IJEEP
INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY
EJ EconJournals
ISSN: 2146-4553

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2026, 16(1), 566-576.

Extending Green Technology Adoption Models: Determinants of MSMEs' Purchase Intention for a Hybrid Solar-Electric Cart in Urban Indonesia

Edi Purwanto[1]*, Hari Nugraha[2], Ismail Alif Siregar[2]

[1]Department of Management, Universitas Pembangunan Jaya, South Tangerang, Indonesia, [2]Department of Product Design, Universitas Pembangunan Jaya, South Tangerang, Indonesia. *Email: edi.purwanto@upj.ac.id

Received: 08 June 2025 **Accepted:** 21 October 2025 **DOI:** https://doi.org/10.32479/ijeep.21334

ABSTRACT

The rapid urbanization of Indonesia's metropolitan regions, particularly Jakarta and its surrounding cities (Jabodetabek), has intensified environmental challenges, including greenhouse gas emissions, air pollution, and energy dependency. The Hybrid Solar-Electric Cart (HSEC) has been developed to address these issues as an innovative, solar-assisted electric mobility solution tailored for micro, small, and medium enterprises (MSMEs). This study investigates the determinants influencing MSME owners' intention to purchase the HSEC, focusing on environmental concern, performance expectancy, effort expectancy, charging time, price, and operational cost, with attitude as a mediating variable. A quantitative survey was conducted with 200 MSME owners in Jabodetabek, and data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). Results show that environmental concern, performance expectancy, price, and operational cost significantly enhance attitudes toward the HSEC, while charging time and effort expectancy exert no significant effect. Furthermore, attitude strongly mediates the relationship between these determinants and purchase intention. This study contributes theoretically by extending green technology adoption models to the context of small-scale, solar-assisted electric mobility in developing economies. This domain has received limited empirical attention. Practically, the findings provide actionable insights for policymakers (e.g., targeted subsidies and charging infrastructure), manufacturers (e.g., cost-effective production and after-sales support), and MSMEs (e.g., operational efficiency and long-term savings). By bridging the gap between technology readiness and market adoption, the study advances Indonesia's transition toward a low-carbon economy while fostering sustainable growth among urban MSMEs.

Keywords: Hybrid Solar-Electric Cart, Green Technology Adoption, MSMEs, Sustainable Urban Mobility
JEL Classifications: Q42, Q55, O33, L62

1. INTRODUCTION

The escalating challenges of urban transportation in rapidly growing metropolitan regions, particularly in developing economies, demand innovative mobility solutions that are both environmentally sustainable and economically viable. In Indonesia, rapid urbanization in Jakarta and its surrounding metropolitan areas (Jabodetabek) has led to worsening traffic congestion, rising energy dependency, and deteriorating air quality. According to the Asian Transport Observatory (2024), urban transport contributes significantly to greenhouse gas emissions. Such conditions highlight the urgent need for alternative mobility solutions to reduce emissions, improve energy security, and remain affordable for small-scale economic actors.

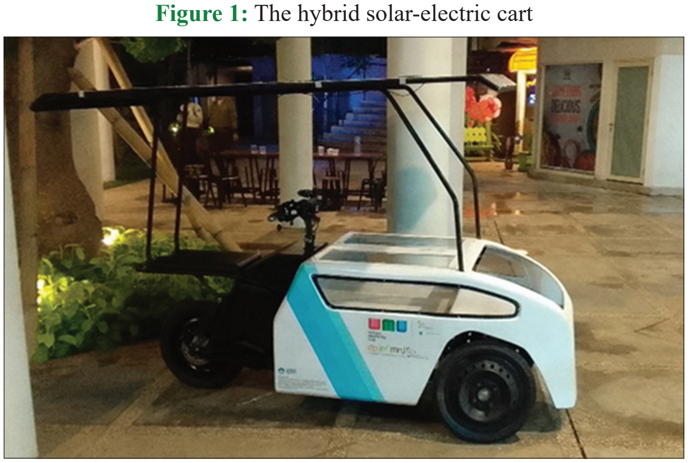
Electric vehicles (EVs) have emerged globally as a promising alternative to conventional internal combustion engine vehicles. Previous studies in China, India, and Vietnam have shown that EV adoption can substantially reduce emissions and improve operational efficiency (Dong et al., 2020; Jain et al., 2022; Hoang et al., 2022). However, adoption among micro, small, and medium enterprises (MSMEs) in Indonesia remains limited due to high acquisition costs, underdeveloped charging infrastructure, and uncertainty about long-term economic benefits. Unlike passenger cars and larger commercial EVs, MSMEs typically require low-cost, flexible, and reliable transport solutions for urban delivery and mobility. This underscores the importance of developing tailored technologies that address the MSME level's environmental and economic needs.

In response to these challenges, this study introduces the Hybrid Solar-Electric Cart (HSEC) (Figure 1), developed through an applied research project funded by the Directorate of Research, Technology, and Community Service (DRTPM), Ministry of Education, Culture, Research, and Technology of Indonesia in 2023 (Purwanto et al., 2023). The HSEC integrates photovoltaic charging technology with electric propulsion, enabling a cost-effective, low-emission, and operationally flexible vehicle designed explicitly for MSMEs operating in dense urban environments (Uddin et al., 2024). Its compact design, adaptability for diverse MSME needs, and reduced reliance on external charging infrastructure provide a practical solution for urban mobility.

Despite its technical readiness, the adoption of solar-assisted micro-electric vehicles like the HSEC remains underexplored. Previous research on EV adoption has predominantly focused on passenger cars and large-scale commercial fleets, emphasizing determinants such as environmental concern, performance expectancy, price, operational cost, charging time, and effort expectancy (Vafaei-Zadeh et al., 2022; Higueras-Castillo et al., 2023; Dong et al., 2020). However, there is a paucity of empirical evidence on how these factors shape adoption decisions for small-scale, solar-assisted vehicles designed for MSMEs in developing economies. Furthermore, the mediating role of attitude, how perceptions of environmental, technical, and economic benefits translate into purchase intention, remains insufficiently examined in this niche context.

To address this gap, this study investigates the determinants influencing MSME owners' intention to purchase the HSEC, focusing on the mediating role of attitude. Using a quantitative approach, survey data from 200 MSME owners in Jabodetabek are analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The study contributes to the literature in three ways: (1) it expands green transportation research by examining a novel solar-assisted micro-mobility innovation, (2) it evaluates the mediating role of attitude in linking technical, economic, and environmental perceptions to behavioral intentions, and (3) it provides evidence-based recommendations for policymakers, manufacturers, and urban planners to accelerate sustainable MSME transport adoption.

Figure 1: The hybrid solar-electric cart



Ultimately, this study aims to bridge the gap between technology readiness and market adoption of renewable energy-based vehicles, thereby supporting Indonesia's transition toward a low-carbon economy while fostering sustainable MSME growth.

2. LITERATURE REVIEW

2.1. Adoption of Electric and Solar-Assisted Vehicles

Global electric-vehicle (EV) adoption continues to accelerate, with over 17 million units sold in 2024, driven by an unprecedented expansion of public charging networks exceeding five million points (IEA, 2025). In emerging markets, adoption trajectories are shaped by a delicate interplay of initial cost, policy incentives, and infrastructure gaps (UNEP, 2025; Zaino et al., 2024).

Recent comprehensive reviews of solar-assisted and vehicle-integrated photovoltaic (VIPV) systems highlight progress in lightweight materials, PV-cell efficiency, and hybrid power-management design (Oluwalana and Grzesik, 2025). These advances reinforce the relevance of the Hybrid Solar-Electric Cart (HSEC) as a form of micro-mobility innovation that combines the operational flexibility of EVs with the renewable self-sufficiency of solar energy, an application still underexplored empirically in developing-country contexts.

The transition toward sustainable urban mobility has generated extensive scholarly interest in electric vehicles (EVs), particularly their potential to reduce greenhouse gas (GHG) emissions, improve energy efficiency, and mitigate the adverse effects of fossil fuel dependency (Dong et al., 2020; Vafaei-Zadeh et al., 2022). In developing countries, small-scale electric transport solutions offer unique advantages due to lower upfront costs, adaptability to congested urban settings, and potential integration with renewable energy sources. The Hybrid Solar-Electric Cart, a solar-assisted micro-electric vehicle, exemplifies this trend, combining photovoltaic energy capture with battery-powered propulsion to serve micro, small, and medium enterprises (MSMEs) in urban areas. Despite its technical promise, however, limited consumer adoption persists, suggesting that technical feasibility alone is insufficient without understanding behavioral and market factors.

2.2. Determinants of Purchase Intention for Green Mobility Solutions

The determinants of EV adoption can be broadly categorised into environmental, technological, economic, and behavioural domains: environmental concern, performance expectancy, effort expectancy, charging time or infrastructure, price, and operational cost. Attitude functions as a key mediating construct.

Recent systematic reviews reaffirm that technical (performance, range), economic (total cost of ownership), and policy (subsidy and infrastructure) drivers interact dynamically to shape adoption intention (Zaino et al., 2024). A meta-analysis by Rosales-Tristancho et al. (2024) further demonstrates a critical consumer trade-off between driving range and charging availability, particularly salient for urban micro-mobility. Similarly, empirical studies highlight the pivotal role of charging infrastructure in influencing willingness to pay (Ahmad et al., 2025; IEA, 2025).

Consumer adoption of green transportation innovations is shaped by environmental, economic, and psychological factors (Higueras-Castillo et al., 2023; Asadi et al., 2021). Environmental concern reflects how individuals perceive their purchasing decisions as contributing to environmental protection (Vafaei-Zadeh et al., 2022). Performance expectancy refers to the perceived functional benefits of the technology, such as efficiency, reliability, and operational effectiveness, which have been shown to influence EV adoption significantly (Chada et al., 2023).

Economic variables, including price and operational cost, play a pivotal role in adoption decisions, particularly among MSMEs with tight budget constraints (Dong et al., 2020). Price captures consumers' perceptions of the vehicle's affordability relative to its perceived value, while operational cost reflects anticipated long-term savings in fuel and maintenance compared to conventional motorized carts. Charging time, representing the duration required to replenish the vehicle's energy storage, may also influence user acceptance, though prior studies have shown mixed findings on its significance (Brückmann and Bernauer, 2023; Austmann and Vigne, 2021). Effort expectancy, or perceived ease of use, further affects attitudes toward adoption, particularly in technology acceptance models (Wang et al., 2022; Jaiswal et al., 2021).

In Indonesia, recent research underscores financial incentives, industrial readiness, and charging accessibility as decisive enablers, while high cost and ecosystem immaturity remain significant barriers (Damanik et al., 2025; AC Ventures, 2023). Behavioural approaches integrating the Protection Motivation Theory with green-branding and policy-trust variables have further illuminated how normative and psychological factors mediate EV adoption (Basmantra et al., 2025; Hakam and Jumayla, 2024).

2.3. The Mediating Role of Attitude

Attitude toward the product is widely recognized as a central mediator linking adoption determinants to behavioral intentions (He et al., 2023; Yegin and Ikram, 2022). In the context of green transport innovations, attitude captures an individual's overall evaluation of the product's desirability, integrating environmental awareness, perceived performance, cost considerations, and usability perceptions into a single evaluative judgment. Positive attitudes have been consistently found to enhance the likelihood of purchase intention, while negative attitudes can neutralize even favorable technical and economic attributes (Sun et al., 2022).

2.4. State of the Art and Novelty

Previous studies have extensively examined the relationship between environmental awareness, attitude toward electric vehicles (EVs), and intention to purchase EVs. Research on the effect of environmental awareness on attitude toward EVs includes Purwanto and Irawan (2024; 2023), Upadhyay and Kamble (2023), Ackaah et al. (2022), Wang et al. (2021), Dutta and Hwang (2021), Jayasingh et al. (2021), and Miranda and Delgado (2020). Studies investigating its effect on intention to purchase EVs include Singh et al. (2023), Bi et al. (2023), Butt and Singh (2023), Yegin and Ikram (2022), Vafaei-Zadeh et al. (2022), Irfanto and Aprilianty (2022), Austmann and Vigne (2021), Cui et al. (2021), and Abbasi et al. (2021).

The influence of performance expectancy on attitude toward EVs has been explored by Chada et al. (2023), Wang et al. (2022), Gunawan et al. (2022), and Jaiswal et al. (2021). Its influence on intention to purchase EVs has been examined by Higueras-Castillo et al. (2023), Digalwar and Rastogi (2023), Jain et al. (2022), Hoang et al. (2022), and Jaiswal et al. (2021). Similarly, studies on the impact of effort expectancy on attitude toward EVs include Wang et al. (2022), Gunawan et al. (2022), Chada et al. (2023), and Jaiswal et al. (2021), while its relationship with intention to purchase EVs has been addressed by Jain et al. (2022), Hoang et al. (2022), Higueras-Castillo et al. (2023), and Jaiswal et al. (2021).

Research on charging time is comparatively limited. Brückmann and Bernauer (2023) and Miranda and Delgado (2020) have investigated its impact on attitude toward EVs, whereas Austmann and Vigne (2021) have examined its influence on intention to purchase. The effect of price on attitude toward EVs has been studied by Vafaei-Zadeh et al. (2022), Asadi et al. (2021), and Dutta and Hwang (2021), while its influence on purchase intention has been explored by Singh et al. (2023), Vafaei-Zadeh et al. (2022), Zhang et al. (2022), Asadi et al. (2021), and Cui et al. (2021).

In terms of operational cost, Dutta and Hwang (Dutta and Hwang, 2021) and Dong et al. (2020) have examined its relationship with attitude toward EVs, whereas Digalwar and Rastogi (2023) and Dong et al. (Dong et al., 2020) have focused on its influence on purchase intention. Lastly, the role of attitude toward EVs as a direct predictor of intention to purchase has been substantiated by He et al. (2023), Chada et al. (2023), Ackaah et al. (2022), Yegin and Ikram (2022), Shakeel (Shakeel, 2022), Sun et al. (2022), Tunçel (2022), and Vafaei-Zadeh et al. (2022).

Although the determinants outlined above have been extensively examined in EVs and larger commercial electric vehicles, empirical studies are scarce focusing on solar-assisted, small-scale EVs designed for MSME applications in emerging markets. The Hybrid Solar-Electric Cart presents a unique case, as it integrates renewable energy technology with micro-urban transport to simultaneously address operational efficiency, cost reduction, and environmental sustainability. By focusing exclusively on this innovation, the present study fills a significant gap by (1) empirically assessing how environmental concern, performance expectancy, effort expectancy, charging time, price, and operational cost influence intention to purchase; (2) evaluating the mediating role of attitude; and (3) providing strategic insights for accelerating adoption among MSMEs in urban Indonesia.

3. METHODOLOGY

3.1. Research Design

This study employed a quantitative, explanatory research design to investigate the determinants of micro, small, and medium enterprise (MSME) owners' purchase intention for the Hybrid Solar-Electric Cart (HSEC), particularly emphasizing the mediating role of attitude. The conceptual framework integrates constructs from the Unified Theory of Acceptance and Use of Technology (UTAUT) and green consumer behavior literature. Structural Equation Modeling (SEM) using the Partial Least Squares (PLS-SEM) technique was adopted because of its predictive orientation, ability to handle complex models with multiple latent constructs, and robustness in studies with relatively small to medium sample sizes. In contrast to covariance-based SEM (CB-SEM), which is primarily confirmatory, PLS-SEM is more suitable for exploratory contexts and evaluating emerging technological innovations such as solar-assisted micro-mobility in developing economies (Hair et al., 2021).

3.2. Population and Sample

The target population consisted of micro, small, and medium enterprises (MSME) owners and operators in the Jabodetabek region (Jakarta, Bogor, Depok, Tangerang, and Bekasi), with potential operational needs for a small-scale transport vehicle. Respondents were selected using purposive sampling, with inclusion criteria requiring participants to (1) be decision-makers in their businesses, (2) have a minimum of one year of operational experience, and (3) express interest in environmentally friendly transport solutions. A total of 200 valid responses were collected.

3.3. Data Collection Procedure

Data were collected through a structured online and face-to-face survey. To ensure informed responses, participants were first provided with an introductory video and digital leaflet describing the Hybrid Solar-Electric Cart's features, operational benefits, and environmental advantages. Product demonstrations and test drives were arranged for a subset of respondents to enhance familiarity with the technology. After this orientation, respondents completed the questionnaire independently.

3.4. Measurement of Variables

All constructs in this study were measured using multi-item scales adapted from validated instruments in previous electric vehicle (EV) adoption research, with wording modifications to fit the specific context of the Hybrid Solar-Electric Cart. Each item was assessed on a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Environmental Concern (ENVC) was measured using items adapted from Vafaei-Zadeh et al. (2022) and Dutta and Hwang (2021), focusing on the extent to which respondents perceive the purchase of the Hybrid Solar-Electric Cart as contributing to environmental protection.

Performance Expectancy (PE), adapted from Chada et al. (2023) and Wang et al. (2022), captured the perceived functional benefits of the cart, including efficiency, reliability, and productivity enhancements. Effort Expectancy (EE) was assessed using items from Jaiswal et al. (2021) and Wang et al. (2022), reflecting the perceived ease of learning and operating the vehicle.

Charging Time (CT) was measured using scales adapted from Brückmann and Bernauer (2023) and Austmann and Vigne (2021), focusing on perceptions of the time required to recharge the vehicle's battery. Price (P) was evaluated through items adapted from Asadi et al. (2021) and Dong et al. (2020), examining affordability relative to perceived value, while Operational Cost (OC), adapted from Dong et al. (2020) and Dutta and Hwang (2021), captured anticipated long-term savings in fuel and maintenance.

Attitude toward the Hybrid Solar-Electric Cart (ATT) was measured using items adapted from He et al. (2023) and Yegin and Ikram (2022), representing respondents' overall evaluative judgment of the vehicle's desirability. Finally, Intention to Purchase (ITP) was measured using items from Vafaei-Zadeh et al. (2022) and Sun et al. (2022), reflecting the likelihood that respondents would acquire the Hybrid Solar-Electric Cart in the future.

3.5. Data Analysis

Data were analyzed using SmartPLS 4.0 in two stages: First, the Measurement Model Evaluation assessed indicator reliability (outer loadings), internal consistency (Composite Reliability), convergent validity (Average Variance Extracted), discriminant validity (Fornell–Larcker Criterion), and coefficient of determination (R^2). Second is the Structural Model Evaluation, which examines path coefficients and significance levels via bootstrapping. For indirect effects, the bootstrapping method was used to test the mediating role of attitude.

4. RESULTS

4.1. Measurement Model Evaluation

Figure 2 presents the measurement model evaluation, which assesses the reliability and validity of the constructs employed in this study. The model demonstrates that all observed indicators load firmly on their respective latent variables, with standardized factor loadings exceeding the widely accepted threshold of 0.70, confirming adequate indicator reliability. This suggests that each measurement item substantially represents its underlying construct, minimizing the risk of measurement error. The constructs, Attitude toward Hybrid Solar-Electric Chart, Performance Expectancy, Effort Expectancy, Intention to Purchase, Charging Time, Environmental Concern, Price, and Operational Cost, are all well-represented in the measurement framework. Furthermore, the absence of low-loading items indicates that no indicators require removal, supporting the internal consistency and robustness of the measurement model. These results provide empirical evidence that the measurement model is both conceptually and statistically sound, offering a solid foundation for subsequent structural model analysis.

4.1.1. Indicator reliability

Table 1 reports the outer loadings of individual indicators for each latent construct, which are the basis for evaluating indicator reliability. The results reveal that all loading values

Figure 2: Measurement model evaluation

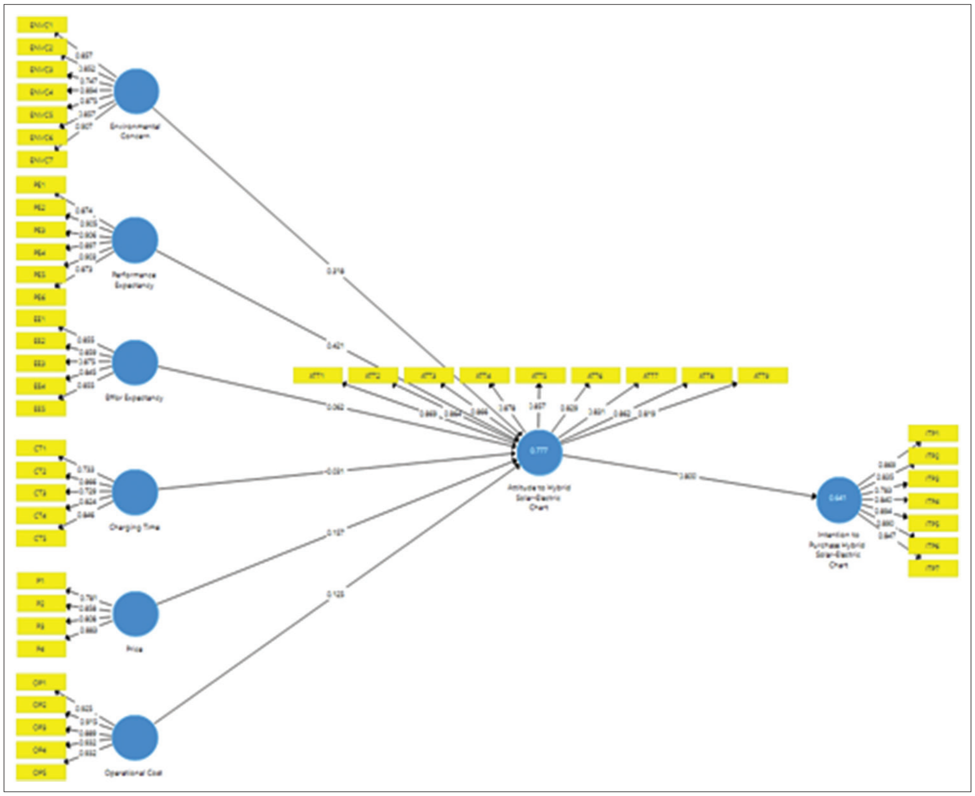


Table 1: Indicator reliability

Attitude toward		Performance expectancy	
ATT1	0.869	PE1	0.874
ATT2	0.864	PE2	0.905
ATT3	0.866	PE3	0.906
ATT4	0.878	PE4	0.897
ATT5	0.857	PE5	0.903
ATT6	0.829	PE6	0.873
ATT7	0.831	**Effort expectancy**	
ATT8	0.862	EE1	0.855
ATT9	0.819	EE2	0.859
Intention to purchase		EE3	0.875
ITP1	0.869	EE4	0.845
ITP2	0.835	EE5	0.855
ITP3	0.783	**Charging time**	
ITP4	0.840	CT1	0.733
ITP5	0.894	CT2	0.866
ITP6	0.890	CT3	0.729
ITP7	0.847	CT4	0.824
Environtmental concern		CT5	0.846
ENVC1	0.857	**Price**	
ENVC2	0.852	P1	0.781
ENVC3	0.747	P2	0.858
ENVC4	0.894	P3	0.808
ENVC5	0.875	P4	0.883
ENVC6	0.857	**Operational cost**	
ENVC7	0.907	OP1	0.925
		OP2	0.915
		OP3	0.889
		OP4	0.932
		OP5	0.932

exceed the recommended minimum threshold of 0.70 (Hair et al., 2021), indicating that the observed variables share a substantial proportion of variance with their corresponding latent constructs. Specifically, the loadings for Attitude toward Hybrid Solar-Electric Chart (ATT1–ATT9) range from 0.819 to 0.878, demonstrating strong internal consistency within the construct. Performance Expectancy (PE1–PE6) exhibits particularly high loadings (0.873–0.906), suggesting a highly reliable measurement scale.

Similarly, Effort Expectancy (EE1–EE5) records loadings between 0.845 and 0.875, while Intention to Purchase (ITP1–ITP7) demonstrates consistently high reliability with values ranging from 0.783 to 0.894. The construct Charging Time (CT1–CT5) displays slightly more variability, with loadings between 0.729 and 0.866; nevertheless, all values still surpass the minimum acceptance level, supporting their retention in the model. The loadings for Environmental Concern (ENVC1–ENVC7) are robust (0.747-0.907), affirming the construct's measurement precision. Price (P1–P4) ranges from 0.781 to 0.883, while Operational Cost (OP1–OP5) records exceptionally high loadings (0.889-0.932), indicating strong representation and minimal measurement error.

These findings confirm that each construct is measured with satisfactory indicator reliability, thus meeting the initial criteria for construct validity and supporting the appropriateness of the measurement model for further structural analysis.

4.1.2. Composite reliability

Table 2 presents all latent constructs' composite reliability (CR) values, assessing their internal consistency. Across all constructs, CR values range from 0.900 (Charging Time and Price) to 0.964

(Operational Cost), far exceeding the conventional minimum threshold of 0.70 (Hair et al., 2021). These results indicate that the items within each construct consistently measure the same underlying concept, reflecting substantial homogeneity and stability of the measurement scales.

The constructs Attitude toward Hybrid Solar-Electric Chart (CR = 0.960), Performance Expectancy (CR = 0.959), Environmental Concern (CR = 0.951), and Intention to Purchase (CR = 0.949) all demonstrate very high composite reliability, underscoring their robustness as latent variables in the model. Effort Expectancy (CR = 0.933) also shows excellent internal consistency, while the more practical and economic dimensions, Price (0.901) and Charging Time (0.900), still maintain values well above the threshold, confirming measurement stability despite covering potentially more diverse perceptions.

The uniformly high CR values suggest the measurement model is free from significant internal inconsistency issues. This strengthens the statistical foundation for proceeding to validity testing, including convergent and discriminant validity assessments, ensuring that the constructs are reliable and valid representations of the concepts under investigation.

4.1.3. Convergent validity

Table 3 reports the Average Variance Extracted (AVE) values for all constructs, which measure convergent validity by indicating the proportion of variance captured by a construct relative to the variance attributable to measurement error. Following the guideline established by Fornell and Larcker (1981), an AVE value of 0.50 or higher is considered acceptable. In this study, all constructs exceed this threshold, with AVE values ranging from 0.643 (Charging Time) to 0.844 (Operational Cost), confirming that each construct explains more than half of the variance of its respective indicators.

Table 2: Composite reliability

Variables	Composite reliability
Attitude to hybrid solar-electric chart	0.960
Charging time	0.900
Effor expectancy	0.933
Environmental concern	0.951
Intention to purchase hybrid solar-electric chart	0.949
Operational cost	0.964
Performance expectancy	0.959
Price	0.901

Table 3: Average variance extracted (AVE)

Variables	Average variance extracted (AVE)
Attitude to hybrid solar-electric chart	0.728
Charging time	0.643
Effor expectancy	0.736
Environmental concern	0.734
Intention to purchase hybrid solar-electric chart	0.726
Operational cost	0.844
Performance expectancy	0.798
Price	0.695

Specifically, Attitude toward Hybrid Solar-Electric Chart (0.728), Performance Expectancy (0.798), and Effort Expectancy (0.736) all exhibit strong convergent validity, indicating that their measurement items are highly correlated with the underlying constructs. Similarly, Environmental Concern (0.734) and Intention to Purchase (0.726) present robust AVE values, effectively capturing the intended conceptual domains. Price (0.695) also meets the criterion comfortably, while Operational Cost stands out with an exceptionally high AVE (0.844), reflecting the high explanatory power of its indicators.

These AVE results, in conjunction with the high composite reliability values reported in Table 2, provide strong evidence of convergent validity for all constructs in the measurement model. This ensures that the latent variables possess internal consistency and adequately represent the theoretical concepts they are intended to measure, laying a solid foundation for subsequent discriminant validity testing.

4.1.4. Discriminant validity

Table 4 presents the Fornell–Larcker Criterion results, which assess discriminant validity by comparing the square root of each construct's AVE (shown on the diagonal) with the inter-construct correlations (off-diagonal values). According to Fornell and Larcker (1981), discriminant validity is established when the square root of a construct's AVE is greater than its highest correlation with any other construct.

In this study, all constructs meet this requirement. For instance, the square root of the AVE for Attitude toward Hybrid Solar-Electric Chart (0.853) is greater than its highest correlation with other constructs, notably Performance Expectancy (0.795) and Intention to Purchase (0.800). Likewise, Performance Expectancy (0.893) surpasses its correlations with Charging Time (0.765) and Attitude (0.795). Constructs with substantial conceptual overlaps, such as Attitude and Intention to Purchase (correlation = 0.800), still maintain distinctiveness, as indicated by their AVE square roots being higher than the inter-construct correlation values.

The Operational Cost construct is particularly noteworthy, as it has the highest AVE square root (0.919) and relatively moderate correlations with other constructs, indicating strong conceptual independence. Even constructs with moderate AVE square roots, such as Charging Time (0.802) and Price (0.833), still demonstrate discriminant validity by exceeding their respective inter-construct correlations.

The Fornell–Larcker Criterion results confirm that each latent construct captures unique aspects of the underlying theoretical

Table 4: Fornell-Larcker Criterion

	ATT	CT	EE	ENVC	ITP	OC	PE	P
ATT	0.853							
CT	0.701	0.802						
EE	0.591	0.680	0.858					
ENVC	0.737	0.598	0.485	0.857				
ITP	0.800	0.691	0.617	0.651	0.852			
OC	0.678	0.611	0.532	0.600	0.685	0.919		
PE	0.795	0.765	0.600	0.571	0.749	0.624	0.893	
P	0.692	0.643	0.491	0.585	0.608	0.547	0.641	0.833

framework, avoiding redundancy and multicollinearity issues. This reinforces the measurement model's robustness and ensures that subsequent structural model estimations will be based on conceptually distinct constructs.

4.1.5. Coefficient of determination (R^2)

Table 5 shows substantial explanatory power for both endogenous constructs. The antecedents jointly explain 77.7% of the variance in Attitude toward Hybrid Solar-Electric Chart ($R^2 = 0.777$; adjusted $R^2 = 0.770$), indicating the predictors provide a tight account of attitudinal formation with minimal shrinkage after adjustment. Likewise, Attitude explains 64.1% of the variance in Intention to Purchase ($R^2 = 0.641$; adjusted $R^2 = 0.639$), constituting a strong level of prediction for behavioral intention in consumer adoption research. The closeness of R^2 and adjusted R^2 in both models suggests limited overfitting and good model parsimony.

Conceptually, these magnitudes align with the pattern of path coefficients: Performance Expectancy and Environmental Concern are the dominant antecedents of Attitude, with Price and Operational Cost providing additional, smaller yet significant contributions. The high R^2 values, therefore, reflect a theoretically coherent and empirically well-supported structure.

Table 5: R square

Endogenous variables	R square	R square adjusted
Attitude to hybrid solar-electric chart	0.777	0.770
Intention to purchase hybrid solar-electric chart	0.641	0.639

4.2. Structural Model Evaluation

Figure 3 illustrates the structural model evaluation, which depicts the hypothesized relationships between the latent constructs and their respective path coefficients. The visual representation highlights the magnitude and significance of the direct and indirect effects among constructs, as tested using Partial Least Squares Structural Equation Modeling (PLS-SEM). The model reveals that Attitude toward Hybrid Solar-Electric Chart exerts the most substantial direct influence on Intention to Purchase ($\beta = 0.800$, $P < 0.001$), underscoring the pivotal role of attitudinal factors in shaping consumers' adoption intentions for hybrid solar-electric technology.

Among the antecedents of Attitude, Performance Expectancy ($\beta = 0.421$, $P < 0.001$) and Environmental Concern ($\beta = 0.318$, $P < 0.001$) emerge as the most influential predictors, indicating that both perceived functional benefits and ecological considerations substantially enhance positive attitudes. Price ($\beta = 0.157$, $P < 0.05$) and Operational Cost ($\beta = 0.125$, $P < 0.01$) also show significant, albeit more minor, effects, suggesting that economic considerations contribute meaningfully to consumer attitudes. In contrast, Effort Expectancy ($\beta = 0.062$, $P = 0.169$) and Charging Time ($\beta = -0.031$, $P = 0.664$) are not statistically significant, implying that ease of use and time-related constraints do not play a decisive role in forming consumer attitudes within this context.

4.2.1. Path Coefficients

Table 6 presents the standardized path coefficients, associated t-statistics, and p-values, providing a statistical basis for interpreting the relationships depicted in Figure 2. The findings confirm that Attitude toward Hybrid Solar-Electric Chart is the

Figure 3: Structural model evaluation

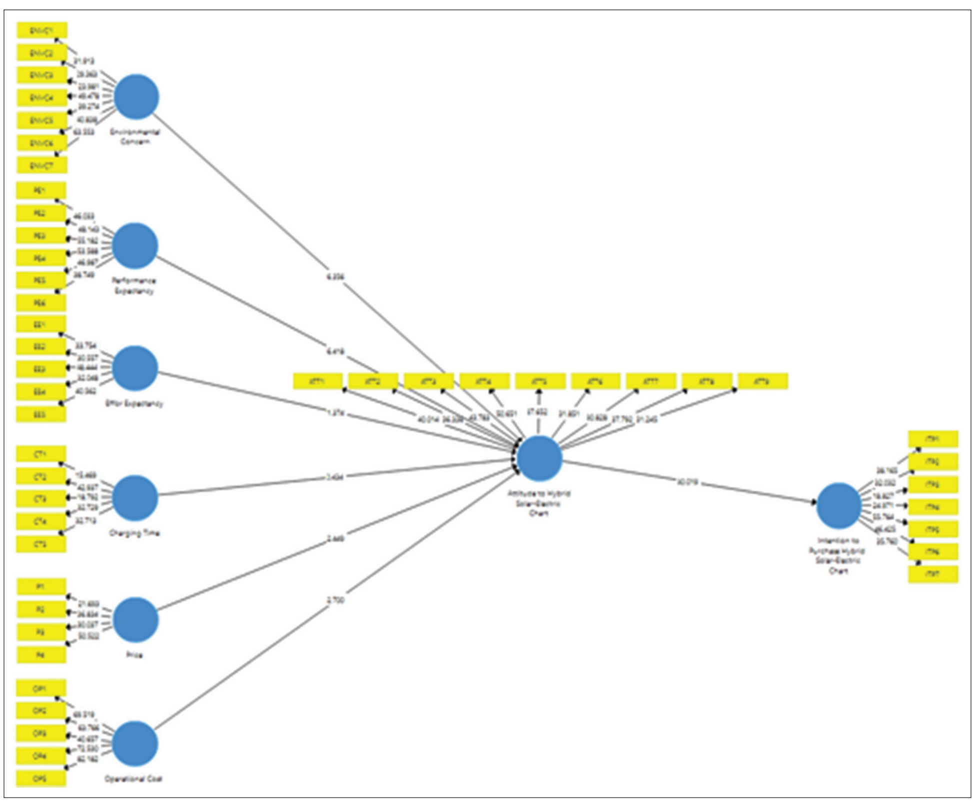


Table 6: Path coefficients

Hypotheses	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P-values
Attitude to hybrid solar-electric chart -> intention to purchase hybrid solar-electric chart	0.800	0.801	0.027	30.019	0.000
Charging time -> attitude to hybrid solar-electric chart	-0.031	-0.033	0.071	0.434	0.664
Effor expectancy -> attitude to hybrid solar-electric chart	0.062	0.061	0.045	1.374	0.169
Environmental concern -> attitude to hybrid solar-electric chart	0.318	0.320	0.050	6.356	0.000
Operational cost -> attitude to hybrid solar-electric chart	0.125	0.124	0.046	2.700	0.007
Performance expectancy -> attitude to hybrid solar-electric chart	0.421	0.424	0.066	6.418	0.000
Price -> attitude to hybrid solar-electric chart	0.157	0.156	0.064	2.449	0.014

Table 7: Specific indirect effects

Hypotheses	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P-values
Charging Time -> Attitude to Hybrid Solar-Electric Chart -> Intention to Purchase Hybrid Solar-Electric Chart	−0.025	−0.026	0.057	0.435	0.664
Effor Expectancy -> Attitude to Hybrid Solar-Electric Chart -> Intention to Purchase Hybrid Solar-Electric Chart	0.050	0.049	0.036	1.365	0.172
Environmental Concern -> Attitude to Hybrid Solar-Electric Chart -> Intention to Purchase Hybrid Solar-Electric Chart	0.255	0.256	0.038	6.665	0.000
Operational Cost -> Attitude to Hybrid Solar-Electric Chart -> Intention to Purchase Hybrid Solar-Electric Chart	0.100	0.100	0.038	2.653	0.008
Performance Expectancy -> Attitude to Hybrid Solar-Electric Chart -> Intention to Purchase Hybrid Solar-Electric Chart	0.337	0.339	0.055	6.132	0.000
Price -> Attitude to Hybrid Solar-Electric Chart -> Intention to Purchase Hybrid Solar-Electric Chart	0.126	0.124	0.050	2.502	0.012

most influential predictor of Intention to Purchase ($\beta = 0.800$, $t = 30.019$, $P < 0.001$), highlighting that consumers with more favorable attitudes are significantly more likely to express purchase intentions.

Among the predictors of Attitude, Performance Expectancy ($\beta = 0.421$, $t = 6.418$, $P < 0.001$) emerges as the strongest driver, suggesting that perceived performance benefits, such as efficiency, reliability, and output quality, are highly influential in shaping positive consumer perceptions. Environmental Concern ($\beta = 0.318$, $t = 6.356$, $P < 0.001$) is the second most powerful factor, indicating that eco-conscious consumers tend to develop stronger favorable attitudes toward hybrid solar-electric technology.

Economic factors also play a notable role: Price ($\beta = 0.157$, $t = 2.449$, $P < 0.05$) and Operational Cost ($\beta = 0.125$, $t = 2.700$, $P < 0.01$) both have significant positive effects, suggesting that affordability and anticipated long-term savings contribute to enhancing consumer attitudes. In contrast, Effort Expectancy ($\beta = 0.062$, $t = 1.374$, $P = 0.169$) and Charging Time ($\beta = -0.031$, $t = 0.434$, $P = 0.664$) are not statistically significant, implying that neither perceived ease of use nor charging duration materially influences consumer attitudes in this context.

These results indicate that the model is driven primarily by performance-related and environmental considerations, supplemented by economic evaluations. At the same time, usability and time-related factors are less critical for influencing attitudes toward hybrid solar-electric adoption.

Table 7 evaluates the mediating role of Attitude toward Hybrid Solar-Electric Cart in transmitting the effects of its antecedents to Intention to Purchase. The results reveal several significant indirect pathways, underscoring Attitude as a key psychological mechanism influencing purchase intentions.

The most substantial indirect effect is observed for Performance Expectancy ($\beta = 0.337$, $t = 6.132$, $P < 0.001$), indicating that perceived functional benefits directly enhance attitudes and translate into higher purchase intentions through attitudinal reinforcement. Environmental Concern follows closely ($\beta = 0.255$, $t = 6.665$, $P < 0.001$), suggesting that consumers' ecological awareness fosters positive attitudes, significantly increasing their likelihood of purchasing hybrid solar-electric products.

Economic considerations also demonstrate meaningful indirect effects. Price ($\beta = 0.126$, $t = 2.502$, $P < 0.05$) and Operational Cost ($\beta = 0.100$, $t = 2.653$, $P < 0.01$) both exert statistically significant indirect influences, indicating that favorable cost perceptions enhance purchase intentions when mediated by positive attitudes.

Conversely, Effort Expectancy ($\beta = 0.050$, $t = 1.365$, $P = 0.172$) and Charging Time ($\beta = -0.025$, $t = 0.435$, $P = 0.664$) display non-significant indirect effects, reinforcing earlier findings that usability and time-related factors are not decisive drivers of purchase intentions in this technological adoption context.

5. DISCUSSION

The findings of this study provide comprehensive insights into the behavioral, technological, and economic determinants influencing MSME owners' intention to purchase the Hybrid Solar-Electric Cart (HSEC). The results reaffirm the centrality of performance expectancy and environmental concern as the strongest antecedents of attitude, consistent with recent findings by Higueras-Castillo et al. (2023), Upadhyay and Kamble (2023), and Chada et al. (2023). However, by focusing specifically on MSMEs in a developing economy, this study reveals a distinctive behavioral pattern: business owners evaluate green mobility innovations not only for ecological merit but also for their operational reliability and productivity enhancement, aligning sustainability with economic rationality.

The strong influence of performance expectancy indicates that perceived functional benefits, such as vehicle reliability, energy efficiency, and low maintenance, form the core of MSME adoption decisions. Unlike individual consumers motivated by lifestyle and environmental identity (Sun et al., 2022), MSMEs assess technology through its capacity to improve day-to-day logistics and profit margins. This supports the view that sustainability adoption is pragmatic rather than symbolic in the context of emerging economies.

Environmental concern ranks as the second most influential determinant of attitude. This confirms that ecological awareness is increasingly embedded within entrepreneurial decision-making, particularly among urban MSMEs operating in environmentally stressed regions such as Jabodetabek. This result aligns with the broader green transition discourse, where pro-environmental values are integrated into market-oriented behavior (Bi et al., 2023). The finding highlights the growing convergence between economic performance and environmental stewardship in the Indonesian MSME ecosystem.

Economic variables, price and operational cost, exert significant yet secondary effects, reinforcing that cost-efficiency remains a crucial motivator in developing contexts (Dong et al., 2020; Digalwar and Rastogi, 2023). The perception that the HSEC offers both short-term affordability and long-term financial savings supports the notion of dual-value alignment, where MSMEs pursue sustainability when it complements profitability. Thus, the study extends green technology adoption literature by emphasizing how economic rationality mediates environmental behavior in small business contexts.

The insignificance of effort expectancy and charging time suggests a maturity in user readiness and contextual adaptation. Since MSMEs use the HSEC primarily for short-distance mobility and have flexible charging options (including solar-based systems), usability and refueling constraints become less relevant. This finding departs from mainstream EV adoption barriers identified in developed markets (Brückmann and Bernauer, 2023), underscoring the context-dependence of technology acceptance across economic strata and technological infrastructures.

Crucially, the study validates attitude as a strong mediating mechanism that bridges environmental, technical, and economic determinants with behavioral intention. This reinforces the theoretical model proposed by He et al. (2023) and Yegin and Ikram (2022) while extending it to a micro-enterprise context rarely examined in prior research. The mediation effect underscores that perception shaping is as important as technical performance for market diffusion of green innovations.

From a policy perspective, the findings carry important implications. Policymakers should prioritize targeted financial incentives, infrastructure for micro-scale charging, and awareness campaigns that highlight both environmental and operational benefits of hybrid solar-electric technologies. For manufacturers, marketing communication should emphasize cost savings, reliability, and ease of maintenance to align with MSME priorities. Meanwhile, academic and research institutions should integrate interdisciplinary collaboration, linking engineering, economics, and behavioral sciences, to strengthen evidence-based innovation adoption strategies.

Theoretically, this study advances the Unified Theory of Acceptance and Use of Technology (UTAUT) by contextualizing it within sustainable MSME mobility. It introduces a hybrid techno-behavioral framework that links green innovation attributes with pragmatic business outcomes. Practically, it demonstrates that achieving environmental objectives in developing economies requires embedding sustainability into entrepreneurial value systems rather than relying solely on consumer activism or state regulation.

Future research could build on this framework by incorporating longitudinal data to observe attitudinal evolution, or by comparing MSME behavior across ASEAN economies to assess cross-cultural variations. Integrating social influence, perceived risk, and regulatory trust would also enhance explanatory power. Ultimately, the present study bridges the gap between green technology readiness and behavioral adoption, contributing conceptually and empirically to sustainable urban mobility.

6. CONCLUSION

This study examined the determinants shaping micro, small, and medium enterprise (MSME) owners' intention to adopt the Hybrid Solar-Electric Cart (HSEC) in urban Indonesia by integrating environmental, technological, and economic dimensions into an extended behavioral framework. Using PLS-SEM analysis on 200 MSME respondents, the results confirm that performance expectancy, environmental concern, price, and operational cost significantly influence attitudes, which strongly mediate purchase intention. Conversely, effort expectancy and charging time do not affect attitude substantially, indicating that usability barriers are less salient in short-range, solar-assisted applications.

The findings of this study offer several meaningful implications for policymakers, industry practitioners, and MSME stakeholders seeking to accelerate green technology adoption in developing economies. From a policy perspective, government agencies should design targeted financial incentives, such as tax deductions, low-interest credit lines, and green financing schemes, to encourage MSMEs to adopt hybrid solar-electric mobility solutions. These measures would reduce initial investment barriers and promote inclusive participation in Indonesia's broader low-carbon transition agenda. At the infrastructural level, local governments and urban planners should prioritize establishing micro-scale charging facilities powered by solar photovoltaic systems to accommodate short-range mobility patterns typical of MSMEs. Equally important is the need for public awareness and education campaigns highlighting the environmental and economic benefits of the Hybrid Solar-Electric Cart (HSEC), thereby reshaping entrepreneurial perceptions of sustainability as an economically viable choice.

Manufacturers and research institutions should collaborate to develop context-specific product designs that align with local climatic conditions, cost constraints, and operational reliability requirements in the industrial domain. Such partnerships can bridge the gap between technological innovation and market readiness, ensuring that sustainability-driven innovations remain affordable, durable, and practical for small enterprises. Collectively, these strategies could strengthen Indonesia's transition toward sustainable urban mobility and contribute to achieving national and global sustainability goals, particularly SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action), as outlined in the RPJPN 2025-2045.

Although this study provides important insights, several limitations should be acknowledged to guide future research. First, its cross-sectional design restricts the ability to draw causal inferences regarding the long-term behavioral evolution of MSME owners. Future research could adopt longitudinal or mixed-method approaches to capture changes in perception and adoption behavior over time. Second, the study's focus on urban MSMEs in the Jabodetabek region limits the generalizability of findings. Extending the analysis to rural areas or conducting cross-country comparisons within ASEAN economies would provide a richer understanding of contextual differences in technology adoption patterns.

Moreover, future models could incorporate additional constructs, such as social influence, perceived risk, policy trust, and innovation readiness, to strengthen explanatory power and theoretical comprehensiveness. Incorporating these variables would help capture the complex interaction between policy, perception, and technological readiness that drives adoption behavior in emerging economies. Finally, integrating qualitative perspectives from MSME owners and policymakers could offer deeper contextual insights beyond quantitative modeling. Addressing these limitations would enhance the robustness and applicability of future research and contribute to a more holistic understanding of sustainable micro-mobility transitions in developing contexts.

7. ACKNOWLEDGMENT

This research was supported by a grant from the Directorate of Research and Community Service (DPPM), Ministry of Higher Education, Science, and Technology of Indonesia (Kemendiktisaintek), under Grant No. 125/C3/DT.05.00/PL/2025; 8087/LL4/PG/2025; 002/PKS-LP2M/UPJ/06.25. The authors gratefully acknowledge this financial support, which made completing this study possible.

REFERENCES

Abbasi, H.A., Johl, S.K., Shaari, Z.B.H., Moughal, W., Mazhar, M., Musarat, M.A., Rafiq, W., Farooqi, A.S., Borovkov, A. (2021), Consumer motivation by using unified theory of acceptance and use of technology towards electric vehicles. Sustainability (Switzerland), 13(21), 1-22.

AC Ventures. (2023), Indonesia's Electric Vehicle Outlook. Jakarta: AC Ventures. p1-46.

Ackaah, W., Kanton, A.T., Osei, K.K. (2022), Factors influencing consumers' intentions to purchase electric vehicles in Ghana. Transportation Letters, 14(9), 1031-1042.

Ahmad, S., Chaveesuk, S., Chaiyasoonthorn, W. (2025), Impact of charging infrastructure on willingness to pay for EV: Mediating role of driving experience and behavior intentions. Acta Psychologica, 254, 104833.

Asadi, S., Nilashi, M., Samad, S., Abdullah, R., Mahmoud, M., Alkinani, M.H., Yadegaridehkordi, E. (2021), Factors impacting consumers' intention toward adoption of electric vehicles in Malaysia. Journal of Cleaner Production, 282, 124474.

Asian Transport Observatory. (2024), Transport and Climate Profile Indonesia. Available from: https://asiantransportoutlook.com/analytical-outputs/transportclimateprofiles

Austmann, L.M., Vigne, S.A. (2021), Does environmental awareness fuel the electric vehicle market? A Twitter keyword analysis. Energy Economics, 101, 105337.

Basmantra, I.N., Santiarsa, N.K.S., Widodo, R.D., Mimaki, C.A. (2025), How the adoption of EVs in developing countries can be effective: Indonesia's case. World Electric Vehicle Journal, 16(8), 428.

Bi, C., Jin, S., Li, S., Li, Y. (2023), Can green advertising increase consumers' purchase intention of electric vehicles? An experimental study from China. Journal of Cleaner Production, 419(620), 138260.

Brückmann, G., Bernauer, T. (2023), An experimental analysis of consumer preferences towards public charging infrastructure. Transportation Research Part D: Transport and Environment, 116, 103626.

Butt, M.H., Singh, J.G. (2023), Factors affecting electric vehicle acceptance, energy demand and CO_2 emissions in Pakistan. Green Energy and Intelligent Transportation, 2(3), 100081.

Chada, S.K., Görges, D., Ebert, A., Teutsch, R., Subramanya, S.P. (2023), Evaluation of the driving performance and user acceptance of a predictive eco-driving assistance system for electric vehicles. Transportation Research Part C: Emerging Technologies, 153, 104193.

Cui, L., Wang, Y., Chen, W., Wen, W., Han, M.S. (2021), Predicting determinants of consumers' purchase motivation for electric vehicles: An application of Maslow's hierarchy of needs model. Energy Policy, 151, 112167.

Damanik, N., Saraswani, R., Hakam, D.F., Mentari, D.M. (2025), A comprehensive analysis of the economic implications, challenges, and opportunities of electric vehicle adoption in Indonesia. Energies, 18(6), 1384.

Digalwar, A.K., Rastogi, A. (2023), Assessments of social factors responsible for adoption of electric vehicles in India: A case study. International Journal of Energy Sector Management, 17(2), 251-264.

Dong, X., Zhang, B., Wang, B., Wang, Z. (2020), Urban households' purchase intentions for pure electric vehicles under subsidy contexts in China: Do cost factors matter? Transportation Research Part A: Policy and Practice, 135, 183-197.

Dutta, B., Hwang, H.G. (2021), Consumers purchase intentions of green electric vehicles: The influence of consumers technological and environmental considerations. Sustainability, 13(21), 12025.

Fornell, C.G., Larcker, D.F. (1981), Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), 39-50.

Gunawan, I., Redi, A.A.N.P., Santosa, A.A., Maghfiroh, M.F.N., Pandyaswargo, A.H., Kurniawan, A.C. (2022), Determinants of customer intentions to use electric vehicle in Indonesia: An integrated model analysis. Sustainability, 14(4), 1-22.

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., Danks, N.P., Ray, S. (2021), An introduction to structural equation modeling. In: Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R. Classroom Companion: Business. Germany: Springer.

Hakam, D.F., Jumayla, S. (2024), Electric vehicle adoption in Indonesia: Lesson learned from developed and developing countries. Sustainable Futures, 8, 100348.

He, Z., Zhou, Y., Wang, J., Shen, W., Li, W., Lu, W. (2023), Influence of emotion on purchase intention of electric vehicles: A comparative study of consumers with different income levels. Current Psychology, 42(25), 21704-21719.

Higueras-Castillo, E., Singh, V., Singh, V., Liébana-Cabanillas, F. (2023), Factors affecting adoption intention of electric vehicle: A cross-cultural study. In: Environment, Development and Sustainability. Netherlands: Springer.

Hoang, T.T., Pham, T.H., Vu, T.M.H. (2022), Examining customer purchase decision towards battery electric vehicles in Vietnam market: A combination of self-interested and pro-environmental approach. Cogent Business and Management, 9(1), 2141671.

IEA. (2025), Global EV Outlook 2025 Expanding Sales in Diverse Markets. p1-173. Available from: https://www.iea.org/reports/global-ev-outlook-2025

Irfanto, N., Aprilianty, F. (2022), Assessing Indonesian consumer adoption of electric vehicles using the extended utaut 2 model. International Journal of Business and, 4(3), 74-87.

Jain, N.K., Bhaskar, K., Jain, S. (2022), What drives adoption intention of electric vehicles in India? An integrated UTAUT model with environmental concerns, perceived risk and government support. Research in Transportation Business and Management, 42, 100730

Jaiswal, D., Kaushal, V., Kant, R., Kumar Singh, P. (2021), Consumer adoption intention for electric vehicles: Insights and evidence from Indian sustainable transportation. Technological Forecasting and Social Change, 173, 121089.

Jayasingh, S., Girija, T., Arunkumar, S. (2021), Factors influencing consumers' purchase intention towards electric two-wheelers. Sustainability, 13(22), 2851.

Miranda, J.L., Delgado, C.J.M. (2020), Determinants of electric car purchase intention in Portugal. Developments in Corporate Governance and Responsibility, 15, 161-172.

Oluwalana, O.J., Grzesik, K. (2025), Solar-powered electric vehicles: Comprehensive review of technology advancements, challenges, and future prospects. Energies, 18(14), 1-33.

Purwanto, E., Irawan, A.P. (2023), Bibliometric analysis of electric vehicle adoption research: Trends, implications, and future directions. International Journal of Safety and Security Engineering, 13(5), 789-800.

Purwanto, E., Irawan, A.P. (2024), The willingness to purchase electric vehicles: A comprehensive review. IOP Conference Series: Earth and Environmental Science, 1324(1), 012091.

Purwanto, E., Nugraha, H., Uddin, N. (2023), Penciptaan Prototipe Gerobak Hybrid Listrik Tenaga Surya. Jakarta: Direktorat Riset dan Pengabdian Masyarakat Direktorat Jenderal Riset dan Pengembangan Kementerian Riset, Teknologi, dan Pendidikan Tinggi.

Rosales-Tristancho, A., Carazo, A.F., Brey, R., Lindhjem, H. (2024), Meta-analysis of consumers' trade-offs between range and charging infrastructure for electric vehicles. Transportation Research Part D: Transport and Environment, 134, 104342.

Shakeel, U. (2022), Electric vehicle development in Pakistan: Predicting consumer purchase intention. Cleaner and Responsible Consumption, 5, 100065.

Singh, H., Singh, V., Singh, T., Higueras-Castillo, E. (2023), Electric vehicle adoption intention in the Himalayan region using UTAUT2 - NAM model. Case Studies on Transport Policy, 11, 100946.

Sun, K.K., He, S.Y., Thøgersen, J. (2022), The purchase intention of electric vehicles in Hong Kong, a high-density Asian context, and main differences from a Nordic context. Transport Policy, 128, 98-112.

Tunçel, N. (2022), Intention to purchase electric vehicles: Evidence from an emerging market. Research in Transportation Business and Management, 43, 100764.

Uddin, N., Purwanto, E., Nugraha, H. (2024), Machine learning based modeling for estimating solar power generation. E3S Web of Conferences, 475, 1-12.

UNEP. (2025), Why 2025 Could be the Year of EVs in Developing Countries. Available from: https://www.unep.org/news-and-stories/story/why-2025-could-be-year-electric-vehicle-developing-countries

Upadhyay, N., Kamble, A. (2023), Examining Indian consumer pro-environment purchase intention of electric vehicles: Perspective of stimulus-organism-response. Technological Forecasting and Social Change, 189, 122344.

Vafaei-Zadeh, A., Wong, T.K., Hanifah, H., Teoh, A.P., Nawaser, K. (2022), Modelling electric vehicle purchase intention among generation Y consumers in Malaysia. Research in Transportation Business and Management, 43, 100784.

Wang, X.W., Cao, Y.M., Zhang, N. (2021), The influences of incentive policy perceptions and consumer social attributes on battery electric vehicle purchase intentions. Energy Policy, 151, 112163.

Wang, Z.X., Jantan, A.H.B., Wu, R.X., Gong, Y., Cao, M.R., Wong, P.P.W., Wang, L. (2022), Exploring consumers' intention toward domestic energy-saving vehicles: Some insights from China. Frontiers in Psychology, 13,927709.

Yegin, T., Ikram, M. (2022), Analysis of consumers' electric vehicle purchase intentions: An expansion of the theory of planned behavior. Sustainability, 14, 12091.

Zaino, R., Ahmed, V., Alhammadi, A.M., Alghoush, M. (2024), Electric vehicle adoption: A comprehensive systematic review of technological, environmental, organizational and policy impacts. World Electric Vehicle Journal, 15(8), 0375.

Zhang, W., Wang, S., Wan, L., Zhang, Z., Zhao, D. (2022), Information perspective for understanding consumers' perceptions of electric vehicles and adoption intentions. Transportation Research Part D: Transport and Environment, 102(96), 103157.