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Psychological, Technological and Economic Factors Influencing Purchase Intention Towards Battery Electric Vehicles: A Conceptual Paper

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Abstract

Battery electric vehicles offer zero-emission solutions to achieve zero CO2 emission by 2050. Despite environmental benefits and diverse models available globally, BEV adoption remains critically low, especially in developing countries most vulnerable to climate impacts. Existing research presents inconsistent and contradictory findings regarding factors influencing BEV purchase intention, creating significant knowledge gaps. This conceptual paper addresses these gaps through extensive literature review, identifying key psychological, technological, and economic determinants affecting consumer decision-making. The study proposes an integrated conceptual framework combining Theory of Planned Behavior (TPB), Norm Activation Model (NAM), and Unified Theory of Acceptance and Use of Technology (UTAUT), enhanced with electronic word-of-mouth, purchasing price, and perceived economic benefits. The software SPSS and Smart-PLS are suggested for descriptive and inferential statistics. The structural equation modeling is proposed to test the relationships

among variables. This integrated framework provides strategic insights for governments, manufacturers, and policymakers to enhance consumer purchase intentions, categorize influential factors by impact magnitude, and accelerate sustainable transportation adoption essential for achieving global climate commitments.

Keywords: Battery electric vehicle, Purchase intention, Psychological acceptance, Technological advancement, Electronic word of mouth

1. Introduction

The transportation sector is experiencing a major shift as electric vehicles (EVs) emerge as an eco-friendly replacement for conventional gas-powered cars due to climate change and global warming (CC&GW). Mukesh & Narwal (2023) stated three main sorts of EVs accessible in the marketplaces. First EVs is only motor-powered by battery known as battery electric vehicles (BEVs). Second is hybrid electric vehicles using a battery with old mechanical engine named hybrid electric vehicles (HEVs). Third is plug in electric vehicles having a big battery with baby engine named as plug in (PHEVs) which is charged externally through plugging with energy power in addition to its own engine source. Fourth is Fuel-cell Electric Vehicles (FCEVs) which use cell fuel through chemical reactions to give electricity to motors. Fifth is Extended-range EVs (EREVs) which includes internal combustion engine to give power to battery whenever it gets lower charge to get higher range (Ullah et al., 2023). BEVs produce (0) emissions and only genuine electric vehicles are considered so far and they are also known as plug-in vehicles. European Commission (EC) has devoted itself to decreasing the minimum emissions by 40% by 2030 in comparison with 1990 (Bednarz et al., 2023). Globally sales of electric vehicles (EVs) are very low but particularly in developing countries are extremely low. Whereas, developing countries around the equator are more vulnerable to the impact of CC&GW (Chaudhary & Kate, 2023) and need more actions to mitigate the risks of CC&GW. Although, alternative solutions to ICE are available in the market in shape of BEVs with variety of models but the adoption of BEVs is still unabated (Buhmann et al., 2024) which is indeed hampering all efforts and initiatives taken by various forums like United Nations (UN), European Union (EU), International Energy Agency (IEA) to mitigate the CC&GW risks and achieving net zero emission of greenhouse gases by 2050.

2. Problem Statement

Customers exhibit progressive approach on green products and environment, tech savvy, communicate digitally, opt new technologies, determined to save funds and grow with the digital age (Cardoso et al., 2024; Liu et al., 2024; Masserini et al., 2024; Thanapongporn et al., 2024). World Economic Forum (2022) acknowledged three key causes that impede the acceptance of the EVs are related to economic and technical nature namely, purchasing price of EV and charging infrastructure and driving range respectively. However, academic researchers suggest the psychological factors are more related to adoption than policy (Ye et al., 2021). There are four research gaps that are identified through the literature review.

First, globally little research carried out on BEVs that's why the adoption of BEV is still low and in infancy in majority countries and not accepted fully (Pandita et al., 2024). Second, the available research is separated with contrasts of developed and developing nations (Bhat et al., 2024), cultural and geographic location bases (Buhmann et al., 2024) and few countries are focused most like China and India, whereas, in some countries few studies are conducted identically in Afghanistan and Pakistan. Third, there is disagreement with the outcome of the research done with these factors as some found positive, some found negative and some found there are no relationships among them. On top of that all, there is inconsistency in the results in terms of single factor ranking like theory of planned behavior (TPB) three variables

found dissimilar ranking in distinct research studies see for example Thakur et al. (2023), Pradeep et al. (2021) and Shakeel (2022). Fourth, there is lack of integrated research framework that combines all psychological, technologic, and economic factors to find the purchase intention for BEVs as high-ticket products.

The earlier research was done by adding two psychological factors like self-interest of TPB and altruism of norm activation model (NAM) (Dong et al., 2020; Ng et al., 2018) or psychological factors with technological aspects like TPB and technology acceptance model (TAM) (Thøgersen & Ebsen, 2019; Vafaei-Zadeh et al., 2022) or unified theory of acceptance and use of technology (UTAUT) (Gunawan et al., 2022) to find purchase intention for EVs. Moreover, there is also no specific type of EV considered, and most researchers combined all types of EVs in their study which produce more confusing results. Like battery electric vehicles and hybrid plugin vehicles, which are basically not pure electric cars but need fossil fuel too and perception and challenges vary for each type of electric vehicle. The sample is also either small and requires variety (Rafiq et al., 2024) or not appropriate for instance, students of undergrad who do not earn but financially depends on parents or guardians. The prospective consumers having lower income face difficulties to purchase EVs and such consumers look for support from others (Ramadan & Othman, 2023). Therefore, there are two objectives to this article. First to see which psychological, technological and economic factors are affecting most purchase intention of BEVs by analyzing existing literature. Second, to propose integrated conceptual framework based on well-known and established theories namely TPB, NAM model and UTAUT.

3. Literature Review and Hypotheses Development

3.1 Theory of Planned Behavior (TPB)

TPB was established by Ajzen (1985) with the ambition of predicting behavioral intentions. Its constructs are attitude represents behavioral beliefs, subjective norm represents normative beliefs, and perceived behavioral control represents control beliefs. These components function as antecedents that contribute to and help explain behavioral intentions (Ajzen, 2011). The TPB is used in the literature for EVs by many authors see for example (Buhmann et al., 2024; Haustein & Jensen, 2018; S. Wang et al., 2016) but the results vary in ranking of variable by the impact size on purchase intention each study and sample also vary.

3.1.1 Attitude (ATT)

The ATT is defined by founder of TPB as an underlying inclination or predisposition for behaving favorably or unfavorably toward a psychological concept or entity (Fishbein & Ajzen, 2010). The ATT is the most positive and important factor in predicting purchase intention for BEVs. Research has been carried out measuring attitudes for various products and services. See the research conducted on adults for attitude towards medicines purchase intention in Vietnam (Doan et al., 2024), study conducted in Lebanon on attitude towards using online platforms for ordering food (Jabbour Al Maalouf et al., 2024), another study conducted for attitude using TPB for robotic products and services in Taiwan (Tai et al., 2024), additional study conducted for attitude towards cosmetic procedure in Netherlands

(Hermans & Veldhuis, 2024) and study conducted in Finland on how religiosity influence attitude towards science and public health (Laliotis et al., 2024). These multidimensional studies on attitude confirm its importance in every field. Therefore, hypothesized as below.

H1: Positive consumer attitudes toward battery electric vehicles (BEVs) drive stronger purchase intentions towards BEVs.

3.1.2 Subjective Norm (SN)

The SN is defined by founder of TPB as a person's belief about whether significant others in their life would approve or disapprove of them engaging in a specific action (Fishbein & Ajzen, 2010). SN in the research study found with contradicting results as Huang & Ge (2019) conducted study in the EVs domain with Beijing sample and found the SN is not linked to adoption of EVs and Pradeep et al. (2021) could not find any statistical evidence to support SN and purchase intention of EVs relationship. However, Liao (2022) conducted study on EV purchase intention with sample from China and found positive relationship with subjective norm and desire to adopt EVs. Therefore, hypothesized as below.

H2: Subjective norm exerts a positive influence on purchase intention towards BEVs.

3.1.3 Perceived Behavioral Control (PBC)

The PBC is defined by founder of TPB as individuals' trust in their capability to execute a specific action or their perceived control over performing that behavior (Fishbein & Ajzen, 2010). It is a factor which differentiates the theory of reasoned action (TRA) from TPB. It is difficult to measure actual control over the behavior, but the actual birth of PCB lies in the notion of self-efficacy, that carries the main clarifying weight in his social cognitive theory. In literature it is found most contradictory in the studies compared to other two variables, i.e. ATT and SN. In the study of Ramadan & Othman (2023) found non-significance of the PBC relationship with PI of EVs in West Bank. Similar results found by Bobeth & Kastner (2020) in Germany. Thakur et al. (2023) also fails to find significant results between PBC and purchase intention for EVs. Furthermore, there are some authors who found a positive relationship between PBC and PI for EVs. Buhmann et al. (2024) found PBC is positively related to BEV adoption. Similarly, Vafaei-Zadeh et al. (2022) got significant results between PBC and PI of millennials for EVs in Malaysia. Therefore, it is hypothesized as below.

H3: Perceived behavioral control has a positive impact on the intention to purchase battery electric vehicles (BEVs).

3.2 Norm Activation Model (NAM)

NAM is developed with three basic prepositions as obligation-activation-defense, where intensity of perceived moral obligation to take a helping action be subject to one's value and norms to take altruistic behavior prior to defense the obligation (Schwartz, 1977). awareness of consequences (AC) and ascription of responsibility (AR) are factors that define personal norm (He & Zhan, 2017). The NAM is widely used in different fields of studies and topic for pro-environmental behavior like corporate social responsibility messages (Surira et al., 2024), waste of masks separation behavior in times of COVID-19 (Arkorful et al., 2023), energy

saving behavior in employees of hotels (Fatoki, 2023), consumption of seaweed in Norway (Govaerts & Olsen, 2022) and EVs PI (Asadi et al., 2021; Dong et al., 2020; Ji et al., 2024; Kumar & Nisa, 2022; Singh et al., 2023). Hence, the NAM is proposed in the current integrated conceptual framework to understand the purchase intention of customers for BEVs.

3.2.1 Personal Norm (PN)

According to Schwartz (1977) when individuals show strong AC and AR, they build strong PN as an altruism behavior, if it helps others. PN is personal norm and distinct from social and subjective norm, where people listen to their own build value more than others' views and values. In the case of BEV, when individuals realize the importance of adoption of BEVs and its impact on environment is stronger than using ICE vehicles which contribute to air and sound pollution, they tend to show higher purchase intention to purchase BEVs and defend their decision with AC and AR support based on built norms and values. Singh et al. (2023) suggested policymakers must revisit their policies and design marketing campaigns in way the awareness about BEV, its benefits to environment, performance of BEVs, and features of BEVs increased and the effects of ICE based vehicles highlighted to increase the purchase intention for BEVs. Moral obligation will guide the moral norm to act on purchasing BEVs (He & Zhan, 2017). Higueras-Castillo et al. (2023) also highlighted the cross-cultural aspects and how they help in building cross cultural values and awareness of environmental issues to boost EVs adoption. Hence, it is hypothesized as below:

H4: Personal norm positively influences purchase intention toward BEVs.

3.2.1.1 Awareness of Consequences (AC) and Ascription of Responsibility (AR)

AC is linked with assessment of people if they know the impact of their non-environmentally friendly actions and their unfavorable consequences, if aware, AC will lead positively PN for taking pro-environmental behavior (Schwartz, 1977). There are two conditions, indeed antecedents, to be activated before personal norm activate and individual act. First, one must be aware of consequences of wellbeing of other people and once an individual is aware as discussed earlier, secondly, individuals essentially feel responsible for his/her actions and their consequences (He & Zhan, 2017; Singh et al., 2023) to activate personal norms. In the context of BEVs, it is to examine whether individuals know using ICE vehicles create environmental issues including emission of CO2, lowering air quality, and overall contributing to the CC&GW. Asadi et al. (2021) found AC and AR are significantly associated to PN in Malaysian sample. Similarly, Ashraf Javid et al. (2021) found AC and AR influenced PN positively. Looking into AC and AR theoretically strong predictors of personal norm following relationships are hypothesized.

H5: AC positively affects PN.

H6: AR positively affects PN.

3.3 Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh et al. (2003) tried to find differences and similarities in 8 models which explained

variance ranging from 17-53% and combined variables from those models namely "TRA, TAM, the motivational model, TPB, combined TAM and TPB, the model of PC utilization, the innovation diffusion theory and the social cognitive theory" and come up with unified model named UTAUT which explained the variance up to 70% adjusted R^2. Hence, UTAUT is the single model considered stronger with higher explanatory power model in area of acceptance of technology. According to Venkatesh et al. (2003) performance expectancy is strongest factor in the original model of UTAUT but in literature it is not always the case and ranking vary study to study (Hoang et al., 2022). The social influence factor is similar in notion to SN as used in TRA, TPB and decomposed TPB and TAM2. Hence, SI is not used in the current integrated conceptual framework but used as SN as a TPB psychological factor. The recent meta-analysis conducted by Dingel et al. (2024) in healthcare sector suggested addition of psychological factors improve model prediction power and psychological factors such as trust emerged as most influential factor than any other technological factor. Hence, the UTAUT model is integrated in the current conceptual framework.

3.3.1 Performance Expectancy (PE)

PE means how individuals believe by adopting battery electric vehicles, it will enhance their effectiveness or productivity in completing their tasks. (Venkatesh et al., 2003). Sari et al. (2024) used UTAUT and studied PE more positively related to adoption than efforts expectancy in nursing field in Morocco sample. While Deshmukh & Mehta (2024) extended UTAUT model to assess information technology professionals for adoption of continuous learning engagement in India. However, PE and EE are positively related, but EE is higher than PE. Similarly, earlier study of Mahzan & Lymer (2014) found significant results for PE, FC and moderating role of experience and volunteerism in adoption of generalized audit software in United Kingdom (UK). Hence, it is hypothesized as below:

H7: Performance expectancy positively influences purchase intention towards BEVs.

3.3.2 Effort Expectancy (EE)

EE is a level linked to efforts required in using the technology system (Venkatesh et al., 2003). As discussed earlier, factors of UTAUT remain inconsistent in explaining variance in the model and positive and negative statistical support. EE remains one of the top inconsistent and negative statistical support receivers. The Jain et al. (2022), Singh et al. (2023), D. Wang et al. (2023), Higueras-Castillo et al. (2023) studied the relationship and found insignificant results for efforts expectancy and purchase intention towards EVs in India, China, India and Spain and India together respectively. Although the cultural differences exist among China, India and Spain. The non-significance results need further verification in other cultures to come up with consistent results for BEVs context. Hence, the relationship is hypothesized as below:

H8: There is positive impact of efforts expectancy on purchase intention towards BEVs.

3.3.3 Facilitating Conditions (FC)

FC is perception of individuals' that adequate managerial and technical assistance systems are

available to facilitate their use of the technology (Venkatesh et al., 2003). The government and companies provide technical assistance and infrastructure that can help individuals to use BEVs easily. D. Wang et al. (2023) confirms that FC plays a positive moderating role connecting perceived risk and EVs adoption intention. Hence, it is proved that the consumer's perceived risk associated with the adoption of EVs can mitigate or reduce with help of facilitation to the customers in shape of infrastructure, incentives, price reduction, lowering maintenance cost and giving any economic benefit to customers. Similarly, Jain et al. (2022) also got positive results for FC and adoption intention. Considering the importance of facilitating conditions in the context of BEV, the relationship is hypothesized as below.

H9: Facilitating conditions positively influences purchase intention towards BEVs.

3.4 Economic Factors

The individual customers focus on the financial aspect of the product involved. The electric cars are high priced products and individually purchasing them focus on price, economic benefits in shape of tax rebate, tax reduction, parking fee exemptions and toll reduction which are still not researched much and need attention to promote purchase of BEVs. In literature purchase price and perceived economic benefits are considered as significant deciding factors for purchasing EVs (Khurana et al., 2020) including e-bikes (Shakya et al., 2024).

3.4.1 Perceived Economic Benefits (PEB)

The development of BEV started with environmentally friendly products, but do customers perceive it as an economic benefit or not? It is still a big question due to lower adoption of BEVs. The customers always look for economic benefit before buying any product particularly when it is a high price product in any field like agriculture (Elshaer et al., 2023), tourism (Hashemi et al., 2022), sustainable consumption (Dabbous & Tarhini, 2019) and electric vehicles (Khurana et al., 2020). Perceived benefit means level a consumer anticipates positive outcomes and benefits from making a purchase decision (Yang et al., 2020). The perceived economic benefits not only include financial i.e. cost of fuel but also include the social factor and how an individual finds it in terms of efficiency and overall acceptability in social setup. Hence, it is hypothesized as below:

H10: Perceived economic benefits positively influence purchase intention towards BEVs.

3.4.2 Purchasing Price of BEV (PP)

The purchase price of a product is the main factor in deciding the purchase. In simple words it is the amount an individual pays to obtain a BEV. In the literature purchasing price is used with different titles, but core meaning same, and found mix results like Manutworakit & Choocharukul (2022) used it as a price value and found non-significant result with purchase intention and Krishnan & Koshy (2021) used as price acceptability and found positive significant results with purchase intention of BEV. Hence, it is hypothesized as below:

H11: Purchasing price of BEV positively influences purchase intention towards BEVs.

H14: Purchasing price of BEV moderates the relationship between ATT and PT towards

BEVs.

3.5 Electronic Word of Mouth (eWOM)

The circulation of favorable or unfavorable comments about a product or company shared by current, potential, or past customers across various online platforms and accessible to numerous individuals and organizations is known as eWOM (Hennig-Thurau et al., 2004). The eWOM is unique in a way it reaches larger population in short span of time, remains in the online databases for very long time, comparatively composed and impartial than word of mouth and the senders are known to the receivers (Kusawat & Teerakapibal, 2024). In the study conducted by Dea Khoirunnisa & Albari, (2023) found a positive impact of eWOM on PI. Further, another study by Baykal & Hesapci Karaca, (2022) also confirms that if customers are engaged in eWOM they exhibit the positive purchase intention. Hence, following hypothesis are proposed.

H12: eWOM positively influences purchase intention towards BEVs.

H13: eWOM plays the role of moderation on the relationship of consumers' attitudes and purchase intention towards BEVs.

Figure 1 graphically represents the integrated conceptual framework showing how relationships are hypothesized, theories are integrated, and factors are categorized in psychological, technological and economic with direction.

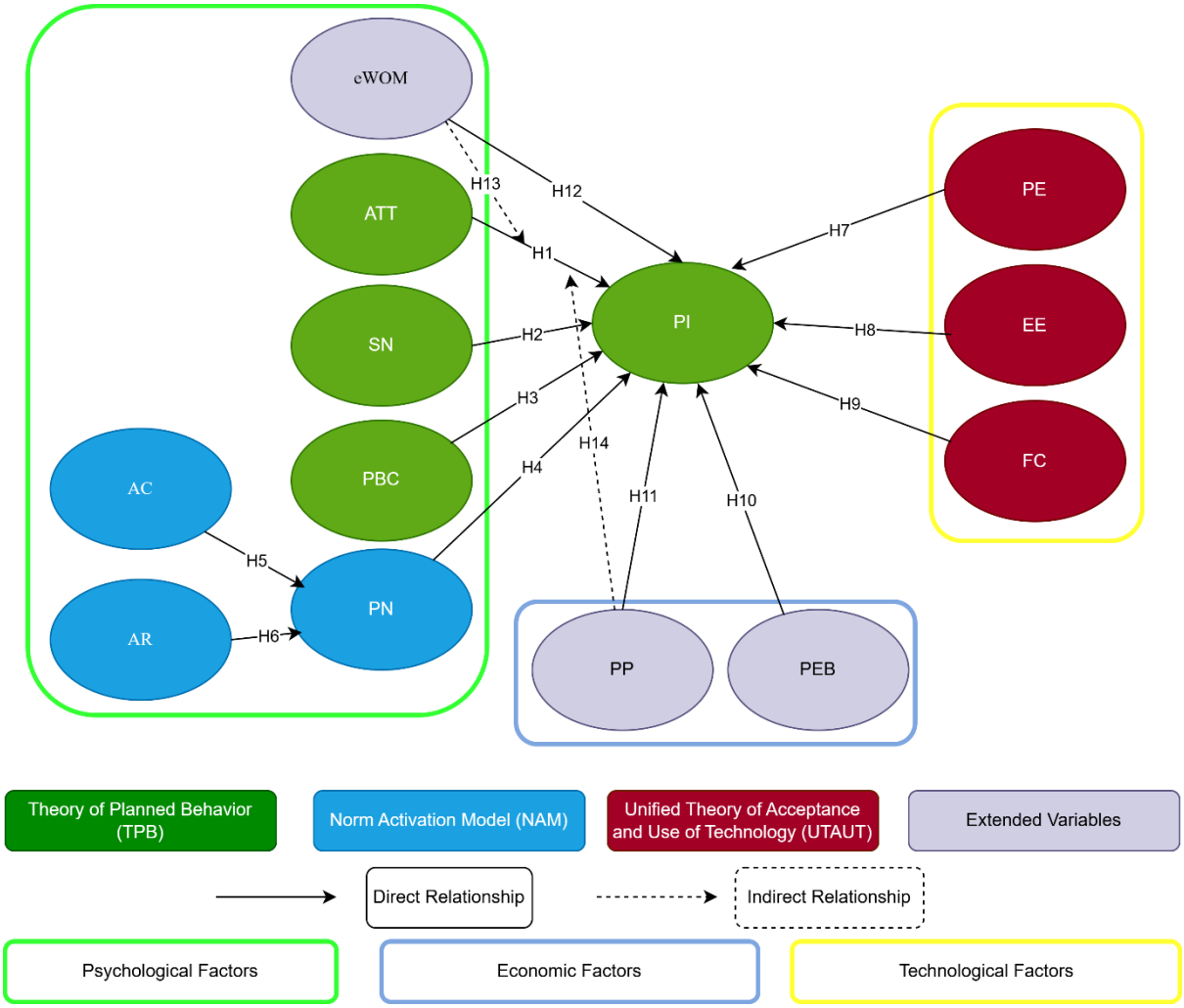

Figure 1. Conceptual framework for purchase intention of customers for Battery Electric Vehicles

4. Methodology

The study is explanatory in nature to find the various factors impacting the purchase intention of the customers (Shakya et al., 2024). The sample can be drawn using arrows pointing towards the dependent variable multiply by 20. In current study there are 10 arrows pointing towards the dependent variable, hence 10 times 20 make it 200 minimum sample size (Rahman, 2023). Measurement items must be adapted from the reputable research for replication and generalizability (Wicki et al., 2023). The structural equation model is the best to test the hypothesis with its two-step process involving measurement model and structural model to validate the measurement and confirm the relationships respectively (Hair et al., 2011). To analyze the data for descriptive and inferential statistics software statistical package for social sciences and Smart-PLS are highly regarded and recommended.

5. Discussion

The proposed integrated research framework is built upon three theories. The TPB is contributing to the psychological part of consumer where individual's self-interest is measured (Ajzen, 2011). Whereas the NAM is used to see the altruistic behavior of individuals for environment (Schwartz, 1977). UTAUT contributes to the technological perspectives of consumers about the BEVs (Venkatesh et al., 2003), particularly cars for personal use. Economic factors such as price and perceived economic benefits are expected to contribute to the economic aspect of individuals potential customers. The output of overall integrated framework will provide guidelines for understanding the customers from multiple fronts and it will provide government and manufacturers insights to improve the BEVs and target customers with right knowledge about their intentions towards BEVs.

This is a conceptual paper, but it proposed the sample of the study dependents on the population, but the sample size can be determined using Krejcie and Morgan table which is 384 sample size (Krejcie & Morgan, 1970) and it is a famous rule of thumb for population over 1 million (Memon et al., 2020). The data must be collected from individuals over 18 years of age, hold a driving license and know battery electric vehicles. The previous literature shows people mixed the vehicles in one study i.e. SUV, CAR, and HEV, PHEV and BEV. However, this paper proposes testing the battery electric cars only on single population and single generation i.e. generation Z. The data collected from all generations will help in understanding the difference between generations, but focus should be on single generation for greater understanding and providing concise information for marketers and government. The researcher may explain well their limitations such as time and resources for collecting data.

6. Conclusion

The urgent climate crisis establishes through global warming and increasingly extreme conditions, creating unprecedented challenges for humanity. The automobile industry is one of significant contributors to CO2 emissions worldwide due to its heavy rely on fossil fuels. BEVs emerged as a promising sustainable substitute that produces "0" emissions while eliminating fossil fuel consumption. Despite the introduction of diverse BEVs models across various nations, particularly in developed countries, adoption rates continue to fall short of global commitments and targets. Existing literature presents inconsistent, varied, and sometimes contradictory findings, necessitating more robust and comprehensive research to properly categorize influential factors. This article, following extensive literature review, proposes an integrated conceptual framework that combines key theoretical models including the TPB, NAM, and UTAUT, alongside economic factors and electronic word-of-mouth considerations. The research output purposes to deliver valued insights and guidelines for governments, producers, marketers, and policymakers, enabling them to better understand and prioritize the factors driving BEV adoption, ultimately accelerating consumer purchase intention through strategic planning that addresses customer needs and facilitates the timely transition to sustainable transportation and reducing climate change impact.

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