







Theoretical Foundations of Consumer Perceptions and Attitudes towards Electric Vehicles: A Review and Synthesis

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Abstract

This study provides a comprehensive review and synthesis of the theoretical foundations underlying consumer perceptions and attitudes towards electric vehicles (EVs). Drawing upon insights from various disciplines including consumer behavior, psychology, economics, and sociology, the research elucidates the multifaceted factors shaping consumer responses to EVs. Key theoretical frameworks such as the Theory of Planned Behavior, Innovation Diffusion Theory, Value-Belief-Norm Theory, and Behavioral Economics are evaluated to understand their applicability and contributions to the understanding of EV adoption. Through

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a systematic analysis of existing literature, common themes, patterns, and discrepancies in consumer perceptions and attitudes towards EVs are identified. The study aims to develop a conceptual framework that integrates diverse theoretical perspectives, providing insights into the underlying drivers of consumer behavior in the EV market. Recommendations are offered for policymakers, industry stakeholders, and researchers to promote the adoption of EVs and address barriers to their widespread acceptance.

Keywords: Electric Vehicles. Consumer Perceptions. Consumer Attitudes. Theoretical Frameworks. Review and Synthesis.

1 Introduction

In recent years, the automotive industry has witnessed a notable surge in the integration of electric vehicles (EVs), primarily driven by mounting concerns surrounding climate change, environmental degradation, and the finite nature of fossil fuel resources. Despite this momentum, the uptake of EVs displays substantial variability across diverse geographical regions and demographic segments. Such divergent adoption patterns underscore the intricate interplay of multifaceted factors that shape consumer perceptions and attitudes towards this transformative technology. Acknowledging this intricate landscape, this research endeavors to undertake a thorough investigation, offering a comprehensive review and synthesis of the theoretical underpinnings governing consumer perceptions and attitudes towards electric vehicles. By delving into the complex web of influences driving consumer decision-making processes, this study seeks to provide valuable insights essential for understanding the dynamics at play within the EV market. Through a meticulous analysis of existing theoretical frameworks, it aims to illuminate the drivers, barriers, and psychological mechanisms that underpin consumer responses to electric vehicles.

By elucidating the theoretical foundations that underlie consumer perceptions and attitudes towards EVs, this research aims to contribute to a deeper understanding of the factors shaping market acceptance and adoption trajectories. Such insights hold significant implications for policymakers, industry stakeholders, and researchers alike, offering valuable guidance for the formulation of strategies aimed at fostering the widespread adoption of electric vehicles and steering transportation systems towards a more sustainable future. Electric vehicles (EVs) stand as a disruptive force within the automotive sector, promising a paradigm shift towards sustainability by presenting opportunities for mitigating greenhouse gas emissions, enhancing energy efficiency, and reducing reliance on finite fossil fuel resources. However, amid these promises lie formidable obstacles hindering the widespread adoption of EVs. Challenges such as exorbitant upfront costs, constrained driving ranges, insufficient charging infrastructure, and apprehensions regarding battery

longevity and performance collectively impede the seamless integration of EVs into mainstream transportation systems.

Central to overcoming these barriers is the recognition of the pivotal role played by consumer perceptions and attitudes in dictating the trajectory of EV market acceptance and diffusion. Consumer sentiments, influenced by a myriad of factors ranging from economic considerations to technological apprehensions and environmental consciousness, serve as potent determinants shaping the adoption landscape of electric vehicles. As such, understanding the intricate interplay between these factors is imperative for stakeholders seeking to navigate the complex terrain of EV market dynamics.

Thus, while the potential benefits of EVs hold considerable promise for steering the automotive industry towards a greener future, their realization hinges crucially upon the alignment of consumer attitudes with the imperatives of sustainability and technological advancement. Thus, elucidating the multifaceted dimensions of consumer perceptions towards electric vehicles is indispensable for devising effective strategies aimed at overcoming barriers, accelerating adoption rates, and ushering in a new era of sustainable mobility. (see figure 1).

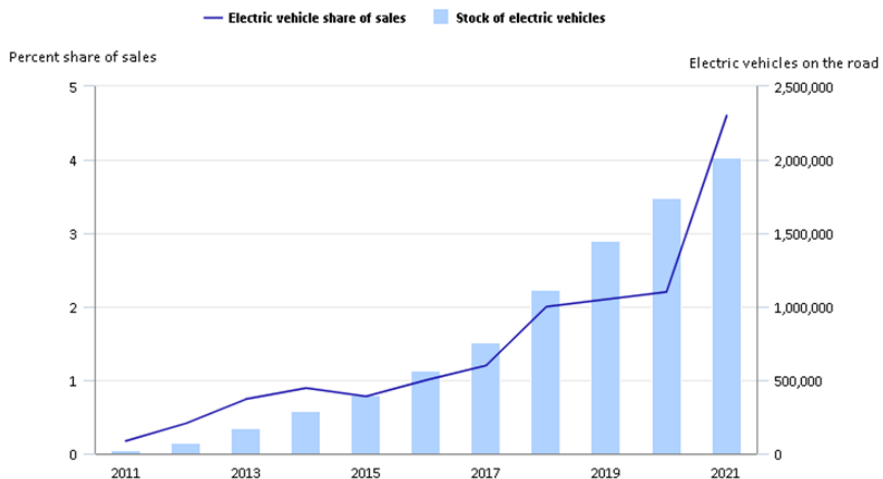


Figure 1. International Energy Agency

Consumer demand for electric vehicles (EVs) has experienced a remarkable surge in recent years, marking a substantial shift towards sustainable transportation options. Between 2011 and 2021, the number of EVs traversing the world's roads soared from a modest

22,000 to a staggering figure exceeding 2 million units. This exponential growth underscores a burgeoning consumer interest in EVs, driven by a confluence of factors poised to sustain and propel this momentum throughout the ensuing decade, from 2021 to 2031. Foremost among these factors is the escalating concern for environmental conservation and combating climate change. With heightened awareness regarding the detrimental impacts of conventional fossil fuel-powered vehicles on air quality and greenhouse gas emissions, consumers are increasingly gravitating towards EVs as a cleaner, more sustainable alternative. The imperative to reduce carbon footprints and mitigate environmental degradation is thus expected to remain a significant driver of consumer demand for EVs in the coming decade. Another pivotal factor bolstering consumer interest in EVs is the expanding array of vehicle choices available in the market. As automotive manufacturers intensify their efforts to diversify their product portfolios and cater to diverse consumer preferences, the proliferation of EV models across various segments – ranging from compact hatchbacks to luxury SUVs – offers consumers a broader spectrum of options to align with their specific needs and preferences. This enhanced diversity in EV offerings is anticipated to stimulate consumer demand by catering to a broader demographic and addressing a wider range of transportation requirements. Furthermore, technological advancements in battery capacity and efficiency represent a compelling catalyst for the continued growth of EV adoption. Breakthroughs in battery technology, coupled with ongoing research and development efforts, have led to significant improvements in EV performance, driving range, and charging infrastructure. As battery costs decline and energy densities increase, EVs are becoming increasingly competitive with traditional internal combustion engine vehicles in terms of range, reliability, and overall driving experience. These advancements are poised to bolster consumer confidence in EVs and mitigate longstanding concerns regarding range anxiety and charging infrastructure limitations.

Lastly, cost savings emerge as a compelling incentive propelling consumer demand for EVs. While the initial purchase price of EVs may still exceed that of conventional vehicles, the total cost of ownership – encompassing factors such as fuel expenses, maintenance costs, and potential incentives or subsidies – often tilts in favor of EVs over the vehicle's lifespan. As economies of scale drive down manufacturing costs and government incentives incentivize EV adoption, the financial attractiveness of EV ownership is expected to continue to improve, making EVs an increasingly compelling option for cost-conscious consumers. In sum, the confluence of environmental awareness, expanding vehicle choices, technological advancements, and cost savings is poised to sustain and augment consumer demand for electric vehicles throughout the 2021–2031 decade. As EVs evolve from a niche market segment to a mainstream transportation solution, their integration into the automotive landscape holds transformative implications for global mobility, environmental

sustainability, and energy security. This study draws upon various theoretical perspectives from the fields of consumer behavior, psychology, economics, and sociology to explore the factors influencing consumer perceptions and attitudes towards electric vehicles. Key theoretical frameworks include:

1. Theory of Planned Behavior (TPB): Developed by Ajzen (1991), TPB posits that attitudes, subjective norms, and perceived behavioral control influence individual intentions and behaviors. In the context of electric vehicles, TPB can help elucidate how consumer attitudes towards EVs, social norms, and perceived barriers impact the likelihood of adoption.
2. Innovation Diffusion Theory (IDT): Introduced by Rogers (1962), IDT examines the process through which new innovations spread within a social system. The theory identifies five key adopter categories (innovators, early adopters, early majority, late majority, and laggards) and highlights the role of communication channels, social networks, and perceived attributes of innovations in shaping adoption decisions.
3. Value-Belief-Norm (VBN) Theory: Proposed by Stern et al. (1999), VBN theory suggests that environmental values, beliefs about consequences, and personal norms influence pro-environmental behaviors. Applied to electric vehicles, VBN theory can help understand how consumers' environmental concerns, beliefs about the environmental benefits of EVs, and moral obligations influence their attitudes and intentions towards adoption.
4. Behavioral Economics: Drawing on insights from behavioral economics, this framework explores how cognitive biases, decision heuristics, and contextual factors influence consumer choices and preferences for electric vehicles. Prospect theory, loss aversion, and reference dependence are among the key concepts that can shed light on consumer decision-making in the EV market.

Despite the increasing popularity and potential benefits of electric vehicles (EVs), the adoption rate of these vehicles varies significantly across different regions and demographics. This variation suggests a complex interplay of factors influencing consumer perceptions and attitudes towards EVs. While numerous studies have examined various aspects of consumer behavior in the context of EV adoption, there remains a gap in understanding the theoretical foundations that underpin these perceptions and attitudes comprehensively. Therefore, the central problem addressed by this research is to review and synthesize the existing theoretical frameworks relevant to consumer perceptions and attitudes towards electric vehicles. By synthesizing diverse theoretical perspectives from fields such as consumer behavior, psychology, economics, and sociology, this study aims to provide a com-

prehensive understanding of the underlying factors shaping consumer responses to EVs. Through the analysis and synthesis of theoretical models such as the Theory of Planned Behavior, Innovation Diffusion Theory, Value-Belief-Norm Theory, and Behavioral Economics, this research seeks to elucidate the cognitive, social, economic, and environmental factors driving consumer perceptions and attitudes towards electric vehicles. By bridging the gap between theoretical frameworks and empirical research, this study aims to inform policymakers, industry stakeholders, and researchers about strategies to promote the adoption of EVs and address barriers to their widespread acceptance in the market.

2 Objectives of the Study

The objectives of the study is to

- To conduct a comprehensive review of existing literature on consumer perceptions and attitudes towards electric vehicles (EVs), spanning diverse disciplines such as consumer behavior, psychology, economics, and sociology.
- To identify and critically evaluate the key theoretical frameworks that have been used to explain and understand consumer perceptions and attitudes towards EVs.
- To synthesize the findings from the reviewed literature and theoretical frameworks, elucidating the common themes, patterns, and discrepancies in the understanding of consumer responses to EVs across different studies and disciplines.
- To identify gaps and areas for further research in the theoretical understanding of consumer behavior towards EVs, including areas that have received limited attention in existing literature or where conflicting findings exist.

3 Literature Review

The Indian electric vehicle (EV) market has garnered significant attention and continues to expand. Electric vehicles are categorized into three distinct powertrain types: Battery-powered Electric Vehicles (BEV), Hybrid Electric Vehicles (HEV), and Plug-in Hybrid Electric Vehicles (PHEV). BEVs rely solely on electric motors for propulsion, with their battery units charged externally. In contrast, HEVs employ both an Internal Combustion Engine (ICE) and an electric motor in their powertrain. The ICE utilizes petrol/diesel for driving power, and during braking, kinetic energy is converted into electric energy and stored in the battery. This stored charge is then utilized to power the electric motor. HEVs typically initiate operation with the electric motor and later switch to the ICE. Similarly, PHEVs utilize both an ICE and an electric motor in their powertrain. Users have the flexibility to operate either the ICE or the battery, but the battery pack can only be charged through an external power supply. Among these EV types, BEV plays an important role

in the Indian market under the four-wheeler passenger car segment.(Munshi, Dhar, & Painuly, 2022). China leads the Electric Vehicle (EV) market with a substantial 9.5 million EVs in use. The country incentivizes EV adoption through subsidies, making them more affordable than in many other nations. In contrast, India stands out as one of the top contributors to greenhouse gas (GHG) emissions, ranking third globally with an annual average CO2 emission of 2660 million tons.(Yao et al., 2022).

The recent surge in crude oil prices, attributed to conflicts such as the Russia-Ukraine dispute and other external geopolitical tensions, has compelled India to expedite the adoption of electric vehicles as the primary mode of transportation.(Deb et al., 2021). This escalating trend underscores the urgency for the nation to transition towards a more sustainable and energy-efficient transportation system amid the volatility in global oil markets. In response to the challenges posed by geopolitical uncertainties and their impact on oil prices, the Indian government and various stakeholders are intensifying efforts to promote the widespread use of electric vehicles, aiming to reduce dependence on traditional fossil fuels and mitigate the economic consequences associated with fluctuating oil prices. The imperative to accelerate the deployment of electric vehicles emerges not only as a strategic response to geopolitical tensions but also as a proactive measure to enhance environmental sustainability and energy security in the long term. Further, the transformative impact on the electric vehicle (EV) market has been propelled by the Indian government's rigorous emission standards, progressive scrap policy, and heightened environmental awareness, as highlighted by Dixit and Singh's (2022). These measures collectively signify a revolutionary shift towards a more sustainable and eco-friendly transportation ecosystem in India.

A growing inclination towards electric vehicles (EVs) among consumers can be attributed to the enticing incentives and tax policies introduced by the Indian government. This strategic approach has not only garnered attention but has also spurred a significant shift in consumer preferences towards EVs. The proactive measures taken by the government to promote sustainable and eco-friendly transportation have played a pivotal role in fostering this transition. Moreover, it is noteworthy that India's automobile industry has achieved remarkable standing on the global stage, securing its position as the fourth-largest in the world according to 2021 statistics provided by Das and Bhat's (2022). This underscores the nation's growing significance in the automotive sector, with a trajectory poised for further expansion and innovation. As the automotive landscape continues to evolve, the combination of government initiatives and the industry's prowess positions India as a key player in shaping the future of electric mobility on a global scale.

MURLIKRISHNA, GUPTA, and VENUGOPAL's (2022) emphasized the role of digital channels in amplifying awareness of newly invented and innovated products, particularly

in the context of the study on the adoption of electric vehicles. Their research highlighted the transformative potential of digital platforms in disseminating information and fostering consumer understanding of emerging technologies such as electric vehicles. By extending this insight, the authors suggested that leveraging digital channels could facilitate the dissemination of information regarding the benefits and features of electric vehicles, thereby promoting their adoption among consumers. Koppala and Akhila's (2023) underscored the significance of customer variety-seeking attitudes, which drive marketers to continuously innovate and promote new products. Their observation highlights the dynamic relationship between consumer behavior and marketing strategies, particularly in response to the ever-changing preferences and demands of consumers seeking variety. By emphasizing the importance of catering to diverse consumer needs and preferences through innovation, the authors advocate for a proactive approach to product development and promotion.

D. Vishnu MurtyKolluru's (2019) underscored the significance of Customer Relationship Management (CRM) activities in enhancing opportunities for raising awareness of new products. Their research highlighted the pivotal role of CRM strategies in fostering meaningful connections with customers, thereby providing avenues for effectively communicating information about new products or services. By emphasizing the importance of nurturing customer relationships through targeted CRM initiatives, the authors suggested that organizations can leverage these interactions to increase awareness and drive adoption of new offerings. In the rapidly evolving landscape of the Indian automotive industry, major players like Tata Motors and Mahindra and Mahindra Ltd. have made significant strides by recently introducing their Electric Vehicle (EV) segments to cater to the growing demand for sustainable and eco-friendly transportation. (Singh et al., 2022). This strategic move not only reflects a proactive response to the global shift towards electric mobility but also underscores the commitment of these automobile giants to contribute to the reduction of carbon emissions and promote a greener future in the Indian market. The introduction of electric vehicles by these companies aligns with the broader industry trends and emphasizes their dedication to technological innovation and environmental responsibility, positioning them at the forefront of the electric revolution in India's automotive sector.

Furthermore, the Indian automotive industry extends a welcoming platform to international electric vehicle (EV) manufacturers, including but not limited to Hyundai, Kia, MG, and BMW, as highlighted by the research conducted by Rohini and Asha's (2022). This industry not only provides an opportunity for these global EV automakers to thrive but also fosters a conducive environment for collaboration and growth within the Indian market. The EV segment available in the market today gives a variety of options to choose from their consumers according to their needs and different price band. All these factors

made rapid growth in the EV market in India in a limited period of time. Further, EV in India comprises Plug-in Hybrid Electric Vehicle (PHEVs) and Battery Electric Vehicle (BEVs) among which BEVs have shown higher sales record. In India, the government has taken proactive measures to promote the adoption of electric vehicles (EVs) by providing concessions for their purchase. Furthermore, there is a crucial initiative in place to facilitate the widespread establishment of public charging infrastructure. Under the FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) scheme, the Indian government allocated a substantial budget of 300 million INR (equivalent to 5 million USD) for the development of charging infrastructure spanning the period from 2015 to 2017.

Despite this financial allocation, the implementation faced challenges, and progress was marked by the initiation of only a few pilot projects addressing the charging system, as noted by Spencer and Awasthy's (2019). The effective execution and operation of these pilot ventures have become integral to understanding the feasibility and functionality of the envisioned public charging infrastructure network. It remains imperative for the government to continue its commitment to enhancing the charging ecosystem, ensuring seamless accessibility

Charging times for the average electric vehicle in India can be quite prolonged, taking a minimum of 7 to 8 hours for a full charge when utilizing a 230 V single-stage flexible charging system. However, there is a growing demand from consumers for significantly shorter battery charging durations. According to research by Sutopo et al.'s (2018) half of the customers expect their electric vehicle's battery to be fully charged in under 2 hours, while 30% of them require a charging time of less than 4 hours. To address this need for faster charging, Direct Current (DC) quick charging units have been introduced, capable of reducing the charging time to under 2 hours. Despite this advancement, there remains a limitation in widespread adoption as these quick charging units cannot be easily installed in domestic or residential locations. The current constraint on the availability of charging units hampers the widespread accessibility of fast-charging technology for electric vehicle users in everyday settings.

When compared to conventional vehicles, the price of the electric vehicle is higher. These days there are almost 25 different models of bike battery-worked vehicles India out of this simply 4 to 5 models are utilizing lithium-ion batteries. 60% of the clients expecting the scope of more than 300 km per charge. (Bhattacharyya, Pradhan, & Shabbiruddin, 2023). There are around 25 different models of four wheelers battery-worked vehicles, most of them are using lithium-ion batteries. But the range of some of these vehicles between 120 and 270 km per charge and some of these have ranged between 300 and 400 km per charge. The reach tension of an electric vehicle would not be a hindrance if

there is a plentiful charging framework inside urban communities in India. Conventional vehicles are a major cause of global warming and environmental air pollution. All types of vehicles produce dust from brakes, tires, and road wear. The average diesel vehicle has a worse effect on air quality than the average gasoline vehicle. But both gasoline and diesel vehicles pollute more than electric vehicles.

Many governments throughout the world have begun to place a greater emphasis on electric vehicles, also known as EVs, and there has been a relentless effort to replace automobiles that consume fuel oil as their primary source of transportation with EVs to alleviate energy concerns. The lack of product innovation on the product front challenges, diminishes the adoption of electric vehicles. The EV's capital and running expenses are the main factor influencing market adoption and consumer approval. Capital cost has always been a significant deciding factor in EV purchases. About 63% of buyers stated that an EV is out of their price range. Lack of charging/swapping Infrastructure is the major obstacle in EV adoption, particularly in the case of personal cars which is the confluence of short-range capability and lack of charging infrastructure. To encourage the public's acceptance of EVs, sufficient charging infrastructure across roads is required in addition to advancements in battery technology EV-power grid integration. Clean energy intake should be required for electric vehicles to run genuinely emission-free. Energy production must be devoid of fossil fuels. Alongside the widespread adoption of EVs, countries that rely heavily on non-renewable resources, face the equally crucial task of "greening" their energy generation. Lack of material resources is the most complicated issue with EV manufacturing. The primary production involves vital and essential metals like cobalt and nickel. Presently there is no Cobalt production in India. Additionally, some of the material resources that the EV system depends on wind up having supply problems because of geopolitical concerns rather than their scarcity. Though the government and EV manufacturing companies talking more about manufacturing EV batteries in India, they actually it is being imported from China only.

Re-usability of EV batteries is the major concern while thinking of EV adoption. To encourage reuse, proper battery collection is necessary, but this cannot be done without an effective End of Life (EoL) management system, which is currently lacking and challenging. (Jaiswal, Deshmukh, & Thaichon, 2022). Adane, Murty, and Venugopal's (2018) highlighted the importance of employee responsibility in providing comprehensive information about the complexities of new products or services. Their research underscored the critical role played by employees as ambassadors for the organization, particularly in ensuring that customers are adequately informed about the intricacies of newly introduced offerings. By emphasizing the need for employees to possess a deep understanding of the features, benefits, and potential challenges associated with new products or services,

the authors suggested that organizations can enhance customer satisfaction and mitigate potential issues.

Gedyon, Getnet, and Venugopal's (2019) conducted an extensive exploration into the multifaceted realm of Customer Relationship Management (CRM) practices and their profound impact on fostering awareness of newly introduced products within the market. Their research delved into the intricate dynamics of how businesses engage with their clientele through CRM strategies, aiming to uncover how these strategies contribute to the successful introduction and promotion of new products. Through a comprehensive analysis of various CRM approaches and their correlation with heightened market awareness, the study provided valuable insights into the intricate interplay between customer relationships and the introduction of innovative offerings. Venugopal et al.'s (2014) illuminated the widespread popularity and consumer appeal of second-hand automobile products. Through their study, they shed light on the notable trend of customers gravitating towards and actively consuming pre-owned automotive goods. By identifying the significant traction and consumer preference for second-hand automobile products, their research underscored the importance of understanding the dynamics driving the thriving market for used automotive items.

While electricity as a vehicle fuel has many benefits, it has two disadvantages: it is bulkier to store and costlier, and slower to refill. The former means that the current electric vehicles would have a smaller range than diesel, and the latter means that they cannot be refuelled easily on the road. This brings us to the major technological factors. (Jensen, Cherchi, & Mabit, 2013). According to studies conducted, range anxiety is found to be a predominant barrier in a customer's decision to buy an EV. (Jensen, Cherchi, & Mabit, 2013). Research suggests that consumers prefer an ideal driving range, which is expected to be between 300 km to 450 km. (Broadbent, Metternicht, & Wiedmann, 2021). However, this at times is not practically possible thereby giving rise to range anxiety. This is mainly observed during battery charge depletion while driving for long hours when the driver fails to predict the approximate distance that could be covered with the remaining battery power. The limited and uncertain vehicle range aroused anxiety among drivers to use EVs for long journeys. (Noel et al., 2020).

According to the Theory of Planned Behavior humans make decisions bases on logical evaluations of stimuli and the plausible outcomes of decisions. (Ajzen, 1991). Customer knowledge and experience have an effect on attitude. Other factors that influence EV adoption are gender, age, income, educational level, tastes and environmental awareness.

Consumers who readily adopt EVs are usually highly educated and environmentally sensitive. Individuals respond to social expectations and social pressure reflected in statements, such as socially acceptable behaviour, being considerate of others, expressing shared

values and social responsibility. Kahn (2007) further goes on to state that a consumer who strongly believes in environmental conservation purchases an EV for two incentives. First, driving a more fuel-efficient car would reduce one's carbon footprint for any given number of miles driven per year. The second incentive is that, everybody in the community sees the type of vehicle that a person drives. In an environmentalist community, driving a fuel inefficient vehicle may trigger some embarrassment and ostracism. This would lead to a person's purchase of an EV due to peer pressure.

4 Methodology

This study employs a systematic literature review approach to achieve its objectives of reviewing and synthesizing the theoretical foundations of consumer perceptions and attitudes towards electric vehicles (EVs). The methodology consists of the following steps:

- The first step involves identifying relevant literature from various academic databases, including but not limited to PubMed, Scopus, Web of Science, and Google Scholar. Keywords related to electric vehicles, consumer behavior, attitudes, perceptions, and theoretical frameworks are used to conduct comprehensive searches.
- The retrieved articles are screened based on predefined inclusion criteria. Only peer-reviewed journal articles, conference proceedings, and books published in English are considered for inclusion. Studies that focus specifically on consumer perceptions and attitudes towards EVs and utilize theoretical frameworks are prioritized.
- Relevant data from the selected literature, including theoretical frameworks employed, key findings, and methodologies used, are extracted and compiled into a structured format. This facilitates the systematic analysis and synthesis of the literature.
- Thematic analysis is employed to identify common themes, patterns, and discrepancies across the reviewed literature. Key theoretical frameworks, such as the Theory of Planned Behavior, Innovation Diffusion Theory, Value-Belief-Norm Theory, and Behavioral Economics, are examined in detail to elucidate their applicability and contributions to understanding consumer perceptions and attitudes towards EVs.
- The extracted data and thematic analysis are synthesized to develop a comprehensive conceptual framework that integrates various theoretical perspectives on consumer behavior towards EVs. The synthesis process involves identifying relationships between different theoretical constructs, exploring how they interact and influence consumer perceptions and attitudes, and highlighting areas of convergence and divergence in the literature.
- Based on the synthesis of findings, gaps and areas for further research in the theoretical understanding of consumer behavior towards EVs are identified. These gaps inform recommendations for future research directions and theoretical development in the field.

- The findings of the review and synthesis are reported in a structured manner, following academic conventions. The synthesized theoretical framework, along with insights and recommendations, is presented in a clear and coherent manner to facilitate understanding and application by policymakers, industry stakeholders, and researchers.
- Through this rigorous methodology, this study aims to provide a comprehensive understanding of the theoretical foundations of consumer perceptions and attitudes towards electric vehicles, thereby contributing to the advancement of knowledge in this important area of research.

5 Analysis and Interpretation

5.1 Comprehensive review

A comprehensive review of existing literature on consumer perceptions and attitudes towards electric vehicles (EVs) reveals a multifaceted landscape influenced by various factors including environmental concerns, technological advancements, economic considerations, and social dynamics. Numerous studies have examined these aspects from different disciplinary perspectives, contributing to a nuanced understanding of consumer behavior in the EV market. Here is an overview of key findings from the literature:

- **Environmental Concerns:** Many consumers are motivated to adopt EVs due to environmental concerns, including reducing carbon emissions and mitigating climate change. Studies consistently show that consumers perceive EVs as more environmentally friendly compared to conventional vehicles, which drives their purchase intentions. However, the extent to which environmental concerns influence actual purchasing decisions varies among different consumer segments.
- **Technological Advancements:** Advances in EV technology, particularly improvements in battery performance, driving range, and charging infrastructure, play a significant role in shaping consumer perceptions and attitudes. Studies indicate that concerns related to range anxiety and charging infrastructure are major barriers to EV adoption, but ongoing technological advancements are mitigating these concerns and increasing consumer confidence in EVs.
- **Economic Considerations:** Economic factors, including purchase price, operating costs, and government incentives, significantly influence consumer perceptions and attitudes towards EVs. While EVs may have higher upfront costs compared to conventional vehicles, studies suggest that lower operating costs, such as reduced fuel and maintenance expenses, make EV ownership financially attractive over the long term. Additionally, government incentives, such as tax credits and rebates, play a crucial role in incentivizing EV adoption.

- **Social Dynamics:** Social influences, such as peer opinions, social norms, and cultural factors, also shape consumer perceptions and attitudes towards EVs. Studies show that positive word-of-mouth and social networks play a significant role in promoting EV adoption. Additionally, cultural factors, such as national policies and attitudes towards sustainability, influence the adoption of EVs in different regions.
- **Psychological Factors:** Psychological factors, including attitudes, beliefs, and emotions, play a crucial role in shaping consumer perceptions and attitudes towards EVs. The Theory of Planned Behavior (TPB) and Value-Belief-Norm (VBN) theory are commonly used frameworks to understand how psychological factors influence EV adoption intentions. Studies show that positive attitudes towards EVs, perceived environmental benefits, and personal norms for sustainability positively influence intentions to adopt EVs.

In conclusion, the literature review highlights the complex interplay of environmental concerns, technological advancements, economic considerations, social dynamics, and psychological factors in shaping consumer perceptions and attitudes towards electric vehicles. Understanding these factors is essential for policymakers, industry stakeholders, and researchers to develop effective strategies to promote EV adoption and accelerate the transition to sustainable transportation systems.

5.2 Key theoretical frameworks

Several key theoretical frameworks have been utilized to explain and understand consumer perceptions and attitudes towards electric vehicles (EVs). Here's an evaluation of some of these frameworks:

- **Theory of Planned Behavior (TPB):** The TPB posits that attitudes, subjective norms, and perceived behavioral control influence individual intentions and behaviors. In the context of EV adoption, TPB has been extensively applied to understand how consumers' attitudes towards EVs, subjective norms (e.g., social influence), and perceived behavioral control (e.g., perceived ease of use, availability of charging infrastructure) influence their intentions to adopt EVs. Studies utilizing TPB have provided valuable insights into the psychological determinants of EV adoption intentions, helping identify key drivers and barriers to adoption.
- **Innovation Diffusion Theory (IDT):** IDT explores the process through which new innovations, such as EVs, spread within a social system. It identifies different adopter categories (innovators, early adopters, early majority, late majority, and laggards) and emphasizes the role of communication channels, social networks, and perceived attributes of innovations in shaping adoption decisions. Studies applying IDT to EV adoption have highlighted the importance of factors such as perceived relative advan-

tage, compatibility, complexity, trialability, and observability in influencing consumer perceptions and attitudes towards EVs. IDT offers valuable insights into the diffusion dynamics of EVs across different consumer segments and market contexts.

- **Value-Belief-Norm (VBN) Theory:** VBN theory suggests that environmental values, beliefs about consequences, and personal norms influence pro-environmental behaviors. Applied to EV adoption, VBN theory helps understand how consumers' environmental values, beliefs about the environmental benefits of EVs (e.g., reduced emissions, energy conservation), and personal norms for sustainable behavior shape their attitudes and intentions towards EV adoption. Studies employing VBN theory have underscored the significance of environmental concerns and moral obligations in driving intentions to adopt EVs, highlighting the importance of fostering pro-environmental attitudes and norms to promote EV adoption.
 - **Behavioral Economics:** Behavioral economics principles, such as prospect theory, loss aversion, and reference dependence, provide insights into the cognitive biases and decision heuristics influencing consumer choices and preferences for EVs. Prospect theory suggests that individuals evaluate gains and losses relative to a reference point and exhibit loss aversion, preferring to avoid losses rather than acquire equivalent gains. Applied to EV adoption, behavioral economics frameworks help elucidate how consumers' perceptions of EV attributes (e.g., range, charging infrastructure) and framing effects influence their preferences and decision-making processes.
- Overall, these theoretical frameworks offer valuable insights into the psychological, social, and economic factors shaping consumer perceptions and attitudes towards electric vehicles. By integrating insights from these frameworks, researchers can develop a more holistic understanding of the determinants of EV adoption and inform strategies to promote the transition towards sustainable transportation systems.

5.3 Consumer Perceptions and Attitudes

Consumer perceptions and attitudes towards electric vehicles (EVs) vary widely and are influenced by a range of factors including environmental concerns, technological considerations, economic factors, and social dynamics. Here are some of the different perceptions and attitudes observed in the literature:

1. **Environmental Concerns:** Many consumers view EVs favourably due to their perceived environmental benefits. EVs produce zero tailpipe emissions during operation, leading to reduced air pollution and greenhouse gas emissions. Consumers who prioritize environmental sustainability may perceive EVs as a more eco-friendly transportation option. However, some consumers express scepticism about the en-

vironmental benefits of EVs, particularly if the electricity used to charge EVs is generated from non-renewable sources such as coal or natural gas. Concerns about the lifecycle environmental impact of EV batteries, including manufacturing and recycling processes, also contribute to scepticism among certain consumers.

2. **Technological Considerations:** Many consumers perceive EVs as a symbol of technological advancement and innovation. Positive perceptions of EVs' technological features, such as regenerative braking, advanced battery management systems, and connected vehicle capabilities, contribute to their appeal among tech-savvy consumers. Despite technological advancements in battery technology, some consumers experience range anxiety – the fear of running out of battery charge before reaching their destination – as a barrier to EV adoption. Limited driving range and concerns about the availability of charging infrastructure contribute to apprehension among potential EV buyers.
3. **Economic Factors:** EVs typically have higher upfront costs compared to traditional internal combustion engine vehicles. While some consumers are willing to pay a premium for EVs due to perceived long-term cost savings on fuel and maintenance, others may be deterred by the initial purchase price. Government subsidies, tax credits, and other financial incentives can positively influence consumer attitudes towards EVs by offsetting the higher upfront costs. Consumers may be more inclined to consider purchasing an EV if they perceive the financial incentives as making EV ownership more affordable.
4. **Social Dynamics:** Social factors, including peer recommendations and social norms, can significantly impact consumer attitudes towards EVs. Positive word-of-mouth and social proof from friends, family, or colleagues who own EVs can influence perceptions and increase acceptance of EV technology. In some social circles, owning an EV may be perceived as a status symbol associated with environmental consciousness and technological sophistication. This perception can contribute to positive attitudes towards EVs among certain consumer segments.
5. **Psychological Factors:** Consumer attitudes and beliefs about EVs play a central role in shaping perceptions and purchase intentions. Positive attitudes towards sustainability, environmental protection, and technological innovation are often associated with favorable attitudes towards EVs. Perceptions of risk, including concerns about vehicle performance, reliability, and resale value, can influence consumer attitudes towards EVs. Addressing these perceived risks through education, demonstration, and improved product offerings can help alleviate consumer apprehensions.

In conclusion, consumer perceptions and attitudes towards electric vehicles are diverse and multifaceted, influenced by a complex interplay of environmental, technological, economic, social, and psychological factors. Understanding these different perceptions and attitudes is essential for policymakers, industry stakeholders, and marketers to effectively promote EV adoption and address barriers to market acceptance.

6 Suggestions

Based on the evaluation of consumer perceptions and attitudes towards electric vehicles (EVs), several suggestions emerge for policymakers, industry stakeholders, and researchers to promote EV adoption and address barriers to market acceptance:

1. Develop comprehensive education and awareness campaigns to inform consumers about the environmental benefits, technological advancements, and cost savings associated with EV ownership. These campaigns should address common misconceptions, such as range anxiety and battery life concerns, and highlight the advantages of EVs over traditional vehicles.
2. Invest in the expansion of EV charging infrastructure to alleviate range anxiety and facilitate long-distance travel for EV owners. This includes deploying charging stations in public areas, residential complexes, workplaces, and along highways to enhance accessibility and convenience for EV users.
3. Continue offering financial incentives, such as tax credits, rebates, and subsidies, to make EVs more affordable for consumers. These incentives can help offset the higher upfront costs of EVs and encourage more people to consider EV ownership as a viable transportation option.
4. Focus on product development to improve EV performance, driving range, and affordability. Continued advancements in battery technology, vehicle design, and manufacturing processes can address consumer concerns and enhance the overall appeal of EVs in the marketplace.
5. Foster consumer engagement and involvement in the EV transition through community outreach programs, test drive events, and peer-to-peer networking opportunities. Leveraging positive word-of-mouth and social influence can accelerate EV adoption by building trust and credibility among potential buyers.
6. Advocate for supportive policies at the local, regional, and national levels to incentivize EV adoption and accelerate the transition to sustainable transportation. This

includes measures such as zero-emission vehicle mandates, low-emission zones, and preferential parking and toll benefits for EVs.

7. Invest in research and development initiatives to address emerging challenges and opportunities in the EV market. This includes exploring innovative technologies, business models, and policy interventions to overcome barriers and drive market growth.
8. Foster collaboration and partnerships among government agencies, industry stakeholders, academic institutions, and non-profit organizations to leverage resources and expertise in promoting EV adoption. Cross-sector collaboration can facilitate knowledge sharing, innovation, and collective action towards achieving common goals.

By implementing these suggestions, stakeholders can work collaboratively to accelerate the adoption of electric vehicles and pave the way for a more sustainable future in the transportation sector.

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