public charging stations are often designed for cars rather than two- and three-wheelers. Third, concerns about battery performance, durability, and replacement costs—including real-world range, degradation under daily use, and the availability of reliable service centers—continue to affect consumer confidence. Fourth, market and regulatory readiness also constrain adoption, with uneven model availability for different needs (such as delivery or passenger service), fragmented technical standards, and limited formal safety and quality requirements. Lastly, although the motor tricycle segment has shown relatively high EV shares in some years, it remains highly sensitive to policy and procurement cycles, given its small market size, thereby leading to volatility in annual EV adoption. Overcoming these barriers through targeted incentives, suitable charging or battery-swapping solutions, clearer standards, and support for informal transport operators will be essential to turn recent progress into a lasting nationwide transition.

Figure 8

New EV Registration and EV Adoption Rate of Motorcycles (RY.12 and RY.17) and Tuk Tuks (RY.4 and RY.8).



1.2.3

Heavy-Duty Vehicles (HDVs) : Bus, HDT (Heavy-Duty Trucks)

Bus registrations in Thailand fluctuated significantly from 2019 to 2025. New registrations fell sharply in 2020–2021 due to the COVID-19 pandemic's impact on public transport demand, then partly rebounded in 2022–2023. However, registrations slowed again in 2024–2025, signaling a slow and uneven recovery in the bus market. Meanwhile, the total number of registered buses steadily declined throughout the period, indicating that vehicle retirements consistently outpaced new registrations (Figure 9). This downward trend suggests a gradual shrinking and aging of the traditional bus fleet, with potential effects on service quality, emissions, and replacement needs.

Electrification in the bus sector has followed a policy- and procurement-driven pathway. EV adoption remained negligible before 2021, followed by a rapid increase in 2022, when EVs accounted for nearly half of new bus registrations (Figure 10). This spike aligned with a rapid rise in new electric bus registrations, reflecting the implementation of targeted public transport programs and pilot projects. However, both the EV adoption rate and new EV registrations dropped significantly after 2023, underscoring the sensitivity of bus electrification to funding cycles, procurement timelines, and policy stability. Overall, while electric buses have demonstrated clear technical feasibility and strong potential to reduce emissions, maintaining and expanding adoption will depend on stable long-term policies, predictable investment strategies, and coordinated infrastructure planning to shift from occasional deployments to a systematic fleet transition.

Figure 9

New Registration and Cumulative Number
of Bus and Truck

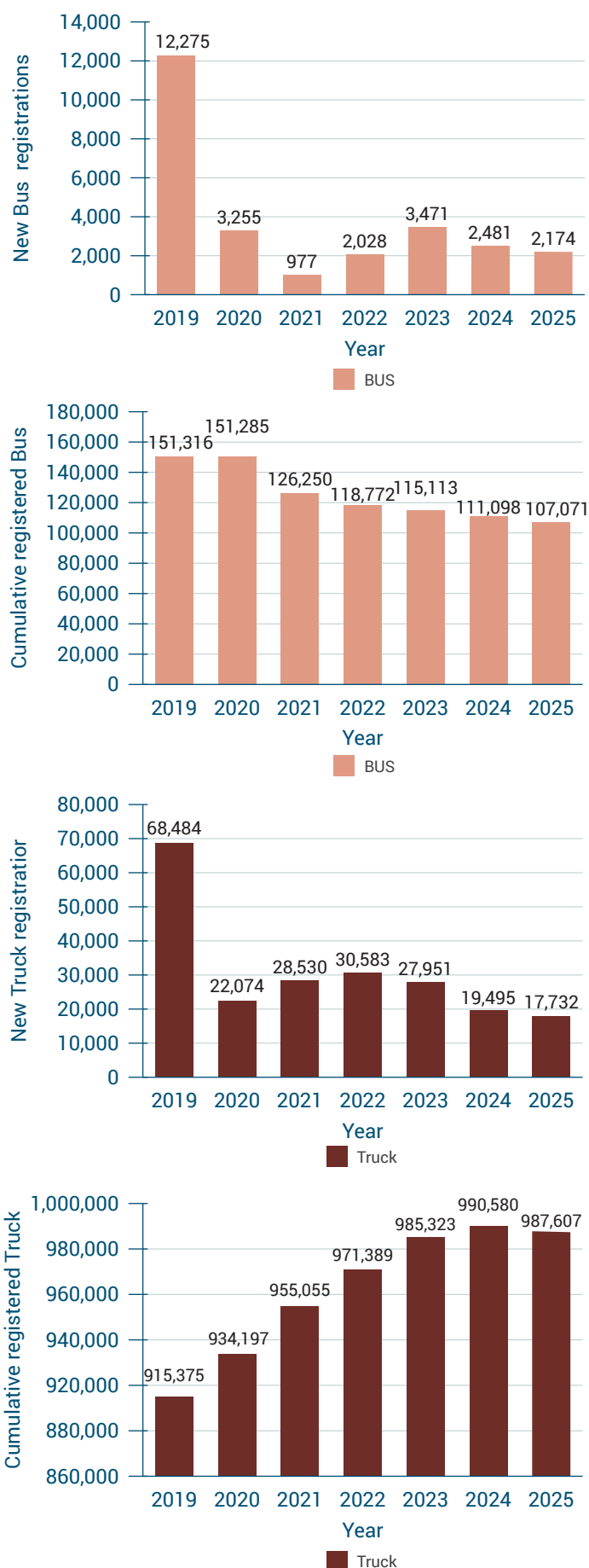




Figure 10 EV Adoption Rate & New EV Registration of Bus and Truck.

Registrations of heavy-duty trucks in Thailand remained relatively stable with moderate fluctuations over 2019–2025 (Figure 9). New registrations increased gradually through 2021–2022, then softened in 2023–2025, reflecting cyclical demand in freight activity and broader economic conditions. In contrast, the cumulative number of registered trucks increased steadily throughout the period, indicating continued expansion of the freight vehicle stock and the long operational lifetime of heavy-duty trucks in Thailand. Electrification in the HDT segment has so far remained limited and nascent. EV adoption remained negligible prior to 2022, followed by an emerging phase of uptake from 2023 onward (Figure 10). The EV adoption rate increased gradually alongside a notable rise in new electric truck registrations before moderating slightly toward the end of the study period. Although the absolute number of electric trucks remains relatively small compared with the overall truck fleet, these trends suggest the early market entry of electric heavy-duty trucks, potentially supported by pilot initiatives, targeted incentives, and specific operational applications such as urban freight and short-haul transport. Overall, while HDT electrification remains at an early stage, the recent growth trajectory indicates emerging momentum, with future expansion likely dependent on vehicle cost reductions, high-power charging infrastructure, and long-term policy support. Despite the significant potential for decarbonization through electrifying Thailand’s bus and heavy-duty truck fleets, several obstacles still hinder large-scale and sustained adoption.

First, high initial vehicle costs and financing challenges remain prevalent, especially for private operators and SMEs, and overall cost savings are not always realized under current usage patterns and electricity–diesel price trends.

Second, deployment is constrained by gaps in charging infrastructure, including the need for high-power depot charging for buses and megawatt-scale charging (or alternative solutions) for long-haul trucks, along with grid capacity upgrades and lengthy interconnection processes.

Third, operational needs and the maturity of technology pose challenges: range limitations under heavy loads, reduced payload capacity due to battery weight, and uncertainties regarding battery lifespan and residual value can complicate fleet planning, particularly for freight logistics with tight schedules.

Fourth, adoption is heavily influenced by procurement cycles and policy stability, as evidenced by the irregular uptake in the bus sector. Inconsistent incentives, fragmented standards, and unclear permitting procedures can slow investment. Lastly, ecosystem’s readiness—including maintenance capacity, spare parts availability, trained technicians, and reliable after-sales support—is uneven, increasing perceived risks for fleet operators.

Overcoming these barriers will require coordinated long-term policies, predictable financing options, targeted infrastructure investments, and clear technical standards to transform pilot projects into widespread fleet transition.

1.3 | Public Transport and Services for First and Last Miles

The electrification of public transport and first-and-last-mile services is a critical component for achieving Thailand's decarbonization goals, yet this sector currently faces significant challenges compared to the private passenger car market. This section covers the adoption trends across electric two-wheelers (E2W), three-wheelers (E3W), and four-wheelers (E4W) used for public services.

In this report, key public service vehicle categories have been tracked (Figures 11-15):

- **Motorcycle Taxis (E2W):** Categorized under RY.17, electric motorcycle taxis are a primary focus for last-mile connectivity in urban areas like Bangkok.
- **Tuk Tuks Taxi (E3W):** Categorized under RY.8, electric motor tricycle taxis are likewise a primary focus for last-mile connectivity in urban areas like Bangkok.
- **Urban and Application-Based Taxis (E4W):** This includes urban taxis (RY.6) and application-based taxis (RY.18). While registration numbers are being monitored, the adoption rate for these commercial fleets is still considered limited compared to private cars.
- **Local Buses and Fixed-Route Taxis:** This category includes "Songthaews" (Local Bus Category 4) and "Kra-Por" (Fixed-Route Taxi RY.7), which are essential for short-distance community transport.

Urban taxi registrations in Thailand experienced significant structural shifts from 2019 to 2025, influenced by market decline and rapid electrification. New urban taxi registrations declined sharply from 2019 to 2021, coinciding with the COVID-19 pandemic and lower urban mobility, then gradually increased from 2022 onward. Despite this rise in new registrations, the total number of registered urban taxis continued to decrease throughout the period, indicating a net fleet reduction caused by vehicle retirements exceeding new entries.

In contrast, adoption of EVs among urban taxis surged rapidly after 2022. New EV taxi registrations were almost nonexistent before 2022 but grew sharply from 2023 onward, leading to a steep increase in the EV adoption rate. By 2025, EVs made up more than 60% of new urban taxi registrations, signaling a significant shift in the industry. This quick transition highlights how urban taxi operators respond strongly to targeted incentives, high vehicle utilization, and predictable charging options connected to fixed operating areas.

Overall, the urban taxi sector demonstrates strong readiness for electrification, despite the overall reduction in fleet size. The combination of high daily mileage, centralized charging options, and policy-driven fleet renewal makes urban taxis an important part of decarbonizing first- and last-mile transportation in Thailand.

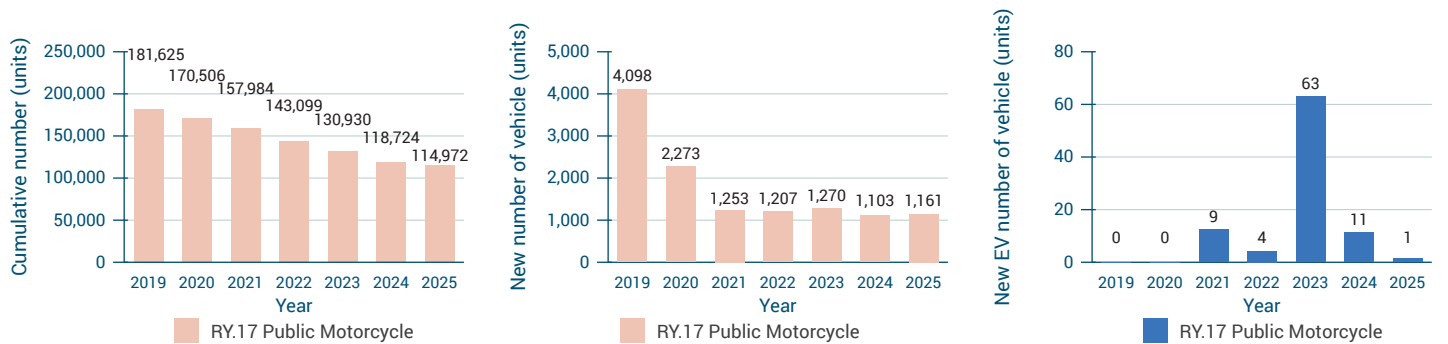


Figure 11 Cumulative, New and EV Registration Number of Motorcycles Taxi (RY.17)

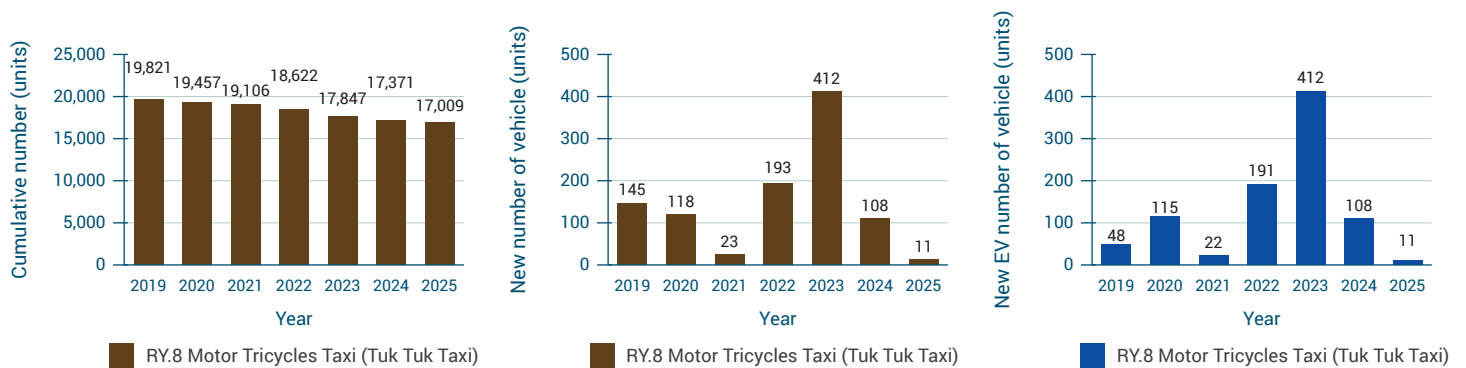


Figure 12 Cumulative, New and EV Registration Number of Tuk Tuks Taxi (RY.8)

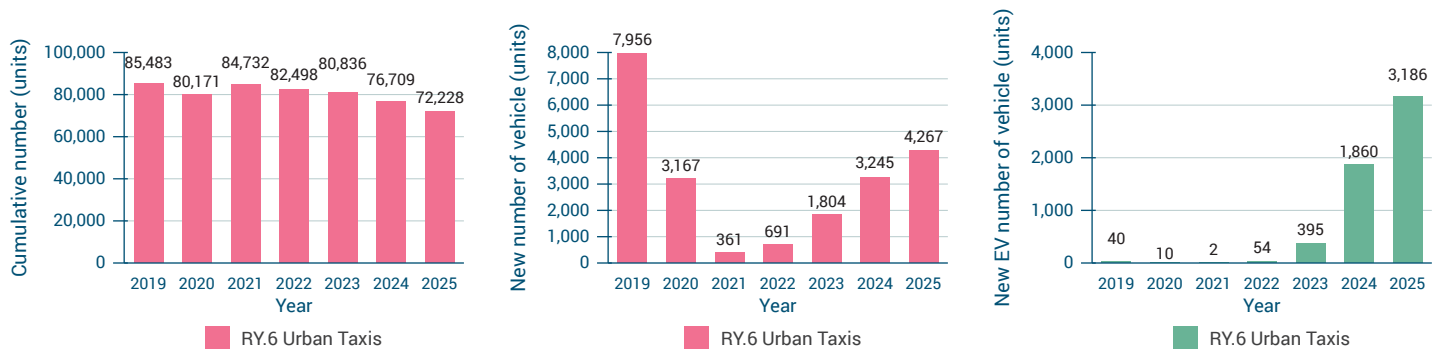


Figure 13 Cumulative, New and EV Registration Number of Urban Taxis (RY.6)

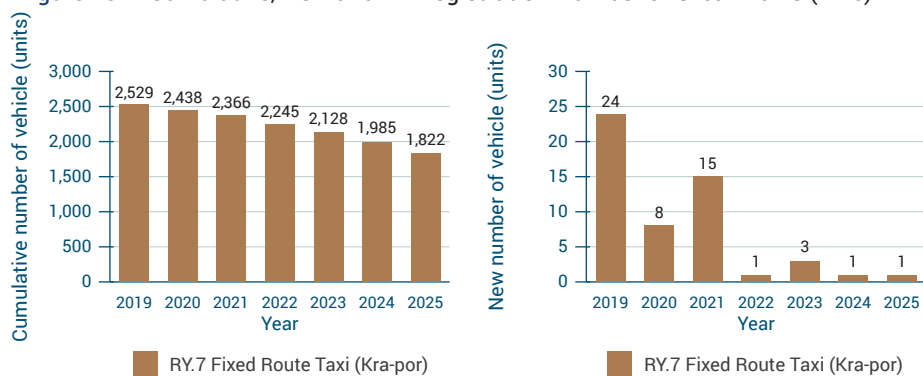


Figure 14 Cumulative and New Registration Number of Fixed Route Taxi (Kra-Por) (RY.7)

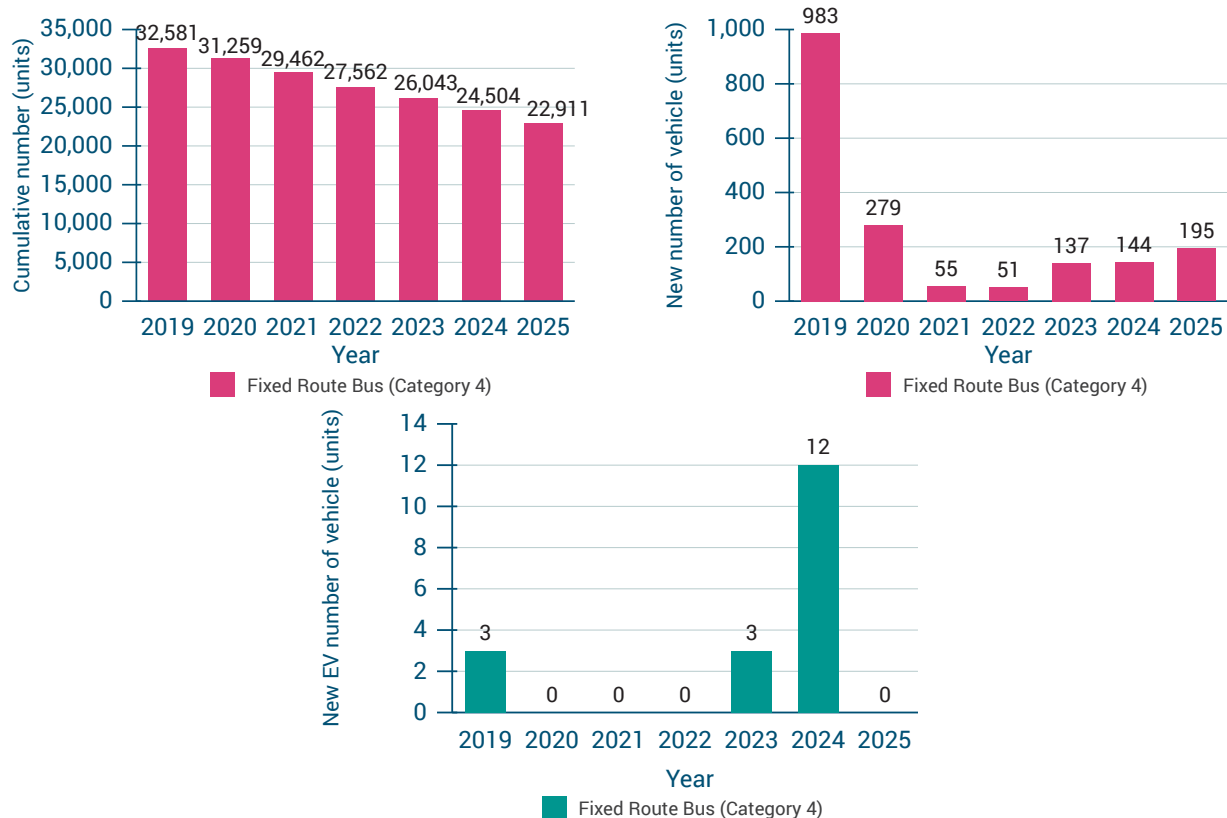


Figure 15 Cumulative, New and EV Registration Number of Local Bus (Songthaew) (Category 4)

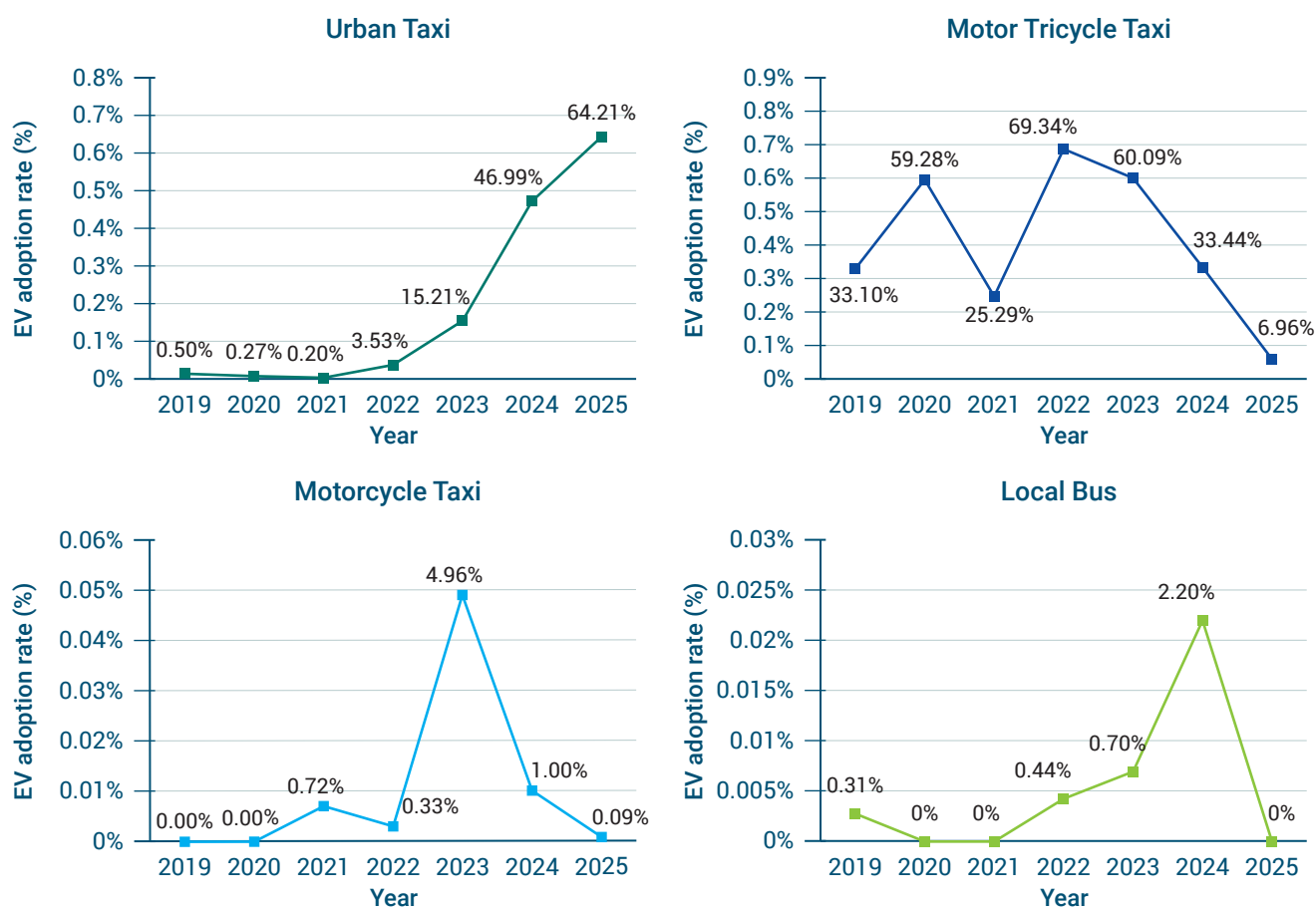


Figure 16 EV Adoption Rate of Urban Taxis, Tuk Tuks Taxi, Motorcycles Taxi, and Local Bus

Although electrifying public transport and first- and last-mile services—such as electric E2W, E3W, and E4W—has significant potential, several structural and operational barriers still hinder widespread adoption. Meanwhile, urban taxis serve as a clear example of a relatively successful transition, showing enabling conditions that could be replicated in other segments.

First,

income instability and sensitivity to upfront costs remain major barriers for motorcycle taxis and Tuk Tuks, where operators are often informal or self-employed and highly sensitive to purchase prices, battery replacement costs, and limited access to credit. In contrast, urban taxi operations are more often organized in fleets or under clearer regulatory frameworks, which provide better access to financing and to targeted incentives, leading to faster EV adoption.

Second,

access to charging and operational convenience vary across segments. E2W and E3W drivers often lack secure home or depot charging and depend on public or ad-hoc solutions that are poorly suited to extended daily operating hours. Urban taxis benefit from more predictable routes and confined operating areas, making depot charging or dedicated charging hubs practical and cost-effective, thereby reducing range anxiety and downtime.

Third,

policy design and continuous incentives are crucial. Short-term subsidies or pilot programs may temporarily increase adoption, especially for E2W and E3W; however, demand often declines once support ends. The quick electrification seen in urban taxi segments highlights the need for stable, well-targeted policies, such as incentives tied to license renewal, fleet procurement, or operational concessions.

Finally,

vehicle durability, performance, and after-sales support remain crucial concerns for individual operators whose livelihoods rely on consistent daily service. Battery degradation, vehicle durability, and limited maintenance networks increase the perceived risk for E2W and E3W users. In contrast, urban taxi EVs often benefit from more centralized maintenance setups and stronger after-sales support, reducing operational risk.

Overall,

while E2W, E3W, and E4W used in public services provide substantial environmental and operational benefits, the urban taxi experience shows that electrification can grow quickly when supporting conditions are in place. Reproducing these conditions—affordable financing, reliable charging infrastructure, organized operations, and steady policy support—will be crucial to accelerating EV adoption across Thailand's broader first- and last-mile transport system.

1.4 | Technological Trends and Infrastructure Development

Thailand's Public EV Charging Infrastructure: Progress and Challenges Ahead

Thailand's public EV charging infrastructure has expanded rapidly in recent years, closely following the country's acceleration in EV adoption. As illustrated in Figure 3, charger deployment between 2020 and 2023 showed a steep upward trajectory, with a pivotal surge in 2023 — a year in which the number of public charger outlets increased by 306.2% year-on-year. By the end of 2023, Thailand had already surpassed its 2025 national target of 4,000 public chargers, reaching this milestone two years ahead of schedule, as shown in Figure 17.

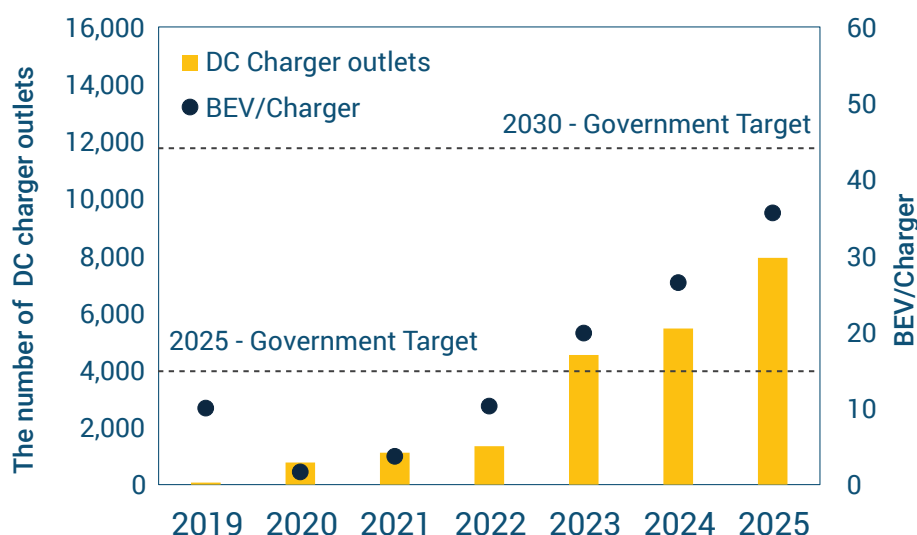


Figure 17 Annual cumulative number of public charger outlets in Thailand, 2020–2025

This exceptional growth can be attributed to several contributing factors. Notably, the Thai government introduced aggressive EV promotion policies under the EV3.0 and EV3.5 incentive packages, which emphasized vehicle purchase subsidies and tax incentives for EV-related businesses (The Board of Investment of Thailand (BOI), 2023). These measures encouraged private investment and accelerated market participation from energy companies, automotive manufacturers, and charging service providers. Increasing consumer confidence in EV technology and rising EV sales also created strong market signals, prompting rapid infrastructure expansion to meet anticipated demand. While Thailand's EV policies primarily focus on supporting EV adoption, the expansion of charging infrastructure has been largely driven by private-sector investment—supported

by BOI investment privileges and partnerships with state utilities such as EGAT and PEA—rather than direct government subsidies for charger installation.

This early achievement signals strong momentum in infrastructure rollout. However, a significant gap remains in achieving the 2030 goal of 12,000 outlets, which will require tripling current capacity. Reaching this target will require not only increased deployment but also attention to geographic distribution and power capacity. Strategic investments will be essential to ensure equitable access—especially in rural areas—and to expand high-power charging networks in line with vehicle technology trends.

**EV Models Are Trending Toward
Higher DC Charging Power**

As seen in Figure 18, there is a clear upward trend in the maximum DC charging power of newly available EV models in Thailand from 2019 to 2024. While early models were typically limited to 50–100 kW, recent entries in the market—especially in 2023–2024—include models capable of handling 150 kW and even beyond 200 kW. This marks a growing shift toward high-power charging capability, in line with global trends. The increasing power capacity of EVs signals an urgent need to scale up high-power DC fast chargers (e.g., 150 kW+), especially along highways and intercity corridors.

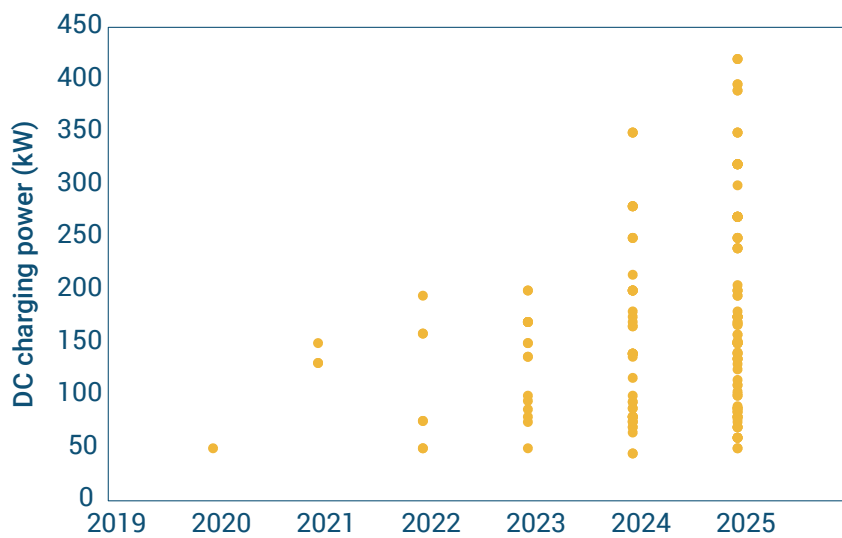


Figure 18 Evolution of EV model DC charging capabilities over time

Figure 19 demonstrates that the number of available EV models in Thailand has grown sharply alongside rising DC charging capabilities. The x-axis represents binned ranges of maximum DC charging power capability of EV models. In 2020, most models had modest power limits, but by 2024, both the number of models and the median charging power have significantly increased. The majority of vehicles introduced in 2023–2024 now support fast charging above 100 kW.

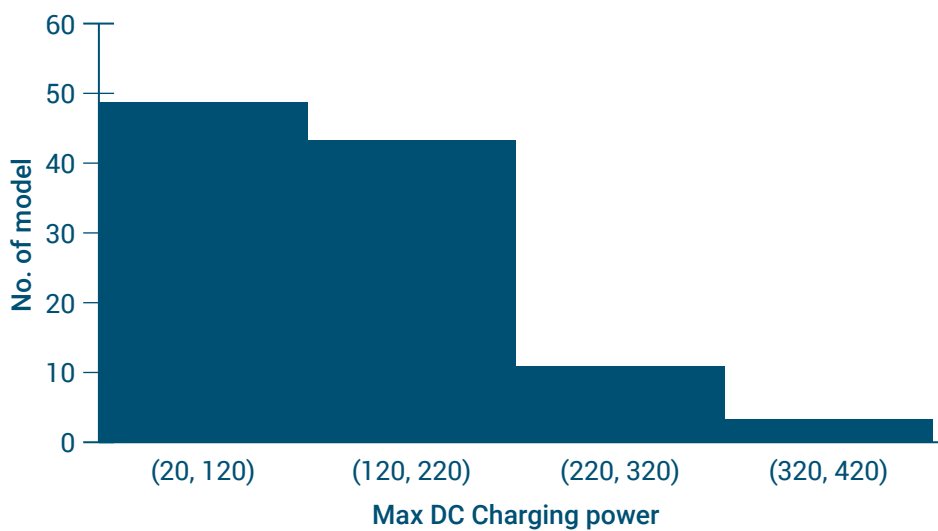


Figure 19 Maximum DC charging power range (kW)

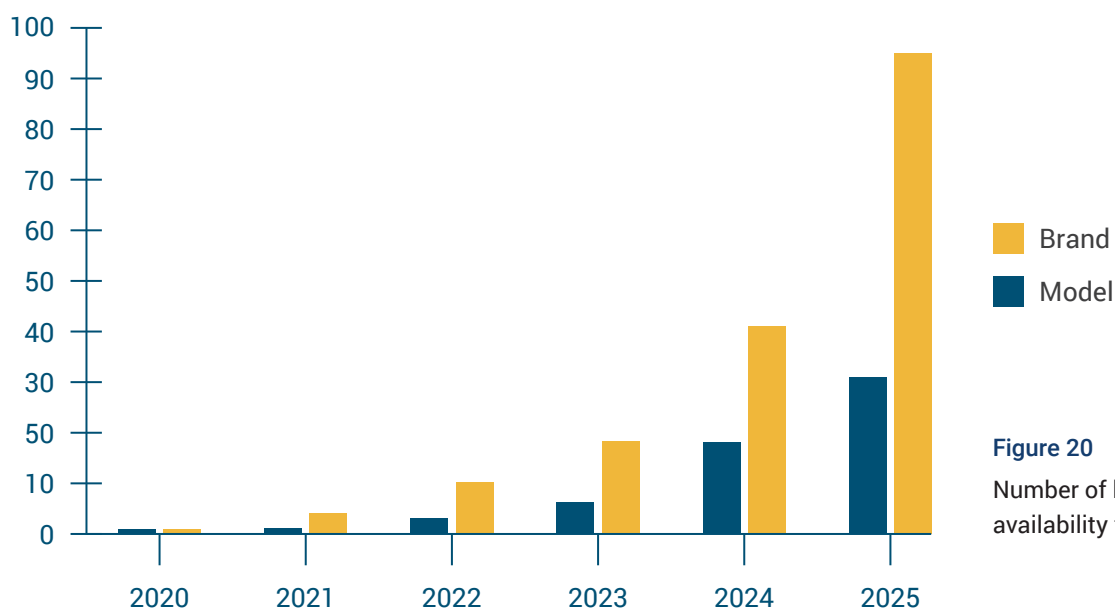


Figure 20
Number of brand and model availability from 2020 to 2025

Rapid Expansion of EV Brands and Models in Market

Figure 20 highlights the accelerating growth in the number of EV brands and models available in Thailand. The number of models increased from fewer than 10 models in 2020 to over 70 in 2024, as shown in Figure 20, which indicates the diversity of offerings is increasing rapidly. Many new entrants—particularly from China—are introducing vehicles optimized for fast charging. The growing diversity of models and brands indicates a more competitive and technologically advanced market. This requires charging infrastructure that is both scalable and interoperable, supporting varied charging curves, communication protocols, and connector types.

Thailand's Expanding EV Charging Network: A Critical Driver of Electric Vehicle Adoption

Public charging points are becoming increasingly essential to support widespread EV adoption in Thailand. While home charging currently meets most charging needs, the demand for publicly accessible chargers is rising to ensure convenience comparable to refueling conventional vehicles. This is especially crucial in urban areas, where limited access to home charging makes public infrastructure a key enabler for EV growth. As of 2024, Thailand has made substantial progress, with over 3,175 charging stations and 10,846 charging outlets nationwide. Figure 21 shows the distribution of public charger outlets by power rating and location type. The pie chart indicates that:

- A large majority (79%) of chargers fall into the 50–150 kW “Fast DC” category.
- Only 17% offer slower DC charging (<50 kW), while ultra-fast chargers (>150 kW) remain limited to just 3%.
- AC chargers account for only 1%, highlighting the predominance of DC chargers in Thailand's public charging network.

*Proportion of DC chargers
by power level*

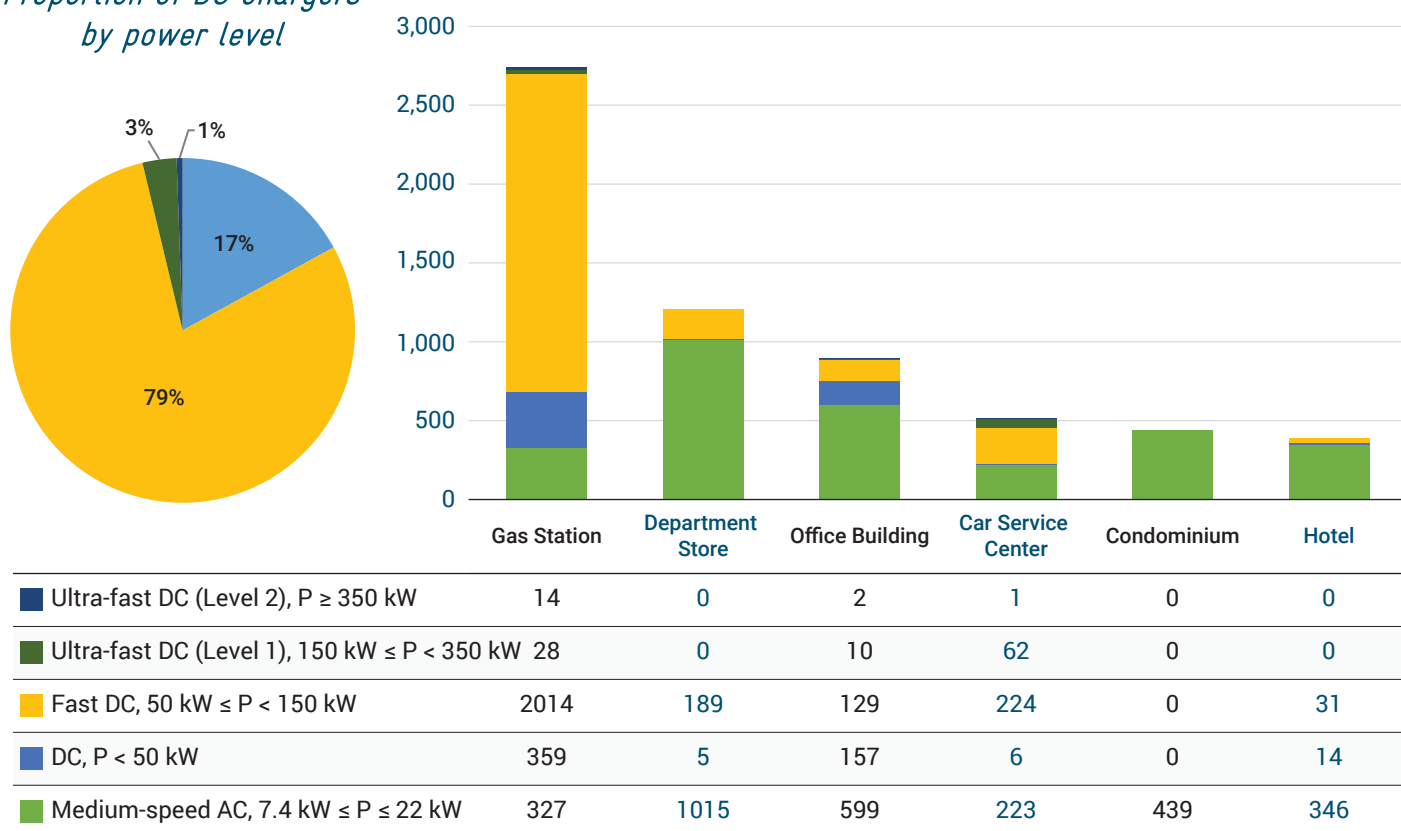


Figure 21 The distribution of electric vehicle charging stations categorized by location types

While urban centers like Bangkok have a higher concentration of charging infrastructure, efforts are underway to extend coverage to rural and remote regions. Nonetheless, challenges remain in sparsely populated areas where infrastructure deployment continues to lag. At the same time, there has been a notable shift in EV technology. As shown in Figure 18, many 2023–2024 EV models support DC fast charging above 150 kW. However, most public charging stations in Thailand currently provide DC chargers with power ratings between 50 and 120 kW.

This mismatch can lead to longer-than-expected charging times for high-capacity vehicles, inefficient charger utilization, and reduced convenience for users, particularly during intercity travel. To address this gap, infrastructure planning should include targets for deploying high-power DC chargers (≥ 150 kW) in strategic locations such as expressways, logistics corridors, and EV-dense urban hubs. Aligning charger power capacity with current and future EV specifications will be key to supporting user expectations and enabling efficient charging behavior.

Despite having the highest number of charging outlets, Bangkok's substantial BEV registration volume leads to a BEV-to-charger outlet ratio of 47.

Electric car uptake and infrastructure deployment remain unevenly distributed across Thailand. Figure 22 shows the geographic distribution of electric car registrations, charger outlets, and EV-to-charger ratios across provinces. As shown in the left panel, the majority of EV registrations are concentrated in the Bangkok Metropolitan Region, which also reports the highest vehicle density and charging station coverage. Surrounding central and eastern provinces follow due to better infrastructure and policy focus under the Eastern Economic Corridor (EEC) initiative. In contrast, many northern and northeastern provinces still report low EV penetration. This disparity can be attributed to differences in income levels (as reflected in regional household income statistics), lower levels of urbanization (fewer dense commercial areas and charging networks), and limited provincial-level policies promoting EV adoption. These factors combine to make EV ownership and charging access less attractive or feasible in these regions.

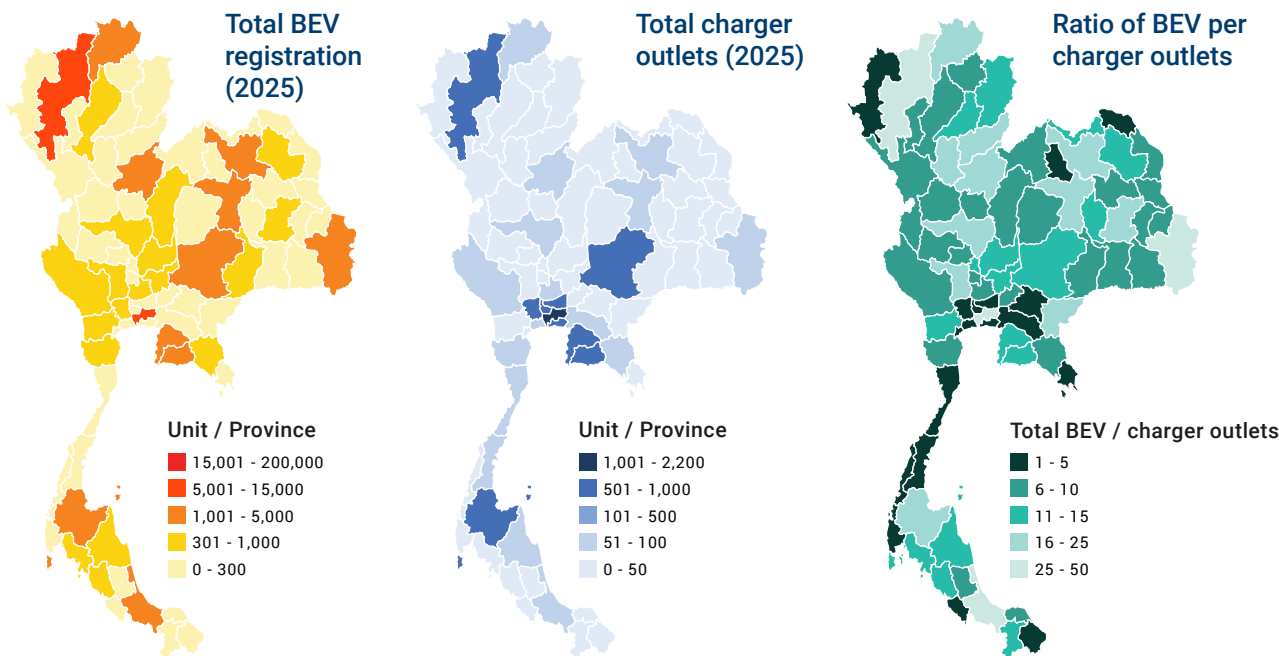


Figure 22 Geographic distribution of electric car registrations, charger outlets,

The central panel of Figure 22 reveals a similar pattern in the distribution of public charging outlets, with a concentration of infrastructure in urban and tourism-heavy provinces. However, the spatial coverage of chargers extends slightly beyond that of EV registrations, indicating early-stage investment in network expansion.

The right panel of Figure 22 illustrates the ratio of EVs per charger outlet, a key metric of charging adequacy. While most provinces maintain ratios between 6 and 15 per charger, several in the north and south exceed 25:1, suggesting potential charging bottlenecks as vehicle adoption increases. Meanwhile, provinces with low EV counts but relatively high charger availability reflect early infrastructure readiness that could support future growth.

Targeted policy and investment strategies are needed to close the gap between vehicle uptake and infrastructure availability. As Thailand's EV market continues to grow, expanding charger deployment in high-ratio provinces will be essential to ensuring equitable and accessible charging services nationwide.

Beyond Passenger Cars: Charging
Implications for Other EV Segments

While passenger cars currently dominate Thailand’s public charging landscape, other EV segments—particularly two- and three-wheelers, buses, and trucks—are becoming increasingly important and require differentiated charging strategies. Two- and three-wheelers typically rely on low-power AC charging or battery swapping due to small batteries and short travel distances, limiting the need for public DC chargers. Electric buses are mainly served by high-power depot-based charging, creating localized grid impacts that require coordinated planning with utilities rather than expanded public networks. Electric trucks, although still emerging, will drive demand for high-power and future megawatt-scale charging along highways and logistics corridors. Together, these segments highlight that passenger car-focused planning metrics alone are insufficient, and that a mix of depot charging, corridor-based hubs, and low-power solutions is essential for a balanced and resilient charging ecosystem. Table 1 summarizes the key charging characteristics, infrastructure implications, and planning focus across major EV segments in Thailand.

Table 1
Summary of Charging
Characteristics Across EV
Segments in Thailand

EV Segment	Main Charging Pattern	Infrastructure Focus
■ Car and Pickup	Home AC + public DC fast charging	Balanced AC–DC mix; growing need for ≥150 kW DC on highways and urban hubs
■ MC and Tuk Tuk	Low-power AC, battery swapping	Decentralized, standardized low-power solutions; minimal need for public DC
■ Buses	Depot-based charging (overnight / opportunity)	High-power depot charging; grid coordination and load management
■ Trucks	High-power DC / future megawatt charging	Corridor-based charging hubs near logistics and industrial zones

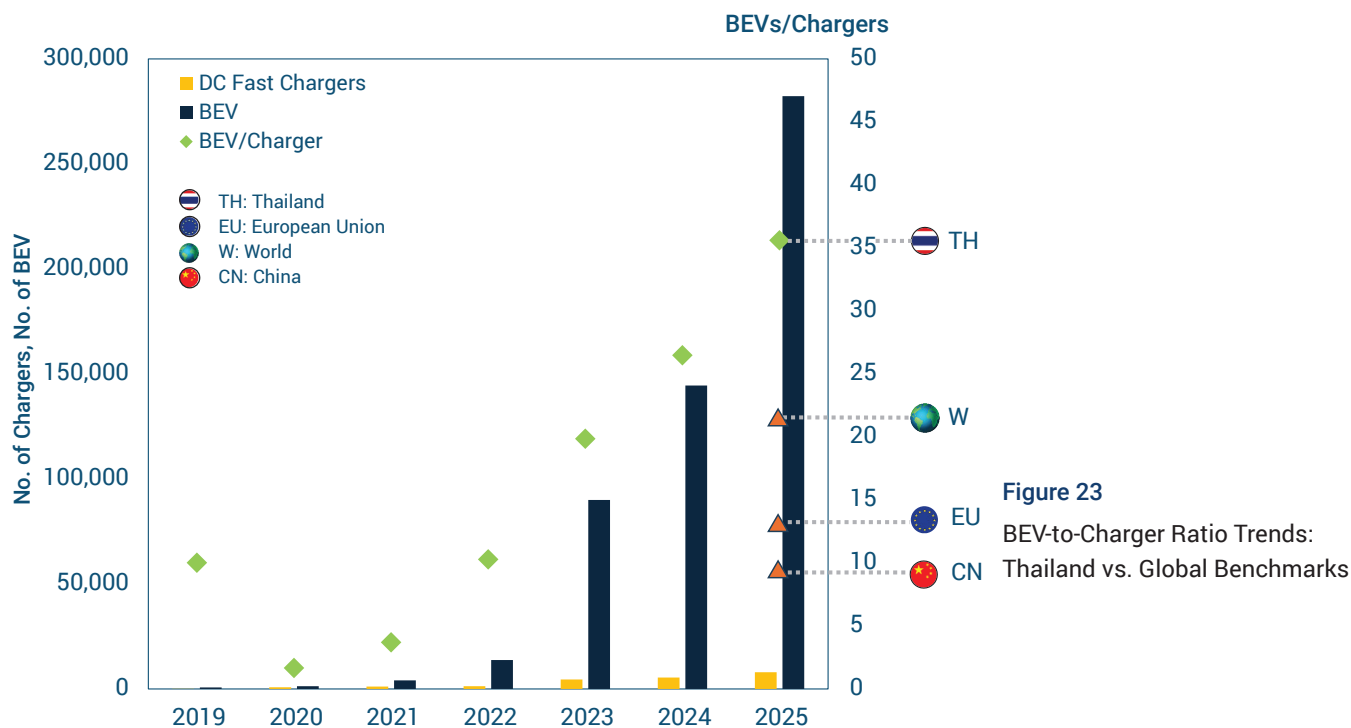


Figure 23
BEV-to-Charger Ratio Trends:
Thailand vs. Global Benchmarks

Figure 23 illustrates annual BEV sales, growth in public charging points, and the resulting BEV-to-charger ratio across key markets from 2015 to 2023. Thailand's ratio has surged in recent years, reaching over 20 BEVs per charger in 2023—well above levels seen in China, the EU, and Japan. This indicates that the pace of BEV adoption in Thailand is outstripping the deployment of public chargers, posing a potential barrier to continued growth. While China leads in total BEV sales and maintains a relatively stable infrastructure balance as indicated by its lower ratio, Thailand's steep trajectory mirrors that of Indonesia, highlighting a growing infrastructure shortfall. Without timely investment in charging infrastructure, this imbalance may limit the convenience and feasibility of EV ownership.

1.5 | Electric Vehicle (EV) battery

The number of EVs is rising due to government policies, industry initiatives, and growing consumer preferences. Consequently, the demand for EV batteries has increased, as illustrated in Figure 24. Total battery usage for all electric vehicle types is estimated by multiplying the number of vehicles by their respective battery capacities, derived from currently available sources such as Thai Eco-Sticker, brochures, and manufacturer websites. This approach yields a preliminary approximation intended to provide a macroscopic overview. For a more accurate and comprehensive analysis, battery capacity data should ideally be sourced from individual vehicle model specifications.

Since 2020, battery capacity has increased significantly. A rapid surge was observed first from 2022 to 2023 (increasing tenfold), and again from 2024 to 2025 (increasing twofold). Although battery usage declined slightly in 2024, this downward trend did not continue. By 2025, usage reached a peak of nearly 9 GWh, driven largely by BEVs, especially passenger cars. Furthermore, attention should be paid to PHEV, as their battery usage is also beginning to rise.

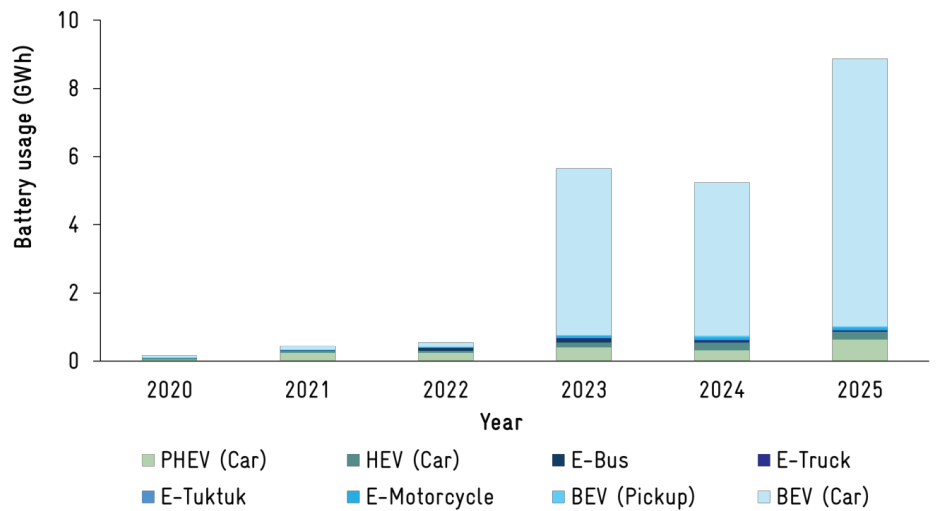


Figure 24

Battery usage for all electric vehicle types (2020-2025)

Shift in battery technology trends: Lithium Iron Phosphate (LFP) batteries lead in volume, while Nickel Manganese Cobalt (NMC) batteries remain favored for long-range applications.

The core of EVs lies in their reliance on batteries for storing electrical energy, leading to a surge in demand for rechargeable batteries. EVs offer a diverse range of battery technologies, each with distinct advantages and characteristics tailored to specific applications. For instance, LFP batteries are known for their safety, long cycle life, and cost-effectiveness, making them ideal for urban commuting and commercial fleets. In contrast, NMC batteries provide higher energy density, making them more suitable for long-range passenger vehicles. This variety allows manufacturers to optimize performance, cost, and safety depending on the intended use, whether for city driving, high-performance vehicles, or heavy-duty transport. As battery innovation continues, matching the right chemistry to the right application is key to advancing the efficiency and sustainability of electric mobility.

In the past, lead-acid batteries were commonly used in uninterruptible power supply systems and automotive applications. Nickel-cadmium batteries were widely utilized in various applications but have largely been replaced by nickel-metal hydride batteries, which are now primarily used in some hybrid vehicles and portable electronic devices due to their durability and cost-effectiveness. Today, Lithium-ion (Li-ion) batteries are the most widely used type in EVs due to their high energy density, efficiency, and extended lifespan, typically around ten years, making them ideal for longer-range EVs (Niri et al., 2024). Emerging technologies, such as solid-state batteries, promise even higher energy density and safety, while newer chemistries like sodium-ion batteries are being explored for their potential cost advantages and resource availability.

Emerging battery chemistries, such as solid-state and sodium-ion batteries, are positioned to influence the future EV landscape.

The analysis of battery chemistry reveals distinct trends from 2020 to 2025. NMC was dominant from 2020 to 2022, driven by PHEVs, HEVs, and E-Buses (Electric Buses). However, from 2023 to 2025, LFP took the lead due to the surge in BEV passenger cars. Total LFP and NMC battery usage from 2020 to 2025 reached approximately 12 GWh and 9 GWh, respectively (Figure 25).

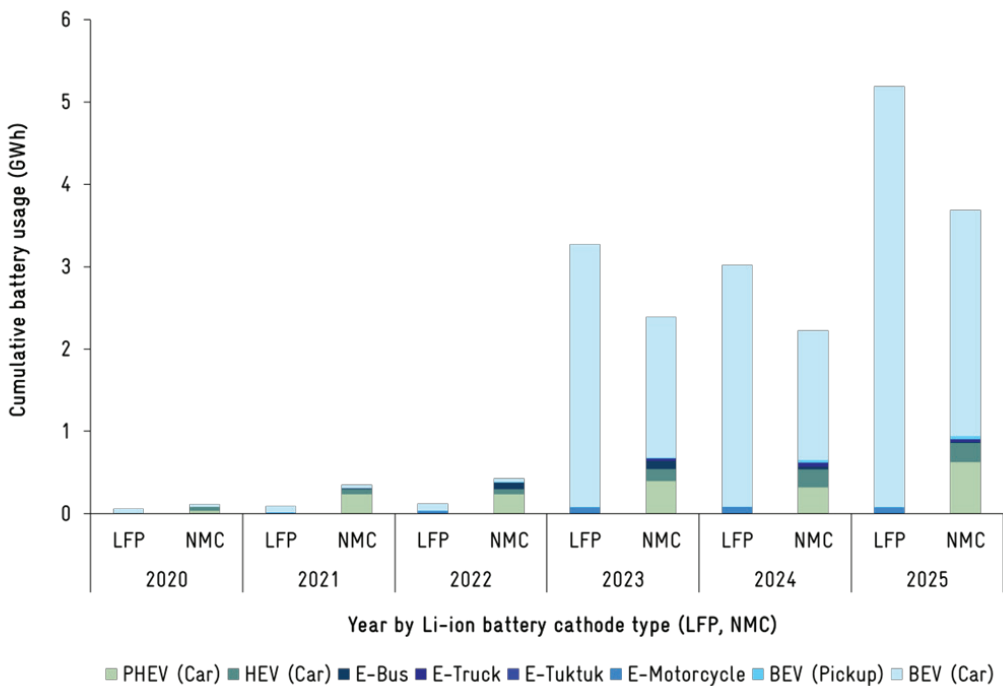


Figure 25 Battery usage by battery chemistries for all electric vehicles (2020-2025)

Regarding vehicle types, HEVs and PHEVs remain key players in the transition. HEVs rely on an ICE combined with an electric motor, charged via regenerative braking for better fuel efficiency without external charging. This configuration improves fuel efficiency and reduces emissions without requiring external charging infrastructure. On the other hand, PHEVs go a step further, allowing external charging to enable pure electric driving for short distances, offering a balance between EV benefits and ICE convenience.

Electric two- and three-wheeled vehicles are also gaining significant attention, particularly in regions where they are a primary mode of transportation. E-Motorcycle and E-Tuk Tuk are popular in densely populated urban areas, offering a more efficient, eco-friendly, and cost-effective alternative to their gasoline-powered counterparts. The rise of these small EVs is driven by their ability to reduce air pollution, lower operational costs, and their compatibility with the growing electric vehicle infrastructure. E-Tuk Tuk, commonly used in countries like Thailand and India for both passenger transport and small cargo delivery, are an important step in reducing urban emissions, while E-Motorcycle are becoming the go-to option for personal urban mobility and delivery services.

Large EVs, such as six- and ten-wheeled trucks, are beginning to attract attention as the logistics and freight industries seek to decarbonize. These heavy-duty vehicles are being developed to serve long-haul transport and freight delivery sectors, where reducing emissions and fuel costs can have significant economic and environmental impacts. While adoption is in the early stages, electric trucks are increasingly viewed as critical to reducing the overall carbon footprint of the transportation sector, particularly as battery technology improves and charging infrastructure expands to accommodate the high energy demands of these vehicles.

Each EV battery type presents a unique balance of energy density, safety, cost, and environmental impact, making the selection process dependent on specific performance requirements and design objectives of the vehicle. This diversity has been pivotal in shaping the evolving EV market, reflected in shifting demands across vehicle types like the rise of PHEVs, and LFP's dominance from 2023 – 2025. These advancements are instrumental in accelerating EV adoption across all sectors. Ultimately, this progress supports a global imperative: the urgent need to combat climate change. The shift from fossil fuel to electric transportation is a keystone strategy for reducing greenhouse gas emissions, supported by government policies for a sustainable, low-carbon future.

1.6 | Policy Landscape in Thailand

1.6.1 EV promotion within Thailand's climate and net-zero framework

Thailand, historically recognized as the “Detroit of Asia” due to its strong ICE manufacturing base, has initiated a gradual and structured transition toward the development of a domestic ecosystem for zero-emission vehicles (ZEVs). The country's approach to electric vehicle (EV) promotion is characterized by a sequenced set of policy instruments, including carbon neutrality commitments, fiscal and tax measures, industrial promotion policies, and targeted support for research, development, and innovation. Since 2016, national strategies have increasingly integrated EV development into broader economic transformation and

environmental sustainability frameworks. As shown in Figure 26, the policy timeline indicates a progression from initial measures focused on investment attraction toward more targeted interventions supporting EV deployment, localization of production, and technological capability development. Taken together, these policy measures are intended to support Thailand's transition toward becoming a regional hub for EV manufacturing and adoption, while contributing to long-term transport decarbonization objectives.

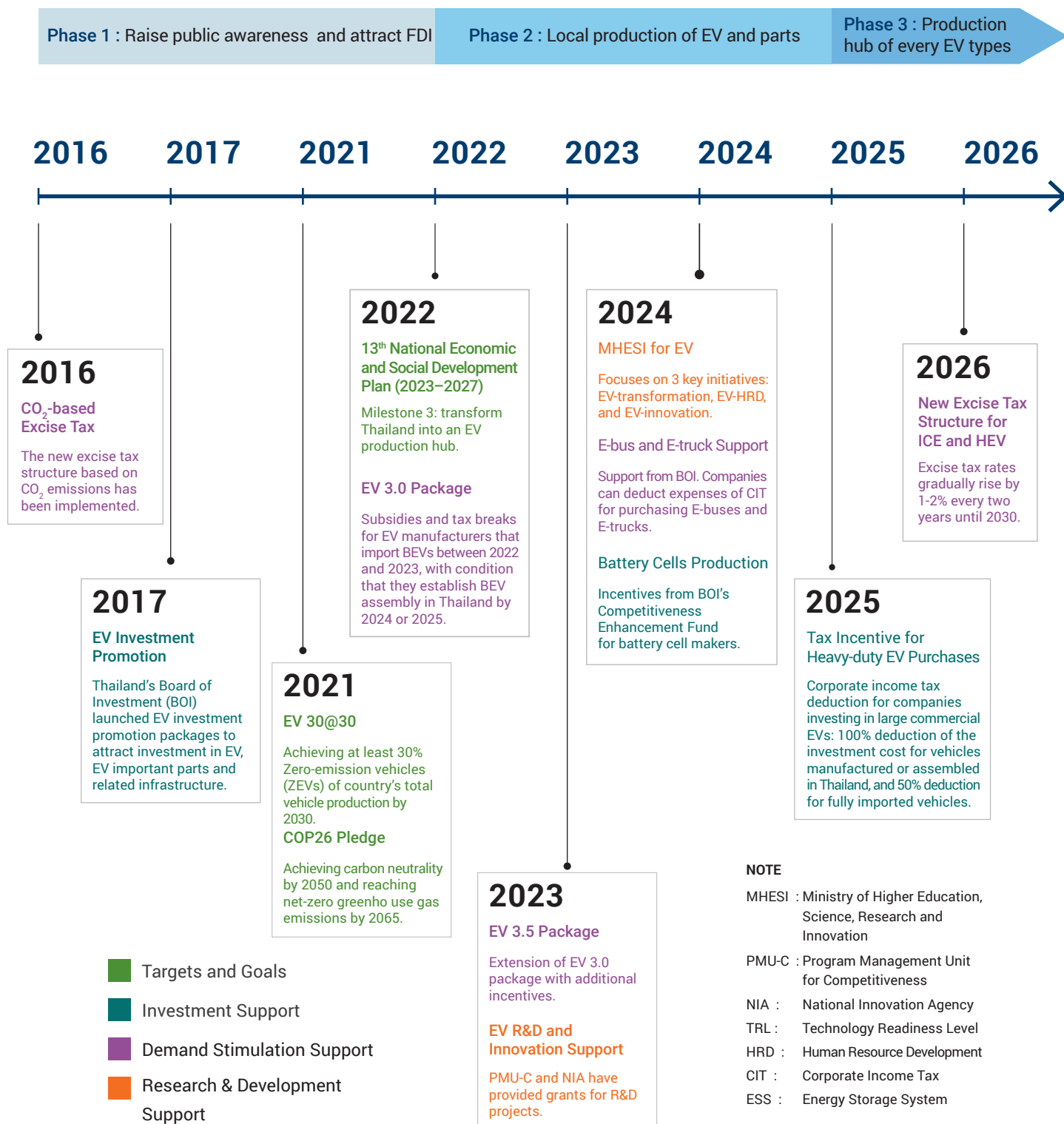


Figure 26 Key milestones in Thailand's EV policy development

1.6.2

National EV 30@30 Vision

The National Electric Vehicle Policy Committee, chaired by the Prime Minister, has established policy guidelines to support Thailand's transition toward a lower-carbon transport system. In alignment with the 30@30 policy framework, these guidelines set a target for ZEVs to account for at least 30 percent of total domestic vehicle production by 2030. A key milestone was the Committee's meeting on 12 May 2021, which formalized medium- to long-term targets for ZEV production and deployment. These targets are intended to provide a common policy reference for coordination across relevant public agencies and private-sector stakeholders in support of the 2030 objectives.

The policy framework specifies quantitative production targets, including 725,000 passenger cars and pickup trucks, 675,000 motorcycles, and 34,000 buses and trucks by 2030. In addition, it encourages the development of electric three-wheelers, ships, and rail-based transport systems. Corresponding usage targets have been established, aiming for 440,000 passenger cars and pickup trucks, 650,000 motorcycles, and 33,000 buses and trucks in operation by 2030. These targets are supported by planned investments in enabling infrastructure, including approximately 12,000 public fast-charging stations and 1,450 battery-swapping stations for electric motorcycles.

To support the achievement of these objectives, the policy framework identifies the following strategic pillars:

Manufacturing and Supply Chain Development:

Measures are intended to strengthen Thailand's role in ZEV and component manufacturing through the development of vehicle and component standards, support for firms transitioning from internal combustion engine-based production to EV-related activities, and targeted workforce development programs.

Demand-Side and Usage Incentives:

A combination of fiscal and non-fiscal measures is proposed to encourage EV adoption. Priority actions include near-term interventions to promote the uptake of electric motorcycles among commercial operators and public-sector fleets.

Charging and Supporting Infrastructure Development :

Policy measures focus on expanding charging infrastructure, establishing regulatory frameworks for charging services, promoting smart grid integration, supporting domestic battery production and utilization, and developing systems for end-of-life battery management. Complementary workforce development initiatives are also envisaged to support infrastructure operations and maintenance.

Table 2 Thailand's production and use target of ZEVs.

ZEV Production and Use	Vehicle Type	Goal (units per year)		
		2025	2030	2035
■ Use (% of total new registered vehicles)	Passenger car / Pickup truck	225,000 (30%)	440,000 (50%)	1,154,000 (100%)
	Motorcycle	360,000 (20%)	650,000 (40%)	1,800,000 (100%)
	Bus / Truck	18,000 (20%)	33,000 (35%)	83,000 (100%)
	3-wheeler	500 (85%)	2,200 (100%)	2,800 (100%)
	Ship	130 (12%)	480 (35%)	1,800 (100%)
	Rail system	620 (70%)	850 (85%)	1,170 (100%)
■ Production (% of total vehicle production)	Passenger car / Pickup truck	225,000 (10%)	725,000 (30%)	1,350,000 (50%)
	Motorcycle	360,000 (20%)	675,000 (30%)	1,850,000 (70%)
	Bus / Truck	18,000 (20%)	34,000 (50%)	84,000 (100%)
	3-wheeler	500 (85%)	2,200 (100%)	2,800 (100%)
	Ship	130 (12%)	480 (35%)	1,800 (100%)
	Rail system	620 (70%)	850 (85%)	1,170 (100%)

1.6.3 Battery Management and Related Policy

Passenger cars, pickup trucks, and two-wheelers benefit from full investment, demand, and R&D support, while three-wheelers and heavy-duty vehicles receive only limited demand incentives through BOI schemes.

EV Investment Promotion by Thailand Board of Investment (BOI)

The BOI has played a central role in supporting national electric vehicle (EV) policy objectives through targeted investment promotion measures. Since 2017, the BOI has progressively refined its incentive framework to reflect technological developments and evolving market conditions in the EV sector. These measures have been applied across key segments of the EV value chain, including vehicle manufacturing, component and equipment production, and charging infrastructure, with the aim of accelerating private investment and strengthening domestic industrial capabilities.

In the area of vehicle manufacturing, BOI incentives have covered a wide range of EV categories, including BEVs, electric motorcycles, three-wheeled vehicles, passenger cars, trucks, and boats. Following the introduction and expansion of these incentives, Thailand has observed a marked increase in investment applications and approvals related to EV assembly and vehicle platform development, particularly from foreign manufacturers seeking to establish or expand production bases in the country. These investments have contributed to the localization of EV production capacity and have supported Thailand's positioning within regional EV manufacturing networks.

With respect to components and equipment, BOI incentives targeting critical EV components, such as high voltage wiring harnesses, reduction gears, battery thermal management systems, and regenerative braking systems, have coincided with increased investment interest in upstream and midstream segments of the EV supply chain. This trend has supported the gradual expansion of domestic component manufacturing and has contributed to higher local content levels in EV production, although dependence on imported batteries and advanced materials remains significant.

In addition, BOI promotion of charging infrastructure investments has been associated with a steady increase in the number of private-sector-led charging station projects, particularly in urban areas and along major transport corridors. While infrastructure deployment continues to lag behind vehicle adoption in some regions, BOI-supported investments have contributed to early network expansion and have reduced entry barriers for new service providers in the charging market.

As of mid-2025, cumulative investment approvals associated with EV manufacturing and related supply chain segments amount to approximately 137.7 billion Baht (around USD 4.2 billion), supported by multiple BOI-promoted projects in vehicles, batteries, components, and charging stations.

EV 1.0 and EV 2.0

Policies

Thailand's EV policy has evolved in a phased and adaptive manner, commonly described as EV 1.0 and EV 2.0, reflecting shifts in policy priorities from market preparation to large-scale industrial transformation. Together, these phases have laid the foundation for Thailand's ambition to become a regional EV manufacturing hub.

EV 1.0 policies, implemented mainly during the mid-2010s to 2017, focused on reducing early adoption barriers and familiarizing both consumers and manufacturers with EV technologies. The core support under EV 1.0 consisted of demand-side incentives and initial investment promotion measures.

EV 2.0 represents a significant policy shift toward industrialization, localization, and ecosystem-wide development, aligning with Thailand's long-term EV30@30 target, which aims for 30% of total vehicle production to be zero-emission vehicles by 2030. This phase expanded both the scale and scope of policy support.

Under EV 2.0, the government introduced substantial purchase subsidies for battery electric vehicles, combined with strict production compensation requirements, obliging importers to manufacture EVs domestically within a specified timeframe. This approach directly linked market incentives to local manufacturing commitments. At the same time, BOI incentives were enhanced, offering corporate income tax exemptions of up to 8–13 years, import duty exemptions for key components and machinery, and full foreign ownership allowances for EV and battery manufacturers.

EV 3.0 and EV 3.5

Policies

The EV 3.0 and EV 3.5 policy measures were introduced to support Thailand's long-term objective of achieving carbon neutrality by 2050, while simultaneously advancing industrial transformation within the automotive sector. In the medium term, the policies aim to accelerate the uptake of BEVs in the domestic market. In parallel, they seek to promote the localization of BEV manufacturing and strengthen Thailand's position within regional and global EV value chains, in line with the national 30@30 target.

The EV 3.0 policy, implemented in early 2022 by the Ministry of Finance and the Excise Department, employs a combination of fiscal incentives and conditional industrial policy measures. Key instruments include subsidies ranging from 70,000 to 150,000 baht per vehicle, differentiated by vehicle specifications. These subsidies are provided to EV manufacturers rather than paid directly to consumers, which differs from EV incentive schemes in many other countries where financial support is typically granted directly to vehicle buyers. Additional measures include reductions in excise tax rates and import duties for BEVs imported during the 2022–2023 period. These incentives are subject to a conditional requirement that participating manufacturers establish BEV assembly operations in Thailand by 2024 or 2025.

Building on EV 3.0, the EV 3.5 policy, introduced in December 2023 and effective over the 2024–2027 period, extends fiscal support for ZEVs while reinforcing domestic production commitments. The scheme allows manufacturers participating in EV 3.0 to transfer unsold imported BEVs into the EV 3.5 framework, provided that updated conditions are met and formalized through a memorandum of understanding with the Excise Department.

In the short term, the EV 3.0 policy resulted in increased availability and affordability of BEVs in the domestic market, contributing to higher import volumes and expanded model offerings during the initial implementation period. The policy also generated firm-level commitments to investing in local BEV assembly facilities within defined timelines. Under EV 3.5, policy outputs include the continuation of market support for BEVs, the rollover of eligible inventory from the earlier scheme, and the formalization of longer-term production and investment plans by participating manufacturers. The details of EV 3.5 support are outlined in Table 3 and Table 4 below. In addition, a comparison of main subsidies as well as requirements for local production is provided in Table 5.

Table 3 Passenger BEVs (Imported and locally assembled)

■ Retail price & Battery capacity	≤ 2 million Baht and > 10 kWh			> 2 million Baht but ≤ 7 million Baht and ≥ 50 kWh
■ BEV standards	Must comply with TISI ¹ standards, pass ATTRIC ² testing, and adhere to Quick Charge standards, as specified by the Ministry of Industry.			
■ Subsidy (per unit) based on battery capacity	Year	≥ 10 kWh but < 50 kWh	≥ 50 kWh	No subsidy
	2024	50,000	100,000	
	2025	35,000	75,000	
	2026 & 2027	25,000	50,000	
■ Subsidy claimant party and period	BEV importers: from 2024 to 2025 Local BEV assemblers: from 2024 to 2027			No subsidy
■ Import tariffs	Up to 40% reduction (for the first 2 years: 2024 – 2025)			No subsidy
■ Reduced excise tax	2% (from 8%)			

Table 3 Passenger BEVs (Imported and locally assembled) (Continued)

■ BEV local assembly requirements	Under this policy, EV manufacturers importing BEVs must locally produce any type of BEV within either of the following volume thresholds: ▪ 1:2 ratio for every BEV unit imported if local BEV production is fulfilled by December 2026. ▪ 1:3 ratio for every BEV unit imported if local BEV production is only fulfilled by December 2027.
■ Battery local assembly requirements	Battery and its parts localization to commence from 2026

NOTE:

- 1 TISI – Thai Industrial Standards Institute.
- 2 ATTRIC – Automotive and Tyre Testing, Research and Innovation Center.

Table 4 BEV pickup trucks and e-motorcycles (locally assembled only)

	BEV pickup trucks (≤ 4,000 kg)	E-Motorcycles
■ Retail price & Battery capacity	≤ 2 million Baht and ≥ 50 kWh	≤ 150,000 Baht and ≥ 3 kWh
■ BEV standards	For locally assembled vehicles: Same as the passenger BEVs mentioned above.	As specified by the Excise Department (refer to the note below)
■ Subsidy (per unit)	100,000 Baht (Year 2024 to 2027)	10,000 Baht (Year 2024 to 2027)
■ Reduced excise tax	2024 – 2025: 0% (from 10%) 2026 onward: 2% (from 10%)	1% (from 5%)
■ Battery local assembly requirements	Battery and its parts localization to commence from 2026	Not applicable

Table 5 Comparison of subsidies, support and requirements of EV 1.0 to EV 3.5 packages

	EV 1.0 (2016 – 2017)	EV 2.0 (2018 – 2021)	EV 3.0 (2022 – 2023)	EV 3.5 (2024 – 2027)
■ Main focus	Preparatory phase to develop an EV ecosystem by raising awareness, initiating charging networks, and offering incentives for infrastructure and components.	Set a national target to transform Thailand into an EV production hub; establish initial tax incentives and early EV uptake policies.	Introduce structured subsidies, excise tax cuts, import duty reductions, and local production compensation requirements to make EV prices more competitive with ICE vehicles	Offer revised subsidy packages for cars, pickups, and motorcycles; continue excise tax and import duty benefits; and strengthen local production ratios to further encourage domestic manufacturing.
■ Main subsidy	Restructured excise tax based on CO ₂ emissions. Initial investment promotion subsidy.	Import duty reductions for CBU, excise tax reductions for battery electric passenger cars and electric motorcycles, and limited purchase subsidies.	• Import duty reductions for CBU EVs • Excise tax reductions for battery-electric passenger cars and electric motorcycles • Purchase subsidies (70,000 – 150,000 Baht per car depending on battery size)	• Consumer purchase subsidies: 50,000 – 100,000 Baht per car (based on battery size) • Excise tax reduced to about 2% and import duties capped (e.g., 40% cap on CBU imports in early years)
■ Main requirements	No formal nationwide production compensation requirements.	No formal nationwide production compensation requirements.	Manufacturers must produce EVs locally to compensate for imports (initially ~1:1, rising over time).	Mandatory local production to compensate for imported EVs – 1:2 in 2026 and 1:3 in 2027

As per the memorandum of understanding, the Excise Department has established the following specifications for BEV motorcycles:

- The lithium-ion battery must be ≥ 48 Volts and certified by the Thailand Automotive Institute (TAI).
- The battery must have a capacity of ≥ 3 kWh or a range of ≥ 75 km on a single charge. It must also pass the Worldwide Harmonized Motorcycle Emission Certification tests/procedures with Class 1 or above, as certified by TAI.

- The motorcycles must use pneumatic tires that meet one of the following standards:
 - Thai Industrial Standards Institute (TISI) standard No. TIS. 2720 - 2017 "Pneumatic [tires] for motorcycles and mopeds" or higher
 - The United Nations Regulation (UN Regulation) no.75 (00 Series or higher).
- To qualify for approval, the motorcycles must meet one of the following BEV-motorcycle safety standards:
 - TISI standard No. TIS. 2952 - 2018 "Vehicles of category L with regard to specific requirements for the electric power train"
 - UN Regulation No. 136 (00 Series or higher)

The manufacturer must obtain a certificate for a motorcycle powered by electric powertrain as announced by the Department of Land Transport.

Excise Tax Structure

The Excise Department has implemented a preferential excise tax structure for battery electric vehicles (BEVs). The tax framework is designed to reflect environmental performance and technological characteristics, including carbon dioxide (CO₂) emissions and the level of vehicle electrification. In parallel, a revised excise tax regime for ICE vehicles is scheduled for implementation from 2026. Under this regime, excise tax rates for ICE vehicles are expected to increase incrementally by approximately 1–2 percentage points every two years through 2030, with vehicles exhibiting higher CO₂ emissions subject to proportionately larger increases. HEVs are expected

to face upward adjustments in excise tax rates to narrow the differential relative to ICE vehicles, while PHEVs are anticipated to experience relatively limited changes in their excise tax treatment.

Research and Development Support

The Ministry of Higher Education, Science, Research, and Innovation (MHESI) has revised its strategic plan to designate the electric vehicle (EV) industry as a flagship priority. The revised policy framework focuses on three core intervention areas.

First,

the EV–Human Resource Development (EV–HRD) initiative addresses skills shortages in the EV sector through coordinated training programs with higher education institutions and industry partners. The initiative targets the training of approximately 150,000 individuals over a five-year period to support workforce readiness for EV manufacturing and related activities.

Second,

the EV–Transformation initiative promotes EV adoption within the public sector, particularly among agencies under MHESI’s supervision, alongside the development of supporting infrastructure such as charging stations. The program sets a target for electric vehicles to account for 30 percent of the Ministry’s vehicle fleet within a five-year period, contributing to emissions reduction and demonstrating public-sector leadership.

Third,

the EV–Innovation initiative prioritizes research, development, and innovation to enhance the competitiveness of Thailand’s EV industry. The program emphasizes collaboration between public research institutions and the private sector to support technology development and strengthen Thailand’s position in regional EV value chains.

Implementation of these initiatives is coordinated by the National Higher Education, Science, Research, and Innovation Policy Council, with operational support from agencies including the National Science and Technology Development Agency (NSTDA), the Program Management Unit for Competitiveness (PMUC), and the National Innovation Agency (NIA).

1.6.4

Battery management and related policy

A key policy shaping Thailand's battery ecosystem is the national EV 30@30 target, which will create a massive future feedstock for EV battery production and end-of-life (EoL) management. On the supply side, the government has moved beyond simple assembly, specifically targeting the cell-to-pack value chain through integrated incentives:

- Tax and investment incentives, such as those provided by the BOI provides 8-year Corporate Income Tax (CIT) exemptions and cash subsidies via the Competitiveness Enhancement Fund. Crucially, excise taxes are reduced from 8% to 1% (or 2% for specific passenger HEVs) for domestically manufactured batteries, effectively penalizing direct imports.
- EV 3.5 mandates the establishment of local battery assembly lines, as EV manufacturers must meet strict production offset ratios (1:2 by 2026 and 1:3 by 2027). From 2026 onward, the national EV support measures tighten local-content valuation rules by limiting the extent to which imported battery components can contribute to localization requirements. While imported cells remain allowable, only a reduced portion of their value can be credited toward domestic content calculations, thereby incentivizing domestic battery assembly and future cell manufacturing.

On the demand side, while cost and safety remain the primary concerns for consumers switching from ICE vehicles, the combination of consumer subsidies and the resulting production offset requirements has become a substantial driver of EV adoption in Thailand.

Regarding battery trends from 2020–2025, 2023 marked the beginning of factory openings, while 2024 marked the start of forced localization driven by the EV 3.5 measures. Almost all major Chinese manufacturers, such as BYD, MG, GWM, and Changan, have set up local battery assembly lines by importing battery cells from China and assembling them into packs. However, some local manufacturers have attempted to produce battery cells through joint ventures (e.g., NV Gotion, AMITA), driven by the 1% tax incentive and BOI subsidies. As of now, Thailand's battery manufacturing sector has successfully secured the cell-to-pack assembly stage and is pushing into the cell production stage, dominated by LFP technology from Chinese partners.

This rise in EV adoption will result in a parallel increase in the number of batteries that need to be responsibly managed, highlighting the urgent need for comprehensive laws, policies, and regulations governing sustainable battery production and disposal. The Thai government has actively introduced policies to promote EVs, primarily focusing on subsidies, investment incentives, and tax reductions; however, it has not paid much attention on EV battery waste or EoL battery management. Currently, EV battery waste is managed under a fragmented legal structure as manufacturing wastes are controlled by the Department of Industrial Works (DIW) under the Factory Act B.E. 2535 and Hazardous Substance Act B.E. 2535. Meanwhile, post-consumer waste (EV batteries) from private owners fall under the Act on Enhancement and Conservation of National Environment Quality B.E. 2535 and the Public Health Act. A significant risk emerges after the 8–10 year battery warranty expires. Without dedicated recovery infrastructure, these high-voltage hazardous wastes risk entering the municipal solid waste stream, managed by local administrations that lack the technical capacity for specialized EV battery disposal.

To sustainably manage EV battery wastes or EoL batteries across the EV battery value chain requires a holistic consideration of all stages within the EV battery lifecycle as illustrated in Figure 27. The life cycle of an EV battery is designed to be a circular and sustainable system from material extraction to active vehicle use, secondary application (life expansion), and finally recycling. Even though existing legislation broadly addresses different stages of the EV battery life cycle, important gaps remain, particularly for post-consumer EoL batteries. Two upcoming legislative initiatives are expected to strengthen the country's transition toward a circular battery system.

- The Draft Industrial Waste Management Act aims to enhance oversight of hazardous waste management by clarifying the responsibility of waste generators throughout the disposal chain and strengthening control over treatment operators. This framework is expected to improve regulatory supervision of battery dismantling and recycling activities.

- The Waste Electrical and Electronic Equipment (WEEE) Act is intended to establish an extended producer responsibility (EPR) framework for electronic products, including EV batteries. The Act is expected to introduce producer take-back responsibilities and structured collection systems, which would support improved tracking, recovery, and recycling of EoL batteries. Digital tracking or labeling mechanisms may be considered in the future to support traceability across first life, second life, and recycling stages.

Through an EPR-oriented system, Thailand seeks to increase recovery of valuable materials (e.g., lithium, nickel, cobalt, and manganese) and strengthen a sustainable and circular battery supply chain in support of its role as a regional EV manufacturing hub.

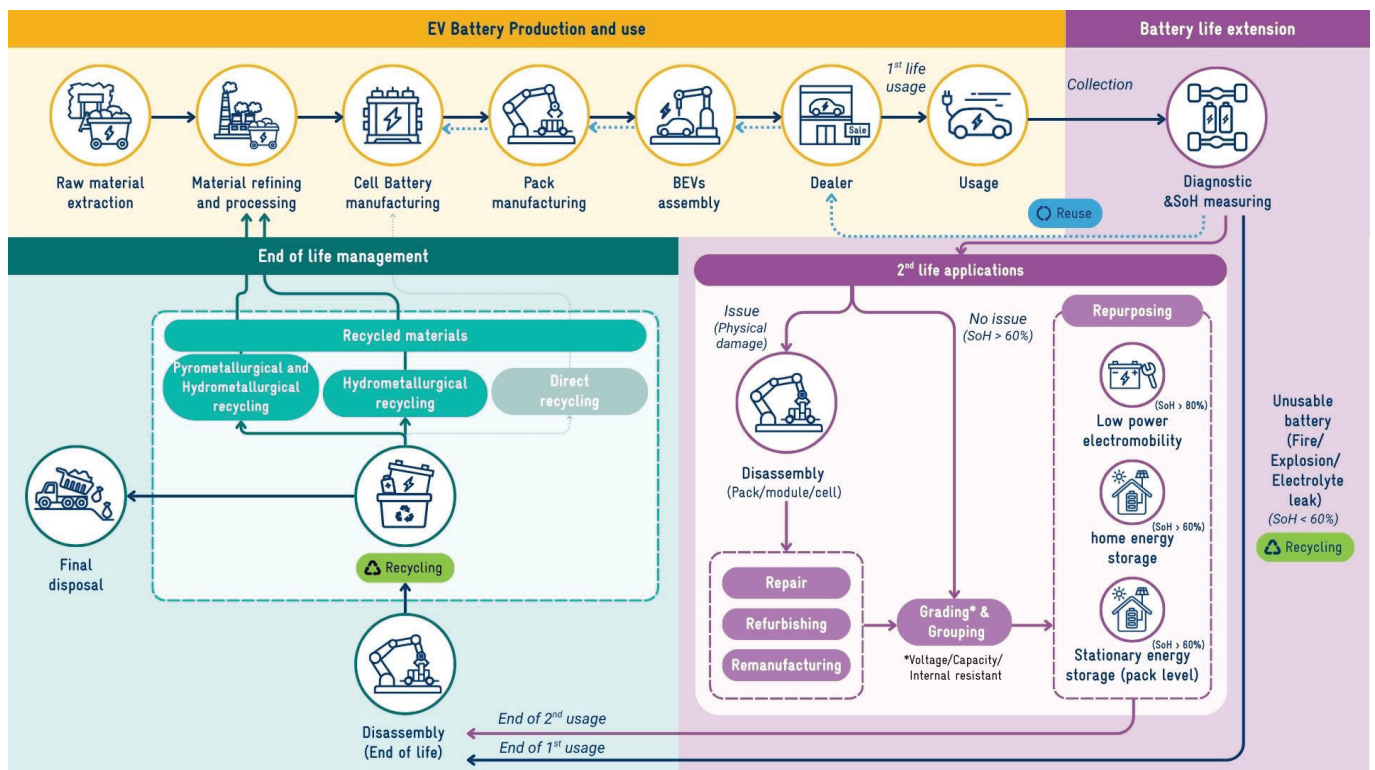


Figure 27 Electric vehicle battery life cycle

1.6.2
National EV 30@30 Vision

EV integration is now recognized as the fifth pillar in Thailand’s medium-term Smart Grid Action Plan (2022–2031). This pillar was newly introduced in response to the anticipated acceleration in EV adoption, driven by the EV30@30 policy set by the National Electric Vehicle Policy Committee. As Thailand moves toward large-scale EV deployment, effective integration with the power grid becomes critical for ensuring efficient, reliable, and sustainable energy management.

The inclusion of EVs in the Smart Grid Action Plan reflects the strategic importance of managing their interaction with the grid to optimize system performance. Proper EV integration can help defer major investments in electrical infrastructure by enhancing system flexibility across both transmission and distribution networks. EVs, when managed effectively, can function as distributed energy storage, supporting grid stability and strengthening the synergy with renewable energy sources. This approach aligns with Thailand’s broader energy reform agenda, which emphasizes a clean, secure, and resilient energy future through the adoption of electric mobility.



To support this transformation, the EV grid integration plan prioritizes policy formulation, technical standardization, and the development of infrastructure and interoperability frameworks necessary for seamless EV-grid interaction. The aim is to facilitate the widespread adoption of V1G (unidirectional smart charging) and V2X (bidirectional energy exchange) technologies, ensuring compatibility across all EV segments—from private vehicles to fleets and public transport.

Thailand's EV grid integration roadmap encompasses 12 projects, distributed among key national energy

- 1. Energy Policy and Planning Office (EPPO): 4 projects
- 2. Energy Regulatory Commission (ERC): 2 projects
- 3. Electricity Generating Authority of Thailand (EGAT): 1 project
- 4. Metropolitan Electricity Authority (MEA): 3 projects
- 5. Provincial Electricity Authority (PEA): 2 projects

A summary of these projects and their specific focus areas is provided in the following table (Table 6).

Table 6 Summary of Key Projects under Thailand's EV Grid Integration Roadmap by National Energy Agencies

Project/ Activity Name	Responsible Organization	Project Timeframe (Planned)	Type of Action	Detail
■ Establishment of Data Center for EV	EPPO	2022–2027	Soft Measure	EPPO will drive the establishment of the EV Data Center, including studying data formats and establishing participation guidelines among agencies and stakeholders.
■ Preparation of EVLA Business	EPPO	2023–2024 (Extension Phase: 2027–2028)	Policy & Regulation, Financial	EPPO will promote the EV Load Aggregator (EVLA) business, assess feasibility, and pilot EV load aggregation as a profitable and competitive business.
■ Study of Dynamic Pricing for EV	EPPO	2024–2025	Policy & Regulation	EPPO will study the suitability and feasibility of applying dynamic electricity rates for EV charging.
■ Promotion for EV Integration	EPPO	2022–2023 (Extension Phase: 2027–2029)	Soft Measure	EPPO will assess EV integration options to support network stability, improve energy efficiency, and defer infrastructure investment.
■ Study of Framework and Criteria for EVLA	ERC	2023–2026	Policy & Regulation	ERC will study and develop regulatory frameworks for EVLAs, including interoperability considerations.
■ Study of Framework and Criteria for Various Types of EV Integrations	ERC	2023–2029	Policy & Regulation	ERC will develop frameworks for technologies such as smart charging and V2G for load response.

Table 6 Summary of Key Projects under Thailand's EV Grid Integration Roadmap by National Energy Agencies (Continued)

Project/ Activity Name	Responsible Organization	Project Timeframe (Planned)	Type of Action	Detail
■ Energy Transfer from Virtual Control Center for V2G and V2H	EGAT	2022	Soft Measure	EGAT demonstrated V2G and V2H power transfer from a simulation control center.
■ Study on EV Smart Charging	MEA	2022–2023	Soft Measure	MEA developed the "MEA EV Smart Charging System" for real-time energy management at charging stations.
■ Data Analysis Platform for EVs	MEA	2022–2023	Soft Measure	MEA developed an algorithm to analyze EV usage data to support electricity distribution planning.
■ AMI Installation for Distribution Transformer in MEA Area	MEA	2023–2027	Soft Measure	MEA plans to install 60,000 smart meters and communication gateways for distribution transformers.
■ R&D for EV Charging Management and Control Systems (Phase 1)	PEA	2024–2026	Policy & Regulation	PEA will develop and install EV charging management systems at the head and regional offices.
■ R&D of EV Charging Management and Control Systems (Phase 2)	PEA	2027–2031	Policy & Regulation	PEA will expand system installation to sub-offices in all provinces.

Thailand accelerates EV infrastructure while confronting urgent gaps in charging equity and battery lifecycle management

Thailand has achieved notable progress in advancing EV infrastructure, particularly in the expansion of public charging networks and the evolving ecosystem supporting EV adoption. From 2018 to 2023, the number of public charger outlets increased by over 300%, surpassing the national target of 4,000 public chargers two years ahead of schedule. This rapid growth reflects strong institutional commitment, effective deployment strategies, and rising consumer demand. A significant portion (79%) of these chargers fall within the 50–150 kW DC fast charging category, aligning with the capabilities of over 70 EV models available in the Thai market as of 2024—many of which support fast charging above 100 kW. Government and utility-led initiatives, including those by EPPO, MEA, EGAT, and PEA, further demonstrate Thailand's proactive efforts to establish smart charging systems, data platforms, and load aggregation services.

Despite these successes, several challenges and systemic barriers threaten to undermine equitable and sustainable infrastructure growth. Charger deployment remains heavily concentrated in Bangkok and central provinces, while the northern and northeastern regions remain underserved. In some areas, the EV-to-charger outlet ratio exceeds 25:1, indicating potential congestion as EV penetration increases. Moreover, ultra-fast chargers (>150 kW) account for only 3% of installations, a figure misaligned with the growing number of EVs that support higher-speed charging. This mismatch may reduce user satisfaction and constrain energy system efficiency. Interoperability also presents ongoing issues due to varied connector types, charging protocols, and power levels across EV models—yet standardization efforts remain limited. Furthermore, many enabling policies and pilot programs are still in development or preparation, with no cohesive national roadmap for integration. In lower-adoption regions, limited financial returns discourage private investment in infrastructure, while real-time coordination across platforms like the EV Data Center is still emerging.

From the EV battery perspective, recent developments indicate a rapidly expanding ecosystem driven by the interaction of government policy, industry investment, and growing consumer adoption, culminating in a battery usage peak of nearly 9 GWh by 2025. A notable market development is the increasing adoption of LFP batteries, which support mass-market BEVs and commercial fleets through relatively lower cost and improved safety characteristics. This has enabled broader electrification across vehicle segments, including passenger cars and small urban commercial vehicles such as E-TukTuk.

However, a significant operational challenge is that the local EV battery industry must navigate the complexity of rapid technological shifts, specifically the sharp transition from NMC dominance (2020–2022) to LFP dominance (2023–2025), which complicates long-term planning for supply chains and recycling. Furthermore, the major barrier to long-term stability is the constant volatility of battery technology, making standardization difficult. The rapid evolution from legacy lead-acid to Ni-MH, then to current Li-ion standards, and now towards emerging solid-state and sodium-ion technologies, creates a moving target for infrastructure and regulation. Additionally, the entire transition remains heavily dependent on external drivers; the momentum is structurally tied to government decarbonization mandates and EV policies.



Industry growth remains strongly policy driven. The national EV 30@30 target and EV incentive packages have successfully attracted investment and localized the cell-to-pack assembly stage. Moving upstream toward domestic cell production remains more challenging due to economic competitiveness and localization requirements associated with incentive schemes. At the same time, EoL battery management remains a regulatory gap, while manufacturing waste is regulated, post-consumer batteries still lack a dedicated nationwide recovery system. The development of WEEE-based EPR mechanisms will therefore be important to support long-term circularity and reduce hazardous waste risks.

Prospects for Electric Vehicle Deployment



2. Prospects for Electric Vehicle Deployment

2.1 Introduction to Scenarios

This chapter explores the prospects for EV deployment in Thailand and the BMR by analyzing current market trends, policy directions, and future scenario planning. It presents an overview of recent developments in vehicle registrations and EV adoption across major vehicle segments, followed by an evaluation of how different policy and technology pathways could influence the future of the road transport fleet. The chapter begins by outlining the scenario framework used in this study, which describes various trajectories for vehicle electrification and emission reduction. Later sections examined segment-specific EV adoption trends for passenger cars, motorcycles, pickup trucks, and light commercial vehicles, emphasizing differences in market readiness, operational needs, and policy impacts. Collectively, these components create a clear outlook for EV deployment and its potential to improve air quality and support long-term transport decarbonization in Thailand. To assess the prospects for EV deployment in Thailand and the BMR, this study applies a scenario-based framework

that explores alternative pathways of road transport development, vehicle electrification, and emission control. The scenarios are designed to capture different levels of policy ambition, technology diffusion, and market response, while maintaining consistency in underlying socio-economic drivers and transport demand.

Three scenarios are considered throughout the analysis:

- Business-as-Usual (BAU)
- Stated Policies Scenario (STEPS)
- Accelerated Zero-Emission Scenario (AZS)

Together, these scenarios provide a structured representation of Thailand's potential EV deployment trajectories, ranging from continuation of current trends to accelerated electrification aligned with long-term decarbonization and air-quality objectives.

2.1.1

Business-as-Usual (BAU)

The BAU scenario assumes the continuation of current trends and regulations, with no new policies introduced beyond those in place as of 2018. Vehicle ownership growth, fleet composition, and overall transport activity develop in line with historical patterns and projected socio-economic changes. Emission standards and fuel quality stay the same, following the regulatory framework effective in 2018. Under the BAU scenario, the adoption of BEVs, PHEVs, and HEVs is not driven by explicit policy targets. Instead, market penetration is estimated using

a model-based adoption framework that connects EV adoption to current economic, technological, and behavioral conditions. Major drivers include financial and policy incentives, availability of charging infrastructure, technology performance and costs, consumer acceptance, domestic industrial capacity, and broader socio-economic and geographic factors. These drivers change according to baseline projections without extra policy intervention, providing a reference pathway against which more ambitious scenarios can be compared.

2.1.2

Stated Policies Scenario (STEPS)

The STEPS scenario reflects the implementation of the currently announced, officially adopted national policies for air pollution control and vehicle electrification. While overall vehicle demand follows the same socio-economic trajectory as in BAU, this scenario incorporates progressive improvements in fuel quality, tighter emission standards, and targeted support for ZEVs. In particular, STEPS aligns with Thailand's 30@30 EV policy, which aims for a 30% share of ZEVs

in new vehicle production and sales by 2030. ZEV adoption varies across vehicle segments, reflecting differences in market readiness and policy support. Passenger cars and motorcycles electrify more rapidly, while heavy-duty vehicles transition more slowly. Beyond 2030, EV adoption continues to grow in line with policy goals, without assuming a complete phase-out of internal combustion engine vehicles within the scenario timeframe.

2.1.3

Accelerated Zero-Emission Scenario (AZS)

The AZS scenario examines an accelerated transition aligned with ambitious air-quality improvement and decarbonization goals. It assumes rapid strengthening of emission standards, full adoption of advanced fuel quality, and a decisive shift toward zero-emission vehicle technologies. Under AZS, EV deployment follows a strong path toward full transition to zero-emission vehicle sales by

the mid-2030s, with intermediate milestones set by vehicle class. Compared to STEPS, electrification progresses more quickly across all segments, including heavy-duty vehicles. Along with new vehicle standards, AZS introduces targeted retrofit measures for existing diesel vehicles, further reducing fleet-average emissions and supporting short-term improvements in air quality.

2.2 | EV Adoption Trend

2.2.1

EV Adoption Methodology

Before presenting the quantitative results of the EV outlook, the analysis follows a sequential and internally consistent modeling framework applied uniformly across motorcycles and four-wheeled vehicles, including passenger cars, pickups, buses, and heavy-duty trucks. The first step is to establish the baseline vehicle market activity by projecting annual new vehicle registrations for each vehicle category over the period 2020–2050.

These projections define the overall market size for new vehicles under each scenario and serve as the basis for subsequent fleet calculations. The cumulative vehicle stock is then derived by combining annual new registrations with vehicle lifetime and retirement assumptions differentiated by vehicle category, allowing the model to capture fleet turnover and long-term changes in the number of vehicles in active use.

The second step focuses on estimating the EV adoption rate, defined as the share of electric vehicles in annual new registrations for each vehicle type. The adoption rate is modeled as a function of multiple independent drivers influencing EV uptake, encompassing economic, technological, and policy-related factors. These include relative purchase costs between EVs and internal combustion engine vehicles (accounting for subsidies and tax incentives), charging infrastructure availability and operational convenience, battery performance and cost trajectories, fuel and electricity price differentials, total cost of ownership considerations, regulatory stringency on vehicle emissions, and broader market and behavioral factors. While the modeling structure is consistent across vehicle categories, the sensitivity to individual drivers varies by segment, reflecting differences in usage intensity and operational requirements.

2.2.2

Two- and Three-Wheeler (2W/3W)

Two- and three-wheelers form the backbone of Thailand's mobility system and constitute the country's largest vehicle segment in terms of both fleet size and daily activity. As shown in Chapter 1, cumulative motorcycle registrations continue to increase steadily, underscoring their long-term importance for commuting, last-mile delivery, and household mobility. Although annual new registrations fluctuate with macroeconomic conditions, the overall motorcycle stock continues to rise. This structural characteristic implies that electrification policies targeting the two- and three-wheeler (2W/3W) segment can deliver wide-reaching, sustained impacts at the national scale.

Finally, annual new EV registrations are calculated by applying the modeled EV adoption rate to the projected number of new vehicle registrations for each category in each year. The resulting annual EV additions are accumulated over time to estimate the total EV fleet size for motorcycles, passenger cars, pickups, buses, and heavy-duty trucks. Scenario differentiation is introduced through alternative trajectories of key drivers, particularly policy support, infrastructure deployment, and technology cost evolution, providing a transparent basis for assessing long-term EV deployment pathways across Thailand's road transport system. Detailed definitions of the scenario assumptions and the formulation of the EV adoption rate function are provided in Appendix A1 and A2.

Recent electrification trends reveal markedly different dynamics between motorcycles and Tuk Tuks. For electric motorcycles, the data presented in Chapter 1 indicate a rapid increase in new EV registrations since the early 2020s, reflecting growing market acceptance and improved product availability. Nevertheless, overall EV adoption rates remain relatively low because the conventional motorcycle fleet is very large; as a result, even strong year-on-year growth in EV sales translates into modest percentage shares. This pattern is characteristic of early-stage diffusion in high-stock vehicle segments, where absolute EV volumes expand quickly while penetration rates rise more gradually. Key constraints inferred from observed trends include affordability relative to ICE motorcycles, uneven availability of charging and battery service infrastructure, and concerns about battery durability and resale value. Despite these challenges, the continued growth in EV motorcycle registrations points to clear near-term prospects, particularly in urban applications with high utilization and favorable operating economics, such as delivery services and shared mobility fleets.

Tuk Tuks exhibit a contrasting electrification profile. While their overall market size is limited and both new registrations and cumulative stock have declined in recent years, EV adoption rates within this segment are comparatively high and volatile. Chapter 1 shows that EV shares for Tuk Tuks can reach substantial levels in certain years despite their small absolute volumes. This behavior suggests that electrification in the 3W segment is primarily driven by targeted procurement programs, pilot projects, and localized replacement initiatives rather than broad-based consumer demand. Electrification is operationally attractive for 3W due to their short travel distances, frequent stop-and-go operation, and predictable routes, which are well-suited to electric drivetrains and depot-based charging. However, the observed volatility in EV tricycle registrations also indicates that uptake can weaken rapidly when incentives or programmatic support decline, highlighting the need for stable financing mechanisms and longer-term implementation frameworks to sustain electrification.

Overall, evidence from Chapter 1 suggests that the prospects for two- and three-wheeler (2W/3W) electrification in Thailand are strongest when policies and market design are aligned with segment-specific characteristics. For motorcycles, large-scale adoption is likely to emerge through improvements in affordability, expansion of charging and battery-service networks, and measures that enhance consumer confidence, with the most significant near-term potential concentrated in high-utilization urban fleets. For Tuk Tuks, electrification prospects depend more on targeted institutional support, with focused replacement schemes enabling rapid adoption within a small but visible segment.

In addition to annual new registrations, the cumulative stock of electric motorcycles provides essential insights into the long-term pace and system-wide impact of electrification.

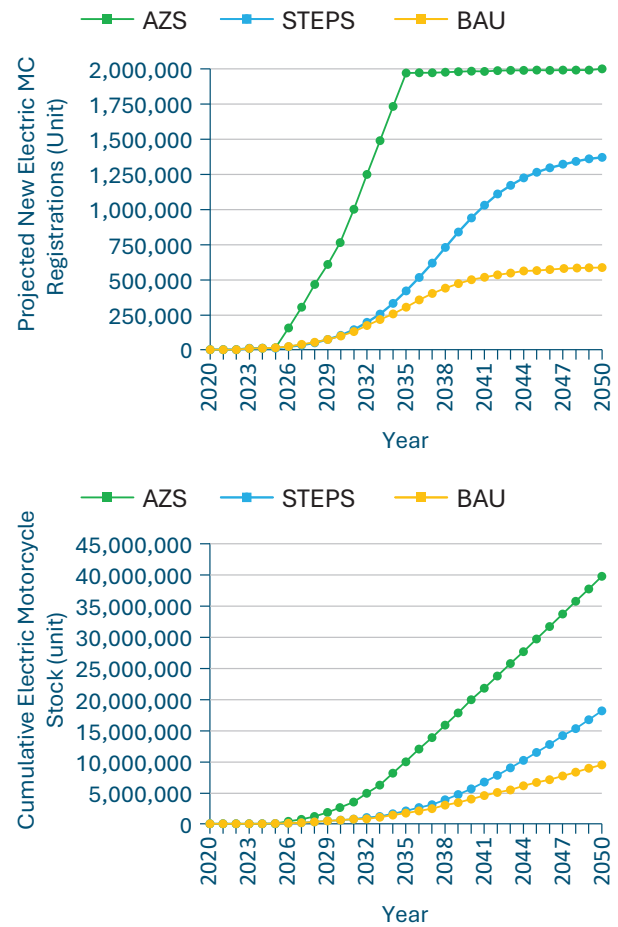


Figure 28 Scenario-based projections of electric motorcycle market growth in Thailand (2020–2050), showing annual new registrations and accumulated fleet size.

Figure 28 illustrates the projected trajectories of new electric motorcycle registrations under three alternative scenarios. Under the BAU scenario, EV adoption increases gradually and stabilizes at a relatively low level, reflecting market-led growth in the absence of additional policy interventions. The STEPS scenario shows a sustained acceleration in EV deployment driven by officially stated policy commitments, resulting in a steady rise in annual registrations through 2050. In contrast, the AZS scenario exhibits a rapid early uptake, with electric motorcycles approaching market saturation by the mid-2030s, highlighting the transformative potential of aggressive policy support and accelerated technology diffusion in the two-wheeler segment.

The projected accumulation of electric motorcycles in Thailand differs substantially across the BAU, STEPS, and AZS scenarios. Although annual new registrations vary markedly among scenarios, the cumulative fleet size highlights the compounding effect of sustained electric vehicle adoption over time. Under the BAU scenario, the electric motorcycle stock grows gradually and remains relatively limited by 2050, reflecting market-driven uptake in the absence of additional policy support. By contrast, the STEPS scenario leads to a substantially larger electric motorcycle fleet, as continuous policy implementation and infrastructure expansion accelerate adoption throughout the projection period.

The AZS scenario shows a significantly different path, with a rapid increase in electric motorcycle stock starting in the late 2020s and reaching near-full penetration levels by the mid-2030s. This faster growth highlights the importance of decisive policy action, technology adoption, and supporting infrastructure in transforming a vehicle segment like motorcycles, which already has a high stock. Significantly, the gap between scenarios widens over time, showing that early adoption not only boosts short-term EV sales but also has lasting effects on fleet composition, energy needs, and emissions reductions.

2.2.2

Light-duty Vehicles (LDVs)

1) Passenger Cars (PC)

Passenger cars constitute a central component of Thailand's LDV fleet and play a pivotal role in shaping long-term transport energy demand and emissions. As discussed in Chapter 1, the total passenger car stock has expanded steadily over the past decade, driven by rising income levels, urbanization, and continued reliance on private vehicles for daily mobility. Within this large and mature market, electrification has accelerated rapidly since the early 2020s, marking a clear structural shift in new-vehicle choices.

Historical data presented in Chapter 1 indicate that EV passenger car adoption remained marginal before 2021, with adoption rates below 1% and new registrations limited to niche early adopters. A pronounced inflection point emerged in 2022–2023, coinciding with the introduction of more substantial financial incentives, expanded model availability, and improved charging infrastructure. By 2023, new EV passenger car registrations increased sharply, and the adoption rate exceeded 10%, reflecting a transition from early-market experimentation to broader consumer acceptance. Although annual registrations have fluctuated slightly in subsequent years, the overall trajectory remains firmly upward, with EVs accounting for a growing share of new passenger car sales by 2025.

Figure 29 illustrates the projected number of newly registered EV passenger cars under the three alternative scenarios. Under the BAU scenario, EV adoption continues to grow but gradually plateaus at a relatively modest level. This trajectory reflects market-led diffusion, driven primarily by incremental cost reductions and limited policy continuity, resulting in slower long-term saturation of EV sales. In contrast, the STEPS scenario shows sustained and accelerated growth in annual EV registrations through 2050, consistent with Thailand's stated policy commitments and the 30@30 target. The AZS scenario shows a much steeper adoption curve, with EV passenger car registrations rising rapidly during the late 2020s and early 2030s, approaching market saturation levels shortly thereafter. This outcome highlights the strong responsiveness of the passenger car market to coordinated policy support, infrastructure expansion, and regulatory signals.

The implications of these divergent pathways become clearer when examining the cumulative EV stock. Even moderate differences in annual registrations translate into substantial divergence in the total number of EV passenger cars over time. Under the BAU scenario, the cumulative EV stock grows steadily but remains well below the levels required for deep decarbonization. The STEPS pathway results in a markedly larger EV fleet by mid-century, reflecting sustained policy-driven momentum. The AZS scenario leads to the most transformative outcome, with cumulative EV passenger car stock expanding rapidly and becoming the dominant share of the fleet by the 2040s. This highlights the importance of early acceleration, as passenger cars have long lifetimes and early adoption has long-term structural effects on fleet turnover dynamics and emissions trajectories.

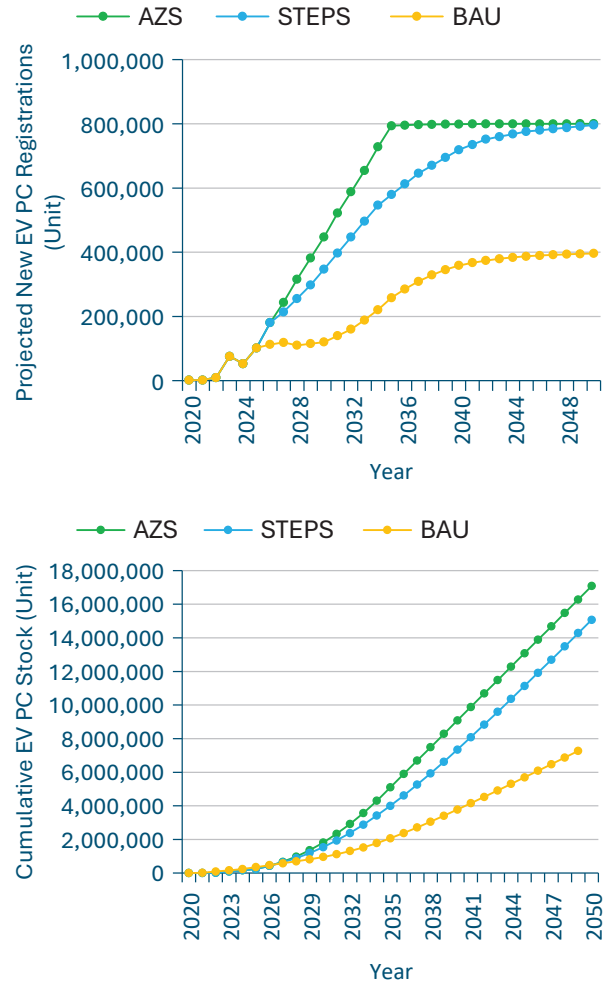


Figure 29 Scenario-based projections of EV passenger car market growth in Thailand (2020–2050), showing annual new registrations and cumulative fleet size.

Overall, the evidence from Chapter 1 and the scenario projections indicates that passenger cars are one of the most impactful segments for EV deployment in Thailand. While initial adoption has already moved beyond the pilot stage, future outcomes remain highly sensitive to policy strength and consistency. The passenger car segment thus serves as a critical anchor for the broader LDV electrification transition. It provides a clear benchmark for evaluating the effectiveness of BAU, STEPS, and AZS pathways in subsequent modeling chapters.

2) Pickup Trucks

Pickup trucks constitute a uniquely important segment in Thailand's road transport system, serving both private and commercial applications and accounting for a substantial share of light-duty vehicle activity. As highlighted in Chapter 1, the conventional pickup fleet remains significant and persistent, reflecting long vehicle lifetimes, high utilization rates, and strong dependence in logistics, agriculture, and small-business operations. These structural characteristics imply that electrification of the pickup segment has the potential to deliver significant long-term emission reductions but also faces higher adoption barriers than passenger cars.

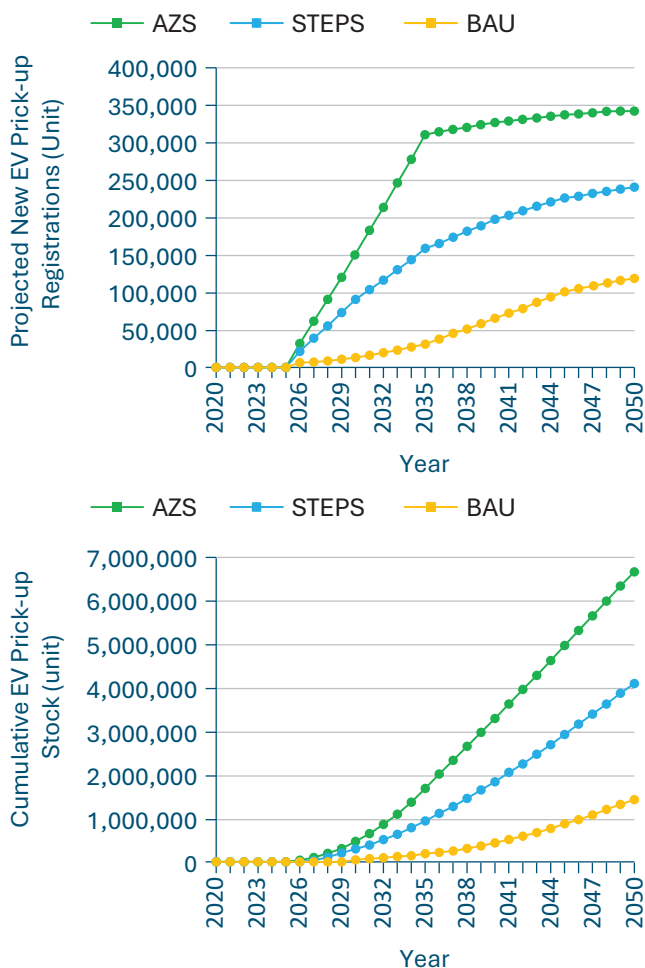


Figure 30 Scenario-based projections of EV pickup truck market development in Thailand (2020–2050), showing annual new registrations and cumulative fleet size.

Figure 30 illustrates the projected trajectories of new electric pickup registrations under the BAU, STEPS, and AZS scenarios. Under the BAU scenario, EV pickup adoption grows slowly after the mid-2020s and gradually throughout the projection period, reaching a relatively modest annual registration level by 2050. This pathway reflects market-led diffusion driven primarily by incremental improvements in battery cost and vehicle performance, without additional policy intervention. High upfront purchase prices, concerns over payload capability and driving range, and limited charging availability along freight and rural corridors continue to constrain adoption in this scenario.

In contrast, the STEPS scenario shows a markedly stronger growth trajectory, with new EV pickup registrations accelerating steadily from the late 2020s onward. This increase is driven by officially stated policy commitments, including incentives for commercial fleets, expanded charging infrastructure, and clearer regulatory signals for vehicle electrification. By the 2030s, annual EV pickup sales under STEPS substantially exceed BAU levels, indicating that policy support can effectively reduce investment risk and improve the total cost of ownership for high-utilization users such as logistics operators and SMEs.

The AZS scenario represents a rapid and transformative transition in the pickup segment. New EV pickup registrations rise sharply in the early 2030s and reach near-saturation levels by the mid-2030s, reflecting aggressive policy measures, strong industrial readiness, and coordinated infrastructure deployment. This scenario assumes that technical concerns related to payload capacity, towing performance, and operational reliability are largely resolved through technological advancements and targeted standards, enabling electric pickups to fully replace conventional diesel models in most use cases.

The cumulative stock of electric pickup trucks differs substantially across scenarios and becomes increasingly pronounced over time due to the long service life of this vehicle segment. Under the BAU scenario, electric pickup adoption remains slow, with the cumulative stock accounting for only a small fraction of the total fleet by 2050. In contrast, the STEPS pathway shows a marked acceleration in cumulative adoption after 2030, resulting in a sizeable electric pickup fleet capable of delivering meaningful reductions in fleet-average emissions. The AZS scenario produces the most transformative outcome, with electric pickup stock expanding rapidly and reaching several million vehicles by 2050, reflecting a near-complete transition of the segment.

Overall, the scenario results indicate that the prospects for electrification of pickup trucks are highly sensitive to policy ambition and market design. Unlike passenger cars, where consumer-driven adoption can scale quickly, the pickup segment requires targeted interventions to address operational requirements, financing constraints, and infrastructure needs specific to commercial use. The divergence among BAU, STEPS, and AZS underscores that, without substantial and sustained policy support, EV pickup adoption is likely to remain limited. In contrast, coordinated measures can unlock a large mitigation potential in one of Thailand's most emissions-intensive LDV segments.

2.2.4

Heavy-duty Vehicles (HDVs)

1) TRUCKS

Electric trucks represent one of the most challenging segments for vehicle electrification in Thailand due to their high capital cost, demanding duty cycles, and their strong dependence on payload capacity and operational reliability. Evidence presented in Chapter 1 indicates that freight activity continues to expand in line with economic growth, implying that decarbonizing this segment is essential for achieving long-term climate and air quality objectives. The scenario-based projections, therefore, illustrate how varying levels of policy ambition can shape the pace and scale of electric truck deployment over time.

Figure 31 presents the projected annual new registrations of electric trucks under three policy scenarios: BAU, STEPS and AZS. In the BAU scenario, electric truck adoption remains limited throughout the projection period, with gradual growth beginning only after the early 2030s and stabilizing at relatively low annual sales levels by 2050. This trajectory reflects market-led adoption driven primarily by niche applications and early adopters, due to the absence of targeted policy support or intense regulatory pressure. High upfront vehicle costs, limited charging infrastructure for heavy-duty applications, and uncertainty regarding battery lifetime under intensive freight operations remain key barriers in this scenario.

In contrast, the STEPS scenario shows a markedly more substantial, more sustained increase in new electric truck registrations from the mid-2030s onward. This acceleration reflects the combined effects of stated policy commitments, including strengthened emission standards, improvements in fuel quality, and explicit support for the deployment of zero-emission vehicles in the freight sector. Although adoption remains slower than in the passenger car segment, the steady rise in annual sales indicates growing commercial viability as technology matures and total cost of ownership improves, particularly for urban logistics and regional freight operations with predictable routes.

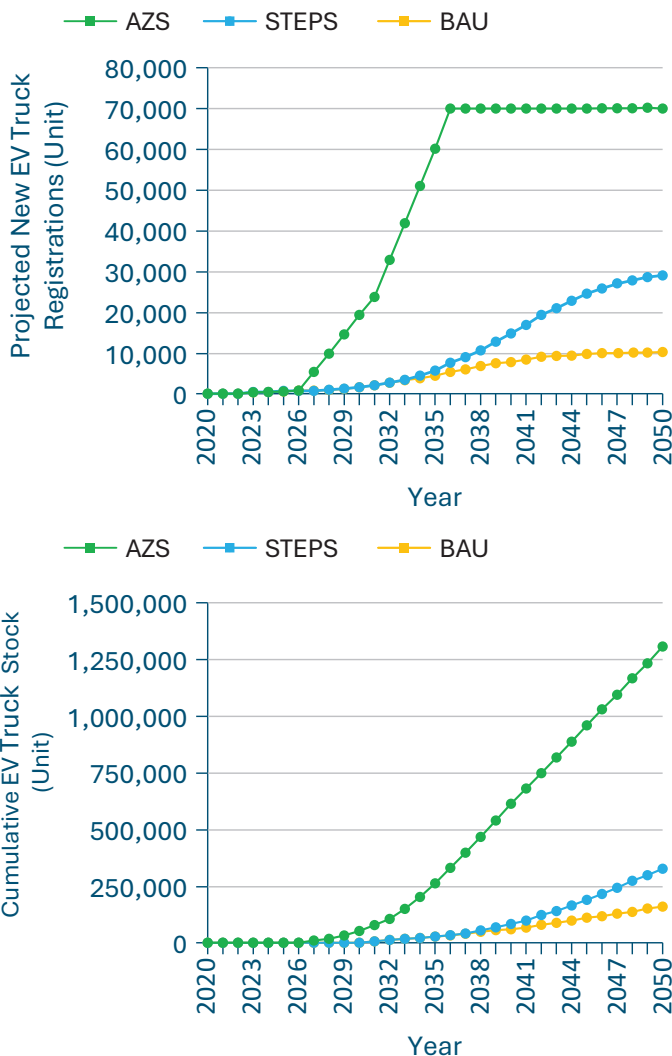


Figure 31 Scenario-based projections of electric truck market evolution in Thailand (2020–2050), showing annual new registrations and accumulated fleet size.

The AZS scenario follows a distinctly accelerated adoption pathway for electric trucks. New registrations rise rapidly from the late 2020s, increasing sharply from around 2027 and reaching approximately 70,000 vehicles per year by the mid-2030s, after which they stabilize. This plateau indicates a near-saturation of zero-emission technologies in new truck sales, as electric trucks move beyond pilot-scale deployment and become the dominant technology in new registrations. Consequently, the cumulative electric truck fleet expands rapidly, exceeding 1.3 million vehicles by 2050.

This transition is driven by the combined effects of aggressive policy assumptions under the AZS pathway, including accelerated tightening of CO₂ and local pollutant emission requirements for heavy-duty vehicles, strong financial incentives, and large-scale deployment of dedicated charging infrastructure. Emission standards are not modeled as a specific regulatory framework but are represented functionally as progressively constraining the market viability of new internal combustion engine trucks, particularly after the early 2030s. Within the model, these assumptions accelerate the phase-out of ICE truck sales and increase the adoption rate of zero-emission trucks, representing an ambitious upper-bound electrification pathway rather than a projection of enacted policies.

The cumulative stock of electric trucks diverges markedly across the three scenarios, highlighting the long-term implications of different adoption pathways. Under the BAU scenario, the electric truck fleet remains small relative to the total truck population, resulting in only limited contributions to system-level emission reductions. The STEPS pathway produces a moderate but steadily expanding electric truck fleet by 2050, sufficient to achieve meaningful reductions in both CO₂ emissions and local air pollutants along high-activity freight corridors. In contrast, the AZS scenario drives rapid adoption of electric trucks, exceeding one million by mid-century and fundamentally reshaping Thailand's freight transport system.

Overall, the comparison between scenarios underscores that electric truck deployment is highly sensitive to policy ambition and implementation strength. While market forces alone yield only incremental progress, sustained policy support under STEPS enables the gradual mainstreaming of electric trucks, and accelerated measures under AZS unlock large-scale transformation. These findings suggest that targeted interventions—such as freight-specific incentives, corridor-based charging infrastructure, and fleet-oriented transition programs—are critical for realizing the full mitigation potential of electric trucks in Thailand's transport sector.

2) BUS

The deployment trajectories of electric buses in Thailand exhibit pronounced divergence across scenarios, reflecting the strong influence of policy design, public procurement mechanisms, and fleet replacement strategies. As shown in Figures 8 and 9, historical data for 2020–2025 indicate a gradual but uneven uptake of electric buses, primarily driven by pilot projects and early-stage public transport electrification initiatives in selected urban areas. While absolute deployment remains limited during this initial period, these early investments establish an essential foundation for large-scale expansion under policy-driven scenarios.

Under the BAU scenario, new electric bus registrations grow steadily but remain relatively modest throughout the projection period. Annual registrations rise gradually after 2025, reflecting incremental fleet renewal by public transport operators without additional policy acceleration. Consequently, the cumulative electric bus stock expands at a moderate pace, reaching a limited share of the total bus fleet by 2050. This pathway highlights the constraints of relying solely on baseline market dynamics and existing replacement cycles, particularly in a capital-intensive segment such as buses, where upfront costs and long asset lifetimes slow technology turnover.

In contrast, the STEPS demonstrates a more pronounced and sustained increase in electric bus deployment. Annual new registrations accelerate progressively after the mid-2020s, consistent with officially announced policies supporting cleaner public transport, improvements in fuel quality, and emission standards. This translates into a steadily growing cumulative electric bus stock, substantially exceeding BAU levels by 2050. The STEPS trajectory underscores the effectiveness of policy-backed procurement programs, regulatory mandates for public fleets, and targeted financial incentives in overcoming the cost and operational barriers to electric bus adoption.

The AZS exhibits a fundamentally different dynamic. As shown in Figure 32, annual electric bus registrations rise sharply in the late 2020s and early 2030s, rapidly approaching saturation levels by the mid-2030s. This rapid scale-up reflects aggressive fleet electrification targets, coordinated national and municipal procurement, and strong institutional commitment to phasing out internal combustion engine buses. As a result, the cumulative electric bus stock increases steeply, surpassing both BAU and STEPS trajectories by a wide margin and dominating the bus fleet well before 2050.

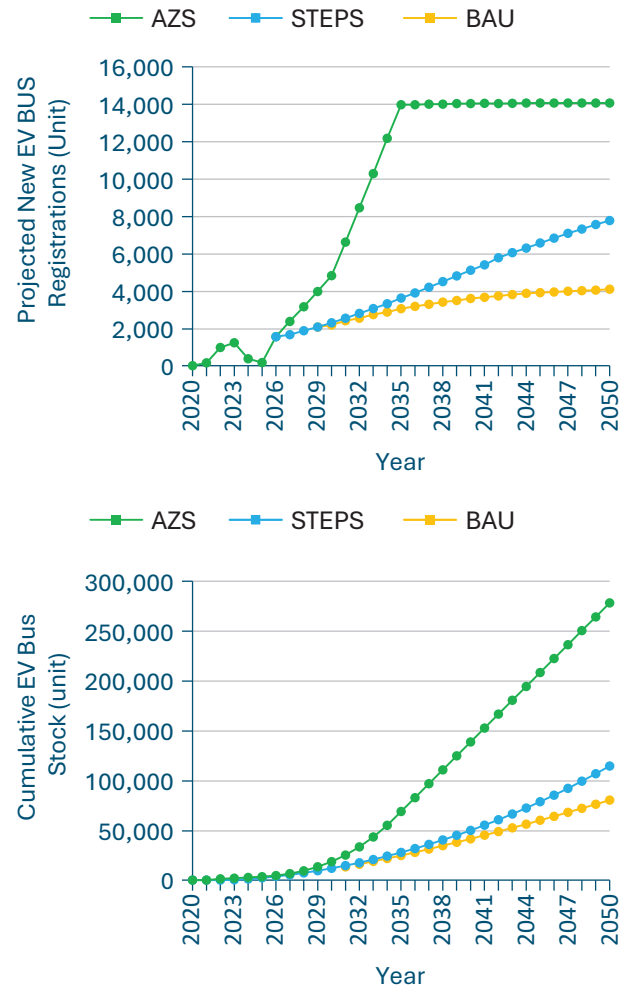


Figure 32 Scenario-based projections of electric bus market development in Thailand (2020–2050), showing annual new

Overall, the comparison across scenarios highlights that electric bus deployment is highly sensitive to policy ambition and implementation capacity. Unlike private vehicle segments, bus electrification depends less on individual consumer choice and more on centralized decision-making, long-term planning, and stable funding frameworks. The results suggest that while incremental improvements under BAU yield limited penetration, well-designed policy packages under STEPS can deliver substantial gains, and fully accelerated strategies under AZS can transform the bus fleet within a relatively short timeframe. These findings emphasize the critical role of electric buses as a high-impact lever for reducing urban air pollution and greenhouse gas emissions, particularly when aligned with broader public transport modernization strategies.

2.2.5 Greenhouse Gas Mitigation Potential under Alternative EV Deployment Scenarios

The greenhouse gas reduction potential under different EV deployment scenarios is estimated using a detailed, fuel-based approach with a tank-to-wheel (TTW) system boundary. Road transport CO₂ emissions are calculated as fuel use (FU) multiplied by fuel-specific CO₂ emission factors (EF), with emission factors sourced from the GAINS framework to maintain consistent methodology. Fuel use is determined from activity-based drivers by combining the number of fuel-consuming vehicles with average annual vehicle-kilometres traveled (VKT) and category-specific fuel economy assumptions. Within this TTW framework, BEVs are assumed to produce zero direct CO₂ emissions, and emissions related to fuel production and electricity generation (well-to-tank, WTT) are explicitly excluded from the analysis. Additional details on equations, assumptions, and parameter values are provided in Appendix A5. This subsection evaluates the potential reduction in CO₂ emissions from Thailand's road transport sector under the BAU, STEPS, and AZS—using BAU as the reference case. Figure 33 illustrates both the projected CO₂ emission trajectories and the corresponding annual CO₂ emission reductions relative to BAU over the period 2010–2050.

Under the BAU scenario, total CO₂ emissions from road transport continue to rise until around 2030, followed by only a modest decline toward 2050. This limited reduction reflects incremental efficiency gains and gradual EV uptake driven solely by market forces in the absence of additional policy intervention. As a result, BAU delivers only marginal long-term decarbonization, leaving a substantial emissions burden well beyond mid-century.

The STEPS scenario demonstrates a noticeably stronger mitigation outcome. As EV deployment accelerates in line with officially stated policies—particularly after the mid-2020s—CO₂ emissions begin to diverge from BAU, with reductions becoming increasingly pronounced after 2030. By 2050, annual CO₂ emissions under STEPS are reduced by approximately 55–60% relative to BAU, reflecting the combined effects of higher EV penetration, improved fuel quality, and tighter emission standards. The gradual but sustained widening of the gap between STEPS and BAU highlights the cumulative impact of policy continuity and steady technology diffusion, even in the absence of a full phase-out of internal combustion engine vehicles.

The AZS scenario delivers the most substantial and rapid CO₂ mitigation. Aggressive electrification targets and early saturation of zero-emission vehicle sales result in an earlier emissions peak and a steep decline thereafter. CO₂ reductions relative to BAU exceed 30% by the mid-2030s and reach approximately 85–90% by 2050. This reduction underscores the transformative potential of accelerated EV deployment, particularly when supported by strong policy signals, infrastructure expansion, and coordinated phase-out pathways for conventional vehicles.

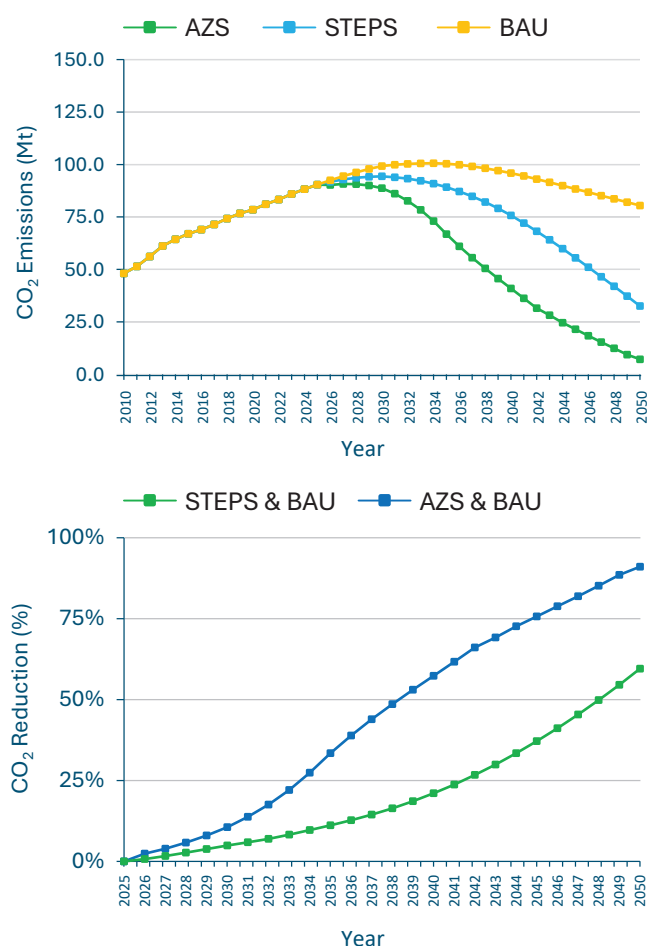


Figure 33

Projected CO₂ emissions from road transport and annual emission reductions relative to BAU under STEPS and AZS scenarios in Thailand (2010–2050).

Overall, the comparison across scenarios indicates that the magnitude and timing of CO₂ mitigation are highly sensitive to the pace of EV adoption. While STEPS offers a realistic pathway for substantial medium- to long-term emission reductions aligned with current national commitments, AZS illustrates the upper bound of potential decarbonization under an accelerated transition framework. These results emphasize that early and sustained policy action is critical not only for achieving climate targets but also for avoiding long-term emissions lock-in within Thailand's road transport system.

2.3 | Public Transportation Trend

While Thailand has seen a rapid surge in private passenger EV adoption, reaching nearly 20% by 2025, the deployment of electric vehicles in public transport and first- and last-mile services remains limited. The contrast between strong private EV growth and the slower electrification of commercial and public mobility services highlights an important structural gap in Thailand's energy transition. Segments such as motorcycle taxis, urban taxis, and local buses continue to face barriers including limited financial incentives, a lack of regulatory frameworks tailored to commercial EV fleets, and infrastructure systems that are not yet designed for intensive service operations.

Analysis presented in Section 1.3 on public transport and first- and last-mile services shows that electrifying these segments is essential for achieving a holistic low-emission transport system. However, as of late 2025, many public service vehicle categories remain in a limited-growth phase. Urban and app-based taxis, including standard taxis and ride-hailing vehicles, have very low EV adoption rates despite their high operational visibility in cities. Fixed-route community vehicles such as Kra-Por taxis continue to rely almost entirely on internal combustion engines. Local buses, including Songthaews,

which remain a cornerstone of mobility in many urban and rural areas, are only beginning to be monitored for EV adoption through new vehicle registrations. At the same time, micro-mobility segments such as motorcycle taxis and tuk-tuk taxis play a critical role in first- and last-mile connectivity but are transitioning to electric power at a much slower pace than required to meet Thailand's national 30@30 policy targets.

One of the key structural barriers lies in the mismatch between existing charging infrastructure and the operational needs of service vehicles. Public service fleets require specialized infrastructure models such as battery-swapping systems for motorcycles or depot-based charging facilities for buses. These systems are fundamentally different from the general public charging networks that have primarily been developed to support private EV users.

Despite these challenges, several emerging mobility service models demonstrate that electrification in public and shared transport is not merely a policy aspiration but an operational possibility under specific service models. The cases of Winnonnie, MuvMi, and Thai Smile Bus illustrate how different segments of the mobility ecosystem are beginning to adopt EV technologies under distinct operational frameworks. Among first- and last-mile services, Winnonnie represents one of the clearest examples of an EV model designed around commercial service use. Its platform targets delivery-oriented users and combines electric motorcycles with a battery-swapping business model that reduces charging downtime and lowers upfront investment barriers. With more than 120 battery-swapping stations and rental-based access that bundles vehicle and battery usage, the system demonstrates how electrification can become economically viable when supported by a service-oriented operating ecosystem rather than relying solely on vehicle ownership. This model is particularly relevant for motorcycle taxis, delivery riders, and other high-utilization urban service segments where operational continuity and time efficiency are critical. In parallel, MuvMi demonstrates the potential of electric three-wheelers as a digitally enabled shared urban transport solution. Its service model operates within defined urban zones and relies on app-based pick-up and drop-off systems to provide flexible mobility services. This approach strengthens first- and last-mile connectivity in dense urban areas by linking passengers with rail stations, commercial centers, and residential districts. The MuvMi case highlights that electrification in public transport should not be understood only through large bus fleets or formal transit systems. Smaller, demand-responsive electric mobility services can also play a significant role in building an integrated low-emission urban transport network.

At a larger operational scale, Thai Smile Bus represents an important example of fleet-based electrification in Thailand's public transport sector. The company has begun deploying electric buses across several routes in Bangkok while integrating EV technology with digital fleet management systems and modern passenger service platforms. Compared with motorcycle and tuk-tuk services, electric bus operations require a different infrastructure and management framework that includes depot-based charging systems, route planning aligned with battery performance, advanced fleet monitoring technologies, and coordinated operational management.

Thai Smile Bus also illustrates how the electrification of bus fleets can support broader smart mobility and smart city initiatives. The integration of digital ticketing systems, GPS-based vehicle tracking, real-time passenger information, and data-driven fleet management helps improve service reliability and operational efficiency. These developments demonstrate that the transition to electric buses is not only a technological shift but also part of a broader transformation in urban mobility management and public transport service delivery.



Taken together, these emerging examples show that the future of Thailand's low-emission mobility will depend not only on the growth of private EV ownership but also on the ability of mobility services to scale. Winnonnie, MuvMi, and Thai Smile Bus represent three complementary pathways for electrification. These pathways include battery-swapping electric two-wheelers for high-frequency service users, shared electric micro-transit systems that support first- and last-mile urban mobility, and large-scale fleet electrification for formal public transport operations.

However, scaling these early signals into a broader system transition will require stronger enabling conditions. Future progress will depend on targeted incentives designed specifically for commercial fleet operators, policy support for domestic manufacturing and research and development, and the establishment of common standards for battery systems and charging infrastructure. Such measures will be essential for bridging the gap between the rapid adoption of private EVs and the slower transition occurring in public transport and first- and last-mile mobility services.

Strengthening these enabling conditions will also be crucial for achieving Thailand's national 30@30 policy target. By aligning infrastructure development, regulatory frameworks, and financial incentives with the operational needs of mobility service providers, Thailand can accelerate the electrification of public transport and build a more integrated and sustainable urban mobility system.

2.4 | Charging Infrastructure and Grid Impact

2.4.1

National Charger Demand Outlook Toward 2030

As Thailand accelerates its transition toward electric mobility, the readiness and expansion of charging infrastructure will be a critical enabler of sustained BEV adoption. Charging infrastructure determines not only the feasibility of EV ownership—particularly for urban residents without access to home charging—but also the reliability of long-distance travel and the operational efficiency of shared mobility, logistics, and public transport fleets. This section assesses Thailand's future charging infrastructure needs based on projected EV uptake, examines the spatial distribution of charger demand, and highlights key implications for planning, investment, and grid readiness.

Thailand's projected EV stock continues to increase across all modeled scenarios—BAU, STEPS, and AZS—driven by expanding model availability, declining battery costs, and supportive government policies. Based on these projections, demand for public charging infrastructure will increase substantially through 2030.

To estimate the required scale of charging deployment, two EV-to-charger ratios—**10 EVs per public charger** and **15 EVs per public charger**—are used. These values are commonly applied in EV infrastructure planning exercises internationally and provide a reasonable range for Thailand's conditions.

- **10 EVs/charger** is applied as a lower-bound estimate. This ratio is used in contexts where a significant share of EV users depends on public charging due to limited access to home charging. This situation is relevant for Bangkok and other high-density urban areas with large condominium populations. A lower ratio implies greater charger availability and is suitable for an early-stage market where charging demand grows faster than infrastructure maturity.
- **15 EVs/charger** is applied as an upper-bound estimate. This ratio reflects conditions in more mature EV markets where most charging occurs at home or at workplaces, and public chargers are used mainly for top-up or intercity travel. It represents a scenario with higher public-charger utilization and more efficient system-wide use of charging assets.

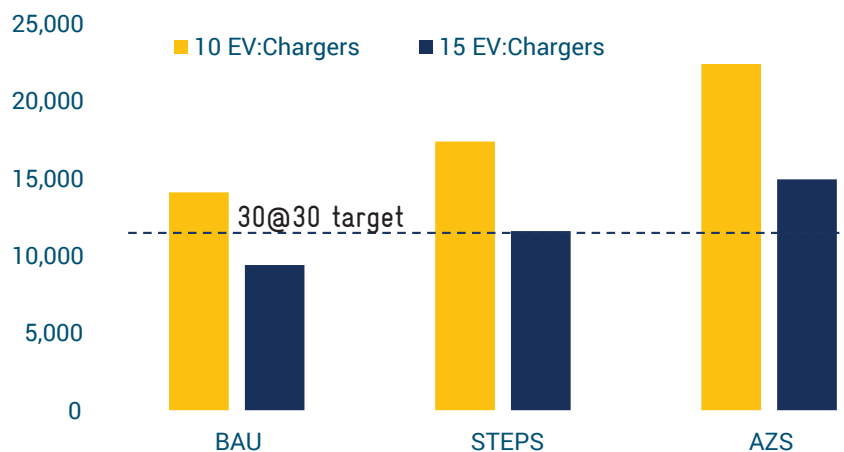


Figure 34 Required number of public chargers in 2030 across BAU, STEPS, and AZS scenarios based on EV-to-charger ratios of 10 and 15.

Using these two ratios, Thailand is estimated to require **approximately 15,000–24,000 public chargers by 2030**, depending on EV uptake and assumed utilization. The lower end corresponds to the 15:1 ratio, while the upper end corresponds to the 10:1 ratio as shown in Fig. 40.

Across all scenarios, the projected infrastructure requirement exceeds the government’s current 30@30 target of approximately 12,000 chargers. The divergence becomes more pronounced under the STEPS and AZS scenarios, where accelerated EV adoption increases the need for DC fast charging in both urban and intercity locations. Even under conservative assumptions, the current national target is below the estimated minimum requirement for 2030.

This indicates that the original 30@30 target, while appropriate at the time of its announcement, does not fully reflect current market dynamics or updated EV-adoption projections. A revised target that incorporates scenario-based planning and updated utilization assumptions would provide a more accurate basis for infrastructure planning and investment decisions.

2.4.2 Spatial Distribution of Future Charging Demand

While national-level estimates indicate the overall scale of infrastructure required, effective planning depends on identifying where charging demand will materialize. The projected BEV stock under the 30@30 target was allocated across provinces based on their current share of BEV registrations, providing an indicative estimate of regional charging requirements. Figure 35 compares the projected spatial distribution of BEVs with the existing distribution of DC charging outlets, enabling assessment of potential geographic imbalances and priority areas for infrastructure expansion.

This comparison identifies provinces where projected BEV growth may outpace current charging availability, signaling the need for proactive deployment strategies, grid readiness planning, and corridor-based infrastructure development to avoid emerging bottlenecks.

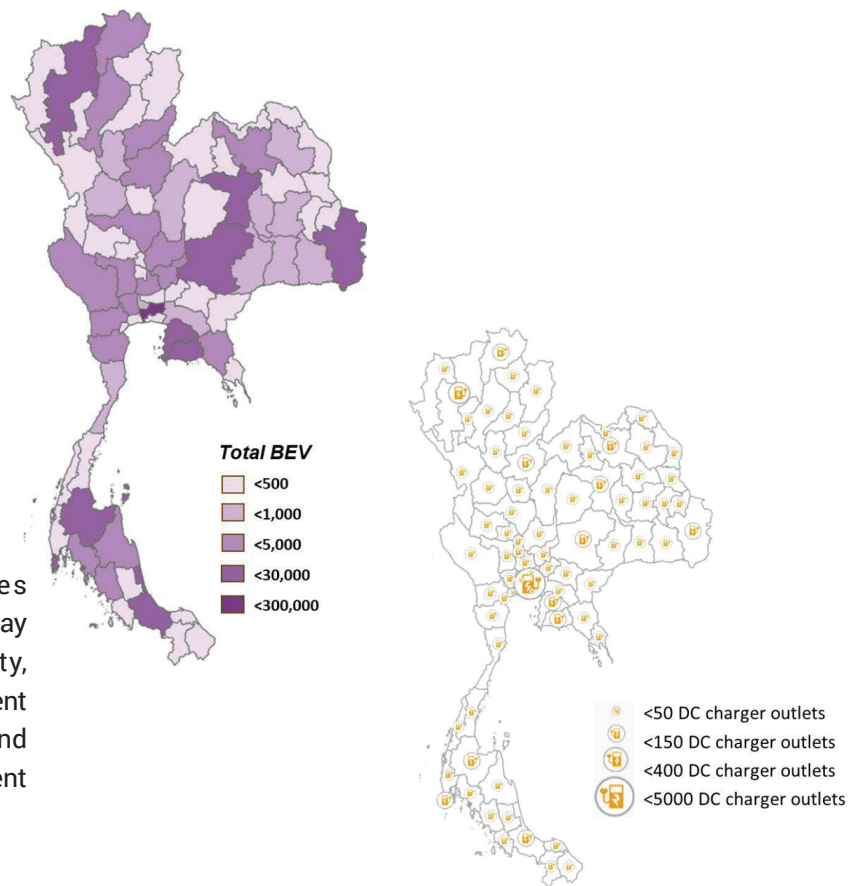


Figure 35 Provincial distribution of projected BEV stock under the 30@30 scenario (left) and current DC charging outlets (right), illustrating regional disparities between vehicle concentration and charging availability.

Bangkok and the Metropolitan Region

Bangkok currently accounts for the largest share of EV registrations and is expected to remain the country's dominant EV market. Several factors influence future charging demand:

- **Limited home-charging availability:** A large share of households resides in condominiums or multi-unit dwellings without access to dedicated AC charging.
- **High trip intensity:** Urban travel pattern involves numerous short trips, increasing the turnover of public charging points.
- **Concentration of commercial fleets:** A high density of ride-hailing, delivery, and logistics fleets require reliable fast charging to ensure operational continuity.

Based on projected BEV distribution, Bangkok alone may require 4,000–5,000 DC outlets by 2030, depending on utilization assumptions. Neighboring provinces including Nonthaburi, Pathum Thani, and Samut Prakan exhibit similar demand pressures due to interconnected commuting flows and dense development. These areas will require substantial expansion of both AC and DC charging capacity.

High-Growth Provincial Cities

Several provincial cities outside Bangkok are emerging as significant EV markets due to rising incomes, regional economic activity, and intercity travel volumes. These provinces function as regional economic and mobility hubs, generating higher charging demand relative to less urbanized regions.

- **Northern region:**

Chiang Mai, Chiang Rai, and Lampang show strong EV adoption driven by tourism and interprovincial mobility. Chiang Mai in particular will require a relatively dense public charging network.

- **Northeastern region:**

Khon Kaen, Udon Thani, and Nakhon Ratchasima serve as major transport hubs along key domestic and regional corridors. Their charger requirements include both urban AC chargers and fast-charging hubs for through-traffic.

- **Eastern region:**

Chonburi and Rayong, located within the Eastern Economic Corridor (EEC), have elevated car-ownership levels and high daily commuting across industrial areas, contributing to substantial DC fast-charging demand.

- **Southern region:**

Songkhla, Surat Thani, and Phuket experience high seasonal tourist flows, creating pronounced peak-period charging demand even if baseline EV ownership remains comparatively lower.

Depending on the province and scenario, projected requirements for public DC fast chargers range from 150 to over 400 outlets. Provinces serving major tourism destinations or functioning as interregional gateways will require higher densities relative to their resident population.

Low-Density And Peripheral Regions

Provinces with currently low BEV adoption will still require baseline charging coverage to support national mobility. Although absolute charger demand is smaller than in urban centers, infrastructure in these areas serves several critical functions:

- Ensuring uninterrupted interprovincial travel, particularly for long-distance EV trips.
- Supporting tourism in rural provinces, where seasonal peaks can stress limited infrastructure.
- Maintaining minimum accessibility and preventing regional disparities in EV usability.

In these regions, deployment will likely focus on corridor-based fast charging rather than dense urban networks. Lower utilization will likely require targeted policy instruments—such as location-specific incentives—to encourage private investment.

2.4.2

EV–Grid Impact Assessment: Introduction and Scope

Thailand's energy transition policies, including the 30@30 target and the long-term goal of carbon neutrality, are expected to significantly accelerate the adoption of electric vehicles. This growth is accompanied by higher charging power levels, larger battery capacities, and expanded deployment of charging infrastructure across residential and public networks.

EV charging introduces a distinct load profile within the electricity system that is spatially and temporally concentrated, particularly within low-voltage and medium-voltage distribution systems. This section assesses the implications of increasing EV charging demand on Thailand's distribution networks. The analysis evaluates the capacity of low-voltage and medium-voltage systems to accommodate incremental EV charging load, with particular attention to voltage performance and equipment loading. The results provide a basis for identifying potential network constraints and informing distribution network planning and reinforcement strategies to support higher levels of EV penetration while maintaining system reliability.

EV–Grid Impact Assessment

The EV grid impact assessment evaluates the interaction between projected EV charging demand and distribution network performance, with a focus on peak charging conditions that represent the most critical operating case for grid constraints. The analysis considers projected EV adoption and charging infrastructure development under the BAU (2030) and STEPS (2030) scenarios.

To capture system-wide impacts, representative distribution circuits from the northern, central, eastern, and southern regions of Thailand are used. Circuit models are differentiated by voltage level and service area. Medium-voltage circuits represent urban and rural distribution networks, while low-voltage circuits represent residential service areas.

Grid impacts are evaluated from the perspective of Thai electric utilities by referencing existing guidelines for EV charger connection and distribution system planning. These guidelines define EV hosting capacity using prescriptive thresholds based on equipment ratings and power quality considerations. Hosting capacity limits are assessed separately for low-voltage (LV) and medium-voltage (MV) networks.

EV Hosting Capacity Criteria and Assessment Results

For LV residential networks, EV charging capacity is constrained by transformer limits. The total EV load connected to an LV circuit must remain below 30% of the transformer rating, and the combined load from EVs and other customers must not exceed 80% of the transformer rating. If these limits are exceeded, connection at the MV level is required. For MV networks serving urban and rural areas, EV installations are subject to feeder-level and transformer-level constraints. Maximum EV charging capacity is limited to 3 MW per feeder for 22-kV systems and 4 MW per feeder for 33-kV systems. In addition, EV load must not exceed 30% of transformer capacity, and total load must remain below 75% of the transformer rating. Exceeding these prescriptive limits would likely trigger grid reinforcement measures.

These planning criteria provide the basis for evaluating EV hosting capacity, voltage performance, and equipment loading across different network types and regions. Figure 36 shows the projected EV hosting capacity based on current utility guidelines for rural, urban, and residential distribution networks in Thailand. The current EV hosting capacity, together with projections under the BAU 2030 and STEPS 2030 scenarios, is illustrated by the blue, orange, and green bars, respectively.

The results indicate that urban distribution networks are expected to experience the most significant increase in EV charging demand. Under both the BAU (2030) and STEPS (2030) scenarios, the projected EV charging capacity in urban areas exceeds the prescriptive hosting capacity thresholds defined in the utility guidelines. This suggests a higher likelihood of triggering network reinforcement or requiring alternative mitigation measures in urban MV systems.

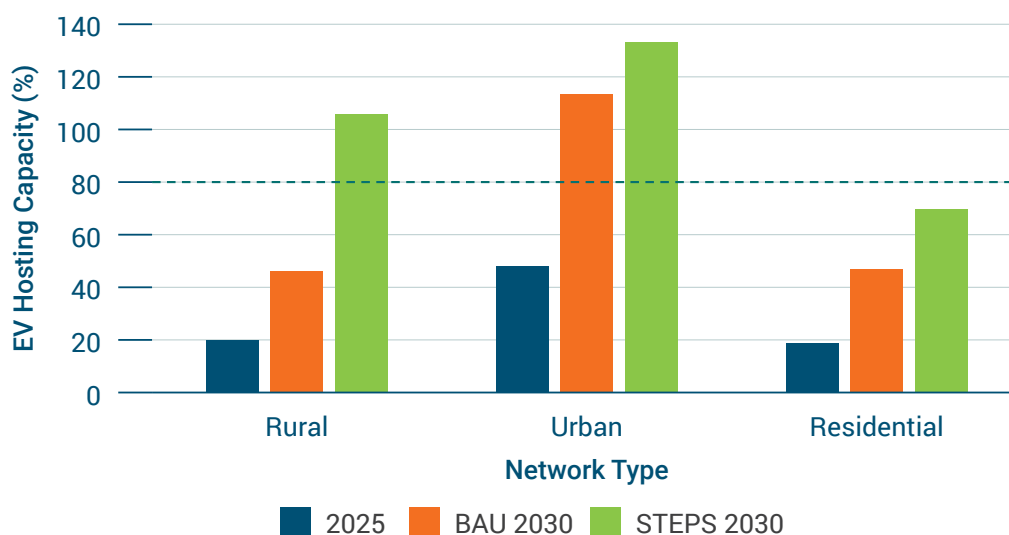


Figure 36 Comparison of projected EV charging demand and hosting capacity limits across rural, urban, and residential distribution networks in Thailand under current, BAU (2030), and STEPS (2030) scenarios.

In rural areas, the projected EV charging demand remains within the hosting capacity limits under the BAU (2030) scenario. However, under the STEPS (2030) scenario, the average EV charging demand exceeds the prescriptive thresholds, indicating potential capacity constraints in rural MV feeders as EV adoption accelerates. For residential LV networks, EV charging demand is projected to increase steadily under both scenarios. Nevertheless, the aggregate EV load remains within the transformer capacity limits defined by the current guidelines for both

BAU (2030) and STEPS (2030). This suggests that, at an aggregate level, residential LV networks are less constrained in the near term, although localized constraints may still arise depending on spatial clustering and charging pattern. Overall, the hosting capacity assessment highlights that, while the existing guidelines provide a conservative buffer for residential networks, urban and rural medium-voltage (MV) networks are likely to encounter binding capacity constraints as EV penetration increases, particularly under policy-driven growth scenarios.

Voltage Impact of EV Charging on Distribution Networks

In addition to capacity constraints, the integration of large-scale EV charging must comply with power quality requirements, particularly voltage regulation limits in distribution networks. From the utility perspective, additional EV loads should not cause unacceptable voltage deviations under normal operating conditions. The assessment evaluates the minimum voltage levels in representative rural, urban, and residential circuits under increasing EV charging demand. Voltage limits are defined in existing utility standards, where minimum operating voltages must remain above 95% of nominal voltage for medium-voltage networks and above 90% of nominal voltage for low-voltage residential networks.

Figure 37 shows the projected voltage impact in rural, urban, and residential distribution networks in Thailand. The current EV hosting capacity and the projected EV hosting capacity under BAU (2030) and STEPS (2030), are shown in blue, red, and green, respectively. As EV charging demand increases, minimum voltage levels decline across all circuit types. However, the projected voltage profiles remain within the allowable operating standards under both BAU (2030) and STEPS (2030) scenarios. These results indicate that, while voltage degradation becomes more pronounced with higher EV penetration, voltage constraints are not the primary limiting factor in most areas at the projected levels of EV adoption levels.

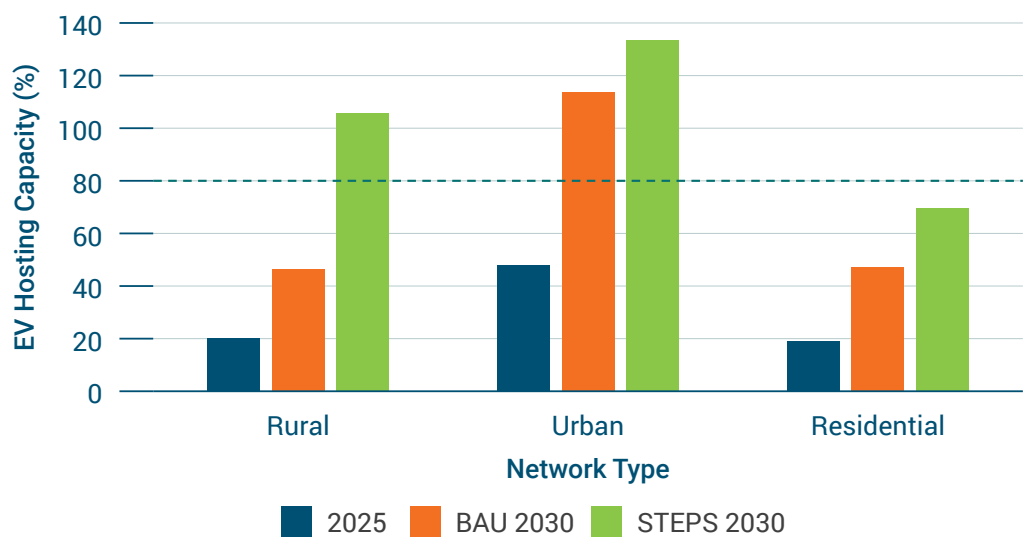


Figure 37 Comparison of minimum voltage levels in rural, urban, and residential distribution networks in Thailand under current conditions, BAU 2030, and STEPS 2030 scenarios.

Equipment Loading
and Thermal Impact
Assessment

Beyond voltage performance, increased EV charging demand may lead to higher thermal loading of distribution system equipment, particularly feeders and distribution transformers. From the utility perspective, EV integration must not result in sustained equipment overloading that could accelerate asset degradation or reduce system reliability. This assessment evaluates the loading levels of key network components in representative rural, urban, and residential circuits under increasing EV charging demand. Equipment loading is assessed relative to thermal limits defined by utility operating standards. Loading levels exceeding rated capacity indicate a potential need for operational mitigation or grid reinforcement.

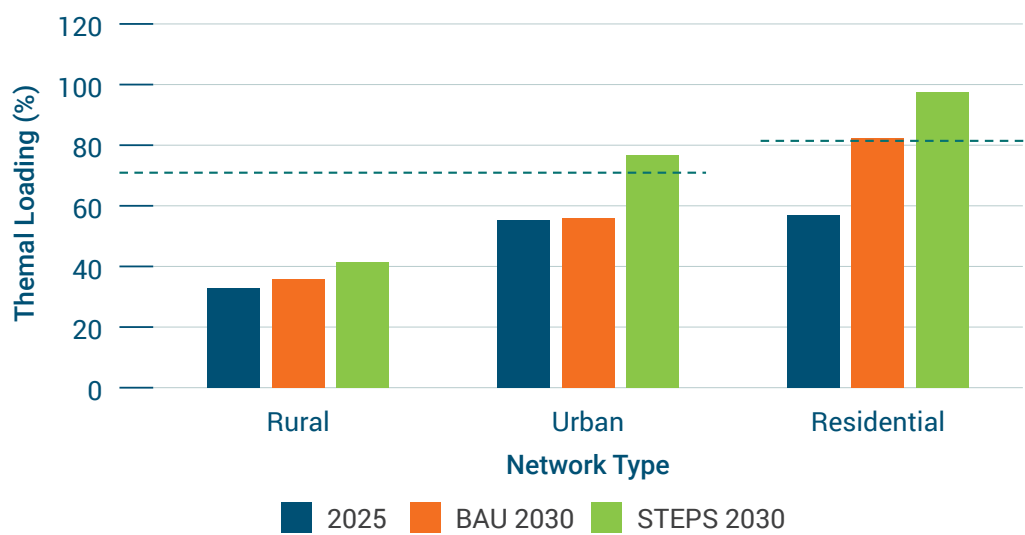


Figure 38 Projected equipment loading in rural, urban, and residential distribution networks in Thailand under current conditions, BAU 2030, and STEPS 2030 scenarios.

Figure 38 shows the projected equipment loading in rural, urban, and residential distribution networks in Thailand. The current EV hosting capacity and the projected EV hosting capacity under BAU (2030) and STEPS (2030), are shown in blue, orange, and green bars, respectively. Equipment loading increases progressively with higher EV penetration across all circuit types. Marginal overloading is observed in certain urban circuits under the STEPS (2030) scenario. In residential circuits, overloading is observed under both BAU (2030) and STEPS (2030) scenarios. These results suggest that thermal constraints of feeders and transformers may become binding earlier than voltage limits in certain areas, particularly in residential and urban networks with high EV adoption.

2.5 Battery Usage Projection

The implementation of the national EV 30@30 policy, which targets 30% of total vehicle production and usage to be ZEVs by 2030, has played a critical role in accelerating the domestic production and adoption of EVs. This ambitious goal has driven increased investment in manufacturing, infrastructure, and battery supply chains. Between 2020 and 2025 (Figure 39), battery usage across various EV types has surged, reflecting the growing diversity in the country's electric mobility landscape. Key vehicle categories contributing to this demand include electric buses and trucks, BEV such as e-cars and e-pickups, as well as e-tuktuk and e-motorcycle. This wide-ranging adoption highlights the country's comprehensive approach to electrifying both public and private transportation sectors, paving the way for a more sustainable and low-emission future. Additionally, the battery capacity market is projected to grow at a compound annual growth rate (CAGR) of 43.7%, increasing from 9 GWh in 2025 to 35 GWh (promoted usage target) in 2030 (Figure 39). However, it is important to note that while CAGR

offers a useful average for evaluating long-term trends, it smooths out annual fluctuations and may not accurately reflect year-over-year changes. This projection is highly sensitive to the initial and final values and could shift significantly due to changes in underlying battery demand, technological advancements, or broader economic and geopolitical factors. If the policy targets for domestic usage and production are achieved in 2030, total battery usage is projected to reach approximately 35 GWh and 54 GWh, respectively. BEVs (including car and pickup) are the primary driver for both targets: contributing approximately 29 GWh to the usage target and 48 GWh to the production target. To meet these 2030 goals, battery demand would need to increase fourfold for the usage target and sixfold for the production target compared to the battery usage in 2025 (Figure 39). This projected growth is expected to spur significant investment in battery manufacturing, further solidifying Thailand's position as a strategic EV assembly hub in Southeast Asia.

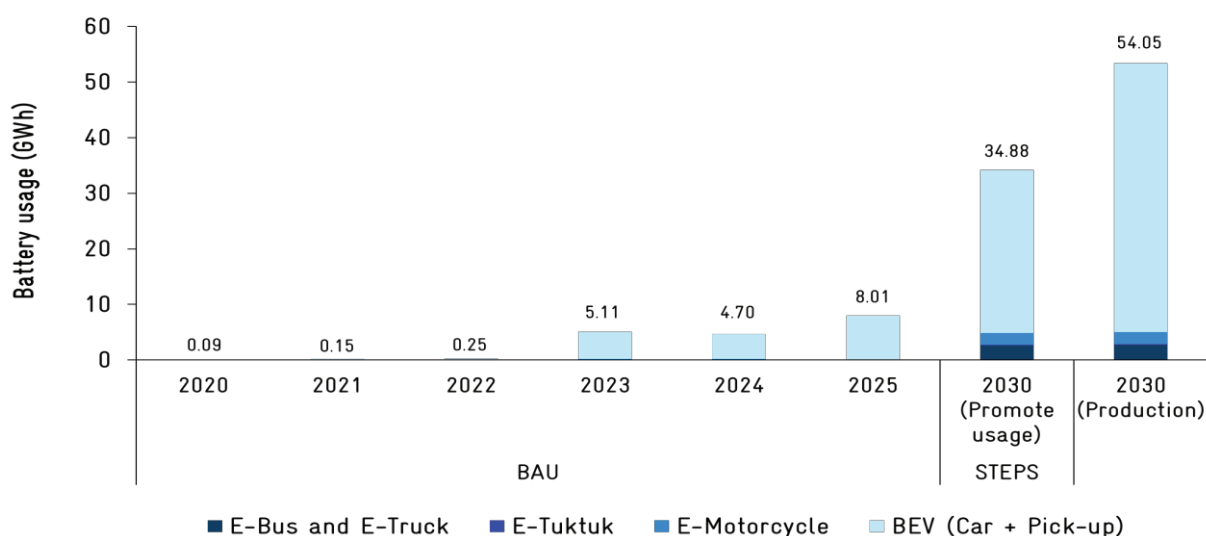


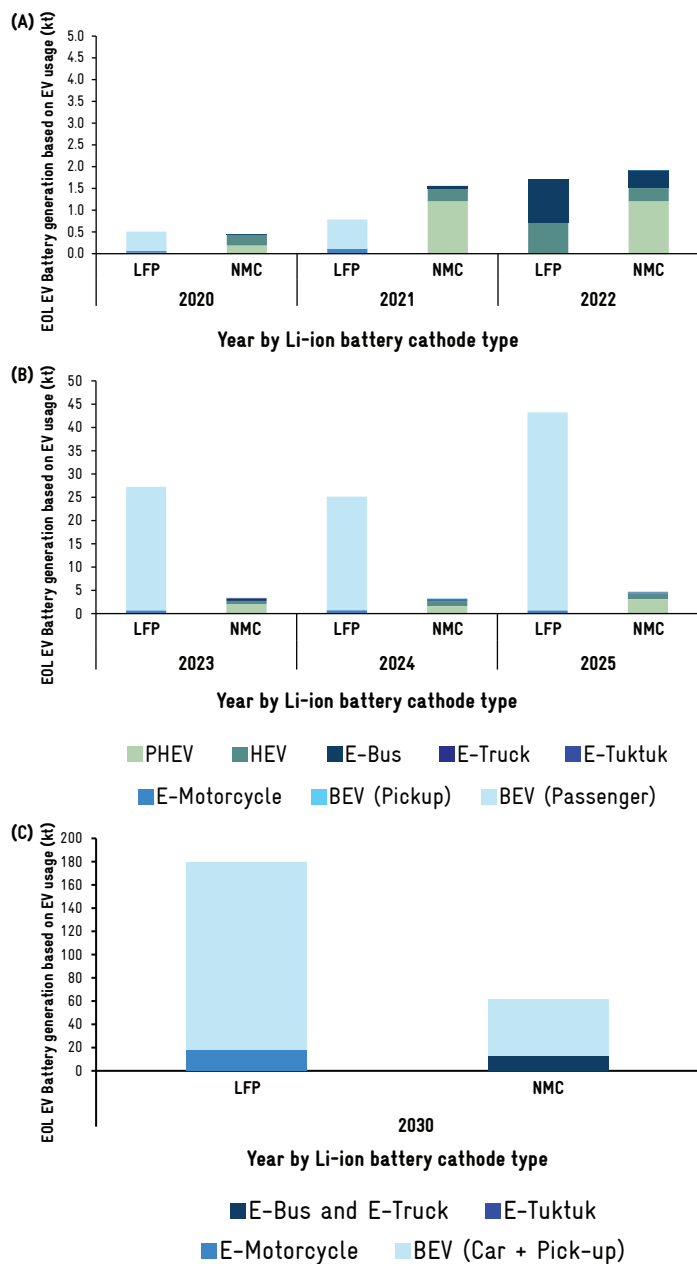
Figure 39 Projection of battery usage for ZEV in 2030, as influenced by the Thailand 30@30 Policy under the different scenario.

However, the timeline and rate of adoption will be influenced by technological advancements, infrastructure development, and the effectiveness of policy measures. To achieve the ambitious 2030 target, different ZEV categories require tailored government support to address challenges and opportunities associated with each segment. Specifically, small and large ZEVs encounter significant barriers to widespread adoption, necessitating stronger government support through targeted policies and incentives. In contrast, medium-sized ZEVs may require less intensive intervention, with efforts focusing instead on public awareness campaigns and promotional initiatives to stimulate consumer demand.

Furthermore, a critical challenge emerging alongside the projected growth of ZEVs is the management of used EV batteries. The State of Health (SoH) is the standard criterion for determining battery performance; replacement is typically required when SoH drops below 80% or when the warranty expires (typically after 8-10 years). Based on this timeline, EoL volumes are projected as follows:

2020-2022 Batch: EoL batteries from this period are expected to generate 6.8 kTon of battery material mass (2.3 kTon LFP and 4.5 kTon NMC) as illustrated in Figure 40(A).	2023-2025 Batch: EoL batteries from this period will increase significantly between 2031 and 2033, reaching over 137 kTon (96 kTon LFP and 41 kTon NMC) as illustrated in Figure 40(B).	2030 Usage Target If the 2030 domestic usage policy targets are met, particularly for BEVs (including car and pickups) approximately 29.3 GWh, the resulting EoL batteries for BEVs are projected to eventually reach over 210 kTon (161 kTon LFP and 49 kTon NMC) as illustrated in Figure 40(C).
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Battery material mass is estimated by dividing total battery usage by the average gravimetric energy densities derived from Durmus et al. (2020): 120 Wh/kg for LFP batteries and 200 Wh/kg for NMC. For a more accurate and comprehensive analysis, specific battery capacity and energy density data should ideally be obtained from individual vehicle model specifications.



The economic value of recycling Li-ion cathodes depends heavily on the metal compositions of LFP and NMC batteries. For LFP batteries, the typical Li:Fe:P ratio ranges from 0.9-1.2:1:1. While the lithium content is sufficient for economic recovery, the iron and phosphorus concentrations offer lower recovery value. For NMC batteries, value is driven by the specific Nickel (Ni), Manganese (Mn), and Cobalt (Co) ratios. NMC 811 contains the highest value of Ni metal recipe, and NMC111 (or NMC 333) has the highest cobalt content. These compositional variations significantly impact recycling economics and sustainability efforts. While lithium recovery remains a priority across all cathode chemistries, the fluctuating market values of transition metals such as nickel and cobalt significantly influence recycling decisions. For instance, NMC 811, composed of 80% nickel, 10% manganese, and 10% cobalt, is designed to reduce cobalt dependency by maximizing nickel content. In contrast, NMC 111 contains equal proportions of each metal (33.3%), making it more cobalt-intensive and potentially more valuable during periods of high cobalt prices. Consequently, the economic viability of battery recycling hinges not only on the metal composition within the cathode but also on global market dynamics and the efficiency of extraction technologies capable of producing battery-grade materials.

Figure 40 Projection of EOL Batteries Usage for ZEVs in 2030, as Influenced by the Thailand 30@30 Policy.

Based on the EoL batteries projected from 2020 to the 2030 promoted usage target, it is estimated that 0.4- 12 kton of lithium could be recovered. This recovered material has the potential to generate approximately 2 GWh to 58 GWh of new capacity, assuming an average yield of 5 kWh per kilogram of lithium (for next-generation LFP battery materials). The lithium content in both LFP and NMC batteries is assumed based on their chemical composition: a minimum lithium content of 4% by weight in LFP batteries, which is consistent with iron phosphate batteries typically containing

around 4%–7% lithium by weight; and 7% by weight in NMC batteries, which is aligned with manganese cobalt batteries typically containing around 7%–9% lithium by weight. In addition, based on a cell-level gravimetric energy density of 200 Wh/kg for next-generation LFP battery materials and considering a minimum lithium content of 4% by weight in LFP batteries, it is estimated that each kilogram of recoverable lithium can theoretically yield approximately 5 kWh cell capacity.

The EoL management of EV batteries is becoming an urgent issue. Batteries from early EVs introduced around 2020 are expected to reach the end of their useful life by 2028–2030, ushering in a wave of used batteries requiring safe and efficient handling. Without adequate systems in place, these EoL batteries could pose serious environmental risks, such as soil and water contamination or fire hazards from improperly handled lithium cells. Currently, Thailand’s recycling infrastructure is insufficient to process the expected volume, and economic barriers such as high costs and low material recovery efficiency further hinder the viability of battery recycling. Valuable metals like lithium, cobalt, and nickel could be lost if robust systems for extraction and reuse are not implemented. Additionally, inconsistent regulations and a lack of harmonization across jurisdictions complicate compliance, especially for global manufacturers.

Beyond recycling, second-life applications offer a promising route for repurposing batteries with diminished capacity. These include uses in stationary storage systems or low-power mobility devices. However, challenges around standardization, design variation, and rapid shifts in battery chemistry present roadblocks to widespread adoption. Effective integration of second-life batteries requires uniform technical standards and clear classification protocols areas in which current policy and industrial practice remain underdeveloped.

2.6 | Policy Gap Assessment

Although Thailand’s electric vehicle promotion policies, particularly EV 3.0 and EV 3.5, have successfully stimulated substantial investment in domestic EV manufacturing facilities and contributed to a significant reduction in EV prices, thereby improving their competitiveness with internal combustion engine vehicles, several challenges remain. These policy packages have resulted in a notable increase in EV registrations, especially for battery electric passenger cars, following the introduction of purchase subsidies, excise tax reductions, and investment incentives linked to local production commitments.

Nevertheless, despite this rapid growth, the cumulative registration of electric passenger cars and electric pickup trucks still faces difficulties in reaching the national targets set for 2030 and 2035, as illustrated in Figure 41. Moreover, registration in other EV categories, such as electric two- and three-wheelers, electric trucks and electric buses, has increased at a relatively lower rate. This situation indicates that, while existing policies have been effective in accelerating early-stage market uptake, additional, more targeted policy measures will be required to ensure that EV adoption across all vehicle segments aligns with long-term national targets.

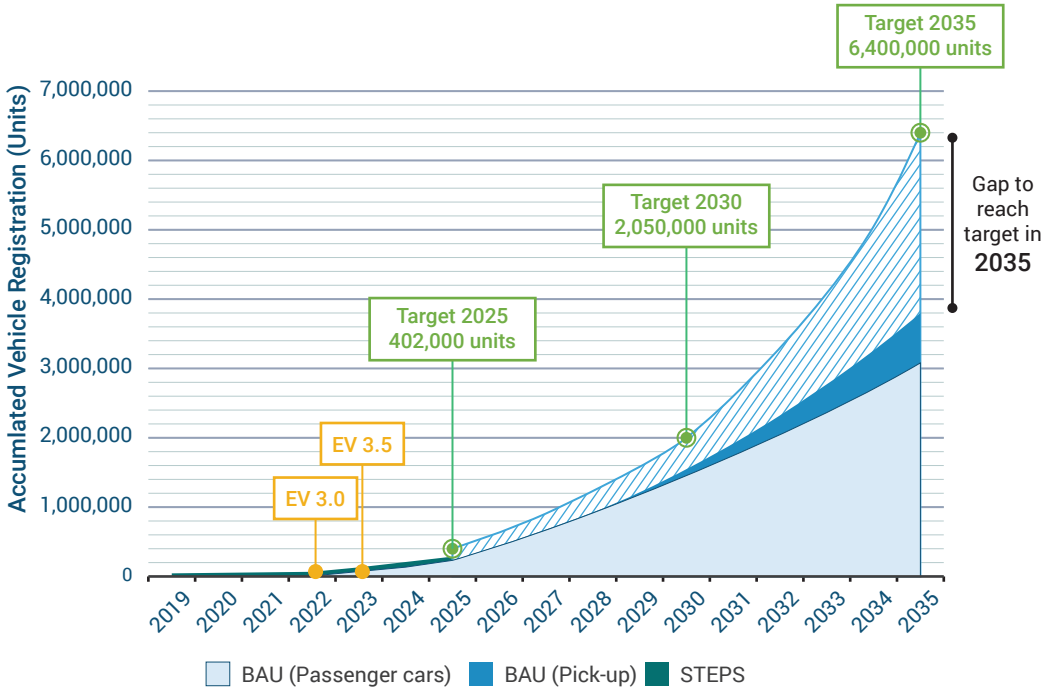


Figure 41
Number of electric passenger cars and pickup trucks accumulated registration as compared with national targets.

To assess Thailand's EV policy gap, an analytical framework developed by Agora Verkehrswende in its study of EV policy support in Maharashtra State, India, was adopted. This framework categorizes EV support policies along the transition pathway from an internal combustion engine-based automotive industry to a fully electrified mobility system, as shown in Figure 42. The framework was adapted and applied to Thailand's context by mapping existing policies across different EV categories, charging infrastructure, and human resource development, to identify areas where Thailand's EV policy framework remains insufficient or underdeveloped. This approach enables a systematic identification of policy gaps and provides an evidence-based basis for formulating additional or revised policy measures to address these gaps in future policy cycles.

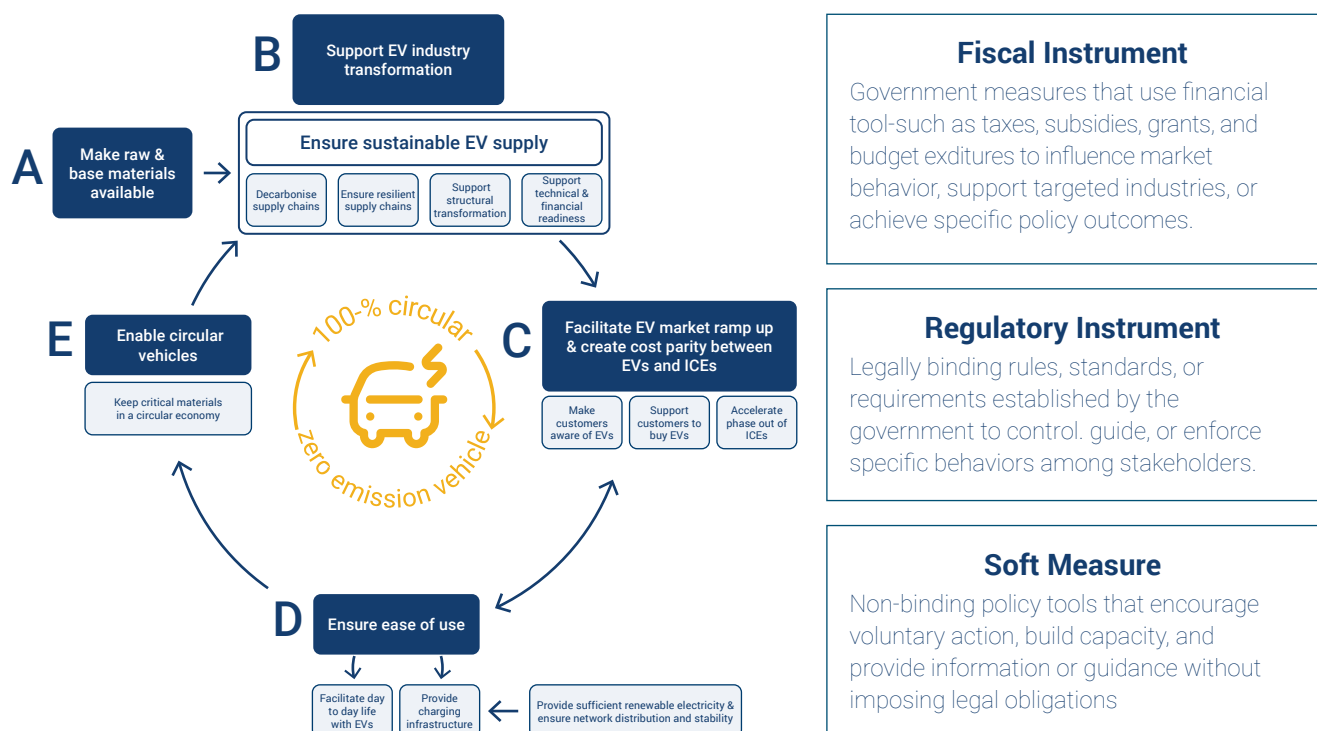


Figure 42 EV Policy gap assessment framework.

Based on the application of this framework to Thailand's current EV policy landscape, as illustrated in Figure 43, several critical policy gaps can be identified.

First,

Thailand lacks explicit policy measures supporting raw materials essential for EV and key-component manufacturing. This gap largely reflects the country's limited domestic availability of upstream materials, such as rare-earth materials used in battery cell production, which are not part of Thailand's current industrial base. While recent policy discussions have begun to emphasize battery cell manufacturing and recycling, concrete upstream material strategies remain limited.

Third,

in the area of EV charging infrastructure, technological development trends increasingly emphasize high-power fast charging systems and the integration of Vehicle-to-Grid (V2G) technologies for more efficient energy management. These developments will require policy readiness in terms of grid capacity planning, smart charging standards, and regulatory frameworks to accommodate increased electricity demand while maintaining system stability. At the same time, there is a growing need for quality control, safety standards, and post-installation inspection mechanisms for charging equipment deployed nationwide.

Second,

existing policies predominantly focus on passenger electric vehicles while support for two- and three-wheeled EVs, electric trucks, and electric buses remains comparatively limited. This imbalance poses a challenge for achieving broader emission reduction goals, especially in freight transport and public transportation. Consequently, additional measures are needed to stimulate domestic production and deployment of these vehicle categories, including tailored fiscal incentives, public procurement programs, and fleet transition schemes.

Fourth,

a major policy gap concerns the end-of-life management and recycling of EVs and critical components, particularly traction batteries. Thailand currently lacks a comprehensive regulatory framework governing battery collection, reuse, recycling, and disposal, as well as a mandatory nationwide EPR scheme. This gap raises concerns regarding potential environmental pollution and long-term waste management risks. International experience and recent domestic policy discussions suggest that clear regulations and extended producer responsibility mechanisms, and incentives for battery recycling facilities will be essential to mitigate these risks and ensure the environmental sustainability of EV deployment in Thailand.



Figure 43 Thailand's EV Policy Gap.

Based on the EV Policy Gap analysis presented above, it is evident that Thailand must further strengthen policy measures to support the development of the EV industry. Enhanced policy support is required to stimulate greater domestic production across all types of EVs, alongside the introduction of incentive mechanisms encouraging both individuals and corporate entities to adopt EVs. Such measures are essential to achieve the national EV 30@30 target and the government's broader objectives for carbon emission reduction in the transport sector.

Preliminary policy recommendations aligned with the above policy gaps are as follows:

1) Policies to Promote the Adoption of Electric Buses, Electric Trucks, and Electric Two- and Three-Wheelers

- Introduce targeted financial measures to support corporate entities procuring electric buses and electric trucks, complemented by tax incentive schemes for organizations operating such vehicles.
- Establish investment promotion schemes for public charging infrastructure designed to accommodate electric buses and electric trucks, particularly to support long-distance transport operations.
- Establish investment incentives for the deployment of battery swapping stations for electric motorcycles and electric three-wheelers to enhance operational convenience and accelerating adoption within these vehicle segments.

2) Policies to Support EV Charging Infrastructure Development

- Update the National Grid Code to ensure readiness for emerging grid integration technologies.
- Develop a centralized national EV charging data platform to serve as a central information resource for electricity generation planning, grid development, and energy management, particularly to support the future integration of V2G technologies.
- Introduce mandatory safety inspection and operational compliance measures for EV charging stations to strengthen user confidence, ensure system reliability, and encourage the safe and sustainable expansion of EV charging infrastructure.

3) Policies to Support EOL Management of EVs and EV Components

- Enact comprehensive legislation governing the management, reuse and recycling of end-of-life EV batteries.
- Promote the development of a regulated end-of-life vehicle (ELV) management ecosystem, including a structured scrappage program, including incentive schemes encouraging proper disposal of old ICE vehicles in exchange for new EV purchases.

Key Findings and Recommendations



3. Key Findings and Recommendations

EV Outlook

The analysis shows that electric vehicle adoption in Thailand is accelerating across all major vehicle segments, but long-term outcomes remain highly dependent on policy ambition and implementation. Scenario results indicate a clear divergence between the BAU, STEPS, and AZS pathways after 2030, highlighting the importance of early and sustained policy intervention. Passenger cars and two- and three-wheelers emerge as the primary near-term drivers of EV growth. These segments respond strongly to financial incentives, expanded model availability, and improvements in charging access. Because of long vehicle lifetimes, early adoption in these categories has a lasting structural effect on fleet composition, energy demand, and emissions reduction. As a result, maintaining policy continuity and avoiding stop-start incentive schemes is critical to sustaining momentum.

In contrast, pickup trucks and buses show slower adoption under market-led conditions and require targeted interventions. Pickup trucks and heavy-duty trucks should be further emphasized in the report, as these vehicle segments represent both a major challenge and a high-impact opportunity for Thailand's transport decarbonization pathway. While electric passenger cars have experienced rapid market growth, EV adoption among pickup trucks and heavy-duty freight vehicles remains comparatively limited, despite their significant role in commercial transport, logistics, agriculture, and small-business operations. Therefore, these segments should be highlighted as priority targets for policy intervention, particularly if Thailand aims to achieve its long-term carbon neutrality and zero-emission vehicle targets.

Their electrification depends primarily on total cost of ownership, operational suitability, and access to dedicated infrastructure. Scenario results demonstrate that without fleet-oriented incentives, procurement programs, and clear regulatory signals, EV uptake in these segments remains limited, even as passenger car electrification accelerates. Public transport and first- and last-mile services lag significantly behind private vehicles, despite their high potential for air quality and climate benefits. This gap reflects the absence of segment-specific regulatory frameworks, dedicated financing mechanisms, and appropriate infrastructure models.

To address this imbalance, EV policy should differentiate more clearly between private and commercial/public vehicles, with tailored support for fleet operators, standardized vehicle and battery specifications, and integration with broader public transport modernization strategies. The findings indicate that Thailand's existing EV targets provide an important foundation but need to be complemented by scenario-based roadmaps that reflect differences across vehicle segments. Strengthening policy coherence beyond headline targets—such as the EV 30@30 goal—and linking EV deployment more explicitly to air-quality and net-zero objectives will be essential to achieving deep and sustained transport decarbonization.

Charging Infrastructure and Grid Impact

The charging infrastructure assessment indicates that Thailand's current national targets underestimate future demand. Based on projected EV uptake, the country is likely to require approximately 15,000–24,000 public chargers by 2030, depending on utilization assumptions. This exceeds the current EV 30@30 target of around 12,000 chargers in all scenarios, including conservative assumptions. The findings suggest that national charger targets should be revised using scenario-based planning instead of fixed numerical benchmarks. Charging demand is highly spatially concentrated. Bangkok and its surrounding metropolitan region account for the largest share of future demand due to limited access to home charging, high trip intensity, and the concentration of commercial and shared fleets. At the same time, provincial economic hubs and tourism-oriented regions show pronounced peak demand, while low-density regions require corridor-based fast-charging coverage to ensure national connectivity. These patterns indicate that a uniform national rollout strategy is unlikely to be effective.

Grid impact analysis shows that urban and rural MV networks are the most likely to face capacity constraints as EV adoption increases, particularly under the STEPS 2030 scenario. In contrast, LV residential networks remain broadly adequate at the system-wide aggregate level, although localized constraints may arise in areas with high EV concentration. Across network types, thermal loading of feeders and transformers emerges as the primarily binding constraint, rather than voltage limits. These findings point to the need for closer coordination between charging deployment and distribution grid planning. Charging deployment strategies should be differentiated by location and use case, with an emphasis on DC fast charging in dense urban areas, mixed AC/DC solutions in provincial cities, and corridor-based fast charging in peripheral regions. In parallel, smart charging, time-of-use tariffs, and managed fleet charging should be promoted to mitigate peak loads and defer or optimize grid reinforcements investments.

EV battery

The transition to electric mobility requires a lifecycle-based approach to EV battery management. As illustrated in Figure 27, the EV battery lifecycle framework enable holistic consideration of all stages, from raw material extraction to EoL, enabling systematic assessment of potential areas of concern. Governance therefore needs to cover the entire value chain, including material sourcing, manufacturing, use, repurposing, and final recycling. At present, policy attention is largely focused on EV adoption and production, while EoL battery management remains comparatively underdeveloped. A structured framework is therefore required to provide stakeholders with a holistic understanding of the EV battery lifecycle and to support informed decisions on appropriate pathways (reuse, repurposing, or recycling) based on battery condition, supported by digital battery traceability systems.

Challenges associated with EoL battery management are expected to arise before 2030. Batteries installed in early-adoption EVs, purchased around 2020, are projected to reach the end of their lifespan by approximately 2028, based on an average lifespan of 8–10 years, which may vary depending on usage patterns, environmental conditions, and technological developments. The first wave of EoL batteries will likely consist mainly of NMC chemistries, followed by increasing dominance of LFP batteries. Consequently, environmental and safety risks, resource recovery, cost-effectiveness, and the development of battery management infrastructure will become major challenges as a significant volume of EoL batteries enters the waste stream. Inefficient management could undermine the environmental benefits of electrification through hazardous waste generation, environmental contamination, and loss of recoverable materials. Comprehensive policies must therefore ensure safe collection, recycling, and disposal while protecting public health and enabling resource recovery. International practices including regulations in the European Union, China, and Japan demonstrate the importance of extended producer responsibility, collection targets, and material recovery standards, as well as regulatory adaptability to evolving battery chemistries.

In conclusion, to effectively manage these challenges, comprehensive lifecycle analyses—considering safety, environmental impacts, standardization, and stakeholder engagement—will provide the foundational framework required for stakeholders to fulfill their responsibilities. The projected surge in battery waste emphasizes the need for robust and proactive laws and regulations. By adopting a holistic view of the battery lifecycle, the country can minimize environmental impacts, conserve valuable resources, and support the long-term viability of the industry in a way that is both environmentally responsible and economically viable.

References

Board of Investment. (2023).

EV Board gives the green light to EV 3.5 package, positioning Thailand as the key regional hub for electric vehicle manufacturing.

https://www.boi.go.th/upload/content/PR119_2566EN.pdf

Department of Land Transport. (2020).

Number of registered vehicles in Thailand 2019. Ministry of Transport.

https://datagov.mot.go.th/dataset/dataset_stat_1_003

Department of Land Transport. (2025).

Statistics. <https://web.dlt.go.th/statistics/>

European Environment Agency. (2019).

EMEP/EEA air pollutant emission inventory guidebook 2019 (EEA Report No. 13/2019). <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019>

International Energy Agency. (2026). Global EV outlook 2026.

<https://www.iea.org/reports/global-ev-outlook-2026>

International Institute for Applied Systems Analysis. (2020).

GAINS—Greenhouse gas and air pollution interactions and synergies model.

<https://iiasa.ac.at/models-tools-data/gains>

Southeast Asia Infrastructure. (2022).

Electric vehicle policy initiatives in Thailand: Focus on buses.

<https://southeastasiainfra.com/electric-vehicle-policy-initiatives-in-thailand-focus-on-buses/>

United Nations Economic and Social Commission for Asia and the Pacific.

(2022). Study report for transitioning to electric public buses in Thailand.

<https://repository.unescap.org/items/dfa60a40-deb9-42e3-9700-9f17fdab9afb>

