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Electric vehicles for cleaner urban logistics: what motivates consumers to choose green delivery?

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Abstract: The rapid expansion of e-commerce has intensified pressures on urban logistics and last-mile logistics flows. This study examines psychological drivers of consumers' intention to select electric vehicle based last-mile logistics within a green logistics flow perspective, integrating the Value-Belief-Norm and Theory of Planned Behavior frameworks. We explicitly frame the problem as reducing the environmental burden of material, information, and financial flows in the last mile while maintaining service quality; the goal is to identify value- and norm-based antecedents that strengthen intentions to choose electric vehicle delivery services. Using a structured survey (n = 618) and PLS-SEM, results show altruistic and biospheric values shape ecological worldviews, which activate perceived adverse consequences and ascription of responsibility, forming pro-environmental personal norms that raise attitude, subjective norms, and perceived behavioral control, thereby increasing behavioral intention toward electric vehicle delivery. This study contributes by theorizing electric vehicle (EV) adoption as a green logistics flow decision rather than a matter of personal mobility, integrating value-to-norm pathways with the flow management requirements of last-mile logistics operations, and proposing actionable strategies for logistics providers to design value-aligned nudges and communicate flow efficiency with lower emissions.

1 Introduction

The boom in Vietnam's e-commerce market in 2023 has created immense pressure on urban logistic sector, particularly last-mile logistics services which primarily rely on gasoline-powered motorcycles in both urban and rural areas in Vietnam - an easy to use, flexible, and cheap method for [1] This is because they are easy to use, flexible, and cheap. They are also used for last-mile logistics services. However, in 2015, more than 40% of greenhouse gas emissions from transportation were attributed to the delivery process [2]. In response to this and the growing trend toward green logistics, in July 2025, the Vietnamese government announced a major policy to phase out gasoline-powered motorcycles in central Hanoi by July 2026, with full enforcement across larger metropolitan zones by 2030. This legislative move, aimed at addressing severe urban air pollution and accelerating the national net-zero roadmap, signals a radical transition toward electric mobility. As a result, the adoption of electric vehicles in Vietnam has risen at a recognizable level. The two-wheeler market, traditionally dominated by internal combustion engine vehicles, is witnessing a significant rise in electric two-wheeler adoption revealing that the market share of electric two-wheelers rose from 4.9% in 2019 to 8.3% in 2020 [3]. A prime example of this transition is Xanh SM, a Vingroup subsidiary. By deploying a massive fleet of electric vehicles for both ride-hailing and its dedicated last-mile logistics service, Xanh SM Express, the company is actively pioneering sustainable logistics solutions in Vietnam. However, while general consumer preferences for sustainability are well-documented, the specific decision-making dynamics behind the adoption of electric vehicle-based delivery services in the Vietnamese context remain under-explored. Though interest in sustainable logistics has expanded among scholars and policymakers, a significant research void persists regarding the behavioral factors that influence consumers'

willingness to accept electric vehicle last-mile logistics services. This gap is especially in emerging markets like Vietnam, where rapid e-commerce growth creates new delivery challenges and opportunities. Current literature primarily emphasizes the technological efficiency, cost-effectiveness, and environmental benefits of electric vehicle fleets [3] while also paying attention to the cognitive, emotional, and social drivers that ultimately determine whether consumers adopt these greener logistics options. Most existing research focuses on electric vehicle adoption for personal travel, leaving a noticeable gap regarding commercial delivery fleets in fast-growing cities worldwide [4]. Recent scholars have urged investigators to blend value-oriented theories with intention models to illuminate how consumers choose greener logistics [5]. This paper addresses these problems by testing a joint Value-belief-norm theory and the Theory of planned behavior framework to examine ecological values, awareness of harm, and perceived control influence consumers to adopt electric vehicle-powered delivery. In doing so, it adds empirical evidence linking psychological drivers to sustainable innovation in commercial logistics.

Acknowledging the limited research on last-mile logistics services using electric vehicles, this study evaluates respondents' perspectives on the values, beliefs, and norms that shape their attitudes toward last-mile logistics. It analyzes the key determinants that affect consumer choices for Xanh SM including electric vehicles during the last-mile logistics stage. The rest of this article is structured as follows. Section two reviews the relevant literature on last-mile logistics, the adoption of electric vehicles in sustainable logistics, and the theoretical underpinnings of the VBN and TPB. Section three describes the research methodology, including measurement development, data collection, and analytical procedures. Section four presents the empirical findings from the PLS-SEM analysis, including descriptive statistics, measurement model assessment, and hypothesis testing then discussing the main conclusions, theoretical contributions, and practical implications while also highlighting the study's limitations and directions for future research.

2 Literature review

2.1 Last-mile logistics

In B2C e-commerce, the last mile is regarded as the last segment of supply chains when parcels are delivered to a specific delivery location or the recipient's residence (doorstep). Last-mile logistics is currently regarded as one of the most important, costly, and inefficient flow management and operations of the e-commerce environment. The rapid expansion of e-commerce and customer demand for fast shipping has significantly escalated last-mile transportation, especially for residential deliveries [6].

2.2 Electric vehicle in sustainable trends

Electric vehicles have emerged as a critical enabler of sustainable mobility, offering a promising solution to reduce greenhouse gas emissions and mitigate the environmental impact of fossil fuel-based transportation [7]. Their lower life-cycle emissions and potential for energy diversification align with global de-carbonization targets and the pursuit of net-zero emissions by mid-century [7]. In the last-mile logistics sector, electric vehicles help both the planet and the budget by removing tailpipe pollution from city streets and by working well with telematics, real-time tracking, and smart routing software. Fresh research shows that, when tied to solar or wind recharging, electric delivery vans cut greenhouse gases, silence diesel engines, boost local energy security, and support circular-economy goals [7]. Better batteries and steady wireless links are also speeding the roll-out of electric vehicle fleets in crowded urban centers where final-leg emissions worsen asthma and heart disease [7]. Together, these trends point to a turning point in logistics, shifting firms from carbon-heavy practices to greener, tech-savvy flow management and operations.

2.3 Value-belief-norm theory

In 2000, Stern developed the Value-Belief-Norm theory by expanding the norm activation theory, which has been established to investigate altruistic purposes and behaviors in the same context to better illuminate pro-environmental behaviors and attitudes by incorporating essential value concepts. The Value-belief-norm theory examines how pro-environmental personal norms are formed through a progressive mechanism, beginning with environmental values, followed by an awareness of the consequences, and the ascription of responsibility, which collectively contribute to shaping personal environmental intentions and actual behaviors [8]. Later, as confirmed by [9], the value orientations were further categorized into altruistic values, biospheric values, and electric vehicles. First, an altruistic value orientation clearly shows that people care about the welfare of other humans. Recent updates to Schwartz's Norm Activation Model (1997) describe how each person gradually builds a unique moral standard, a private sense of obligation that feels binding. When they think serious harm is likely, that internal rule pushes them to act, often with little cost-benefit weighing attached. Second, a biospheric value frame broadens the idea of personal norms by making nature, the planet, and all non-human life part of the moral community, allowing altruistic instincts to extend into environmental cases. Third, an egoistic view centers on self-interest; when green actions appear too costly, it can freeze or derail even well-meaning citizens. This study, grounded in the Value-belief-norm model, asks how those three orientations-altruistic, biospheric, and egoistic-shape awareness of outcomes, feelings of responsibility, and the growth of personal normative pressure. To

answer, we combine Value-belief-norm with the Theory of planned behavior and track whether people adopt new, cleaner technologies electric last-mile logistics vehicles-particularly in urban zones-when they see those choices aligned with their respective value profiles.

2.4 Theory of planned behavior

The Theory of Planned Behavior offers a useful mini framework that breaks down human choice into three clear parts: attitude toward the behavior gauges whether a person broadly approves or disapproves of a specific act, subjective norms capture the social signals, from friends or headlines, that nudge someone closer or further away from that act, and perceived behavioral control reflects the confidence or doubt a person feels about carrying the act out when the moment arrives. When combined, attitude toward the behavior, subjective norms, and perceived behavioral control jointly signal the strength of a person's intention to behave in a certain way, a point underscored in recent work by Lee description of responsibility colleagues (2023) [10]. Core beliefs, of course, form the filter through which every technological promise must pass: they quicken or slow the response long before a gadget ever lands on a kitchen counter. Turning electric vehicles into the backbone of last-mile logistics therefore entails more than swapping batteries for diesel; it means revising a logistics playbook generations have relied upon [10]. Moreover, for many companies, the choice to use electric vehicles for the final stage of shipping has become a visible commitment to sustainability.

Consumer decisions are commonly influenced by outside initiatives, such as educational protests and metropolitan green movements, and by inward beliefs, like seeing oneself as a green shopper [11]. To turn a sporadic choice into routine behavior, consumers need more than prompts; they must also possess convictions that push them to keep going [11]. Because electric vehicles could fundamentally change how goods move through neighborhoods and how residents commute, combining the Value-belief-norm theory with the Theory of planned behavior offers a fuller map of the mental journey that ends in a purchase. Both frameworks show that underlying beliefs and cherished values can lead people to buy-or keep them from doing so. Pinpointing that link matters to Xanh SM as it aims to link its electric vehicles to daily green habits and help solve urgent last-mile logistics issues.

2.5 Hypothesis development

According to the Value-belief-norm theory, egoistic, altruistic, and biospheric value orientations are the three main components that impact pro-environmental behavior [12]. In the context of green transportation, an egoistic value is a symbol of personal happiness, which reflects a family's or individual's desire for a clean and healthy home environment. Egoistic values encourage people to conserve aspects of the environment that affect them. For example, individual health satisfaction, such as good health or a higher quality of life, may motivate people to behave environmentally. This idea has been reconfirmed by a study by Gansser and Reich (2023) [13], who also argue that the more egoistic environmental concerns are advanced, the more environmentally sustainable behavior regarding the environment and climate will be led. While egoistic values consider self or family concerns, altruistic values refer to personal decision-making when a person is conscious of the consequences of their action and individually responsible for others [14]. The more a person is aware of the consequences of their decision, the more likely they are to exhibit self-sacrificing behavior [14]. Altruistic values are rudimentary for influencing consumer environmental behavior [14] and increasing the effort to provide a cleaner solution for environmental problems, energy conservation, and recycling. altruistic value positively promotes more environmental awareness among consumers. Biospheric values play another key role in value models when it encompasses environmental behavior and reveals how alternative values influence pro-environmental actions [14]. Biospheric values have already been a significant concern for ecologists and environmentalists. It is clarified as the energy and resources required to sustain Earth's activities, including human economic activities [14]. Human environmental concern is increasing as people become increasingly aware of unsustainable consumption forms, which lead to serious environmental issues, such as disastrous pollution, climate change, and global warming [13]. Due to the increasing consumer environmental concern driven by egoistic values, altruistic values, and biospheric values, as evidenced above, the following hypotheses are formulated:

H1: Egoistic values positively influence ecological worldview.
H2: Altruistic values have a positive influence on the ecological.
H3: Biospheric values positively influence ecological worldview.

People with a high ecological worldview tend to make choices that are better for the environment, like buying electric cars as part of their sustainable lifestyle [15]. They believe electric cars are a cleaner, more sustainable option than those that run on fossil fuels, as they aim to reduce air pollution, greenhouse gas emissions, and fossil fuel use [16]. Using electric vehicles for last-mile logistics highlights the environmental impact of excessive resource consumption, which is detrimental to the environment. Consumers who care a lot about the environment want to meet their needs more quickly and easily with electric vehicles without having a direct effect on the environment [12].

H4: Ecological worldview has a positive influence on perceived adverse consequences for valued objects.

Adverse consequences for valued objects explain how people become concerned about the harm their choices can cause to things they care about once they grasp the link between their behavior and that harm [9]. From this perspective, norm activation is the mental switch that occurs when individuals recognize the links, accept responsibility for the damage caused by agencies, and take a particular pro-environmental action. When a consumer realizes, for instance, that ordering rides that rely on petrol cars makes the planet worse, they often feel compelled to explore greener alternatives [17]. Substituting that ride with an electric scooter or e-bike then appears less like an optional upgrade and more like a minor but essential act toward cleaner air and smaller carbon counts, a belief shared by many last-mile users today [11]. For this reason, we advance the following hypothesis:

H5: Adverse consequences for valued objects positively influence the perceived ascription of responsibility.

The ascription of responsibility ascription of responsibility refers to the degree to which individuals believe they share blame for environmental degradation and its consequences. According to the Norm Activation Model, personal pro-environmental norms pro-environmental personal norms emerge from internalized values, perceived moral duties, and self-imposed expectations to act in ways that safeguard nature [18]. Different contexts have shown a consistent positive link between ascription of responsibility and pro-environmental personal norms. He & Zhan (2018) argued that people form stronger personal norms in favor of electric vehicles, electric vehicle adoption, and related services once they acknowledge their environmental accountability [19]. Consequently, ascription of responsibility can shape intentions to shift toward electric or hybrid vehicles [10]. The following hypotheses are proposed:

H6: Ascription of responsibility positively influences perceived pro-environmental personal norms.

Personal or moral norms are self-expectations, obligations, and punishments rooted in internalized values. In general, behavioral contexts, people may purchase green items due to both hedonic motivation and obligation-based individual standards. Pro-environmental personal norms shape an individual's moral responsibility to mitigate harmful impacts and support cleaner practices [20]. Positive attitudes toward electric vehicle adoption emerge when it is seen as desirable or socially acceptable [10]. Empirical evidence from other studies has shown that personal norms influence pro-environmental behavior. In this study, we assume that:

H7: Pro-environmental personal norms positively influence attitude toward the behavior.

Personal norms encourage subjective norms by fostering an environment where sustainable practices are morally valued and socially accepted as cleaner alternatives. In general behaviors, pro-environmental personal norms impact subjective norms through social modeling and the promotion of eco-friendly practices. People's sense of social responsibility for environmental issues strengthens when personal norms align with societal pressure to adopt eco-friendly lifestyles. For last-mile logistics using electric vehicles, Haustein and Jensen (2018) argued that subjective norms are shaped by personal norms, which influence vehicle choice [21]. Additionally, Niu et al. (2023) demonstrate that pro-environmental behaviors can influence others' actions [22], supporting a specific hypothesis:

H8: Pro-environmental personal norms positively influence subjective norms.

Lee et al. (2023) suggest that a connection exists between pro-environmental personal norms and perceived behavioral control [10]. Niu et al. (2023) note that people's norms regarding environmentally friendly behavior can encourage them to adopt practices that protect the environment [22]. Some authors suggest that people are more likely to adopt eco-friendly and cleaner habits when they have strong personal norms that support environmental conservation. Based on the evidence, we suggest the following hypothesis:

H9: Pro-environmental personal norms positively influence perceived behavioral control.

Attitude-the degree to which a person views an action or a behavior favorably or unfavorably is a key driver of intention in behavioral research because it pushes people to act [23]. Generally speaking, individuals commit to a behavior when they believe that the outcome will benefit them personally [23]. Convenience, speed, and dependability steadily encourage consumers to use delivery platforms regularly, for instance, when those elements are promised and delivered [24]. Electric vehicle fleets add a distinctive layer to this puzzle: their low emissions, modern interfaces, and even novel sound profiles often heighten positive expectations and amplify favorable attitudes. Building on that evidence, we propose the following hypothesis:

H10: Attitude toward the behavior positively influences behavioral intention in applying electric vehicles.

Subjective the perception of approval or disapproval from relevant others - has a robust influence on individuals' behavioral intention [25]. People tend to adopt a course of action when they believe respected reference groups visibly endorse it [26]. Similarly, consumers display greater compliance with green initiatives when firms visibly pivot toward sustainable flow management and operations [26]. Offering eco-preferable delivery modes not only reinforces these

norms but also safeguards a positive standing with environmentally aware stakeholders [26]. In this study, we assume that:

H11: Subjective norms positively influence behavioral intention.

Perceived behavioral control refers to the belief that an individual can perform a specific action. It has a significant impact on how consumers perceive behavioral intention As the trend toward sustainability grows, people's beliefs in their ability to make a difference and the support they receive from others for green practices, such as government incentives or widespread electric vehicle adoption, make perceived behavioral control even stronger [27]. Based on what we found, we came up with the following hypothesis:

H12: Perceived behavioral control positively influences behavioral intention.

Figure 1 illustrates the proposed research model, which integrates the Value-belief-norm theory and the Theory of Planned Behavior.

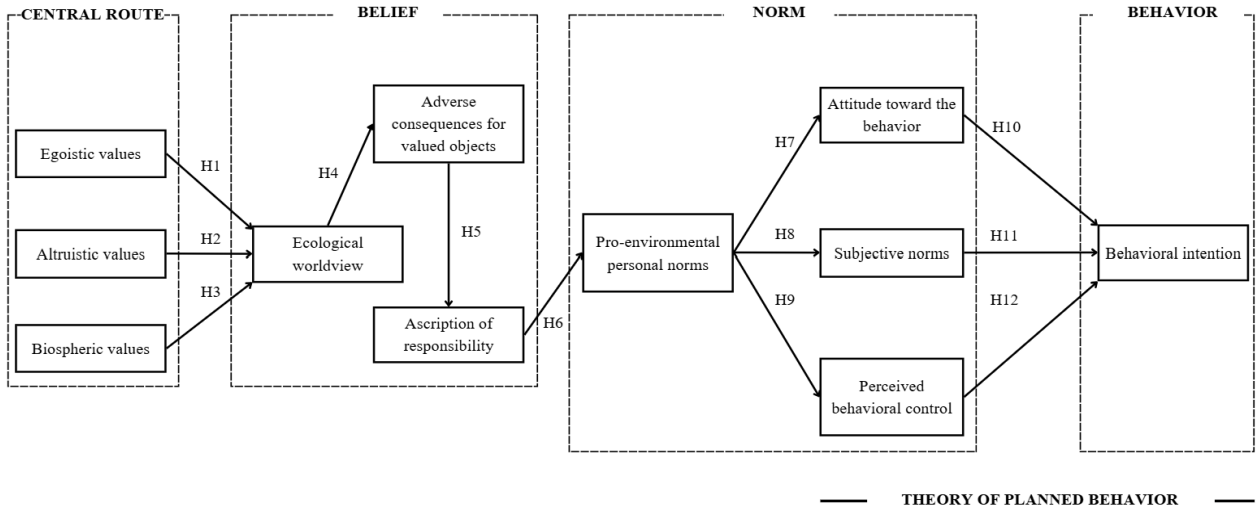

Figure 1 Proposed model

3 Methodology

3.1 Measurement scale and survey development

Following an extensive literature review, a questionnaire was constructed specifically for this study. Likert-type scales with seven points are employed for measurements for all items ranging from 'strongly disagree' to 'strongly agree.' All items used in the measurement are based on pre-existing scales and well-established and reliable instruments. Some measurement items were chosen from authorized sources for the comprehensive software assessment. For egoistic, altruistic, and biospheric values, four items have been selected for each variable [28]. For the ecological worldview, three items have been chosen for each variable [29]; adverse consequences for valued objects and ascription of responsibility [30]. Four items have also been selected for assessing pro-environmental personal norms and attitudes toward the behavior [30]. Lastly, to assess subjective norms, perceived behavioral control, and behavioral intention, three items have been identified for each variable [10].

3.2 Sampling and data collection

After minor adjustments, the close-ended survey, conducted through the Google Forms platform, targets participants from diverse age groups. The survey has two main sections. Demographic data about the respondents were included in the first section of the survey, and related measurement items were included in the second section. (Appendix A). Survey forms are distributed to participants via various Facebook Groups. Data collection occurred from September to December 2024. A total of 630 responses were collected during the study period, and 618 legitimate samples were used in the subsequent analysis. The sample size collected in this study meets the statistical requirements for an empirical study.

3.3 Data analysis

Using PLS-SEM with SmartPLS 3, the measurement and structural models were assessed to validate the hypotheses. Since our measurement model is built with reflective latent factors, it is crucial to evaluate and fulfill specific criteria, including the significance of outer loadings of each observation variable, reliability, composite reliability, average

variance extracted, and discriminant validity. Our research model will be tested for the structural model to confirm the suitableness of several key criteria, e.g., collinearity between variables, the significance of main path coefficients, R^2. Data analysis was performed using SmartPLS 3 to ensure precision and comprehensive results.

4 Results and discussion

4.1 Descriptive characteristics of the sample

Table 1 presents the demographic characteristics of the 618 respondents who participated in this study and provided valid data. In terms of gender, 60.4% of the participants were female, while 39.6% were male, indicating a slight female dominance in the sample. Concerning age, most respondents were between 26 and 35 years old (41%), followed by those aged 36-45 (20%), 16-25 (17.8%), and 46-55 (14.3%). Only 6.9% were above 55 years of age, suggesting that the majority of the sample was concentrated in the working-age population under 45 years old. In terms of monthly income, the most significant proportion of respondents (42.3%) reported earning between 10 and 15 million VND, followed by 21.1% earning below 5 million VND, and 20.1% earning between 5 and 10 million VND. A smaller portion of participants earned from 15 to 20 million VND (12%) and above 20 million VND (4.5%), reflecting a modest income distribution across the sample. Regarding education level, the majority (58%) held an undergraduate degree, while 25.1% had completed high school or lower education. Additionally, 16.9% of respondents obtained a postgraduate degree. This suggests that most participants were relatively well-educated, with over 70% holding a university-level education or higher.

Table 1 Descriptive characteristics of the sample

	Profile	Frequency N=618	Percentage 100%
Gender	Male	**245**	**39.6%**
	Female	**373**	**60.4%**
Age	16 - 25	**110**	**17.8%**
	26 - 35	**254**	**41%**
	36 - 45	**123**	**20%**
	46 - 55	**88**	**14.3%**
	Above 55	**43**	**6.9%**
Income Per Month	Below 5 million VND	**130**	**21.1%**
	From 5 million VND to 10 million VND	**124**	**20.1%**
	From 10 million VND - 15 million VND	**261**	**42.3%**
	From 15 million VND - 20 million VND	**74**	**12%**
	Above 20 million VND	**29**	**4.5%**
Education level	High school or below	**155**	**25.1%**
	Undergraduate level	**358**	**58%**
	Postgraduate level	**105**	**16.9%**

4.2 Measurement model

The measurement model's discriminant validity, convergent validity, and reliability have all been calculated (Table 2). The outer loading values of all observation items are above 0.708, indicating that these variables have contributed significantly to the corresponding factor. Regarding reliability, the composite reliability value and Cronbach's alpha value for every item exceeded 0.7, indicating good reliability. The average variance extracted values exceed 0.5, indicating strong convergent validity.

Table 2 Reliability and convergent validity assessment

Variables	Items	Outer loadings	Cronbach's alpha	Composite Reliability	AVE
Egoistic values	EV1	**0.870**	**0.883**	**0.919**	**0.739**
	EV2	**0.857**			
	EV3	**0.847**			
	EV4	**0.866**			
Altruistic values	AV1	**0.850**	**0.875**	**0.915**	**0.729**
	AV2	**0.899**			
	AV3	**0.821**			
	AV4	**0.844**			
Biospheric values	BV1	**0.876**	**0.896**	**0.927**	**0.764**
	BV2	**0.859**			
	BV3	**0.893**			
	BV4	**0.862**			

Ecological worldview	EW1	**0.861**	**0.771**	**0.868**	**0.688**
	EW2	**0.858**			
	EW3	**0.766**			
Adverse consequences for valued objects	AC1	**0.880**	**0.831**	**0.899**	**0.748**
	AC2	**0.890**			
	AC3	**0.822**			
Ascription of responsibility	AOR1	**0.896**	**0.877**	**0.924**	**0.802**
	AOR2	**0.902**			
	AOR3	**0.890**			
Pro-environmental personal norms	PPN1	**0.864**	**0.892**	**0.925**	**0.756**
	PPN2	**0.882**			
	PPN3	**0.845**			
	PPN4	**0.886**			
Attitude toward the behavior	ATB1	**0.868**	**0.877**	**0.915**	**0.730**
	ATB2	**0.849**			
	ATB3	**0.856**			
	ATB4	**0.845**			
Subjective norms	SN1	**0.877**	**0.886**	**0.929**	**0.814**
	SN2	**0.914**			
	SN3	**0.915**			
Perceived behavioral control	PBC1	**0.833**	**0.843**	**0.906**	**0.762**
	PBC2	**0.901**			
	PBC3	**0.883**			
Behavioral intention	BI1	**0.850**	**0.845**	**0.907**	**0.764**
	BI2	**0.883**			
	BI3	**0.889**			

Discriminant validity has been evaluated using the heterotrait-monotrait correlation ratio. The testing results in Table 3 demonstrate that none of these values exceeded the conservative threshold of 0.85, indicating discriminant validity. Therefore, the discriminant validity of the measurement model is appropriate.

Table 3 Heterotrait-Monotrait Ratio index of the research model

Items	AC	AOR	ATB	AV	BI	BV	EV	EW	PBC	PPN	SN
AC	-										
AOR	**0.847**										
ATB	**0.638**	**0.679**									
AV	**0.444**	**0.428**	**0.535**								
BI	**0.628**	**0.704**	**0.780**	**0.459**							
BV	**0.511**	**0.443**	**0.562**	**0.697**	**0.548**						
EV	**0.419**	**0.448**	**0.400**	**0.697**	**0.383**	**0.482**					
EW	**0.842**	**0.678**	**0.606**	**0.515**	**0.550**	**0.596**	**0.359**				
PBC	**0.557**	**0.595**	**0.773**	**0.469**	**0.696**	**0.437**	**0.383**	**0.531**			
PPN	**0.738**	**0.813**	**0.808**	**0.479**	**0.781**	**0.505**	**0.461**	**0.637**	**0.600**		
SN	**0.521**	**0.534**	**0.728**	**0.384**	**0.719**	**0.393**	**0.417**	**0.432**	**0.481**	**0.749**	-

Note: Egoistic values - EV; Altruistic values - AV; Biospheric values - BV; Ecological worldview - EW; Adverse consequences for valued objects - AC; Ascription of responsibility - AOR; Pro-environmental personal norms - PPN; Attitude toward the behavior - ATB; Subjective norms - SN; Perceived behavioral control - PBC; Behavioral intention - BI.

4.3 Structural model

Multicollinearity, R-squared value, and the statistical significance known as the P-value of structural connections are used to examine the structural model. In this research, the VIF (variance inflation factor) values are below five, indicating that multicollinearity is not a significant problem. Adjusted R-squared values have been calculated for four dependent variables: "ecological wordview" (0.271), "adverse consequences for valued objects" (0.453), "ascription of responsibility" (0.523), "pro-environmental personal norms" (0.518), "attitude toward the behavior" (0.513), "subjective norms" (0.443), "perceived behavioral control" (0.275) and "behavioral intention" (0.553). Table 4 shows the path coefficients of major effects.

Table 4 PLS-SEM results

	Path	VIF	Path coefficient (β)	P-value	Result
H1	Egoistic values → Ecological worldview	**1.616**	**0.028**	**0.669**	**Not supported**
H2	Altruistic values → Ecological worldview	**2.111**	**0.173**	**0.020**	**Supported**
H3	Biospheric values → Ecological worldview	**1.620**	**0.386**	**0.000**	**Supported**
H4	Ecological worldview → Adverse consequences for valued objects	**1.000**	**0.673**	**0.000**	**Supported**
H5	Adverse consequences for valued objects → Ascription of responsibility	**1.000**	**0.723**	**0.000**	**Supported**
H6	Ascription of responsibility → Pro-environmental personal norms	**1.000**	**0.720**	**0.000**	**Supported**
H7	Pro-environmental personal norms → Attitude toward the behavior	**1.000**	**0.716**	**0.000**	**Supported**
H8	Pro-environmental personal norms → Subjective norms	**1.000**	**0.666**	**0.000**	**Supported**
H9	Pro-environmental personal norms → Perceived behavioral control	**1.000**	**0.524**	**0.000**	**Supported**
H10	Attitude toward the behavior → Behavioral intentions	**2.521**	**0.296**	**0.000**	**Supported**
H11	Subjective norms → Behavioral intentions	**1.702**	**0.325**	**0.000**	**Supported**
H12	Perceived behavioral control → Behavioral intentions	**1.794**	**0.256**	**0.000**	**Supported**

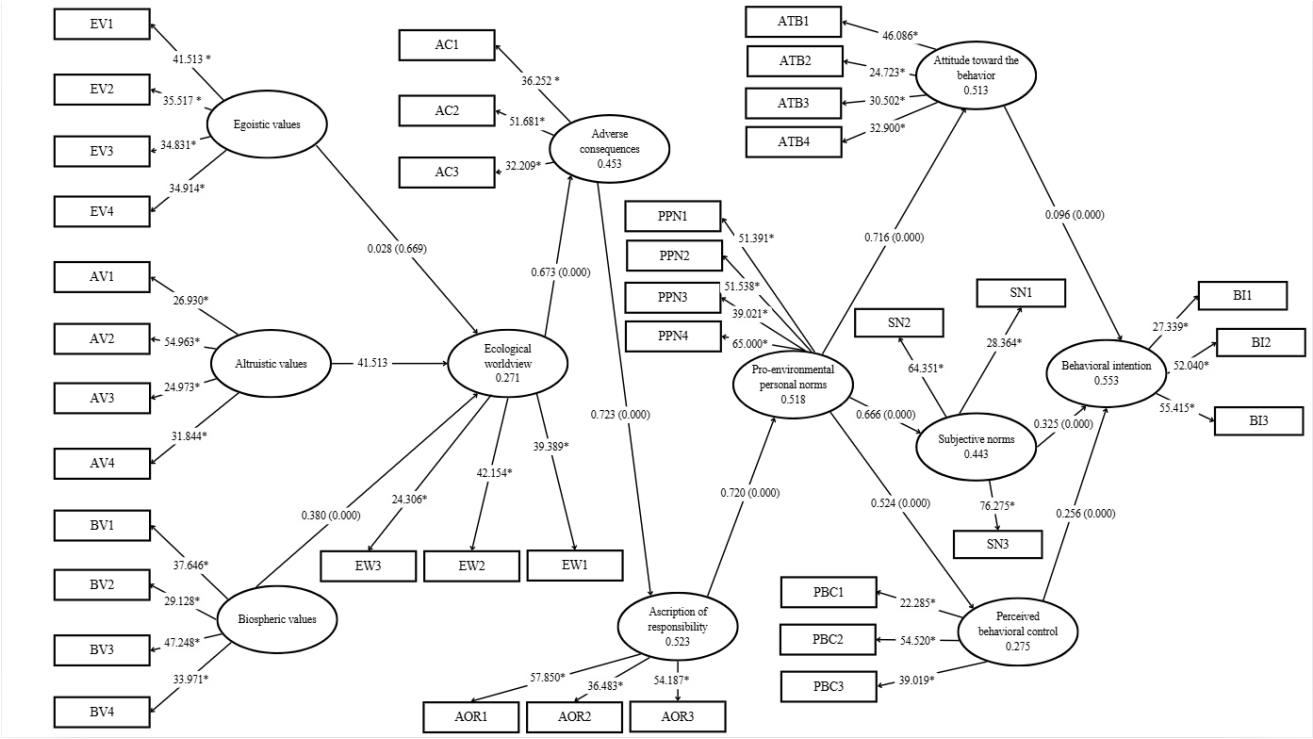

Figure 2 PLS-SEM results

*Note, *: T-statistic*

Table 4 shows that all main effects are statistically significant at the 5% level or lower. Furthermore, the directions of most path coefficients match our expectations, indicating that all hypotheses except H1 are supported. Regarding significant relationships, altruistic values (β = 0.173, p = 0.021) have a positive influence on ecological worldview, supporting H2. Likewise, biospheric values (β = 0.380; p = 0.000) demonstrate a substantial positive impact on ecological worldview, confirming H3. These results (Figure 2) emphasize that individuals with altruistic and biospheric orientations are more likely to adopt an ecological worldview, reflecting the essential role of these values in fostering environmentally conscious thinking. Moreover, ecological worldview has a significant impact on adverse consequences for valued objects (β = 0.673, p = 0.000), supporting H4. This relationship highlights the importance of ecological awareness in recognizing risks to valued objects. Following this, adverse consequences for valued objects has a strong influence on ascription of responsibility (β = 0.723, p = 0.000), supporting H5. This indicates that understanding negative environmental consequences motivates individuals to take responsibility for addressing these challenges. Next, ascription of responsibility has a significant effect on pro-environmental personal norms (β = 0.720; p = 0.000), supporting H6 and highlighting its role in shaping norms that encourage pro-environmental behaviors. A pro-environmental personal norm strongly impacts attitude toward the behavior (β = 0.716; p = 0.000), supporting H7. This suggests that individuals with strong personal norms regarding pro-environmental behavior are likely to develop favorable attitudes toward such actions. Similarly, pro-environmental personal norms also significantly influence subjective norms (β = 0.666; p = 0.000), supporting H8. This

highlights the role of personal norms in shaping social perceptions and expectations regarding pro-environmental behavior. The relationship between pro-environmental personal norms and perceived behavioral control is also significant ($\beta = 0.524$, $p = 0.000$), confirming H9. This suggests that stronger personal norms positively enhance an individual's perception of their ability to perform pro-environmental behaviors. Furthermore, attitude toward the behavior has a significant effect on behavioral intention ($\beta = 0.296$, $p = 0.000$), supporting H10. This underscores the importance of positive attitudes in encouraging intentions to engage in pro-environmental actions. Subjective norms also exhibit a statistically significant positive impact on behavioral intention ($\beta = 0.325$; $p = 0.000$), validating H11 and emphasizing the role of social influences in shaping intentions. Lastly, perceived behavioral control has a significant influence on behavioral intention ($\beta = 0.256$; $p = 0.000$), supporting H12. This finding highlights the critical role of perceived ease or difficulty in performing a behavior in forming behavioral intention. Conversely, egoistic values do not exhibit a significant relationship with ecological worldview ($\beta = 0.028$; $p = 0.652$), rejecting H1. This finding suggests that self-centered motivations might not align with ecological thinking.

4.4 Discussion

The Vietnamese fuel-vehicle ban provides significant real-world validation for our study. This policy is projected to dramatically accelerate consumer adoption of electric vehicle-based delivery services, especially in urban last-mile logistics. While internal motivations such as biospheric values and moral norms remain key drivers, regulatory mandates and infrastructure availability will become equally influential on consumer choices after the ban. Our research highlights the possibility of applying electric vehicles instead of gasoline-powered vehicles in last-mile logistics services. Utilizing the Value-belief-norm framework [14], this research attempts to study how the framework's components affect consumers' behavioral intention in using electric vehicles for last-mile logistics services that carry parcels. According to the results, most hypotheses were accepted and showed a positive relationship. Two of the value orientations, altruistic and biospheric, positively affect ecological worldview, which means consumers who love nature have more green consumer behaviors [31].

On the other hand, there is no evidence to support the hypothesis that egoistic values are related to ecological worldview. Perhaps in this data sample, ecological worldview is not influenced by concerns about social dominance, wealth, and authoritative power affecting others. Another explanation is that people with a self-centered mindset are also less inclined to prioritize environmental-benefitting behaviors unless they directly impact their personal lives. For example, adopting electric delivery vehicles may not be regarded as an environmentally friendly practice but rather as a practical convenience. The following positive relation concerns the ecological worldview and adverse consequences for value objects, and adverse consequences for value objects and ascription of responsibility, and then ascription of responsibility and pro-environmental personal norms. This correlation suggests that a person must be aware of the potential consequences of their behavior before feeling responsible for engaging in that behavior and admitting their contribution is valuable. Moreover, consumers with a more urgent perception of environmental issues tend to have a more favorable perspective toward green consumption activities, including the use of electric vehicle services, which is a perfectly relevant statement.

This study also presented a positive relationship between pro-environmental personal norms and attitude toward behavior, subjective norms, and perceived behavioral control. For example, the higher a consumer's moral bond with pro-environmental norms, the higher the consumer's perceptions and expectations in using electric vehicles' last-mile logistics services for pro-environmental purposes [32]. The last correlation is the positive relation between attitude toward the behavior, subjective norms, perceived behavioral control, and behavioral intention. There might be a significant change in consumers' intentions to act accordingly if their family, friends, or coworkers expect them to make pro-environmental, responsible choices.

4.5 Implications

4.5.1 Theoretical implications

First, this study tests and extends the Value-belief-norm framework by examining how it explains consumer support for last-mile electric delivery. Evidence shows that linking values to norms shapes preferences for green logistics, underscoring the need to foster a sense of individual duty if intentions are to translate into action in environmentally sustainable transport.

Second, the authors re-evaluate the ecological impacts of electric vehicles while probing the interplay of altruistic and biospheric motives. Results reveal that both altruistic values and biospheric values play a strong role in shaping choices about commercial delivery. This pattern emerges in contrast to earlier observations reported by de Groot and Steg (2008) [9]. Egoistic concerns, by comparison, exert only a weak influence when viewed alongside the larger environmental worldview. Collectively, the shift points to a growing number of consumers who now place ecological welfare ahead of personal gains such as lower costs or greater convenience.

Third, the authors integrate findings from previous research using the Value-belief-norm model in diverse settings [30] and tackle the shortcomings that plagued earlier EV-adoption studies. Consistent with the methodology developed

by Lee et al. (2023) [10]. In recruiting participants for the survey, we restricted the sample to individuals who are well acquainted with and regularly use electric delivery systems. By inviting only acknowledged experts with extensive experience in the area, we ensured that the insights obtained would be both trustworthy and relevant for real-world applications.

Additionally, our work addresses several notable gaps in the literature by providing a more detailed examination of how personal values, environmental beliefs, and intentions to act sustainably align. By linking these elements, we clarify how people's core convictions and their attitudes toward nature influence the choice to switch to electric vehicles. Moreover, we extend existing theory by demonstrating that emerging technologies can indeed reshape everyday behavior. Building on Hwang et al. (2020) 's findings, we demonstrate that pairing new gadgets with strong environmental messaging can significantly enhance consumers' green motives, particularly in densely urban markets [28].

Last but not least, this study offers theoretical insights that are useful for both policy making and business planning. It supports earlier research that suggests both normative and motivational factors influence consumer choices [33]. Our study helps build strong frameworks for promoting green last-mile logistics by mapping the connections between consumers' values, beliefs, norms, and their willingness to use new, eco-friendly delivery methods. It broadens the theoretical range of the Value-belief-norm model.

4.5.2 Practical implications

The research integrates the Value-belief-norm framework with conventional ethical practices to enhance awareness of sustainable green consumption while also underscoring the pivotal role of cognitive behavior in environmental preservation, a theme extensively explored in the literature.

First, by establishing the connection between values, beliefs, and pro-environmental intentions, earlier studies have shown that altruistic motives, ecological concerns, and environmental values collectively drive the shift toward cleaner delivery methods, reaffirming the influence of individual environmental norms and reinforcing a sense of moral duty and ecological consciousness.

Moreover, this transition may also present significant constraints. Key areas of concern include the availability of financial assistance, investment in charging infrastructure, and the development of communication strategies targeted at vulnerable groups such as freelance delivery drivers and motorbike taxi operators. Without such measures in place, the policy could unintentionally widen social inequalities and weaken its intended environmental and public health outcomes.

Furthermore, consumer engagement can be enhanced through marketing approaches that promote carbon footprint reduction, align with global sustainability targets, emphasize collective behavioral expectations, and facilitate informed decision-making. Logistics firms, in turn, can enhance consumer loyalty by embedding these insights into their corporate social responsibility initiatives. Companies actively incorporate sustainability into their business practices and marketing efforts, often receiving favorable responses from consumers.

Finally, by incorporating sustainability principles into incentive schemes, companies can motivate users to choose electric vehicle-based transportation, thereby reinforcing pro-environmental behavior and gaining a strategic advantage in the logistics sector. Both monetary and non-monetary rewards, such as discounts, loyalty points, or public acknowledgment for eco-friendly choices, can play a crucial role in fostering sustainable consumption habits.

4.6 Limitations and future research

Despite offering valuable insights into consumer behavior toward electric vehicle based last-mile logistics services, this study has certain limitations. First, the data were collected through a cross-sectional survey design, which restricts the ability to capture dynamic behavioral changes over time. Future studies could adopt longitudinal or experimental designs to understand better how consumer perceptions evolve as exposure to electric vehicle logistics services increases. Second, while this research focused on Xanh SM as a representative case of electric vehicle adoption in last-mile logistics, it did not compare multiple service providers or vehicle brands. Broader comparative studies encompassing diverse electric logistics providers would enhance the generalizability of findings. Third, although the model integrated well-established psychological constructs, it did not account for contextual or infrastructural variables such as delivery time reliability, electric vehicle charging infrastructure, or service availability across geographic regions. Future research could incorporate these operational and contextual factors to provide a more holistic understanding of the determinants influencing electric vehicle-based delivery adoption. Finally, expanding the sample to include respondents from different socioeconomic backgrounds and regions could further enrich the insights and support more robust policy and managerial recommendations.

Appendix A

All of the measurements of this study were adapted from previous validated studies and used a 7-point Likert scale, ranging from 1 “strongly disagree” to 7 “strongly agree”. The measurement of three value orientations: egoistic, altruistic, and biospheric was derived from studies of Hwang et al (2020) with 4-items for each value [28]. Ecological worldview was assessed using 3 items adapted from Kiatkawsin and Han (2017) [29]. The constructs of adverse consequences for

valued objects (3 items) and ascription of responsibility (4 items) were measured following the approach of Youn et al. (2020) [30]. The pro-environmental personal norm was also measured using 4 items adapted from Youn et al. (2020) meanwhile the constructs of attitude toward the behavior (4 items) were operationalized based on Lee et al. (2023) [10,30]. Subjective norms (3 items) was measured using items adopted from Youn et al. (2020) [30], while perceived behavioral control (3 items) and behavioral intention was based on the scale developed by Lee et al. (2023) [10].

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