

Electric Vehicle Use Trends: A Systematic Literature Review of the Global Key Drivers

*Electric Vehicle Use
Trends: A Systematic
Literature Review*

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ABSTRACT

This study aims to examine the global trend of electric vehicle (EV) adoption by highlighting the urgency, implementation challenges, and supporting factors. Using a Systematic Literature Review (SLR) approach based on PRISMA guidelines, this study analyzed 58 selected articles from the Scopus and Google Scholar databases. The literature search process was conducted using a combination of keywords that reflect the urgency of EV use, inhibiting factors, and consumer decisions. Data analysis was conducted bibliometrically using VOSviewer and Publish or Perish software, resulting in the visualization of seven interconnected thematic clusters, such as climate change, charging infrastructure, incentive policies, and public perception. The results show that EV adoption is a systemic response to the environmental crisis, dependence on fossil fuels, and the need for a sustainable transportation system. Although EVs offer long-term efficiency and ecological benefits, barriers such as high initial prices, limited infrastructure, and low public literacy remain major challenges. This study provides a comprehensive understanding for formulating policy strategies and developing the EV industry in Indonesia, in line with the government's targets to reduce emissions and encourage the transition to clean energy.

Keywords: *Carbon Emissions, Consumer Perception, Cruising Power, Electric Vehicles, Electric Vehicle Use Policy, Technology Adoption.*

ABSTRAK

Penelitian ini bertujuan untuk mengkaji tren adopsi kendaraan listrik (EV) secara global dengan menyoroti urgensi, tantangan implementasi, dan faktor-faktor pendukungnya. Menggunakan pendekatan Systematic Literature Review (SLR) berdasarkan pedoman PRISMA, studi ini menganalisis 58 artikel terpilih dari database Scopus dan Google Scholar. Proses pencarian literatur dilakukan dengan kombinasi kata kunci yang mencerminkan urgensi penggunaan EV, faktor penghambat, serta keputusan konsumen. Analisis data dilakukan secara bibliometrik menggunakan perangkat lunak VOSviewer dan Publish or Perish, menghasilkan visualisasi tujuh kluster tematik yang saling terhubung, seperti perubahan iklim, infrastruktur pengisian, kebijakan insentif, dan persepsi publik. Hasil penelitian menunjukkan bahwa adopsi EV merupakan respons sistemik terhadap krisis lingkungan, ketergantungan energi fosil, dan kebutuhan akan sistem transportasi berkelanjutan. Meskipun EV menawarkan efisiensi jangka panjang dan manfaat ekologis, hambatan seperti harga awal yang tinggi, infrastruktur yang terbatas, dan rendahnya literasi publik masih menjadi tantangan utama. Studi ini memberikan pemahaman komprehensif untuk merumuskan strategi kebijakan dan pengembangan industri EV di Indonesia, sejalan dengan target pemerintah dalam mengurangi emisi dan mendorong transisi menuju energi bersih.

Kata kunci: *Emisi, Persepsi Konsumen, Daya Jelajah, Kendaraan Listrik, Kebijakan Penggunaan Kendaraan Listrik, Adopsi Teknologi.*

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INTRODUCTION

Electric vehicles (EVs) have seen rapid development in recent years, becoming a significant focus in efforts to reduce greenhouse gas emissions and mitigate the impacts of climate change (Hossain et al., 2022). The use of electric vehicles is not only a technological innovation but also a key strategy in the transition to clean, environmentally friendly energy (Jiang et al., 2024). This phenomenon has been recognized globally as a solution to overcome dependence on fossil fuels, which cause air pollution and worsen climate change. (Sun et al., 2019). This has led to the broader adoption of electric vehicles in various countries, including both developed and developing nations. Globally, the electric vehicle market is experiencing significant growth. This trend is influenced by various factors, including the increasingly affordable price reduction of electric vehicles and government policies that support the use of environmentally friendly vehicles (Udendhran et al., 2025). China is the largest market, with more than 11 million electric vehicles sold in 2024, accounting for two-thirds of total global electric vehicle sales (Wang, 2024).

This is inseparable from the strong support of the Chinese government, which has provided subsidies and attractive tax incentives for electric vehicle buyers (Kirchner, 2025). Additionally, innovations in the production of more affordable and efficient electric vehicles have accelerated the adoption of electric vehicles in the country. In Europe, despite stagnant EV market growth due to reduced subsidies, countries such as Norway continue to show high adoption rates, with 90% of new car sales being electric vehicles (EcoWatch, 2025). Conditions in the United States despite electric vehicle sales increasing by 10% by 2024, challenges such as higher prices and limited affordable models are becoming significant obstacles to mass adoption (Smith, 2006).

The adoption of electric vehicles in Indonesia is still in the early stages of development. However, there is excellent potential to be harnessed. Indonesia is the fourth most populous country in the world and the largest producer of nickel, having significant advantages in the production of electric vehicles, especially in terms of raw materials for electric vehicle batteries. The Indonesian government is aware of the importance of the transition to electric vehicles. The government has implemented several policies to support the development of the electric vehicle industry in the country. One of them is the target of reaching 600,000 units of electric vehicles per year by 2030, accompanied by the placement of 2 million electric vehicles on the highway in the same year. The government is also targeting the construction of more than 31,000 electric vehicle charging stations by 2025 as part of efforts to support the infrastructure needed by the electric vehicle market. The main challenges still faced are the lack of significant incentives for domestic consumers and manufacturers, as well as the reliance on imports of electric vehicles and related components.

Based on this background, this study will conduct a systematic literature review on trends in electric vehicle adoption, focusing on the challenges and opportunities. This study aims to provide an understanding of the urgency of electric vehicle adoption, the challenges associated with it, and the factors that support electric vehicle acceptance. By understanding global trends and local market conditions, the results of this study are expected to make a significant contribution to the development of the electric vehicle industry in Indonesia the achievement of government targets in reducing emissions and transitioning to clean energy.

LITERATURE REVIEW

External Factors: Technology, Economy, and Policy

A complex mix of technological, economic, psychological, and policy factors influences the adoption of electric vehicles (EVs). Key motivators include advancements in battery technology, increased mileage, reductions in greenhouse gas emissions, and government incentives such as tax breaks and investments in charging infrastructure, all of which have significantly increased consumer interest and market share in recent years (Forsythe et al., 2023; Zaini et al., 2024). However, key barriers remain, notably high

purchase prices, limited charging infrastructure, mileage anxiety, and consumer concerns about performance and safety (Machado et al., 2023). Socio-demographic factors such as income, environmental attitudes, and homeownership also play a role, with early adopters often being tech-savvy, environmentally conscious, and high-income individuals (Brückmann et al., 2020). Although government policies and incentives are important, their effectiveness varies, and there remains uncertainty about the optimal strategies for infrastructure development and market stimulation (Coffman et al., 2017). Organizational adoption, such as fleet electrification and the integration of EVs with renewable energy sources, further enhances environmental benefits.

Challenges and Barriers to EV Adoption

The deployment of electric vehicles (EVs) in any country faces several significant challenges, including high initial costs, limited charging infrastructure, concerns about range, and concerns regarding battery performance and recycling (Alanazi, 2023). Disruptions to supply chains, such as shortages of essential minerals and semiconductors, further increase costs and slow production, while reliance on non-renewable energy sources for power generation can undermine environmental benefits, especially in countries with coal-heavily power grids (Zhang, 2024). Consumer misconceptions about the true ecological footprint of electric vehicles, as well as a lack of awareness and trust in their performance and safety, also hinder widespread acceptance. Equality issues arise because low-income and marginalized communities often have less access to electric vehicles and their supporting infrastructure (Alshahapy et al., 2025). The complexity of policies and regulations, the lack of government incentives, and the need for cross-sector coordination between the energy and transportation sectors add further obstacles (Adamashvili & Thrassou, 2024). Addressing these challenges requires holistic approaches such as expanding and upgrading charging networks, investing in battery technologies, integrating renewable energy, offering targeted incentives, and ensuring inclusive policy frameworks (Kumar & Alok, 2020). Collaboration among government, industry, and stakeholders is crucial for creating a sustainable and equitable transition to electric mobility (Muzir et al., 2022).

Individual and Social Factors in EV Purchase Decisions

A combination of personal, technological, economic, and social factors influences the decision to buy an electric vehicle (EV). Key determinants include consumers' perceptions of control over resources (such as affordability and access to charging), environmental awareness, and acceptance of new technologies, all of which strongly shape behavioral intentions toward EVs (Tu & Yang, 2019). Positive attitudes are fostered when consumers believe EVs offer individual, environmental, or national benefits, and when they consider EVs to be easy to use and cost-effective compared to traditional vehicles (Lashari et al., 2021). Economic considerations, such as price values and available incentives, play an important role, as do concerns about vehicle mileage and reliability (Ling et al., 2021). Social influences, including opinions from family and peers, can be significant in some contexts, although the impact varies by region and demographic. Previous experience with EVs, whether through ownership or trials, increases the likelihood of a purchase by reducing perceived risk and increasing perceived profits (Xu et al., 2020). Infrastructure barriers, such as limited charging stations, and technological issues, such as battery life, can negatively affect purchase intent (Higuera Castillo et al., 2020). Demographic factors, including income, gender, and previous vehicle ownership, also contribute to the likelihood of adopting an EV. Policy measures, such as monetary and non-monetary incentives, are increasingly encouraging adoption, especially among middle- and low-income groups (Shakeel, 2022).

RESEARCH METHOD

This study employed a Systematic Literature Review (SLR) approach, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)

guidelines. This approach aims to systematically and structuredly identify, analyze, and synthesize literature to evaluate global trends in electric vehicle (EV) adoption. Literature was collected through the Scopus database using Publish or Perish 8 software, with three main keyword combinations: urgency, electric vehicle, and country; adoption, challenges, and electric vehicle; and customer, EV purchase decision, and satisfaction factor. The initial search yielded 416 articles. After title screening and duplication elimination, 215 articles remained for further selection. Abstract-based selection was conducted by considering topic suitability, discussion coverage on EV adoption factors, and the involvement of public policy and consumer decisions. A total of 165 articles were eliminated because they did not meet the criteria, leaving 50 primary articles. To complete the review, eight additional relevant articles were screened from Google Scholar, resulting in a total of 58 articles analyzed.

Data analysis was conducted using bibliometric methods, combining VOSviewer and Publish or Perish. The analysis process included identifying the relationship between frequently occurring keywords (co-occurrence analysis) to uncover the thematic structure within the reviewed literature. The visualization results in the form of network mapping show the existence of seven main interconnected thematic clusters, including: climate change, transportation and energy, charging infrastructure, environmental impact, policy incentives, machine learning, and consumer perception. The visualization of the relationships between topics can be seen in Figure 1.

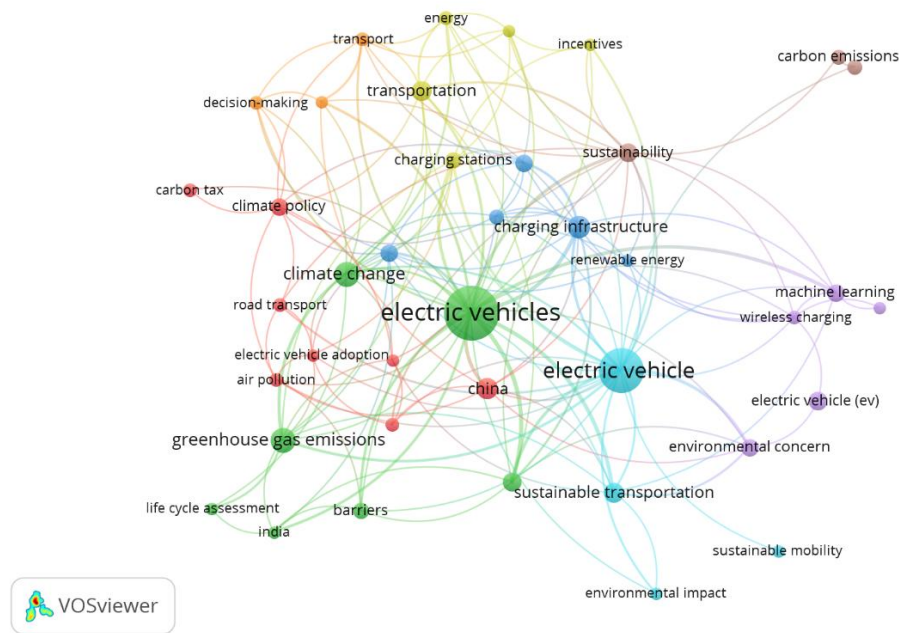


Figure 1. Visualize a network with 6 similarities using VOSviewer

All literature findings were analyzed thematically to address the primary research objectives: to examine the urgency of electric vehicle adoption, implementation challenges in various countries, and supporting factors for systemic electric vehicle adoption. The analysis results are used as a basis for developing policy recommendations and sustainability strategies toward a low-emission transportation transition.

RESULTS

The Urgency of Using Electric Vehicles

Rising global temperatures and deteriorating air quality have highlighted the urgency of the transition to a more sustainable mode of transportation. In this context, the use of electric vehicles (EVs) has emerged as a crucial solution capable of addressing the various environmental, economic, and social challenges resulting from dependence on fossil fuel

vehicles. This analysis will elaborate on this urgency through several important aspects, supported by case studies from various countries. There are findings that support the use of electric vehicles are the potential to significantly reduce greenhouse gas (GHG) emissions and local air pollutants. Conventional vehicles, especially those that run on gasoline and diesel, are major contributors to emissions of carbon dioxide (CO₂), nitrogen oxides (N₂O), particulate matter (PM_{2.5}), and volatile organic compounds (VOCs) (Wang et al., 2021). These emissions not only contribute to climate change, but also have a direct impact on public health, causing respiratory problems, cardiovascular disease, and even premature death (Holland et al., 2021). For example, a case study in China shows that the mass adoption of electric vehicles has great potential to reduce PM_{2.5} concentrations in cities, which directly impacts improving air quality and population health (Li et al., 2020). Similarly, in Europe, incentive policies for electric vehicles have been positively correlated with a decrease in air pollution levels in major cities. Although the production of electric vehicle batteries has an initial carbon footprint, the *life-cycle emissions* of electric vehicles, including production and use, are substantially lower than those of conventional vehicles, especially if the electricity used is sourced from renewable energy (Majeau-Bettez et al., 2011).

The urgency of using electric vehicles is also closely related to the issue of energy dependence and security of supply. Most countries, including Indonesia, are still heavily dependent on petroleum imports to meet the energy needs of the transportation sector. Global oil price fluctuations and geopolitical tensions can have a significant impact on national economic stability. By switching to electric vehicles, dependence on fossil fuels can be reduced, thereby increasing the energy independence of a country. Norway becomes an interesting case study in this context. As one of the countries with the highest adoption rate of electric vehicles in the world, Norway has managed to drastically reduce fossil fuel consumption in the transportation sector, even though it is also a major oil producer. This success is supported by the abundant availability of renewable energy sources, especially hydroelectrics, to charge electric vehicles (Figenbaum & Kolbenstvedt, 2018). This shows that diversification of energy sources and the use of electricity from renewable energy can strengthen the overall security of energy supply.

The transition to electric vehicles also encourages technological innovation and creates new economic opportunities. Investments in more efficient battery research and development, advanced charging infrastructure, and intelligent energy management systems are increasing (Lutsey et al., 2015). This condition opens up new jobs in the manufacturing, services, and research sectors. The U.S. government and its private sector have invested billions of dollars in the development of the electric vehicle ecosystem, from gigafactory battery factories to fast charging networks on the highway. This not only reduces the cost of production and ownership of electric vehicles, but also triggers innovative competition among automotive manufacturers (Shafiei & Topal, 2019). In addition, the concept of Vehicle-to-Grid (V2G), in which electric vehicles can reflow energy to the power grid when not in use, promises the potential to stabilize the power grid and optimize the use of renewable energy.

Challenges of Using Electric Vehicles

Although electric vehicles (EVs) offer a wide range of benefits, their implementation still faces a number of challenges that need to be overcome through collaboration between governments, industry, and communities. One of the main barriers to the development of the EV market is inconsistent policies. Electric vehicles are an important step in realizing global sustainability, but various obstacles still exist that require technological innovation, supportive policies, and increased public awareness. With the right strategy, the transition to electric vehicle use can be accelerated, bringing benefits to the environment, economy, and public health globally. Based on research conducted by Noel et al. (2020) using semi-structured interviews with experts, it was found that several main factors are obstacles to the use of electric vehicles, namely cruising power, vehicle prices, public charging infrastructure, and consumer knowledge and experience.

Electric vehicle (EV) range is one of the most frequently discussed challenges by experts. Although countries with high EV adoption rates, such as the United States and Norway, have made significant progress, this issue persists (Yang et al., 2023). A 2017 study by Carley et al. (2019) also found that range remains a significant factor influencing electric vehicle purchase decisions in the United States. The same is true in Norway, which has the highest EV adoption rate in the world, where longer range can significantly increase the appeal of electric vehicles (Veza et al., 2022). Many consumers on a budget find it difficult to make a large initial investment even though they recognize the long-term savings, especially in markets lacking government incentives or subsidies (Machado et al., 2023). Without adequate incentives, such as government subsidies or tax breaks, EV adoption tends to be slow. This situation makes electric vehicles unaffordable for many (Bryla et al., 2022; Sriram et al., 2022; Rubens et al., 2020). Price sensitivity is also high among low-income and low-education groups, as is the case in China (Bryla et al., 2022; Ling et al., 2021). This price issue is not unique to developing countries but is also a concern in emerging economies. In Norway, despite high per capita income, the price of electric vehicles remains a major barrier to adoption (Yang et al., 2023).

The limited availability of public charging infrastructure remains a major obstacle to electric vehicle adoption. Sriram et al. (2022) found that the lack of charging stations in India has become a significant barrier to the adoption of electric vehicles in the country. Developing public charging infrastructure is crucial to alleviate consumer concerns about range and support wider electric vehicle adoption (Yu, 2021). This infrastructure development requires significant investment and collaboration between the government and the private sector (Wang, 2023). Consumers' lack of knowledge and understanding of electric vehicles is also a significant challenge. Many consumers in India do not fully understand the benefits and advantages of electric vehicles, including savings on fuel and maintenance costs, as well as their environmental impact (Feng et al., 2019).

Noel et al. (2020) stated that a lack of consumer knowledge and experience is a major barrier to electric vehicle adoption. Their research shows that technical barriers, such as range, charging speed, and charging infrastructure, are rooted in consumer perception issues, who are unaware that electric vehicles can cover most average trips. Consumer anxiety about range is often caused by ignorance about the technical capabilities of electric vehicles. Similarly, economic barriers are also closely related to consumers' lack of knowledge, who are unaware that electric vehicles can reduce fuel and maintenance costs (Narassimhan & Johnson, 2018).

Supporting Factors for Electric Vehicle Adoption

The adoption of electric vehicles (EVs) has become a fundamental element of the global agenda for climate change mitigation and achieving sustainable development goals. Policy Incentives and Government Subsidies: Government support through policy incentives and subsidies is a key catalyst in accelerating EV adoption. These policies are designed to reduce initial financial barriers and increase the attractiveness of EVs to consumers. Various forms of incentives have been implemented in various countries (Figenbaum & Kolbenstvedt, 2018; Hauge et al., 2021). China has used substantial purchase subsidies, tax breaks, and even free license plate systems in major cities to address congestion and air pollution issues, effectively encouraging mass adoption (Wang et al., 2017; Li et al., 2020).

Many countries also offer non-financial benefits such as access to dedicated bus lanes HOV, free or discounted parking, and exemptions from tolls or congestion charges. In California, United States, electric vehicles can use HOV lanes regardless of passenger numbers, providing significant benefits in daily travel (Diamond, 2009; Helms et al., 2018). Research shows that the combination of financial and non-financial incentives has a strong synergistic impact on purchase intentions and adoption of electric vehicles (She et al., 2017; Higuera-Castillo et al., 2020).

The availability of widespread, reliable, and accessible charging infrastructure is a fundamental prerequisite for overcoming range anxiety and facilitating the mass adoption

of electric vehicles. With the development of public charging stations, both Alternating Current (AC) and Direct Current (DC), the Netherlands has been a pioneer in building a dense charging network, particularly in urban areas, supported by collaboration between municipalities, utilities, and the private sector (Plum et al., 2020; Jochem et al., 2018). This is crucial for encouraging policies that support the installation of charging facilities in residential properties and in office parking lots (Hardman et al., 2018). These developments directly impact consumer perceptions of the practicality of electric vehicles (Dubey, 2024). Challenges include standardization of charging connectors, network interoperability, and the capacity of the electricity grid to support the increasing charging load (Yao et al., 2020).

Revolutionary advances in battery technology have been a key driver of the appeal and feasibility of electric vehicles. Innovations in battery chemistry, particularly lithium-ion, have resulted in significant increases in energy density, enabling electric vehicles to travel longer distances on a single charge (Zaino et al., 2024; Dubey, 2024). This cost reduction is directly correlated with a decrease in the selling price of electric vehicles, making them more affordable for a wider market segment (Nykqvist & Nilsson, 2015; Ahmed et al., 2020). Projections indicate that battery costs will continue to decline, approaching the point where EVs will reach price parity with unsubsidized gasoline vehicles (Dubey, 2024). Innovations such as solid-state batteries and fast charging promise further breakthroughs in the future (Zubi et al., 2018).

Rising environmental awareness among global consumers has become a significant non-financial motivator. The perception that electric vehicles contribute to reducing local air pollution and greenhouse gas emissions is a key attraction (Zhang et al., 2024; Ramadhan et al., 2025). Studies show that pro-environmental attitudes and social norms supporting sustainability positively impact electric vehicle purchase intentions (She et al., 2017). Electric vehicles are often seen as symbols of technological progress, innovation, and modern lifestyles (Sierzchula et al., 2014). A Dutch study showed that social factors and the experiences of other users play a significant role in adoption decisions (Noppers et al., 2014). While the initial purchase price of an electric vehicle may be higher, lower long-term operating costs often make electric vehicles a more economical choice. In countries with competitive electricity prices, these savings can be significant (Bögel et al., 2021; Graham & Brungard, 2021). While historical data is still evolving, several studies suggest that electric vehicles can maintain competitive resale values, particularly with continued advances in battery technology (Fontaras et al., 2017).

DISCUSSION

The transition to electric vehicles (EVs) represents a systemic response to the global environmental crisis, fossil energy dependence, and the need to build a sustainable transportation system. The findings show that electric vehicles have occupied a strategic position as a multifunctional solution that is able to answer ecological, social, and economic challenges simultaneously. The adoption of EVs in various countries is not only driven by technological and regulatory factors, but also by increased public awareness of sustainability and long-term economic efficiency. Basically, EV development is faced with enormous challenges, these challenges include limited vehicle cruising, high initial purchase price, limited charging infrastructure, and low public knowledge about the advantages of electric vehicles. The cruising issue, for example, has fueled consumer distrust of EVs' ability to travel long distances. On the other hand, the high starting price in the absence of fiscal incentives makes EVs considered unaffordable, especially for low-income groups.

Low public awareness of the cost-efficiency and environmental impact of electric vehicles is a barrier that can be addressed through educational campaigns and government incentives. Electric vehicle adoption can be increased through supporting factors such as fiscal and non-fiscal incentive policies, advances in battery technology, the development of inclusive charging infrastructure, and positive public perception of environmentally friendly vehicles. The government plays a strategic role through regulations that

encourage automotive manufacturers to meet emissions targets and offer purchase incentive schemes. The availability of fast-charging stations and incentives for home charging are important complements in establishing a comprehensive electric vehicle ecosystem. The long-term cost of electric vehicle ownership is considered more economical due to minimal fuel and maintenance costs. The Total Cost of Ownership (TCO) concept shows that although the initial price of electric vehicles is relatively high, their energy efficiency, low service requirements, and competitive depreciation make them increasingly competitive.

The electric vehicle adoption process involves various interdependent dimensions that shape the policy, technology, economic, social, and environmental landscape. A comparative analysis of the supporting and inhibiting factors indicates that the success of the transition to electric vehicles is greatly influenced by how a country or region is able to manage the balance between potential and challenges in each of these aspects. In terms of economy and cost, it is known that electric vehicles promise long-term efficiency through lower operating costs and minimal need for routine maintenance. The concept of Total Cost of Ownership (TCO) emphasizes that EVs tend to be more economical in a certain period of ownership than conventional vehicles. The high initial purchase price of EVs, especially in markets that do not have strong incentive schemes, is a major obstacle for people with lower middle to lower purchasing power. This inequality makes clear the need for targeted fiscal policy interventions.

From a policy and regulatory perspective, governments play a catalytic role in creating a healthy and progressive electric vehicle market. Case studies in Norway, China, and California show that fiscal incentives (such as tax exemptions, direct subsidies, and license plate fee waivers) and non-fiscal incentives (fast lane access, free parking) are effective in increasing public interest in electric vehicles. However, policy effectiveness depends heavily on consistency and integration across sectors. Policy inconsistencies, delays in implementation, or conflicts of interest between institutions can hinder the positive impact of designed policies.

CONCLUSION

The transition to electric vehicles (EVs) is a systemic response to the global environmental crisis, dependence on fossil fuels, and the need for a sustainable transportation system. This study confirms that EVs have a strategic position as a multifunctional solution to simultaneously address ecological, social, and economic challenges. EV adoption is driven not only by technological and regulatory factors, but also by growing public awareness of sustainability and long-term economic efficiency. However, electric vehicle development still faces significant challenges, such as limited range, high initial prices, limited charging infrastructure, and low public awareness of EV advantages. Negative public perceptions, particularly regarding battery life and cost, are also significant barriers. Inequality in access and incentives also highlights the need for more targeted fiscal policy interventions. EV adoption can be driven through a combination of fiscal and non-fiscal incentive policies, advances in battery technology, the development of inclusive charging infrastructure, and strengthening public perception of an environmentally friendly lifestyle. The government plays a strategic role in creating a comprehensive EV ecosystem, from emissions regulations to support for fast-charging technology and ownership incentives. The Total Cost of Ownership (TCO) concept shows that despite high initial prices, low operating costs of EVs make them competitive in the long run. Future research is recommended to develop region-based evaluation models that measure the effectiveness of incentives, public perception, and infrastructure readiness in driving EV adoption. Cross-country quantitative studies comparing policy impacts and the role of the private sector are also crucial for formulating more adaptive and sustainable EV adoption strategies.

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