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Editorial

Research Trends of Electric Vehicles (EVs) in Indonesia, Malaysia, and Thailand: A Quick Analysis using Bibliometric

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Abstract

The electric vehicles (EVs) market in ASEAN has seen rapid growth in 2024, driven by the global trend towards sustainable transportation and strong government support. Thailand, with strong government policies and extensive charging infrastructure, has emerged as a regional leader. Malaysia and Indonesia are still in the early stages of adoption, grappling with high vehicle costs, limited charging infrastructure, and public acceptance challenges. A bibliometric analysis of research output from 2015–2025 reveals an exponential growth trend in EV-related studies, with Malaysian universities leading the research focus. Despite differences in progress, Indonesia, Malaysia, and Thailand face similar challenges, including limited infrastructure, high cost of ownership, and the need for greater public awareness. Tailored policies, infrastructure improvements, and regional collaboration are critical for ASEAN countries to realize their potential as key players in the global EV transition.

Keywords: Electric Vehicles (EVs); ASEAN; EV Adoption; Infrastructure development; Government policies

1. Introduction

The electric vehicles (EVs) market in ASEAN is projected to grow rapidly in the first half of 2025, in line with the global shift towards sustainable transportation [1], [2]. This growth is driven by supportive government policies, including tax incentives and import duty exemptions, which facilitate EV adoption. Chinese automakers also play a significant role by accelerating EV availability, increasing competition, and offering a wider range of product choices [3], [4]. Meanwhile, local brands actively promote electric vehicles, further contributing to the growth momentum. EV sales are expected to grow by 24% in 2024, although challenges such as limited charging infrastructure remain globally. With strong policy support and growing consumer interest, ASEAN has a significant opportunity to position itself as a global hub for electric vehicle development [4].

In recent years, Thailand has become a regional leader in EV adoption. In 2023, Thailand recorded sales of around 76,000 EVs across various models, far surpassing other ASEAN countries. This achievement is closely related to proactive government policies, including tax cuts and subsidies aimed at consumers and manufacturers. In addition, the government has developed more than 2,500 charging stations by 2023, further positioning Thailand as a regional hub for EV production. In addition, large foreign investment has strengthened Thailand's status as a major hub for electric vehicle manufacturing in Southeast Asia [5].

On the other hand, Malaysia is making more measurable progress in adopting electric vehicles. Electric vehicle sales in the country are projected to reach 20,000 units by 2024, marking a 50.76% increase compared to 2023 [6]. While still lagging behind Thailand, the Malaysian government's initiatives, such as tax exemptions for electric vehicles and the development of charging infrastructure, show a clear commitment to driving market growth. Additionally, the entry of global players such as Tesla into Malaysia signals promising prospects for the country's electric vehicle industry.

Meanwhile, Indonesia has significant potential in the EV sector due to its abundant reserves of nickel, a key component in electric vehicle batteries. The government has set an ambitious target of putting two million electric cars and 13 million electric two-wheelers on the road by 2030 [7]. To support this goal, various incentives have been introduced to attract investment in EV manufacturing and infrastructure. Despite these efforts, Indonesia's EV adoption rate is still below 0.3% [8], [9], lagging far behind Thailand and Malaysia. Charging infrastructure is also limited, with around 1,131 public charging stations currently available across the country, a number projected to increase to 4,300 units by 2025 [10]. High vehicle prices and limited access to charging infrastructure are among the major challenges hampering EV development in Indonesia.

From this comparison, Thailand leads in adoption and infrastructure development, while Malaysia and Indonesia remain in the early stages and require faster progress. Malaysia is making strides through strategic policies and international partnerships, whereas Indonesia needs to address cost and infrastructure challenges to fully leverage its natural resource potential. With the right strategies, these three countries have significant opportunities to spearhead the EV transition in Southeast Asia.

From the scientific literature search, there have been many studies discussing the adoption of EVs in Indonesia [9]–[11], Malaysia [12]–[14], and Thailand [15]–[17]. However, information discussing the relationship between the electric vehicle (EV) market trend in ASEAN and the research trend on electric vehicles in these countries is very limited. Therefore, this article presents a quick analysis of the productivity of EV research by scientists in Indonesia, Malaysia, and Thailand. This analysis includes publication trends, research institutions, and topics discussed.

2. Data Sources and Analysis Approaches

To assess the scope of research on electric vehicles in Indonesia, Malaysia, and Thailand, we conducted a bibliometric analysis using data from the Scopus database. The query we used was: TITLE-ABS-KEY ("electric vehicles" OR "EVs") AND PUBYEAR > 2014 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (AFFILCOUNTRY , "Malaysia") OR LIMIT-TO (AFFILCOUNTRY , "Thailand") OR LIMIT-TO (AFFILCOUNTRY , "Indonesia")) and found 1,484 documents. We obtained the data on January 10, 2025.

3. Current Trends in Research Related to EVs

Figure 1 shows the trend of publications related to EVs combined from the three countries analyzed. It appears to form an exponential trend indicating good research development over time. Furthermore, **Figure 2** shows universities that focus on research in the field of EVs. Of the top 15 rankings in the Scopus database, Malaysia leads with 9 universities, including Universiti Malaya, Universiti Tenaga Nasional, Universiti Kebangsaan Malaysia, Universiti Teknologi Malaysia, Universiti Sains Malaysia, Universiti Putra Malaysia, Universiti Teknologi MARA, International Islamic University Malaysia, Universiti Malaysia Pahang Al-Sultan Abdullah, and Universiti Tun Hussein Onn Malaysia. Thailand with three universities, namely Mahidol University, Khon Kaen University, and Chulalongkorn University. Indonesia also has three universities, namely the Bandung Institute of Technology, the Sepuluh Nopember Institute of Technology, and the University of Indonesia. From these data, universities in Malaysia are leading in research in the field of EVs.

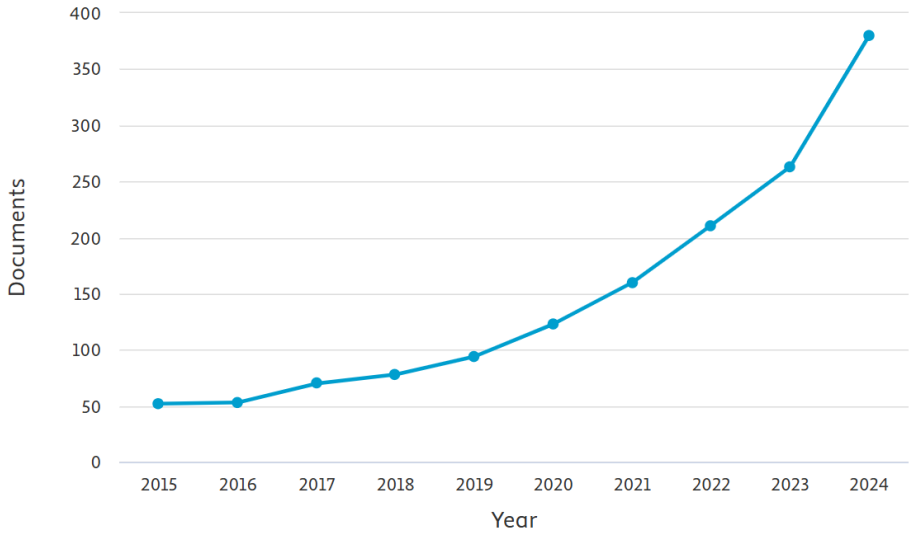

Figure 1. Number of documents discussed EVs in Scopus Database (Indonesia, Malaysia, Thailand)

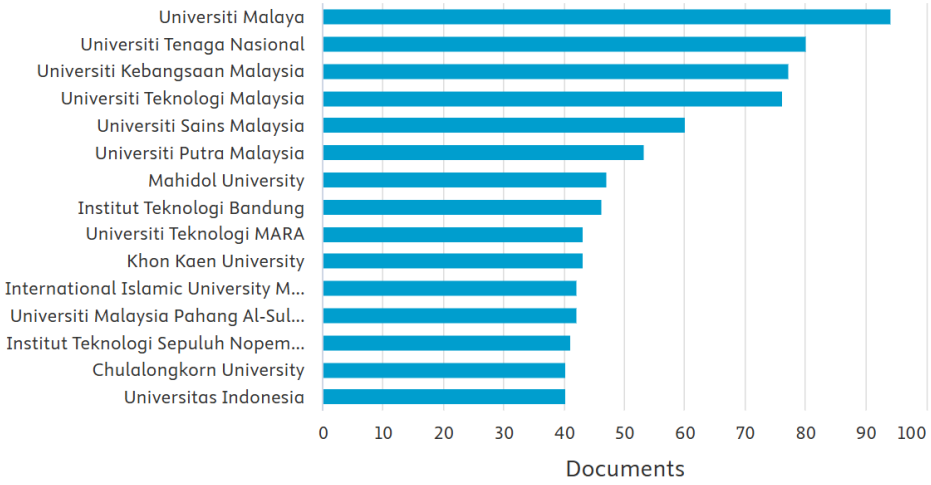

Figure 2. Top 15 universities contributing to EVs research

4. Discussion

4.1. Current EVs Technology Design Trend in ASEAN Market

There's a significant shift in consumer expectations related to EVs in the ASEAN Market. Modern EV buyers are looking for a complete package that combines technological innovation with practical features. Customers want advanced technology, attractive design aesthetics, efficient use of space, multiple model options, and high safety standards. Manufacturers are responding to these demands through advanced Product Lifecycle Management systems, allowing OEMs to develop more variants while shortening development cycles. Second, the autonomous vehicle sector is showing promising developments, particularly in commercial applications. Third, the industry still faces a fundamental challenge: range limitations. Despite lower operational costs, EVs continue to lag behind traditional vehicles in two critical areas:

a) Charging duration (longer than conventional refueling), and
b) Travel distance between charges.

The industry is actively working on solutions, especially in battery technology to overcome the customer pain points when utilizing EVs. Battery technology is experiencing transformative innovations across multiple fronts to tackle range anxiety and charging duration challenges. Solid-state batteries, led by companies like Toyota and QuantumScape, promise higher energy density and faster charging while offering enhanced safety through non-flammable electrolytes. Silicon anodes are showing potential to increase energy capacity up to 10 times compared to traditional graphite anodes, though managing silicon expansion remains a challenge. New chemical

compositions, including lithium-sulfur and sodium-ion batteries, offer promising alternatives with higher energy density or lower costs. Structural batteries are being integrated into vehicle design to reduce weight and increase efficiency, while advanced AI-powered battery management systems optimize charging and extend battery life. High-power charging systems (350kW+) and battery-swapping technologies provide practical solutions for reducing charging time, with companies like NIO successfully implementing swap stations in China. Meanwhile, dual-chemistry battery packs combine different battery types to optimize both range and fast charging capabilities, representing a pragmatic approach to meeting diverse performance requirements.

4.2. Indonesia

Indonesia has been actively promoting the adoption of EVs through initiatives like Presidential Regulation Number 55 of 2019, aimed at accelerating the use of battery electric vehicles [18], [19]. However, despite these efforts, EV market share remains low at 1.47%, primarily due to inadequate charging infrastructure, limited public incentives, and high initial costs. Research in Indonesia underscores the need for enhanced government policies, incentives for producers, and increased public awareness to boost EV adoption [19]. Conductive charging has been identified as the most suitable technology to address infrastructure challenges [20], yet barriers such as the dominance of global original equipment manufacturers (OEMs) [21] and the environmental impact of coal-dependent electricity generation persist, reducing the overall benefits of EVs in the country [22].

4.3. Malaysia

Malaysia is actively promoting EV adoption through various government policies, including the National Automotive Policy (NAP) 2014 and the National Energy Policy (NEP) 2022-2040, which aim to achieve net-zero carbon emissions by 2050 [23], [24]. The government targets 1.5 million EVs on the road by 2040 [24], supported by ongoing research to address challenges such as high costs, inadequate charging infrastructure, and low consumer awareness [6], [23]. Recommendations include expanding the charging network, developing cost-effective strategies, and integrating renewable energy sources [6]. Despite these efforts, adoption barriers persist, including high ownership costs, uneven charging station distribution, and consumer concerns over safety and acceptance [6], [23]. To mitigate these issues, initiatives such as modular electric bus systems are being developed to enhance public transport and accelerate EV adoption [25]. Furthermore, Malaysia's leading car manufacturer, Proton, has recently introduced a new EV model, the Proton eMAS, while Perodua, the nation's second-largest car manufacturer, is set to launch another EV model later this year. These advancements are expected to make EVs more accessible and affordable for Malaysians, signaling a potential surge in EV acceptance shortly.

4.4. Thailand

The Thai government actively supports the adoption of EVs as part of its strategy to reduce greenhouse gas emissions and promote sustainable transportation, emphasizing incentive policies and the development of charging infrastructure [26]. Research in Thailand has explored factors influencing EV adoption, highlighting environmental concerns, satisfaction with government incentives, and the availability of charging infrastructure as critical drivers, alongside the roles of trust and behavioral intentions [26]. However, challenges persist, as adoption rates are affected by factors such as price value, hedonic motivation, and habits, while the moderating effect of charging infrastructure on use behavior has shown insignificant results, underscoring the need for further improvements in infrastructure and policy implementation [26].

Learning from the available literature, Indonesia, Malaysia, and Thailand are making great efforts to promote the adoption of EVs. Each country faces unique challenges that need to be addressed through targeted policies, infrastructure improvements, and increased public awareness, as presented in **Table 1**. Therefore, the implementation and development of EV technology in Indonesia, Malaysia, and Thailand have some similarities and face the same challenges. **Table 2** shows a comparative review based on the literature studied.

Table 1. Comparison of government initiatives, research focus, and key challenges in Indonesia, Malaysia, and Thailand

Country	Government Initiatives	Research Focus	Key Challenges
Indonesia	Presidential Regulation 55 of 2019	Policy improvement, charging technology, public awareness	High costs, limited infrastructure, OEM dominance
Malaysia	NAP 2014, NEP 2022-2040	Cost-effective strategies, renewable integration	High ownership costs, uneven charging station distribution, low consumer acceptance
Thailand	Incentive policies, charging infrastructure	Environmental concerns, incentive satisfaction	Price value, hedonic motivation, insignificant infrastructure impact

Table 2. Comparative analysis of EVS development in Indonesia, Malaysia, and Thailand

Aspect	Indonesia	Malaysia	Thailand
Infrastructure	Developing, lacks sufficient charging stations [20], [27]	Insufficient, AI-enhanced solutions being explored [12], [28]	Needs enhancement, especially in rural areas [29]
Government Policies	Presidential decree for EV adoption [20]	National Automotive Policy, National Energy Policy [23]	Government targets for EV penetration [29], [30]
Public Awareness	Low acceptance and awareness [12], [31]	Low awareness and sales [12]	Influenced by demographics and environmental values [29], [32]
Battery Technology	Exploring conductive charging [20]	AI-enhanced charging infrastructure [28]	Focus on hybrid and full EVs [30]
Market Penetration	Modest, hybrid vehicles as transition [33], [34]	Lower adoption rate compared to neighbors [23]	Higher production and export volumes [27]
Environmental Impact	Limited due to coal reliance [22]	Aiming for zero carbon emissions by 2050 [23]	Significant potential for emission reduction [29]
Economic Incentives	High incentives needed [34]	Various incentives proposed [23]	Targeted policies and incentives recommended [29]

5. Conclusion

The electric vehicle (EV) sector in ASEAN countries, particularly Indonesia, Malaysia, and Thailand, shows promising potential, although the pace of adoption and infrastructure development varies widely across the region. Thailand has established itself as a regional leader in EV adoption, driven by strong government policies, substantial infrastructure development, and foreign investment. Malaysia, while making strides, still faces barriers such as high vehicle costs and patchy charging infrastructure, but its commitment to long-term targets and the involvement of global automakers such as Tesla bode well for its future. Indonesia, despite its vast natural resources, faces significant challenges in EV adoption, primarily due to high costs, limited infrastructure, and the dominance of traditional vehicle manufacturers.

Research in these countries also reflects market trends, with Malaysian universities leading the way in EV research. Despite these efforts, all three countries will need to address specific challenges, from raising public awareness and charging infrastructure to developing cost-effective solutions, if they are to fully harness the potential of EVs. With the right policies, infrastructure development, and international collaboration, Indonesia, Malaysia, and Thailand can play a significant role in the ASEAN region's transition to sustainable transportation. The approaches taken by each country, while unique, underscore the importance of sustained investment and strategic planning to overcome barriers and drive electric vehicle adoption.

Author's Declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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