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Factors influencing consumer adoption of electric vehicles: A literature review

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ABSTRACT

Electric vehicles (EVs) are considered a key method for reducing transportation emissions, improving city air quality, and supporting sustainable travel. Although global EV sales have grown rapidly, the adoption rates differ by region. Many countries still face significant challenges in getting more people to use electric EVs. This study examines research on what affects people's decisions to buy EVs. It uses a method to group the findings into six main areas: economic and financial, technological, behavioral and psychological, infrastructure and policy, socio-demographic, and market and industry factors. The study shows that economic factors, such as the price and total cost of owning an EV, are important for buyers. Technological factors such as battery range, charging time, and reliability also affect consumer trust. However, other factors such as how useful and easy to use people think EVs are, their environmental values, social influence, and what they know about EVs also matter. Policies and charging infrastructure are crucial, especially when they provide long-term support and reduce uncertainty. Industry factors, such as brand trust and aftersales service, help reduce perceived risks. Overall, the study suggests that to increase EV use, strategies need to be coordinated and specific to each area of focus. They should address costs, technology, trust, awareness, and everyday use, especially where EV adoption is low.

Keywords: Electric Vehicles; Factors Influencing; Consumer Adoption; Purchase Intention.

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1. INTRODUCTION

Electric vehicles (EVs) have re-emerged as a central focus in global transportation strategies owing to rapid advancements in battery technology, heightened environmental concerns, and the tightening of vehicle efficiency and emission standards. Battery electric vehicles (BEVs) offer significant benefits by minimizing or completely removing the reliance on gasoline and diesel. This leads to a reduction in greenhouse gas emissions, enhanced air quality in cities, and decreased noise pollution. These environmental and public health benefits have positioned EVs as a promising technological solution for the worldwide transition toward sustainable mobility.

Although global EV adoption has shown rapid growth in recent years—with EV sales reaching more than 17 million units in 2024 and EVs exceeding 20% of global new car sales (IEA, 2025)—current adoption levels remain far from what is required to achieve global decarbonization targets under a net-zero emissions scenario. Although the global EV fleet is expected to approach 58 million units by the end of 2024, this represents only approximately 4% of the world's total passenger vehicle stock. This indicates that the vast majority of vehicles on the road are still powered by internal combustion engines (ICEs). Looking ahead, the global electric vehicle fleet is expected to expand significantly, reaching nearly 250 million by 2030, with more than 90% of EVs being battery electric vehicles (IEA, 2025).

This gap is global and geographical. EV adoption is heavily concentrated in a few major markets—primarily China, Europe, and the United States—which together account for nearly 95% of global EV sales, whereas many other countries, particularly in the developing world, continue to exhibit very low adoption levels (IEA, 2025). This uneven distribution reflects the structural differences in market readiness, industrial capacity, and regulatory frameworks across regions.

In leading markets, rapid EV diffusion has been driven by the convergence of stringent climate policies and green industrial competition (Ullah et al., 2025). Institutional developments have further reinforced this shift. For example, the European Union has proposed legislation to allow only zero-emission vehicle sales by 2035, signaling a decisive regulatory shift away from internal combustion engines (Cabeza-Ramírez et al., 2025). Similarly, national initiatives, such as India's EV30@30 program, demonstrate strong governmental commitment to accelerating electrification in emerging economies (Chandra, 2022). These policy signals collectively indicate a structural transformation in the global automotive industry.

However, despite these ambitious commitments, observable conditions on the ground suggest that mass adoption remains constrained by persistent situational barriers, including affordability concerns, infrastructure limitations, technological uncertainties, and consumer behavioral resistance. Consequently, the transformative potential of EVs to enable a widespread transition toward low-emission mobility has not been realized uniformly across regions. This substantial disparity between technological and policy potential and the realities observed on the ground underscores the need for a systematic examination of the factors influencing EV adoption.

This study synthesizes peer-reviewed literature on the factors influencing consumer adoption of EVs. The analysis employs a thematic synthesis approach, through which the identified factors are systematically grouped into economic, technological, psychological, policy, demographic, and market and industry factors. This framework offers a thorough view of the global trends and motivators behind EV adoption. By consolidating existing evidence and highlighting areas where understanding remains limited, this study aims to generate insights that can support policymakers, industry stakeholders, and researchers in developing more effective strategies to accelerate the uptake of electric vehicles.

2. METHOD

This study uses a systematic literature review approach to bring together and examine existing empirical and theoretical research on the factors that influence consumer adoption of electric vehicles. A systematic approach was chosen to ensure that the review process is transparent, consistent, and rigorous,

allowing relevant studies to be identified, screened, and analyzed in a structured way. Relevant articles were collected from major academic databases, including Scopus, Web of Science, and ScienceDirect. The search used combinations of keywords such as "electric vehicle adoption," "EV purchase intention," "consumer behavior electric vehicles," "factors influencing EV adoption," and "electric mobility adoption." To reflect recent developments in technology, policy, and consumer behavior, the search focused on peer-reviewed journal articles published between 2015 and 2025.

Clear inclusion and exclusion criteria were applied to ensure that only relevant and high-quality studies were considered. Articles were included if they were published in peer-reviewed journals, examined factors related to electric vehicle adoption or purchase intention, presented empirical or theoretical insights, and were written in English. Studies were excluded if they focused purely on technical or engineering performance without discussing adoption behavior, were conference abstracts without full papers, or consisted of reports, editorials, or other non-scholarly sources. In this review, the unit of analysis is individual studies that explore determinants of electric vehicle adoption across different contexts.

Each selected study was carefully reviewed to extract key information, including the research context, theoretical perspective, methodology, variables examined, and main findings. The collected information was then analyzed using a thematic synthesis approach, which made it possible to group the identified determinants into six broad categories: economic factors, technological characteristics, behavioral and psychological influences, policy and infrastructure conditions, socio-demographic factors, and market-related aspects. This process helps to identify common patterns and differences across studies while providing a comprehensive understanding of the various drivers shaping electric vehicle adoption.

3. RESULT AND DISCUSSION

The results of this review provide a comprehensive overview of the key factors that shape consumer adoption of electric vehicles across different contexts and markets. By synthesizing findings from the selected studies, several recurring themes emerge, highlighting the multidimensional nature of adoption decisions. To present these insights in a clear and structured manner, the findings are organized into six major categories that consistently appear in the literature: economic and financial factors, technological attributes, behavioral and psychological drivers, infrastructure and policy conditions, sociodemographic characteristics, and market and industry influences. The following sections discuss each category in detail, emphasizing key insights, areas of convergence, and remaining challenges identified across prior studies.

3.1 Economic and Financial Factors

The literature identified economic and financial factors play a central role in determining consumers' willingness to adopt EVs. Consumers often evaluate EVs based on perceived affordability, long-term financial implications, and the economic conditions surrounding vehicle ownership. This section explores key financial dimensions including total cost of ownership and government incentives and subsidies that shape consumer decision-making and influence the broader market acceptance of EVs.

3.1.1 Total Cost of Ownership (TCO)

Total Cost of Ownership (TCO) is a comprehensive estimation of all costs and incentives associated with owning a vehicle throughout its lifetime, including the purchase price, operating costs (such as taxes, fuel, and maintenance), and resale value. The initial cost is a major barrier, often outweighing technological and environmental considerations in consumer decision-making (Bhat & Verma, 2025). EVs generally have lower fuel and maintenance costs, which positively influence adoption (Gupta et al., 2025). TCO is consistently identified as one of the most important factors influencing EV adoption, often outweighing other considerations such as environmental benefits or technological features (Al Irsyad et al., 2025; King & Datta, 2018; Kumar & Alok, 2020).

Consumers tend to prioritize short-term cost savings over long-term benefits, which makes initial purchase subsidies more effective than incentives spread over the vehicle's lifetime (Bhat et al., 2024). Studies conducted across multiple countries consistently show that purchase price remains one of the most influential factors shaping EV adoption decisions. Many potential buyers are discouraged by the relatively high upfront cost of EVs compared to conventional vehicles, a gap that is largely driven by the high cost of battery packs (Cecere et al., 2018). From a business perspective, adoption decisions are similarly costdriven, with the total cost of ownership—encompassing both acquisition and operating expenses—playing a decisive role in determining whether EVs are integrated into commercial vehicle fleets (Alali et al., 2025)

3.1.2 Government Incentives and Subsidies

Government incentives play a critical role in improving the economic viability of EVs and accelerating adoption. Government incentives, such as subsidies, tax reductions, and other financial aids, significantly influence consumer adoption of electric and hybrid vehicles (Higueras-Castillo et al., 2020). Empirical studies consistently show that direct consumer subsidies effectively stimulate EV adoption (Chen et al., 2025). However, their impact depends on policy design. When charging infrastructure is mainly provided by private firms, consumer-focused subsidies tend to be more effective. When governments invest heavily in infrastructure, combining consumer and infrastructure subsidies produces better results, highlighting the importance of coordinated policy design.

The form and timing of incentives also matter. Point-of-sale rebates are generally more effective than delayed tax credits, especially for lower-income households, as they reduce liquidity constraints and uncertainty (Roberson & Helveston, 2022). Nevertheless, tax credits have been shown to significantly increase EV and PHEV sales, with declines observed after incentives expire.

Country-specific evidence reinforces these findings. In Indonesia, adoption remains limited despite incentives, due to financial constraints, infrastructure shortages, and low consumer awareness (Hakam & Jumayla, 2024; Lazuardy et al., 2024). Similar patterns are observed in Jordan and Saudi Arabia, where adoption depends on a mix of financial incentives, non-financial benefits, and infrastructure investment (Alyamani et al., 2024; Samawi et al., 2025).

Government incentives—including tax credits, purchase subsidies, rebates, tax exemptions, and reduced registration fees—are widely recognized as effective policy instruments for lowering the financial barriers associated with electric vehicle (EV) adoption (Chanda et al., 2024). Empirical evidence suggests that direct financial incentives tend to have a stronger influence on adoption decisions than indirect measures, particularly for firms and lower-income consumers, for whom upfront cost reductions are especially critical.

3.2 Technological Factors

The literature identifies the technological attributes of EVs remain a decisive factor in consumer evaluations. Concerns about battery performance, charging time, and long-term reliability continue to influence perceived usefulness and trust. This section reviews key technological determinants and summarizes evidence from prior studies.

3.2.1 Battery Range and Range Anxiety

Battery range is consistently identified as one of the most influential technological factors affecting EV adoption. Limited driving range gives rise to range anxiety, defined as concern over whether an EV can complete a journey or reach a charging station when needed. This concern is particularly strong among consumers who frequently travel long distances with limited charging infrastructure (Pamidimukkala et al., 2023).

Battery range anxiety is a critical and influential factor that represents a fundamental barrier to electric vehicle adoption (Ullah et al., 2025). EV batteries typically have a warranty of only eight to ten years, and since they are costly, the need for replacement constitutes a significant barrier to EV adoption

(Pamidimukkala et al., 2023). Empirical studies further show that battery range influences not only adoption decisions but also how intensively EVs are used after purchase. The presence of range anxiety has been shown to significantly and negatively impact individuals' intention to use or purchase EVs, with higher anxiety correlating with lower adoption rates (Khazaei & Tareq, 2021).

Charging infrastructure plays a crucial complementary role. While battery capacity determines how far an EV can travel, the availability and reliability of charging stations determine whether that range feels sufficient. Battery range anxiety is identified as the most influential factor affecting EV adoption, with advancements in battery technology seen as essential for improving driving range and alleviating consumer concerns (Ullah et al., 2025).

3.2.2 Charging Time and Charging Speed

Charging time and speed remain among the most frequently cited technological barriers to widespread EV adoption. Prospective consumers express concerns regarding the duration required for charging electric vehicles (Pamidimukkala et al., 2023). Compared to conventional vehicles that can be refueled in minutes, EVs typically require longer charging durations, especially when using standard home chargers or slow public stations. This difference in refueling experience represents both a practical inconvenience and a psychological barrier for many consumers.

Advances in fast-charging technology have been critical in addressing these concerns. Improvements in DC fast chargers, high-voltage architectures, and power electronics have significantly reduced charging times, allowing EVs to recover substantial driving range in shorter periods. Advancements in battery technology and fast-charging infrastructure have the potential to substantially reshape consumer perceptions and increase adoption rates.

Studies by Zhao et al. (2024) indicate that faster charging speeds are associated with higher levels of both EV adoption and user satisfaction. Importantly, these studies also suggest that even consumers who are initially reluctant to adopt EVs become more willing to switch when charging times approach those of conventional internal combustion engine vehicles.

3.2.3 Vehicle Performance and Reliability

Beyond range and charging, overall vehicle performance and reliability strongly influence consumer trust and purchase intentions. Consumers evaluate EVs not only as environmentally friendly alternatives but also as practical vehicles capable of meeting daily mobility needs.

However, reliability concerns remain, particularly regarding battery durability, maintenance costs, and availability of technical support. These issues are especially relevant in markets with limited EV service infrastructure, where uncertainty can undermine consumer confidence (Lazuardy et al., 2024). Reliable operation, supported by accessible maintenance services and charging networks, plays a critical role in translating positive attitudes into actual purchase decisions (Chinen et al., 2022).

Vehicle performance and technological capability play a central role in shaping consumer confidence in EVs. Key concerns related to driving range, power output, battery lifespan, charging time, reliability, and safety continue to influence adoption decisions. As a result, the availability of EVs that offer performance levels comparable to those of conventional internal combustion engine vehicles is widely regarded as a fundamental prerequisite for achieving widespread market adoption (Zirganos et al., 2022). Performance attributes such as acceleration and low engine noise are cited as important factors that enhance the attractiveness of EVs (Hakam & Jumayla, 2024). A lack of trust in the reliability of EVs can significantly reduce consumers' willingness to adopt (Pamidimukkala et al., 2024).

3.3 Behavioral and Psychological Factors

The literature identifies psychological and behavioral factors play a crucial role in shaping how consumers evaluate and ultimately adopt electric vehicles (EVs). Beyond financial and technological considerations, individual perceptions, attitudes, social influences, and levels of knowledge significantly

affect decision-making. This section explores key psychological constructs that help explain variations in consumer acceptance of Evs

3.3.1 Perceived Usefulness and Perceived Ease of Use

Perceived usefulness (PU) and perceived ease of use (PEOU), as conceptualized within the Technology Acceptance Model (TAM), are among the most extensively utilized constructs in elucidating the adoption of electric vehicles (EVs). PU denotes the degree to which consumers perceive EVs as offering substantial benefits, such as reduced operating costs, diminished environmental impact, or enhanced driving experience. PEOU pertains to the anticipated simplicity and effortlessness associated with EV ownership and operation. Both PU and PEOU play a pivotal role in shaping consumer attitudes, as perceptions that an electric vehicle is easy to operate and maintain lead to more favorable evaluations and, ultimately, an increased willingness to purchase (Yi et al., 2025)

Empirical studies have consistently identified perceived usefulness as a strong predictor of EV adoption intention. Consumers are more inclined to adopt EVs when they perceive clear value, particularly in terms of cost savings and environmental benefits. Importantly, usefulness perceptions often extend beyond purely functional gains to include symbolic and ethical value. Many consumers derive satisfaction from contributing to environmental sustainability, reinforcing a form of "green perceived usefulness" that links personal choices with broader societal goals (Chawla et al., 2023; Chinen et al., 2022).

Perceived ease of use is equally important, as EVs introduce new behaviors such as charging, route planning, and interaction with digital systems. When these activities are perceived as simple and compatible with daily routines, consumers are more likely to adopt EVs. Research shows that PEOU not only directly increases adoption intention but also strengthens PU by reducing perceived effort and uncertainty (Salim et al., 2024). Facilitating conditions—such as accessible charging infrastructure and supportive policies—further reinforce both PU and PEOU by signaling that EV use is practical and socially supported (Wang et al., 2023).

3.3.2 Environmental Concerns and Sustainability Values

Environmental concerns and sustainability values are widely recognized as powerful psychological drivers of EV adoption. As awareness of climate change, air pollution, and fossil fuel dependence increases, many consumers view EV adoption as a tangible way to act responsibly and contribute to environmental protection. Individuals who possess strong environmental values or who integrate proenvironmental behavior into their self-concept are more inclined to support EVs (Yi et al., 2025).

Empirical evidence demonstrates a strong positive relationship between environmental awareness and willingness to adopt EVs. Studies employing advanced analytical approaches identify environmental protection awareness as one of the most influential attitudinal predictors of adoption (Bas et al., 2021). For many consumers, EVs symbolize a practical solution for reducing carbon emissions and improving urban air quality, particularly in rapidly motorizing regions (Schvartz et al., 2024).

Environmental knowledge and awareness of the consequences of conventional vehicle use play an important role in shaping personal norms and strengthening consumers' intentions to adopt electric EVs (Chanda et al., 2024). Numerous studies indicate that perceived environmental benefits—such as reduced emissions and lower environmental impact—serve as a key motivational driver, with early and primary EV adopters generally exhibiting higher levels of environmental consciousness.

3.3.3 Social influence and peer effects

Social influence and peer effects significantly shape EV adoption decisions. Consumers rarely decide in isolation; instead, they are influenced by the experiences and opinions of family members, friends, and colleagues. Seeing EVs used by peers reduces uncertainty, increases perceived legitimacy, and normalizes the technology (D. Wang et al., 2023). Direct exposure to EV owners also facilitates information sharing about real-world performance and costs, lowering perceived risk (Alyamani et al., 2024).

Social influence and peer effects play a meaningful role in enhancing the acceptance and perceived desirability of EVs. The visibility of EV use among peers, family members, or public figures—along with support from social networks—contributes to the normalization of EV ownership and encourages wider adoption (Bhat et al., 2024). However, the influence of subjective norms appears to be context-dependent. In certain settings, such as the secondary market for used EVs, social pressures may play a more limited role, as consumers tend to rely more heavily on utilitarian considerations, including cost, reliability, and perceived value.

3.3.4 Impact of brand and marketing

Brand perception and marketing further shape consumer attitudes. Strong brands can reduce perceived risk and signal quality, which is especially important for high-involvement purchases such as vehicles. Purpose-driven branding and authentic environmental messaging strengthen emotional engagement and trust, increasing purchase intention and word-of-mouth advocacy (Fernandes & Guzmán, 2024).

Brand trust and effective marketing can mitigate perceived risks and foster positive attitudes, thereby increasing purchase intentions (Chanda et al., 2024). Marketing strategies that highlight environmental benefits, product reliability, and cost savings can enhance perceived value and adoption intentions (Yi et al., 2025). Negative information about EV performance or safety can hinder market growth, while positive experiences and brand goodwill support adoption (Chanda et al., 2024).

Brand trust and effective marketing play a crucial role in reducing perceived risks and fostering positive consumer attitudes toward electric vehicles (EVs), which in turn strengthens purchase intentions (Chanda et al., 2024). Marketing strategies that clearly communicate environmental benefits, product reliability, and long-term cost savings can enhance perceived value and encourage adoption (Yi et al., 2025). Conversely, negative information about EV performance or safety can hinder market growth, while positive experiences and accumulated brand goodwill help build credibility and reinforce consumers' willingness to adopt EVs (Chanda et al., 2024).

3.3.5 Levels of Knowledge

Consumer knowledge plays a foundational role in adoption. Higher levels of knowledge about EV technology, costs, incentives, and charging infrastructure are consistently associated with stronger adoption intentions. Knowledge significantly influences adoption intentions by enabling consumers to identify the practical, environmental, and financial benefits of EVs (Chanda et al., 2024). Knowledge reduces uncertainty, improves feasibility assessment, and enhances confidence in decision-making (Bas et al., 2021). In markets such as Indonesia, knowledge gaps remain a major barrier, limiting the effectiveness of otherwise supportive policies.

Knowledge about EVs is a significant positive predictor of attitudes and intentions to adopt, as increased awareness of benefits and functionalities leads to greater willingness to purchase (Asadi et al., 2021; Choo et al., 2024). Environmental knowledge, in particular, has both direct and indirect effects on behavioral intentions, often mediated by attitudes and personal norms (Choo et al., 2024). Information about technology, cost, and charging infrastructure also shapes consumer perceptions and reduces perceived risks (Asadi et al., 2021)

3.4 Infrastructure and Policy Factors

The literature indentifies policy frameworks and infrastructure readiness are fundamental to enabling large-scale EV adoption. This section examines how national EV policies and regulations, as well as the development of public charging infrastructure networks, influence market growth and shape the overall adoption trajectory

3.4.1 National EV Policies and Regulations

National policies and regulations play a decisive role in accelerating EV adoption by shaping the costs, infrastructure environment, and perceived legitimacy of EV technology. Most studies agree that policy impact is strongest when it is sustained, predictable, and supported by infrastructure deployment. For instance, a panel analysis across 20 countries finds that tax reduction policies, charging density, and household income significantly increase EV market share—suggesting that incentives alone are not enough unless they are paired with a usable charging ecosystem and a consumer base able to absorb new technology (Xue et al., 2021). National and local policy frameworks that include emissions regulations, EV mandates, and targeted incentives are repeatedly identified as crucial for stimulating EV adoption and overcoming barriers such as high acquisition costs and limited model availability (Mashrur & Mohamed, 2025).

Indonesia illustrates a clear gap between policy intent and adoption outcomes, as electric vehicle uptake remains relatively low despite supportive national policies, largely due to limited charging infrastructure, insufficient public awareness, and financial constraints, underscoring the need for more comprehensive policy approaches that integrate consumer incentives, producer-side support, and broader public education to more effectively address adoption barriers (Lazuardy et al., 2024). Related work emphasizes that policy is central not only to boosting EV sales but also to realizing broader economic outcomes such as job creation, industrial development, and energy security—benefits that can strengthen political and public support for EV transitions over time (Damanik et al., 2024).

Regulations can also drive adoption through "fleet turnover" mechanisms that accelerate retirement of fossil-fueled vehicles. Policies such as cash-for-clunkers programs incentivize consumers to replace older, high-emitting cars with EVs, producing emissions benefits while also supporting cost reductions through economies of scale as EV sales increase (Naumov et al., 2023). In this way, regulation is not only about promoting EVs directly; it can also make ICE vehicle ownership less attractive, tightening the transition pathway. Regulatory frameworks such as zero-emission vehicle mandates, emission reduction targets, and battery recycling mandates also play a significant role in shaping market demand and the strategic direction of firms in the EV sector (Alberini & Vance, 2025)

National policies that provide financial incentives have a substantial positive impact on EV adoption rates by lowering the upfront cost for consumers and making EVs more attractive compared to internal combustion engine (ICE) vehicles. These incentives can include direct purchase subsidies, tax exemptions, and reductions in road or registration taxes (Hakam & Jumayla, 2024; Zhang et al., 2018). However, the effectiveness of these incentives can vary: in some cases, preferential policies (such as access to restricted zones or license plate lotteries) have a stronger influence on consumer adoption than direct financial subsidies (Ehsan et al., 2024). There are also findings that suggest the impact of subsidies may be limited if consumers have concerns about EV technology or if other barriers persist (D. Wang et al., 2023)

3.4.2 Public Charging Infrastructure Networks

Public charging infrastructure is one of the strongest practical predictors of EV adoption because it directly shapes convenience, range confidence, and day-to-day usability. The extensive adoption of electric vehicles (EVs) is dependent on the availability of a sufficient number of charging stations. The current scarcity of such infrastructure poses a significant barrier to consumer acceptance (Pamidimukkala et al., 2023). Accessible charging infrastructure significantly increases adoption likelihood, and when combined with non-financial incentives such as designated EV parking, it strengthens consumer motivation even further (Alyamani et al., 2024). Locations with more public charging stations generally have higher EV adoption rates, and the expansion of charging infrastructure is often driven by government subsidies and regulations (Alberini & Vance, 2025)

Research also shows that infrastructure density can shape collective sentiment, not just individual decisions. A study examining rural U.S. communities finds that positive public sentiment toward EVs tends to be higher in areas with more charging stations, suggesting that visibility and local availability help communities feel more comfortable with EV technology (Wang et al., 2024). This matters because adoption often spreads socially: infrastructure can indirectly influence adoption by shaping local norms

and reducing shared skepticism. Empirical evidence from multiple countries demonstrates that the presence of a robust charging network is associated with higher EV market share and increased willingness to adopt EVs (Robbennolt et al., 2025).

Charging infrastructure investments interact with subsidy design: models suggest that combining purchase incentives with charging investments tends to outperform isolated interventions, improving adoption while distributing costs more efficiently across the ecosystem (Chen et al., 2025). Expansion of charging networks and improvements in charging facilities are crucial for increasing EV adoption, as the availability of infrastructure directly impacts consumer perceptions and usage (Hakam & Jumayla, 2024).

3.4.3 Comparison of Global Policies

Comparative research shows that EV policy effectiveness varies sharply across regions. The European Union (EU) emphasizes emissions reduction through stringent regulations and broad incentives, supported by strong infrastructure investments. Norway is often cited as a leading example, with EVs representing over 90% of new vehicle registrations—an outcome linked to strong, consistent incentives and supportive systems (Patil et al., 2024). China, in contrast, follows a state-driven strategy combining subsidies, infrastructure expansion, and manufacturing support, with evidence that policy effects differ by city tier: in smaller cities, infrastructure expansion may be more influential than subsidies alone. The United States presents a more fragmented landscape, with federal and state incentives but persistent barriers related to upfront cost and uneven charging availability, especially along long-distance routes (Pamidimukkala et al., 2024)

Developing countries face distinct constraints—lower purchasing power, unequal infrastructure, and lower public familiarity with EVs—so incentives alone often produce weaker outcomes unless paired with infrastructure development and awareness-building. In contexts such as Indonesia, Jordan, and Saudi Arabia, studies highlight the need for tailored policies that combine affordability measures, charging expansion, and consumer education (Alotaibi et al., 2022; Samawi et al., 2025). Cross-national analyses suggest that policies like tax reductions and infrastructure density strongly predict EV market share in developed economies, but in developing settings they must be paired with socioeconomic support and trust-building to achieve similar effects (Xue et al., 2021).

3.5 Socio-Demographic Factors

The literature identifies socio-demographic factors as significantly influencing EV adoption, with preferences varying across income levels, age, gender, education, urban vs. rural differences and household characteristics. This section reviews how these factors shape consumer profiles.

3.5.1 Income Levels

Income level is consistently identified as one of the strongest predictors of EV adoption. Because EVs typically involve higher upfront purchase prices and associated costs—such as home charging installation—higher-income households are more capable of absorbing these expenses, making them more likely to adopt EVs than lower-income groups. Higher income is consistently associated with greater EV adoption, as wealthier households are more able to afford the high upfront costs of EVs and the necessary charging infrastructure (Nanaki, 2021; Zhuge & Shao, 2019).

Evidence from developed economies reinforces this relationship. Analysis of U.S. National Household Travel Survey data shows that higher household income significantly increases the probability of EV ownership, while renters and lower-income households remain underrepresented among EV owners (Sadeghvaziri et al., 2024). Similarly, research in Texas indicates that individuals with higher income and education levels express stronger enthusiasm for EV adoption, whereas high purchase prices and battery replacement costs continue to constrain middle- and lower-income consumers (Pamidimukkala et al., 2024).

In developing countries, income plays an equally important—if not more pronounced—role. In Indonesia, wealthier and better-educated consumers show moderate preference for battery electric

vehicles, driven by emotional appeal, functional benefits, and cost considerations. However, overall adoption remains low due to limited charging infrastructure and the inability of lower-income households to overcome the high upfront cost barrier (Febransyah, 2021). These findings highlight that income constraints interact with infrastructure limitations, amplifying inequality in adoption opportunities.

Research from Saudi Arabia illustrates how income sensitivity shapes adoption, showing that consumers in Riyadh are more sensitive to EV prices than to conventional vehicle prices, with higherincome households adopting EVs despite cost premiums, while affordability remains a key condition even when non-financial incentives such as designated parking or charging access are available. Study indicates that the average income of households owning electric vehicles in the United States was notably higher compared to those owning vehicles with internal combustion engines (Wong et al., 2025). However, some studies found no significant impact of income on EV adoption intention, suggesting that in certain contexts, operating costs and other factors may outweigh the influence of income (Bhat & Verma, 2025; Cabeza-Ramírez et al., 2025).

3.5.2 Age, Gender, and Education

Age, gender, and education significantly influence EV adoption by shaping attitudes toward technology, environmental awareness, and risk tolerance. However, their effects are often context-specific and intertwined with income and cultural norms. Age plays a moderating role in adoption intention. Studies from China show that age significantly influences willingness to adopt EVs, suggesting that different life stages correspond to different priorities and risk perceptions (Wang et al., 2023). In Saudi Arabia, consumers in their 40s show a higher likelihood of purchasing EVs, possibly reflecting a balance between financial stability, family needs, and environmental awareness. In contrast, U.S. evidence suggests that middle-aged consumers—particularly men with higher income and education—are the most enthusiastic adopters, highlighting how age interacts with socioeconomic status (Pamidimukkala et al., 2024).

The relationship between age and electric vehicle (EV) adoption remains inconclusive, with empirical evidence pointing in different directions. Several studies suggest that younger individuals are more inclined to adopt EVs, a tendency often attributed to greater openness to new technologies, stronger environmental awareness, and higher receptiveness to sustainability-oriented innovations (Chandra, 2022; Krishnan & Koshy, 2021; Westin et al., 2018). In contrast, other research indicates that middle-aged and older consumers may exhibit a higher propensity to purchase EVs, potentially reflecting greater financial stability, heightened environmental concern, and a stronger appreciation for comfort and convenience features (Chandra, 2022). The effect of age can also moderate adoption perceptions and willingness to pay, with personal norms having a stronger influence on younger individuals (CabezaRamírez et al., 2025). Overall, these mixed findings suggest that age does not influence EV adoption in a uniform manner but instead interacts with economic, psychological, and contextual factors.

Gender differences in EV adoption are also evident, though they vary by region. In China, gender moderates adoption intention, indicating different perceptions of benefits and risks between males and females. In Riyadh, females exhibit a higher likelihood of EV adoption than males, potentially reflecting stronger environmental attitudes or differing evaluations of operational convenience (Alyamani et al., 2024). Conversely, in Texas, middle-aged men demonstrate higher enthusiasm, suggesting that cultural and market contexts strongly shape gender effects (Pamidimukkala et al., 2024).

Education emerges as a particularly robust predictor of EV adoption. Higher education levels are generally associated with increased likelihood of EV adoption, possibly due to greater environmental awareness and understanding of long-term benefits (Krishnan & Koshy, 2021; Zhuge & Shao, 2019). Machine-learning studies identify knowledge and awareness as key drivers of adoption intention, reinforcing the idea that education enhances both cognitive understanding and favorable attitudes toward EVs (Bas et al., 2021). Education thus operates as a gateway variable, amplifying the influence of environmental concern, perceived usefulness, and policy incentives. However, some studies found no impact or even a negative influence of education on EV adoption intention, suggesting that the effect may depend on sample characteristics or other contextual factors (Bhat et al., 2024; Bhat & Verma, 2025).

3.5.3 Urban VS Rural Differences

Geographic location—particularly the urban–rural divide—significantly affects EV adoption patterns. Rural consumers consistently show lower adoption rates than urban residents due to infrastructure shortages, economic constraints, and differing mobility needs. Urban residents are generally more inclined towards EV adoption, likely due to better infrastructure, higher availability and accessibility of EVs, and prioritization in urban planning (Wong et al., 2025). In contrast, peri-urban and rural areas face significant gaps in EV infrastructure and higher cost barriers, leading to lower adoption rates (Chandra, 2022). Regional variations are observed, with BEV adoption concentrated in urbanized, infrastructure-rich areas, and PHEV adoption more common in less urbanized regions (Hu et al., 2025)

Charging infrastructure availability is the most cited barrier in rural areas. U.S. survey data reveal that rural households have significantly lower EV ownership rates, largely due to limited access to public charging stations, which exacerbates range anxiety and operational inconvenience (Sadeghvaziri et al., 2024). Supporting this, sentiment analysis of rural U.S. communities shows more positive attitudes toward EVs in areas with greater charging infrastructure density.

Trip characteristics and social exposure also matter. Urban residents typically have shorter daily trips and greater exposure to EV owners, making EV use more compatible with their lifestyles. Rural residents often travel longer distances and have fewer EV-owning peers, limiting both practical feasibility and social diffusion (Alyamani et al., 2024).

In developing countries such as Indonesia, rural infrastructure gaps further suppress adoption. Limited charging networks outside major cities and higher upfront costs present substantial barriers, reinforcing the need for geographically targeted infrastructure investment (Damanik et al., 2024). Addressing urban–rural disparities is therefore essential for achieving equitable and widespread EV adoption.

3.5.4 Household Structure and Lifestyle

Household structure and lifestyle patterns increasingly shape EV adoption decisions, as vehicles are often chosen at the household—not individual—level. Household size, family size, car ownership, and home ownership are important determinants of EV adoption (Bhat & Verma, 2025). Households with more vehicles or higher car ownership are more likely to consider adopting an EV as an additional vehicle (Hakam & Jumayla, 2024). The number of vehicles in the family and the structure of the household can impact adoption decisions (Du et al., 2020; Hakam & Jumayla, 2024). Housing characteristics, such as the ability to install home charging infrastructure, also play a significant role.

Research shows that household demographics significantly predict EV adoption and vehicle transaction decisions. Socially influenced households—those more responsive to peer behavior and environmental norms—are particularly receptive to EV promotion policies (Nazari et al., 2023). Lifestyle factors such as frequent short trips, urban commuting, and ridesourcing usage are also associated with higher adoption willingness (Bas et al., 2021).

Household energy dynamics further influence adoption feasibility. Studies modeling residential energy consumption show that EV adoption affects neighborhood peak electricity demand, creating tradeoffs between energy efficiency and charging needs (Howell et al., 2024). These dynamics highlight the importance of household-level charging management and smart-grid integration.

Demographic composition within households also matters. Evidence from Riyadh suggests that households with females, middle-aged members, and social familiarity with EV owners are more likely to adopt Evs. Environmental consciousness within households influences adoption, but only when paired with positive quality judgments and perceived value (Chinen et al., 2022).

Finally, segmentation studies reveal that late adopters or "EV converts" differ from early adopters in lifestyle and household characteristics, indicating that adoption strategies must evolve over time to reach new segments (Williams & Anderson, 2021).

3.6 Market and Industry Factors

Market dynamics and industry practices play an essential role in shaping consumer confidence and overall acceptance of EVs. Beyond economic and technological considerations, factors such as brand reputation, service quality, and competitive positioning within the broader automotive market influence how consumers evaluate EV options. This section examines how these industry-related elements contribute to consumer adoption decisions.

3.6.1 Brand Trust and Manufacturer Credibility

Brand trust and manufacturer credibility are central to consumer acceptance of EVs because they directly shape perceived value, perceived risk, and purchase intention. EV adoption often involves higher uncertainty than conventional vehicle purchases, as consumers must evaluate unfamiliar technologies, charging ecosystems, and long-term performance. In this context, trusted brands and credible manufacturers act as psychological anchors that reduce uncertainty and build confidence.

Manufacturer credibility further moderates perceived risks associated with EV adoption. Technology acceptance studies show that concerns about driving range, charging availability, and vehicle reliability can negatively affect adoption intentions. However, these concerns are significantly reduced when consumers believe that manufacturers are competent, transparent, and capable of delivering reliable products and support. Credible manufacturers can more effectively communicate technological benefits and reassure consumers about performance, safety, and durability, leading to more favorable attitudes toward EVs (Salim et al., 2024).

Country of origin and brand reputation also influence trust. Research examining American consumers' perceptions of Chinese-brand EVs manufactured domestically reveals that eco-consciousness alone does not directly translate into purchase intention. Instead, acceptance is shaped by perceived quality and value judgments, which can be undermined by country-based animosity or geopolitical perceptions (Chinen et al., 2022). This suggests that manufacturer credibility extends beyond engineering quality to include cultural, political, and reputational dimensions that shape consumer trust.

A broader interdisciplinary review confirms that trust functions as a key psychological enabler in EV adoption. When consumers trust a brand or manufacturer, they are more willing to tolerate uncertainties related to infrastructure gaps, higher upfront prices, or unfamiliar technology. In effect, trust amplifies perceived benefits while dampening perceived risks. Building brand trust and credibility is therefore essential for converting early interest into actual adoption, particularly in markets where EV technology is still emerging.

3.6.2 After-Sales Service and Warranty Support

After-sales service and warranty support are critical industry factors influencing EV adoption, particularly because EVs are often perceived as technologically complex and unfamiliar compared to conventional vehicles. The insufficient availability of support centers and facilities for the maintenance and repair of EVs, in comparison to those accessible for conventional vehicles, results in dissatisfaction among current EV owners (Pamidimukkala et al., 2023). Consumers frequently express concern about maintenance availability, repair costs, battery degradation, and long-term service reliability. Robust aftersales systems and comprehensive warranties play a central role in alleviating these concerns.

The literature consistently emphasizes that accessible and reliable after-sales service infrastructure—including trained technicians, spare parts availability, and service centers—is essential for mass EV adoption. Without such support, consumers may hesitate to switch from internal combustion vehicles that benefit from well-established service networks (Hardman et al., 2024). Warranty coverage, especially for high-cost components such as batteries, significantly reduces perceived financial risk and increases purchase confidence.

Beyond basic repairs, value-added after-sales services further enhance EV appeal. Digital diagnostics, over-the-air software updates, scheduled maintenance packages, and extended warranties

simplify ownership and improve user experience. These services reduce lifetime ownership costs and signal long-term manufacturer commitment, which strengthens trust and perceived value (Dcosta et al., 2024).

Positive after-sales experiences also contribute to brand loyalty and social diffusion. Satisfied customers are more likely to recommend EVs to others, generating positive word-of-mouth and reinforcing broader market acceptance. Conversely, inadequate service support can damage brand reputation and slow adoption, particularly when consumers compare EVs with conventional vehicles that offer predictable and accessible maintenance options (Chinen et al., 2022).

In emerging markets, after-sales and warranty support are even more critical. Where charging infrastructure is limited and technical expertise is scarce, strong service networks act as risk mitigators for first-time EV buyers. Studies from developing contexts highlight that after-sales assurance can compensate for other weaknesses in the EV ecosystem, making it a key enabler of adoption (Damanik et al., 2024).

A positive after-sales experience plays an important role in sustaining the long-term appeal of EVs, particularly by addressing consumer concerns related to maintenance, service availability, and overall reliability (Choo et al., 2024). High-quality after-sales support can strengthen consumer confidence and enhance the broader market impact of EVs. Previous studies emphasize that manufacturers seeking to accelerate EV adoption should prioritize improvements in after-sales service and actively communicate these efforts to the public. Such strategies include expanding purchasing channels and offering a wider range of EV models across multiple brands, thereby increasing consumer choice, convenience, and perceived value (Singh et al., 2020).

4. CONCLUSION

This study offers a comprehensive synthesis of peer-reviewed literature concerning the factors influencing consumer adoption of EVs, emphasizing the multidimensional and interdependent nature of adoption decisions. The findings indicate that EV adoption is not driven by a singular dominant factor but rather results from the interaction of economic and financial considerations, technological performance, psychological and behavioral drivers, policy and infrastructure conditions, sociodemographic characteristics, and market and industry dynamics. Although global EV sales have increased rapidly in recent years, adoption remains uneven across regions, highlighting the persistent gap between technological potential, policy ambition, and actual consumer behavior.

Economic factors, such as the total cost of ownership and government incentives, significantly impact adoption decisions. Technological factors, including battery range, charging time, and vehicle reliability, shape consumer trust and perceived usefulness. Psychological factors, such as perceived benefits, environmental values, social influence, and knowledge levels, also play a crucial role. Infrastructure readiness and supportive policies are essential for enabling widespread adoption, particularly in regions with lower EV uptake. Socio-demographic characteristics, including income, age, education, and geographic location, influence adoption patterns. Finally, market and industry dynamics, such as brand trust and after-sales service, contribute to consumer confidence and overall EV acceptance. The study highlights the need for coordinated, context-specific strategies that address costs, technology, trust, awareness, and practical usability to accelerate EV adoption, especially in regions where uptake remains low. Future research should move beyond qualitative synthesis and employ quantitative empirical approaches to test the strength, direction, and interaction of these factors across different regional and socioeconomic contexts, enabling a more precise understanding of how adoption mechanisms operate in practice and how targeted interventions can be designed to accelerate electric vehicle uptake.

Ethical Approval

Not Applicable

Informed Consent Statement

Not Applicable

Authors' Contributions

RNH conceptualized the study, conducted literature analysis, and drafted the manuscript. MKB and DD contributed to data synthesis, interpretation of findings, and manuscript revision. All authors have read and approved the final manuscript.

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The Authors declare that they have no conflict of interest

Data Availability Statement

The data presented in this study are available upon request from the corresponding author for privacy.

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