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Factors Influencing the Intention to Purchase Electric Vehicles Using an Extended TPB Model Approach

Hilmi Muhammad Harits Machsar*[1], Rizal Ramdan Padmakusumah[1], Lutfi Auliarahman[2]
Universitas Widyatama, Indonesia[1], Universitas Sebelas Maret, Indonesia[2]
*Corresponding Email: hm.harits@gmail.com

Abstract: Electric vehicles are currently being predicted to become a potential solution to the air pollution crisis occurring in major cities, such as Bandung. This study investigates factors that influence people's intention to purchase electric vehicles using the Extended TPB approach. The method employed is a descriptive quantitative approach using Partial Least Square–Structural Equation Modeling (PLS-SEM). SmartPLS V3 purposely served as the main analytical tool. The sample population of this study consists of residents of Greater Bandung, with a sample of 137 respondents. The results of the study indicate the influence and significance of Customer Innovativeness and Perceived Benefits on EV Adoption Intention, as well as the roles of Attitude Toward EV Adoption and Perceived Behavioral Control as its mediators.

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INTRODUCTION

According to the 2024 Environmental Performance Index (EPI), Indonesia ranks at 163 out of 180 countries, with a score of 33.6. In addition, Indonesia's position in climate change mitigation stands at 32.1 points, placing it as the 20th out of 25 Southeast Asian countries, sitting far below Timor Leste, which ranks first with 65.2 points (Block et al., 2024). The development of urbanization in major cities has caused serious problems, such as increased air pollution (Pravitasari et al., 2022). Throughout 2025, West Java ranked second among the ten regions with the highest Air Pollution Standard Index (ISPU) in Indonesia (Fadhlurrahman, 2025). PM2.5 levels in its capital, Bandung, reached a staggering 29.4 µg/m³ (micrograms per cubic meter), far exceeding the WHO standard of 5 µg/m³ (Energy Policy Institute at the University of Chicago (EPIC), 2024). Combustion of fossil fuels is the primary source of particulate pollution (PM2.5), contributing around 60% of total emissions (Lee & Greenstone, 2021). Evidence shows that electromobility can play a significant role in reducing air pollution, as demonstrated in the case of Szczecin City, Poland (Pietrzak & Pietrzak, 2020).

As a member of the countries in Southeast Asia, Indonesia possesses a low EV sales rate, at only 8% in the first quarter of 2023, far behind Thailand at 78% (Annur, 2023). Based on a comparative analysis of government policies supporting EV sales conducted by Yuan et al. (2024), several significant differences between Indonesia and Thailand may influence EV adoption rates in each country. The policy differences related to EV incentives that Indonesia does not have compared to Thailand include road tax reductions, exemption of vehicle registration fees, incentives and subsidies for charging-station providers, and income-tax exemptions for EV manufacturers. Indonesia's primary focus remains on the upstream sector, specifically nickel mining for electric vehicle (EV)

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battery materials, and at the same time, it lacks a cohesive strategy to attract greater investment in EV manufacturing.

Car sales data from 2020 to 2024 show that Indonesia's market is still overwhelmingly dominated by conventional vehicles, reaching up to 4.339.174 units sold. In comparison, hybrid cars accounted for 128.089 units and fully electric vehicles only 71.378 units (Gaikindo, 2025; Nurdifa & Rajendra, 2025; Rajendra, 2025). These figures highlight a substantial yet largely untapped growth opportunity for electric mobility in the country. In 2024, the landscape of electric vehicle sales was notably led by Chinese manufacturers, surpassing many long-established automotive brands in Indonesia (Kurniawan & Maulana, 2025). A survey by PwC Indonesia (2024) found that 78% of respondents expressed interest in purchasing an electric vehicle, and 84% expected to buy one within the next five years. The primary motivations included lower fuel or per-kilometer costs, environmental considerations, and the convenience of home charging. However, 15% of respondents remained skeptical, indicating no intention to purchase an EV in the same period. Their concerns centered on limited driving range, lengthy charging times, and uncertainty about battery lifespan. When evaluating new electric vehicles, respondents highlighted at least five major decision factors, with price, battery range, infotainment/connectivity features, and vehicle design among the most important.

Indonesia's two-wheeler market competition from 2020 to 2023 remains heavily dominated by conventional motorcycles, with sales reaching 20.176.594 units, while electric motorcycles accounted for only 75.015 units (Javier, 2025). Compared with electric motorcycles, the adoption of electric cars has been relatively stronger. A major contributing factor is that electric cars now offer advanced features and technology while being priced more competitively than their conventional and hybrid equivalents. In contrast, electric motorcycle sales have grown more slowly due to the structure of Indonesia's motorcycle industry, where around 90% of the market relies on leasing. This financing model poses a significant barrier to electric motorcycle ownership (Raharja, 2025).

Based on the study by (Maulina et al., 2022), the Theory of Planned Behavior (TPB) serves as the primary theoretical framework for explaining the purchase behavior of environmentally friendly products. To investigate the factors influencing the intention to adopt electric vehicles in Indonesia, the Extended Theory of Planned Behavior (Extended TPB) is a suitable theoretical approach. Recent studies conducted by Boo & Tan (2024), Buhmann et al. (2024), Dutta & Hwang (2021), He et al. (2022), Shalender & Sharma (2021 Yeğin & Ikram (2022) have used the Extended TPB approach to examine the factors that shape the intention to adopt electric vehicles.

Research conducted (Buhmann et al., 2024; Dutta & Hwang, 2021; Shalender & Sharma, 2021) has presented that the intention to adopt electric vehicles (EVs) is positively influenced by attitude, subjective norm, and perceived behavioral control. Studies by Boo & Tan (2024) and He et al. (2022), on the other hand, show that only attitude and perceived behavioral control positively influence EV adoption intention. Featherman et al. (2021) explain that perceived risk has a negative effect on EV adoption intention, while perceived benefit has a positive effect. In addition, Loh & Hassan (2022), in the context of food truck products, explain that perceived benefits have a positive influence on customer attitudes, which ultimately leads to a stronger intention to repurchase. On the other hand, perceived risk has a negative effect on customer attitudes.

Pratminingsih et al. (2025) highlight that individuals with high novelty-seeking tendencies exhibit stronger behavioral intentions in the context of creative tourism. According to Chauhan et al. (2021), personal innovativeness also has a positive effect on the intention to purchase green products online. Furthermore, Hoque et al. (2024) found that perceived behavioral control partially mediates the relationship between consumer innovativeness and continuance intention of e-money.

Several prior studies on electric vehicle adoption that apply extended versions of the Theory of Planned Behavior have not jointly examined customer innovativeness, perceived benefits, and perceived risk within a single analytical framework. In addition, empirical research using an extended TPB model to explain electric vehicle adoption in developing-country contexts, including Indonesia, remains limited.

This study addresses these gaps in three ways. First, it expands the TPB framework by incorporating customer innovativeness, perceived benefits, and perceived risk as key determinants of electric vehicle adoption intention. Second, it evaluates the mediating roles of attitude toward EV adoption and perceived behavioral control within an integrated model. Third, it provides empirical evidence from the Greater Bandung area, an urban region facing significant air pollution challenges, thereby strengthening the understanding of electric vehicle adoption behavior in emerging market contexts.

Therefore, this study aims to examine the effects of customer innovativeness, perceived benefits, and perceived risk on electric vehicle adoption intention, as well as the mediating roles of attitude toward EV adoption and perceived behavioral control, using an extended TPB model in the Indonesian context.

LITERATURE REVIEW

Wei et al. (2025) explain that the Theory of Planned Behavior (TPB), introduced by Icek Ajzen in 1991, represents an important development of the Theory of Reasoned Action (TRA). This theory aims to explain how an individual's intention can influence their behavior. Within the TPB framework, the intention to perform a particular action is the most important factor in determining whether a person will actually carry out that action. The intention to engage in a behavior is influenced by three main factors. First, attitude toward the behavior, which refers to an individual's evaluation of whether a particular action is considered good or bad. Second, subjective norms, which reflect an individual's perception of social pressure or encouragement from people around them to perform or not perform the action. Third, perceived behavioral control, which refers to an individual's belief about how easy or difficult it is to act, and this is closely related to their sense of capability or confidence in carrying it out.

Featherman et al. (2021) state that purchasing an electric vehicle exposes consumers to potential negative outcomes and personal losses, while Perceived Benefits relate to an individual's view of the advantages an EV offers, including improvements to personal lifestyle through the driving experience. Featherman et al. (2021) outline several dimensions of Perceived Risk: (a) performance risk, the possibility of issues related to driving performance and reliability; (b) financial risk, potential financial losses from the purchase and maintenance of an EV; (c) privacy risk, the risk of personal driving information being compromised; (d) time risk, the potential loss of time caused by challenges in charging the vehicle; (e) psychological risk, feelings of frustration, stress, or reduced peace of mind associated with EV ownership and use; (f) social risk, the concern of losing social status within one's social network; (g) physical safety risk, the possibility of personal injury related to charging the EV at home.

The dimensions of Perceived Benefits identified by Featherman et al. (2021) in the context of electric vehicles include: (a) time savings, the belief that using an EV reduces time spent on tasks such as refueling or routine maintenance like oil changes; (b) financial savings, the belief that EV adoption will lead to long-term cost reductions over the vehicle's lifetime; (c) environmental savings, the belief that EV use improves local environmental quality by reducing reliance on oil and gasoline that generate harmful emissions; (d) sustainability, the belief that EV adoption supports national energy independence by decreasing dependence on imported oil; (e) driving excitement, the belief that using an EV enhances daily enjoyment and driving pleasure; (f) eco pride and satisfaction, the belief that EV adoption provides a form of self-expression connected to personal identity and lasting satisfaction.

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Chao et al. (2022) categorize the decision to choose a vehicle as a highly involving product category because it involves high economic value, decision-related risk, as well as emotional and symbolic meanings associated with consumer identity. In high-risk purchase decisions, consumers tend to pay greater attention to technical aspects, hedonic experiences, and the symbolic meaning of the vehicle to obtain greater value. Furthermore, the study by Chao et al. (2022) finds that consumer innovativeness, particularly Domain-Specific Innovativeness (DSI), plays an important role; however, its direct effect on actual adoption is relatively weak.

Therefore, this study aims to examine the effects of customer innovativeness, perceived benefits, and perceived risk on electric vehicle adoption intention, as well as the mediating roles of attitude toward EV adoption and perceived behavioral control, using an extended TPB model in the Indonesian context. Accordingly, this research proposes nine hypotheses, that is:

H1: Attitude toward EV adoption has a positive effect on EV adoption intention.
H2: Subjective norm has a positive effect on EV adoption intention.
H3: Perceived behavioral control has a positive effect on EV adoption intention.
H4: Perceived risk has a negative effect on attitude toward EV adoption.
H5: Perceived benefits have a positive effect on attitude toward EV adoption.
H6: Perceived risk has a negative effect on EV adoption intention.
H7: Perceived benefits have a positive effect on EV adoption intention.
H8: Customer innovativeness has a positive effect on perceived behavioral control.
H9: Customer innovativeness has a positive effect on EV adoption intention.

METHODS

In this study, a causal research design with a quantitative approach is used. This study analyzes the causal links between the independent variables (perceived risk, perceived benefits, subjective norm, and customer innovativeness) and the dependent variable, electric vehicle adoption intention, with attitude toward behavior and perceived behavioral control functioning as mediating variables. Hair et al. (2021) explain that the determination of the minimum sample size should continue to take into account the strength of the statistical power of the estimation results, and researchers may use the power tables introduced by Cohen in 1992. The sample size also exceeds the minimum requirement of 130 respondents for an endogenous construct with six predictors at $\alpha = 0.05$ and power = 0.80. In this study, the total number of samples successfully collected was 137. The questionnaire was distributed through two channels: directly at the GIIAS exhibition in Bandung and via social media.

This study's questionnaire includes 27 indicators drawn from the core TPB constructs, Attitude Toward the Behavior, Subjective Norm, Perceived Behavioral Control, and Adoption Intention, adapted from (Shalender & Sharma, 2021). The constructs of Perceived Risk and Perceived Benefits are adapted from Featherman et al. (2021), while Customer Innovativeness is measured using the Domain-Specific Innovativeness Scale (DSI Scale). Respondents provide their answers using a Semantic Differential Scale for the Attitude Toward the Behavior construct and a Likert scale for other constructs.

The sampling technique used in this study is purposive sampling, a non-probability approach in which respondents are deliberately selected based on specific criteria aligned with the research objectives (Creswell & Creswell, 2023). The sample criteria target individuals aged 20–59 years living in the Greater Bandung area, including Bandung Regency, West Bandung Regency, Bandung City, and Cimahi City. A report according to Perusahaan Listrik Negara (PLN) (2025) shows that the ratio of Public Electric Vehicle Charging Stations (SPKLU) to the amount of electric vehicles in West Java is 1:18, meaning one SPKLU serves roughly 18 EVs.

This ratio suggests that although EV adoption in the province is increasing rapidly, charging infrastructure remains limited, positioning West Java as a potentially strategic and attractive market for electric vehicle promotion.

The questionnaire data were analyzed using the PLS-SEM (Partial Least Squares–Structural Equation Modeling) method in SmartPLS V3. In this study, the outer model was evaluated using the reflective measurement model assessment guidelines proposed by Hair et al. (2021), which include examining indicator loadings, construct reliability, convergent validity, and discriminant validity. The inner model analysis further assesses the model's predictive capability using several indicators: coefficient of determination (R^2), effect size (f^2), cross-validated redundancy (Q^2), and the size and significance of the path coefficients.

RESULTS AND DISCUSSION

In this study, 57% of respondents reported that they are currently looking for a new vehicle, 20% were undecided, and 23% indicated they were not in the market for a new vehicle. Furthermore, 65% of respondents expressed interest in electric cars, while 35% showed interest in electric motorcycles. In addition, respondents in this study were predominantly aged 20-29 years and were employed as private-sector employees.

Table 1. Outer Model

Variables	Item	Outer Loadings	Cronbach's Alpha	Composite Reliability	AVE Value
Perceived Risk (X1)	PR 1	0,78	0,884	0,914	0,854
	PR 2	0,85			
	PR 3	0,78			
	PR 4	0,85			
	PR 5	0,84			
Perceived Benefits (X2)	PB 1	0,90	0,901	0,938	0,803
	PB 2	0,88			
	PB 3	0,95			
Subjective Norm (X3)	SN 1	0,86	0,864	0,906	0,955
	SN 2	0,76			
	SN 3	0,83			
	SN 4	0,89			
Customer Innovativeness (X4)	CI 3	0,76	0,878	0,924	0,811
	CI 4	0,89			
	CI 5	0,89			
EV Adoption Intention (Y)	AI 1	0,97	0,976	0,984	0,835
	AI 2	0,98			
	AI 3	0,97			
Attitude Toward EV Adoption (Z1)	AT 1	0,94	0,915	0,946	0,679
	AT 2	0,91			
	AT 3	0,91			
Perceived Behavioral Control (Z2)	PBC 1	0,82	0,882	0,928	0,707
	PBC 2	0,92			
	PBC 3	0,94			

Source*:* Data that has been processed by the author (2025)

According to Hair et al. (2021), indicator loadings above 0.708 indicate that a construct can explain more than 50% of the variance in its indicators. Cronbach's Alpha and Composite Reliability values between 0.70 and 0.95 reflect a satisfactory level of reliability. An AVE value of ≥ 0.50 indicates that, on average, the construct explains 50% or more of the variance of its indicators, signifying adequate convergent validity.

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Table 2. Heterotrait-Monotrait Ratio

Variables	AT	CI	AI	PBC	PB	PR	SN
AT							
CI	0,779						
AI	0,770	0,834					
PBC	0,737	0,761	0,720				
PB	0,778	0,769	0,824	0,708			
PR	0,344	0,501	0,394	0,519	0,494		
SN	0,705	0,786	0,742	0,792	0,724	0,551	

Source*:* Data that has been processed by the author (2025)

Hair et al. (2021) describe discriminant validity testing as the final step in evaluating a reflective measurement model. In PLS-SEM, discriminant validity is commonly assessed using the Heterotrait–Monotrait Ratio (HTMT). An HTMT value below 0.85 indicates that the constructs are clearly distinct, while values below 0.90 remain acceptable for constructs with conceptual similarities (Hair et al., 2021).

An R^2 value of 0.75, 0.50, and 0.25 can be interpreted as substantial, moderate, and weak, respectively (Hair et al., 2021). Based on the R Square results, the R^2 for Attitude Toward EV Adoption scored at 0.502, for Perceived Behavioral Control scored at 0.459, and EV Adoption Intention scored at 0.744. Additionally, Hair et al. (2021) explain that a Q^2 value greater than zero for an endogenous construct indicates that the model has adequate predictive relevance, whereas a Q^2 value below zero suggests a lack of predictive capability. The blindfolding results show that the Q^2 values for Attitude Toward EV Adoption, Perceived Behavioral Control, and EV Adoption Intention are all greater than zero, at 0.419, 0.367, and 0.700, respectively.

Table 3. Effect Size

Variables	AT	CI	AI	PBC	PB	PR	SN
AT			0,028				
CI			0,147				
AI							
PBC			0,010				
PB	0,793		0,161				
PR	0,000		0,011				
SN			0,026				

Source*:* Data that has been processed by the author (2025)

According to Cohen's criteria cited in Hair et al. (2021), an f^2 value of 0.02 indicates a small effect, 0.15 indicates a medium effect, and 0.35 indicates a large effect. Based on the results, customer innovativeness shows a large effect on perceived behavioral control with a value of 0.84. In addition, perceived benefits demonstrate a large effect on attitude toward EV adoption intention with a value of 0.79. To determine whether the relationships between variables are significant, the bootstrapping procedure is applied to obtain significance levels, using 5,000 subsamples (Hair et al., 2021). The significance level (α) used in this study is 0.05 (5%), with a one-tailed test.

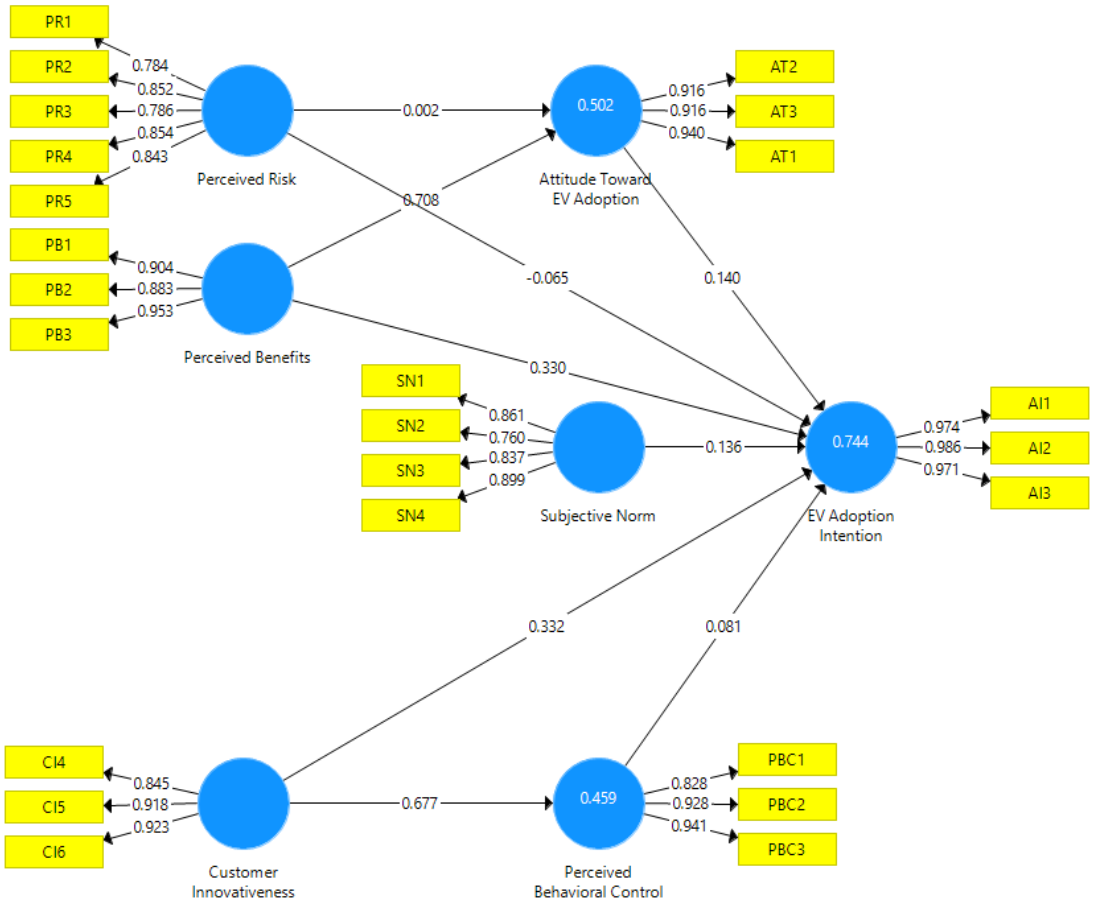

Figure 1. Path Coefficient Extended TPB Model Towards EV Adoption Intention
Source*:* Data that has been processed by the author (2025)

Hair et al. (2021) further explained that if the *t* value is above 1,96, it indicates that the path coefficient differs significantly from zero at the 5% significance level. In addition, the *p*-value must be smaller than 0,05 for the tested relations to be considered statistically significant.

Table 4. Output Path Coefficient

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Conclusion
PR→AT	0,002	0,000	0,072	0,026	0,490	Positive and Not Significant
PR→EV AI	-0,065	-0,062	0,057	1,141	0,127	Negative and Not Significant
PB→AT	0,708	0,712	0,054	13,069	0,000	Positive and Significant
PB→EV AI	0,330	0,328	0,103	3,197	0,001	Positive and Significant
AT→EV AI	0,140	0,136	0,093	1,507	0,066	Positive and Not Significant
SN→EV AI	0,136	0,141	0,096	1, 419	0,078	Positive and Not Significant

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	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Conclusion
CI→PBC	0,677	0,681	0,051	13,168	0,000	Positive and Significant
CI→EV AI	0,332	0,336	0,117	2,845	0,002	Positive and Significant
PBC→EV AI	0,081	0,075	0,099	0,817	0,207	Positive and Not Significant

Source*:* Data that has been processed by the author (2025)

Perceived Risk (X1) exhibits a positive but statistically insignificant relationship with Attitude Toward EV Adoption (Z1) (β = 0.002; t = 0.026; p = 0.490) and a negative, non-significant relationship with EV Adoption Intention (Y) (β = −0.065; t = 1.141; p = 0.127). In contrast, Perceived Benefits (X2) demonstrate a positive and statistically significant effect on both Attitude Toward EV Adoption (Z1) (β = 0.708; t = 13.069; p < 0.001) and EV Adoption Intention (Y) (β = 0.330; t = 3.197; p = 0.001). These patterns align directionally with Featherman et al. (2021), confirming the expected negative association of perceived risk and the positive role of perceived benefits, despite the absence of statistical significance for perceived risk in the present analysis. The strong positive influence of perceived benefits is further consistent with findings by Loh and Hassan (2022), who reported a significant contribution of perceived benefits to attitudes. While earlier studies typically identify a negative and significant effect of perceived risk on attitudes (Loh & Hassan, 2022), the current results indicate a positive yet insignificant relationship, suggesting that in the Greater Bandung context, perceived risk plays a limited role in attitude formation, potentially due to risk normalization and the predominance of benefit-based evaluations.

Attitude Toward EV Adoption (Z1) has a positive but non-significant effect on EV Adoption Intention (Y) (β = 0,140; t = 1,507; p = 0,066). Subjective Norm (X3) also has a positive but non-significant effect on EV Adoption Intention (Y) (β = 0,136; t = 1,419; p = 0,078). Perceived Behavioral Control (Z2) shows a positive yet non-significant effect on EV Adoption Intention (Y) (β = 0,081; t = 0,817; p = 0,207). Although the relationships are not statistically significant, their positive direction is consistent with findings reported in earlier studies (Boo & Tan, 2024; Buhmann et al., 2024; Dutta & Hwang, 2021; He et al., 2022; Shalender & Sharma, 2021; Yeğin & Ikram, 2022), indicating that the TPB framework receives partial support at the level of directional consistency. Customer Innovativeness (X4) has a positive and significant effect on Perceived Behavioral Control (Z2) (β = 0,677; t = 13,168; p = 0,000) as well as on EV Adoption Intention (Y) (β = 0,332; t = 2,845; p = 0,002). These findings are consistent with prior empirical findings (Chauhan et al., 2021; Hoque et al., 2024; Pratminingsih et al., 2025).

CONCLUSION

The findings yield several key conclusions. Customer innovativeness emerges as a significant positive determinant of both perceived behavioral control and intention to adopt electric vehicles, indicating that more innovative consumers feel more capable of adopting new technologies and are more inclined to do so. Perceived benefits also exert a strong positive influence on attitudes toward EV adoption and adoption intention, whereas perceived risk shows no significant effect on either attitudes or intentions, despite exhibiting the expected directional signs. Subjective norms display a marginally stronger influence than certain individual-level factors, particularly perceived behavioral control, highlighting the relevance of social influence in shaping adoption intentions. These results indicate that EV adoption in the studied context is driven primarily by innovativeness and perceived benefits, suggesting that the explanatory power of the core

attitudinal and control mechanisms of the Theory of Planned Behavior may be contingent on the technological novelty of the product context. The absence of a significant role for perceived risk suggests that adoption decisions are largely opportunity-driven, especially among innovative consumers who are more willing to tolerate uncertainty when anticipated benefits are salient. This aligns with innovation diffusion theory, which posits that early-stage adopters tend to tolerate uncertainty when anticipated benefits outweigh potential drawbacks. Nevertheless, the persistence of a gap between intention and actual adoption points to the importance of structural and contextual constraints that limit behavioral realization. Accordingly, the findings extend the TPB framework by emphasizing the need to incorporate innovation-related and ecosystem-level factors when examining adoption in technologically novel markets. From a practical perspective, manufacturers should focus on communicating tangible EV advantages through education, emphasizing cost efficiency, low maintenance, and environmental value, while policymakers should target highly innovative consumers as opinion leaders through communities and experiential initiatives. Complementary policy measures, including the expansion of SPKLU charging infrastructure and the provision of financial incentives such as reduced purchase costs, parking benefits, and lower electricity tariffs, are essential to translate adoption intentions into actual uptake.

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