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Voltage variations: Unraveling electric vehicle appeal in urban vs. rural areas

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ABSTRACT

This study investigated the influence of residence location (urban/rural) on the perceived value factors and emotions shaping consumer intentions toward electric vehicle adoption. Using a quantitative approach, the research surveyed urban and rural residents to examine the impact of quality, emotional, price, social, and green value considerations on adoption intentions. Data were collected from 847 respondents. The findings reveal distinct variations between urban and rural settings in the significance and impact of perceived value factors on the intention to purchase electric vehicles. Emotional aspects weighed more heavily among rural residents, while urban counterparts emphasized price and social value. Furthermore, the study highlights a stronger correlation between attitude and intention among urban consumers. This research suggests a more tailored approach in formulating strategies and interventions, contributing to the understanding of consumer behavior in diverse residential environments.

1. Introduction

The pressing need to tackle climate change underscores the significance of mitigating the release of greenhouse gasses (Zhang et al., 2022), particularly in the transportation sector. Electric vehicles (EVs) have emerged as a critical technology in advancing the decarbonization of the transportation sector and reducing atmospheric pollution and emissions from mobility (Pinto-Gutiérrez, 2024). Increasing the market share of EVs is crucial to reducing atmospheric pollution and emissions deriving from mobility (Zhang et al., 2022), but despite their potential for decarbonizing the transportation sector, EVs must overcome significant obstacles, such as high costs and underdeveloped charging infrastructure (Babic et al., 2022; Higueras-Castillo et al., 2020). In addition to EVs' pivotal role in enhancing public transportation systems, many nations position them as the quintessential harbinger of future individual mobility paradigms (Xu et al., 2020).

Previous research has focused on investigating individuals' EV adoption intentions and the various factors that affect their choices (Habich-Sobiegalla et al., 2018; Singh et al., 2023; Sun et al., 2022). Recent research investigating urban rural disparities (Kester et al., 2020; Zulauf & Wagner, 2021) highlighted that almost all sustainability innovations in the transportation sector (e.g., ride sharing, car sharing, on-demand scooter rental systems) are designed for urban life. Taking a broader perspective, Nelson et al. (2023) argued that scholarly research needs to inform 'what works and under what human and environmental conditions' to support the sustainable transition in urban and rural environments'. The pace and approach to transition to EVs varies by country and culture. Extant studies have examined purchase intentions for EVs within specific national contexts, such as Germany (Degirmenci & Breitner, 2017), Spain (Higueras-Castillo et al., 2021), and Chile (Girard et al., 2019). Germany has charted an expeditious course in this regard, whereas the slow adoption of EVs in Spain and Chile (despite promotional campaigns and government interventions) underscores the need to bridge the relevant research gap.

Marketing revolves around perceived value, understood as customers' assessment of a product's worth. This essential factor

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determines customer satisfaction and loyalty and is vital in attracting and retaining customers. Guided by factors identified in contemporary research, such as that of Hu et al. (2023) and Singh et al. (2020), companies strive to enhance perceived value. Consumer decision-making relies on quality, emotions, social and price values. *Quality* denotes a product's excellence, which impacts satisfaction and loyalty. *Emotional value* refers to the emotional benefits customers anticipate from a product or service, which their values and experiences can influence. *Social Value* is the impact a product or service has on the customer's social environment. It encompasses how a product or service affects the wider community, as well as its positive or negative consequences. *Price value* drives purchase decisions as consumers weigh benefits against costs. Studies by Taherdoost (2017) and Ariffin et al. (2016) identify quality as the link between value and adoption. Notably, perceived price shapes purchase intentions as shown by Lu and Hsiao (2010), Singh and Alok (2022), and Hidayat-ur-Rehman et al. (2020). As Rahardjo et al. (2020) note, the nuanced nature of this relationship warrants further study. Understanding customer perception remains essential in crafting valuable products and services for today's market, as these dimensions guide businesses in satisfying customers and fostering loyalty. Notably, the evaluation of car registrations or other official statistics fail to cover the antecedents of EV buyers' decisions and are also limited to a backward view in time. In their recent reviews of scholarly research on EV adoption Secinaro et al. (2022) and Brescia et al. (2023) pinpoint the ambiguity of results in the customers perception of EV and the antecedents (e.g. price or charging infrastructure) impacts on their adoption decisions.

Addressing the research gap of a forward-thinking understanding of customer perceptions and their willingness to adopt EVs, the study's focus on both urban and rural residents is a unique advantage. By examining these distinct groups, the research captures diverse perspectives on EV adoption that are often overlooked in studies focused solely on urban areas. Emphasizing this distinction can showcase how the study provides a more holistic view of EV adoption behavior, addressing the needs of both population segments. The study addresses the following research question: *How does residence location (urban/rural) moderate consumers' EV purchase intention?* The current study makes significant contributions by (1) interrogating EV adoption behavior through perceived value and (2) employing a research design that accounts for daily life situations by distinguishing urban from rural consumers.

The research aim of this explorative study is to contribute empirical evidence on EV buyers' attitudes and purchase intention explaining be psychographic antecedents such as green perceived value, their attitudes and their EV-related appraised such as emotional value, quality, price and social value of the EVs. For this type of predictive analysis composite models by means of partial least squares model fitting has been demonstrated to be superior to the classical covariance-based fitting of structural equation models.

Following this introduction, the theoretical foundations of the study are meticulously described in an extensive literature review, accompanied by a rigorous rationale for the proposed research hypotheses. The article then explains the methods used, describes the research results, and concludes by concisely summarizing the key findings.

2. Literature review

Perceived value is a crucial concept in marketing, referring to the worth or usefulness of a product or service in customers' eyes based on their perceptions of what they will receive in exchange for the cost (Dodds et al., 1991). This value perception is essential in shaping consumer decisions, especially in competitive markets where customers have multiple options. Consumer value plays a vital role in decision-making (Zeithaml, 1988), and companies continuously strive to enhance perceived value to attract and retain customers. In the context of EV adoption, perceived value is particularly significant, as it influences not only initial purchase intentions but also long-term satisfaction and loyalty (Higueras-Castillo, Molinillo, et al., 2019; Vallejo-Morales et al., 2021).

Over the years, the concept of perceived value has evolved. Initially grounded in utility theory (Fishburn, 1968), researchers later incorporated other dimensions such as perceived quality (Zeithaml, 1988) and emotional benefits (Butz Jr & Goodstein, 1996). In the case of EVs, the dimensions of quality, emotional, price, social, and green value are all critical in shaping consumer preferences (Hu et al., 2023). EVs represent a substantial shift in consumer behavior, driven by the intersection of technology, environmental awareness, and economic considerations.

By understanding which factors influence perceived value, companies can create products that are more likely to attract and retain customers. Below the dimensions of perceived value that are relevant to EV adoption are studied and provide justifications for the hypotheses.

First, *quality value* refers to a customer's perception of a product's overall excellence, typically evaluated based on attributes such as design, functionality, durability, and reliability. In competitive markets, quality can often be the deciding factor between different brands. For EVs, perceived quality includes important elements such as battery performance, vehicle reliability, and the overall driving experience (Stylidis et al., 2020). As EVs are still considered relatively new technology by many consumers, the perceived reliability of these vehicles plays a crucial role in adoption decisions. Although perceived quality often leads to higher satisfaction and brand loyalty, it does not always guarantee adoption intentions, as other factors—such as price or emotional value—may take precedence, particularly in emerging markets (Higueras-Castillo, Molinillo, et al., 2019).

In traditional consumer markets, perceived quality has been shown to significantly impact purchasing decisions. For example, Taherdoost (2017), found that perceived quality strongly influences the intention to use e-services, while Ariffin et al. (2016) demonstrated that quality impacts green product repurchase intention. However, other studies highlight that perceived information quality did not influence the intention to use e-government services. Similarly, Singh and Alok (2022) found that perceived quality had no impact on the repurchase intention of organic food. These discrepancies indicate that while quality is important, its influence may vary across contexts. Considering the evidence, we propose the following hypothesis:

H1. The perceived quality value of electric vehicles positively influences the intention to adopt them.

Second, *emotional value* refers to the affective consumers derive from using a product, including feelings of happiness, pride, or satisfaction. Emotional drivers are particularly important in marketing, as they can create deep consumer connections with a brand or product. In the contexts of EVs, emotional value often stems from the satisfaction of owning an environmentally friendly vehicle and contributing to sustainability goals (Hu et al., 2023). As environmental awareness grows, the emotional appeal of making eco-conscious decisions becomes increasingly relevant for many consumers. This sense of contributing to a greater good—such as reducing carbon emissions—can serve as a strong motivator for adopting EVs (Jiang, 2016).

Numerous studies have shown that emotional value plays a significant role in shaping consumer behavior. For instance, Joshi et al. (2021) found that emotional value encourages green purchase intentions, while Ravi et al. (2022) demonstrated that emotional value influences consumers' purchase intention of social enterprise products. For EVs, the emotional gratification from driving a sustainable vehicle is often cited as a primary reason for adoption (Higueras-Castillo, Liébana-Cabanillas, et al., 2024; Li et al., 2023). However, some research suggests that emotional value may not always directly influence adoption behavior in all segments of the population (Han et al., 2017). Thus, the following research hypothesis was proposed:

H2. The emotional value of electric vehicles positively influences the intention to adopt them.

Third, *price value* represents the perceived balance between the cost of a product and the benefits it provides. For many consumers, price is a decisive factor in purchasing decisions, particularly for products with high upfront costs. In the case of EVs, price value is especially relevant due to their higher initial cost compared to traditional internal combustion vehicles (Krishnan & Koshy, 2021). Consumers frequently weigh the initial investment against long-term savings from lower fuel and maintenance costs, which can improve the overall perception of price value. However, the perception of a high price barrier can delay adoption for many consumers (Asadi et al., 2021).

The relationship between perceived price and adoption is well-documented in various product categories. Lu and Hsiao (2010) demonstrated that perceived price is a strong determinant of perceived value and intention to pay for services, while Singh and Alok (2022) found that perceived price influenced the repurchase intention of organic food. For EVs, the long-term financial benefits of reduced fuel consumption and maintenance costs can improve perceived value, but the initial purchase cost remains a significant hurdle for many consumers. In this sense, consumers may also consider government incentives and rebates as factors that affect price perception (Higueras-Castillo, Ramdhony, et al., 2024).

In some cases, studies suggest that environmental performance may even outweigh price considerations when it comes to adoption decisions, particularly for consumers who prioritize sustainability (Degirmenci & Breitner, 2017). However, as price remains a primary concern for many, we propose the following research hypothesis was proposed:

H3. The price value of electric vehicles positively influences the intention to adopt them.

Fourth, *social value* concerns how a product impacts a consumer's social standing or the way they are perceived by others. For EVs, social value is closely tied to the perception of being environmentally responsible, a trait that enhances social status among certain peer groups (Higueras-Castillo et al., 2020). Consumers may adopt EVs in part because they believe that doing so will positively affect how they are perceived by others, especially in communities that place a high value on environmental consciousness.

Studies on social influence have consistently shown that individuals often adopt behaviors based on peer trends or social expectations. Leow et al. (2021) found that normative pressures significantly influence behavioral intention, while Wang and Chuan-Chuan Lin (2011) demonstrated that social influence directly impacts usage intentions. In the EV market, social influence has been identified as a key factor, as consumers are likely to follow the behaviors of their peers or social networks when making purchasing decisions (Cui et al., 2021). Consumers may be more inclined to adopt EVs if they see friends, family, or colleagues doing the same, reinforcing the social value associated with such a choice.

However, not all studies point to a direct link between social value and purchase intention. For example, Wahl et al. (2020) found no significant effect of social value on the intention to purchase EVs in Germany, suggesting that social factors may not always be primary drivers in every market. Wu et al. (2018) also noted that the influence of social value could be mediated by other factors, such as hedonic and utilitarian values, meaning that while social value is present, it may not always be the strongest predictor of behavior. In view of the above, the following research hypothesis was proposed:

H4. The social value of electric vehicles positively influences the intention to adopt them.

Green perceived value refers to the environmental benefits that consumers associate with eco-friendly products. In the case of EVs, GPV is critical, as consumers see these vehicles as a means to reduce their environmental impact and promote sustainability (Chen, 2013). Many consumers are motivated to purchase EVs because of the positive environmental effects associated with their use, such as reduced greenhouse gas emissions and energy efficiency. As awareness of climate change and environmental degradation grows, GPV is becoming an increasingly important factor in consumer decision-making (Cheung et al., 2015; Riva et al., 2022; Roh et al., 2022; Toulabi et al., 2021).

Research has consistently shown that GPV is a strong predictor of green product adoption. For instance, studies by Wu et al. (2019) and Mombeuil and Diunugala (2023) have confirmed that green perceived value significantly influences the intention to adopt EVs. In these cases, consumers who prioritize sustainability and reducing their carbon footprint are more likely to perceive EVs as high-value products that align with their environmental goals. This alignment between consumer values and the green credentials of EVs helps explain the strong correlation between GPV and adoption intentions.

In view of the above, the following research hypothesis was proposed:

H5. The green perceived value of electric vehicles positively influences the intention to adopt them.

Attitude is another crucial factor in understanding consumer behavior, defined as a consumer's overall evaluation or feeling toward a product or service (Eagly & Chaiken, 1993). In the context of EV adoption, a positive attitude—often shaped by beliefs about the environmental and economic benefits of EVs—has been shown to strongly influence purchase intentions (Higueras-Castillo, Liébana-Cabanillas, et al., 2019). Attitudes toward EVs are generally positive when consumers are well-informed about the advantages of electric mobility, including long-term cost savings and environmental benefits.

The theory of planned behavior (Ajzen, 1991) suggests that attitudes, along with perceived behavioral control and subjective norms, predict intentions and behaviors. Numerous studies have confirmed the positive relationship between attitude and green product adoption. For example, Asadi et al. (2021) found that attitudes significantly influence the intention to adopt sustainable transportation solutions, including EVs. Similarly, Jaiswal et al. (2021) highlighted that positive attitudes toward EVs lead to higher adoption intentions, as consumers perceive them as beneficial both for themselves and for society. In view of the above, the following research hypothesis was proposed:

H6. Attitude toward electric vehicles positively influences the intention to adopt them.

A moderating variable influences the relationship between an independent variable and a dependent variable, either by strengthening or weakening the relationship (Hayes, 2017). In this study, we explore the moderating effect of residence location (urban vs. rural) on the relationships that drive EV adoption, as suggested by Zulauf and Wagner (2021). Prior research has highlighted how urban and rural environments shape consumer behavior differently, especially in terms of mobility and environmental concerns. Urban residents tend to be more environmentally conscious and are more likely to adopt sustainable technologies such as EVs (Fransson & Gärling, 1999). Meanwhile, rural residents may face barriers such as longer travel distances and limited access to charging infrastructure, which can affect their willingness to adopt EVs. Prior research has explored the influence of urban accessibility on the dynamics of mobility (Sala et al., 2021) and identified a pronounced reliance on automobile-centric mobility stemming from the phenomenon of urban sprawl (Duarte & Ratti, 2018), which is particularly observed among populations residing in peri-urban or exurban environs. These variations in mobility attributes are discernible in the distinct mobility profiles exhibited by inhabitants of urban and rural landscapes (Giménez-Nadal & Molina, 2022). Rural regions are distinguished by a spectrum of economic prospects intertwined with distinct societal customs and heritage (Akgün et al., 2015), but they encounter societal pressures to transition from entrenched traditional rural mindsets toward embracing more urbanized, environmentally conscious attitudes.

In addition, Schirmer et al. (2014) conducted a broad review of residential location choice models, examining how transportation costs and urban density impact mobility behavior. Their findings suggest that location plays a significant role in shaping transportation preferences, with urban residents often having more access to alternative mobility options. Similarly, Lee and Waddell (2010) specifically analyzed the impact of mobility costs on residential location decisions, using a nested logit model to explore how different transportation costs influence where people choose to live.

In the context of EV adoption, Higueras-Castillo et al. (2022) found that urban residents are more likely to adopt sustainable mobility solutions, driven by greater concern for environmental consequences. This suggests that urban residents may have stronger intentions to adopt EVs due to heightened environmental awareness and better infrastructure for electric mobility. Based on these insights, the following research question was proposed: Does residence location (urban/rural) moderate the relationships proposed in the behavioral model? The research model in Fig. 1 consolidates the hypotheses derived from the literature review.

3. Methodology

The data for this study was collected through an online survey administered via a professional survey panel provided by Cint, resulting in a non-probabilistic sampling approach. The survey was distributed in April 2022, and after data cleaning, the final sample comprised 847 valid responses. To ensure the sample met the criteria of adults over 18 years old who possessed a valid driver's license, specific screening questions were integrated into the questionnaire. During the recruitment process, panel participants were asked to confirm their age and license status before proceeding with the survey. Responses from individuals who did not meet these requirements were automatically disqualified during the initial stage of data collection. Additionally, a thorough data cleaning process was carried out, removing any incomplete or unreliable responses, ensuring the quality and validity of the final dataset. Of the sample, 55.5 % were male, the average age of 41 years old, 52.7 % had a monthly income of €0.00–€3499.00, 79 % reside in an urban area, and a majority had either purchased an EV or intended to purchase one in the coming months (see Table 1). The panel used for this research allowed for a geographically diverse group of participants, enabling an analysis that considers potential differences in perceptions of electric vehicles between individuals residing in urbanized versus rural environments. This distinction is critical, as urban areas tend to have better charging infrastructure and higher population density, which may influence attitudes toward electric vehicle adoption.

Table 1
Sample characteristics.

Variable	Frequency	Percentage
Gender		
Male	470	55.5
Female	377	44.5
Net household income		
Up to 1500€	85	10.2
1500–2499€	170	20.1
2500–3499€	190	22.4
3500–4499€	154	18.2
4500–5499€	102	12
5500–6499€	60	7.1
6500–7499€	36	4.3
7500 or more	26	3.1
I do not wish to answer	23	2.7
Residence zone		
Rural	178	21
Urban	669	79
Have you purchased an electric vehicle in the last few months or do you intend to buy or lease one in the next few months?		
I have purchased an electric vehicle in the last 12 months	230	27.2
I have purchased an electric vehicle in the last 6 months	87	10.3
I will buy an electric vehicle in the next 6 months	130	15.3
I will buy an electric vehicle in the next 12 months	295	34.7
None of the above	105	12.4

The variables were measured on 5-point Likert scales adapted from previous studies (see Table 2). Regarding the analysis process, a partial least squares (PLS) structural equation model was used in the SmartPLS 4 software. The procedure consisted of analyzing the psychometric properties of the variables and items by analyzing the reliability and validity (including multicollinearity) and the fit of the model. Subsequently, the path coefficients of each structural path and significance were examined. Finally, the explanatory capacity of the model was determined.

4. Results

4.1. Analysis of the measurement scales

In the analysis of the psychometric properties of the measurement scales (see Table 2), reliability was examined through Cronbach's alpha and composite reliability (CR), and all the standardized loadings were significant and higher than 0.7 (Hair, 2011). One item of the attitude

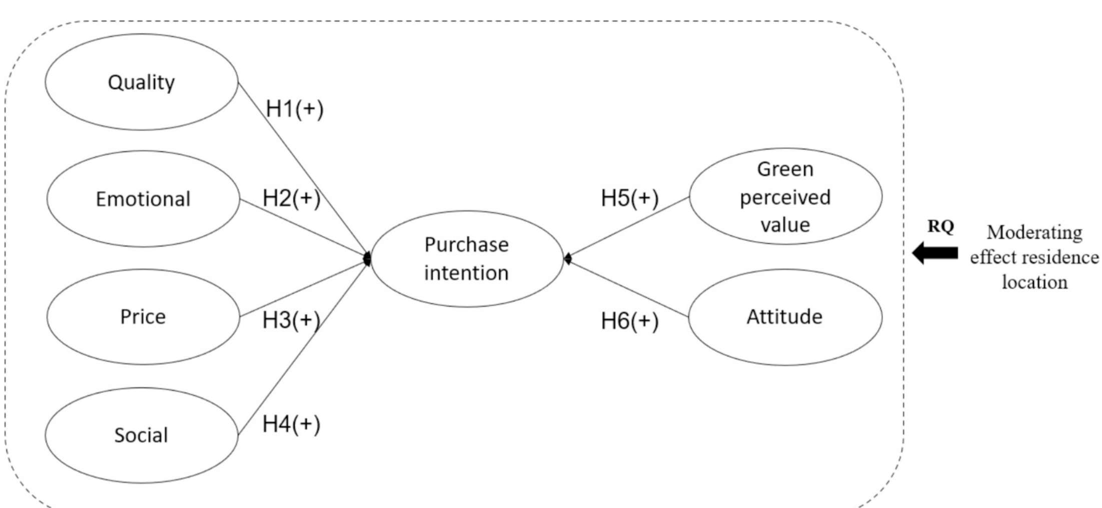

Fig. 1. Proposed behavioral model.

Table 2
Outer model assessment.

CONSTRUCTS AND MEASURED ITEMS	STANDARD LOADINGS	VIF
PERVAL (adapted from Walsh et al., 2014)		
Quality (Cronbach's α = 0.814; CR = 0.889; AVE = 0.728)		
Is of high quality	0.821	1.707
Is well built	0.870	1.906
Has an acceptable standard of quality	0.869	1.805
Emotional (Cronbach's α = 0.851; CR = 0.910; AVE = 0.770)		
Would enjoy one of them	0.881	2.133
Would make me want to use it	0.886	2.300
Would make me feel good to have one	0.866	1.014
Price (value for money) (Cronbach's α = 0.837; CR = 0.901; AVE = 0.751)		
Is reasonably priced	0.817	1.830
Offers good value for money	0.888	2.130
Is a good product for the price	0.893	1.977
Social (Cronbach's α = 0.868; CR = 0.919; AVE = 0.791)		
Would help me to feel accepted by others	0.894	2.424
Would improve the way I am perceived by others	0.888	2.504
Would make a good impression on other people if I had one	0.885	2.038
Green perceived value (Cronbach's α = 0.910; CR = 0.932; AVE = 0.734) (adapted from Chen, 2013)		
The benefits of EVs on the environment are extremely positive.	0.828	2.269
The benefits of EVs on the environment meet my expectations.	0.825	2.159
I would purchase an EV because it is more environmentally friendly than an internal combustion vehicle.	0.879	2.736
I would purchase an EV because it is environmentally friendly.	0.872	2.740
I would purchase an EV because of the positive impact on the environment compared to traditional internal combustion vehicles.	0.878	2.884
Attitude (Cronbach's α = 0.892; CR = 0.933; AVE = 0.823) (adapted from Ajzen, 1991)		
Bad/Good	0.885	2.333
Unfavorable/Favorable	0.909	2.756
Negative/Positive	0.927	3.191
Purchase intention (Cronbach's α = 0.869; CR = 0.920; AVE = 0.793) (adapted from He & Zhan, 2018; Sahin et al., 2012)		
The EV is my first choice when purchasing a new car.	0.894	2.392
I will buy an EV in the near future.	0.862	2.020
Next time, I will buy an EV.	0.915	2.903

scale had to be eliminated, as it did not have the appropriate parameters. Additionally, the values of the average variance extracted (AVE) were observed to be higher than 0.5, so it was concluded that the scales possessed internal consistency and convergent validity (Fornell & Larcker, 1981; Hair, Hult, et al., 2017).

The dependent variables were also checked for multicollinearity by observing variance inflation factor (VIF) values. These are considered acceptable when their value is less than 5.0, which was met in all cases (Hair, Hollingsworth, et al., 2017). Specifically, the mean value is 2.148. Finally, the model fit was examined using the value of the standardized mean squared residual (SRMR) ratio. This indicator shows the difference between the observed correlation and the predicted correlation of the model and should be less than 0.08 (Henseler et al., 2014). In this case, it is 0.049, so the fit is adequate.

Next, discriminant validity was examined using the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) ratio. In the first case, correlations between dimensions should be less than the square root value of the AVE (Fornell & Larcker, 1981). In the second, correlations between constructs should be below 0.9 (Henseler et al., 2014), and this was confirmed (see Table 3).

4.2. Hypothesis testing

The structural model analysis was performed without considering the moderating effect of the residential zone. The research hypotheses were tested through comparative analysis of the structural coefficients. The bootstrapping analysis was performed with 5000 subsamples randomly extracted from the original data set. It was concluded that five of the six hypotheses are supported, as their *p*-value is less than 0.05. Specifically, H1 ($\beta_{\text{Quality Intention}} = -0.032$, *p*-value = .465) is rejected. H5 ($\beta_{\text{GPV Intention}} = 0.232$, *p*-value = .000) and H4 ($\beta_{\text{Social Intention}} =$ 0.230, *p*-value=. 000) are significantly different from zero and have the greatest impact, followed by H3 ($\beta_{\text{Price Intention}} = 0.182$, *p*-value = .000) and H6($\beta_{\text{Attitude Intention}} = 0.179$, *p*-value = .000). Finally, H2 ($\beta_{\text{Emotional Intention}} = 0.164$, *p*-value = .465) is also supported (see Table 4). In addition, the model's predictive ability was examined through the multiple squared correlation coefficient (R^2). The value for purchase intention was 0.452, which means that perceived value, GPV, and attitude explain 45.2 % of purchase intention.

4.3. Multigroup analysis

In analyzing the moderating effect of area of residence, the sample was divided into two groups: urban area ($n = 669$) and rural area ($n = 177$). First, the invariance analysis was performed through the MICOM procedure of SmartPLS 4 (Henseler et al., 2016). The analysis showed that the first step (configural invariance) and second step (compositional invariance) were correctly fulfilled. Step 3 (composite equality) yields results regarding mean (step 3a) and variance (step 3b). In these last two steps, three variables yielded inadequate values. In conclusion and overall balance, there is partial measure invariance (Henseler et al., 2016).

The results indicate that area of residence moderates four of the six proposed relationships: H2, H3, H4, and H6 (see Table 5). For participants living in a rural area, the emotional aspect is more important, whereas price and social value are more important for those living in an urban area. Moreover, the relationship between attitude and intention is significantly stronger for consumers living in urban areas (see Fig. 2).

5. Discussion

5.1. Theoretical implications

The study offers crucial insights into perceived value theory within the realm of EV adoption, reshaping its application and conceptual

Table 3
Discriminant validity. The diagonal elements are the square roots of the AVE. Fornell-Larcker test below the diagonal elements and HTMT ratio above the diagonal elements.

	Attitude	Emotional	GPV	Intention	Price	Quality	Social
Attitude	0.907	0.265	0.336	0.475	0.369	0.317	0.397
Emotional	0.231	0.878	0.719	0.545	0.401	0.777	0.363
GPV	0.303	0.633	0.857	0.548	0.388	0.690	0.264
Intention	0.419	0.469	0.490	0.890	0.559	0.515	0.556
Price	0.328	0.356	0.350	0.488	0.867	0.604	0.631
Quality	0.272	0.650	0.592	0.436	0.509	0.854	0.428
Social	0.351	0.318	0.240	0.487	0.540	0.360	0.889

Note: GPV = green perceived value.

Table 4
General model solving using SmartPLS.

Research hypothesis		Path co-efficient	Std dev.	*t*-value	*p*-value	Result
H1(+)	Quality Intention	−0.032	0.044	0.731	0.465	Not supported
H2(+)	Emotional→ Intention	0.164	0.047	3.499	0.000	Supported
H3(+)	Price Intention	0.182	0.043	4.248	0.000	Supported
H4(+)	Social Intention	0.230	0.039	5.836	0.000	Supported
H5(+)	GPV → Intention	0.232	0.040	5.768	0.000	Supported
H6(+)	Attitude Intention	0.179	0.087	0.052	0.000	Supported

Note: GPV = green perceived value.

Table 5
Bootstrap multigroup analysis.

Research hypothesis		Urban			Rural			Differences	
		Path	SD	*p*-value	Path	SD	*p*-value	Difference	*p*-value
H1(+)	Quality Intention	−0.007	0.050	0.883	−0.020	0.079	0.801	0.013	0.880
H2(+)	Emotional Intention	0.080	0.049	0.104	0.407	0.108	0.000	−0.327	0.006
H3(+)	Price Intention	0.215	0.049	0.000	0.022	0.063	0.734	0.194	0.014
H4(+)	Social Intention	0.255	0.045	0.000	−0.005	0.064	0.934	0.260	0.001
H5(+)	GPV Intention	0.272	0.046	0.000	0.252	0.088	0.004	0.020	0.843
H6(+)	Attitude Intention	0.155	0.033	0.000	0.321	0.070	0.000	−0.166	0.030

Note: GPV = green perceived value.

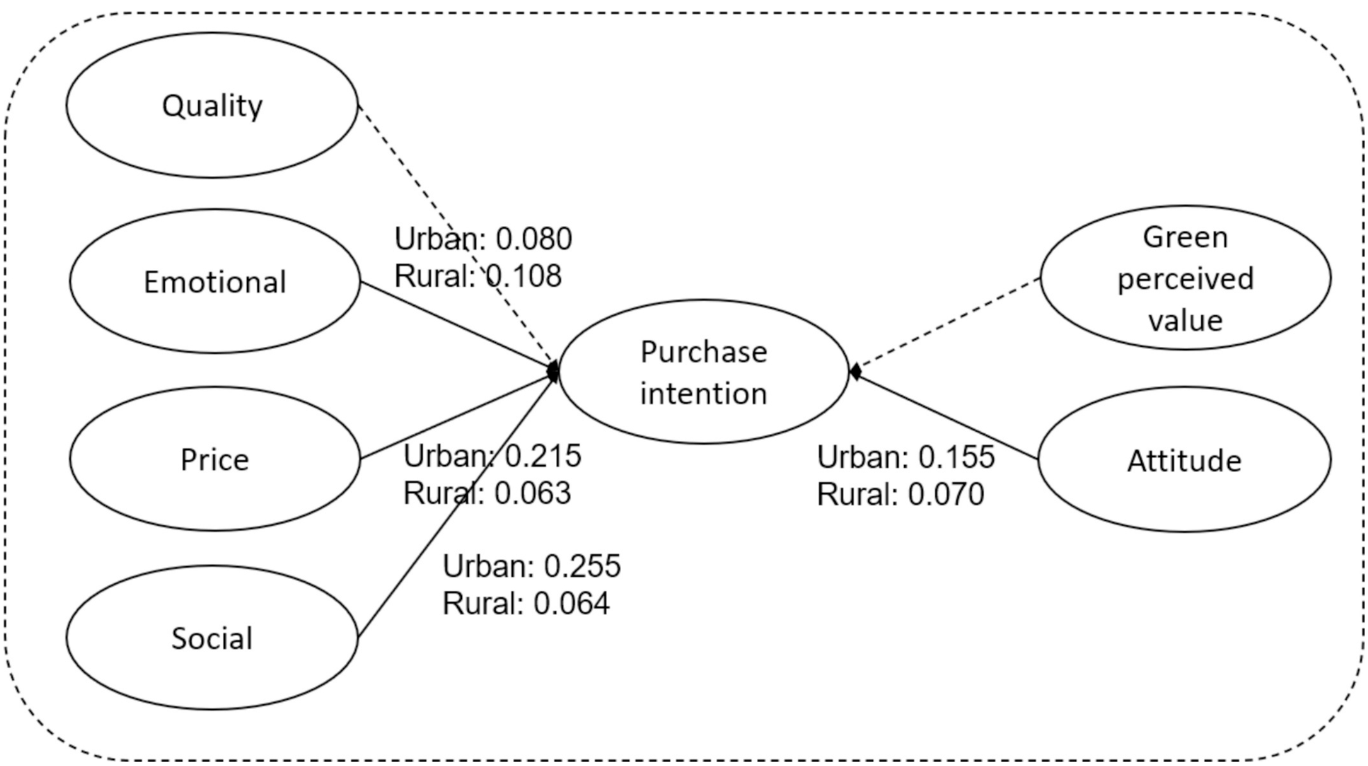

Fig. 2. Multigroup results.

understanding. By scrutinizing the relationship between perceived value factors and EV adoption intentions across urban and rural settings, the research challenges the conventional uniformity of perceived value's influence across different residential contexts. It illuminates that emotional, price, and social considerations weigh diversely among urban and rural residents when they intend to adopt EVs. This contextual divergence underscores the need to tailor perceived value propositions to distinct preferences and priorities, urging a departure from the one-size-fits-all approach. Consequently, the study enriches perceived value theory by emphasizing the contextual nuances crucial in framing value perception, suggesting a more personalized approach in EV-related value propositions catering to urban and rural consumer landscapes. These findings expand on earlier studies, such as those by Degirmenci and Breitner (2017) and Zulauf and Wagner (2021), which suggested the importance of segmenting consumers based on location to improve adoption rates.

In our study, the most influential factor identified in promoting EV adoption was the perceived green value. This factor plays a crucial role in the adoption process, as it responds to consumers' environmental concerns and aligns their personal benefits with a positive impact on the environment. This finding is in line with previous research by Chen (2013) and Riva et al. (2022), who also identified green value as a key determinant in the adoption of sustainable technologies. However, our results differ from those of Degirmenci and Breitner (2017), who found that price was more determinant in some contexts, suggesting that the perception of green value may be of increasing importance in the current context, where environmental awareness is growing. This shift in priorities toward environmental concerns has also been noted in studies across different regions, including those by Girard et al. (2019), which emphasize the global trend toward sustainability.

These findings suggest that promoting perceived green value through targeted awareness policies and information campaigns could significantly increase the rate of EV adoption. By addressing perceived barriers and emphasizing environmental benefits, marketing strategies can align with the motivations of consumers interested in contributing to sustainability. A comparative analysis with other regions, such as those conducted by Asadi et al. (2021), indicates that such strategies could yield higher effectiveness in areas with higher environmental awareness, reinforcing the applicability of these findings to a wider range of geographical contexts. This comparison with previous studies and detailed analysis strengthens our conclusions, placing our research in a broader context within the literature on sustainable technology adoption.

The analysis of the total sample supported five of the six hypotheses, exhibiting statistically significant relationships ($p < .05$). Notably, the rejected hypothesis H1 (Quality → Intention) and one of the supported hypotheses, H5 (GPV → Intention), had no differences by area of residence, whereas all the other supported hypotheses—including H2 (Emotional → Intention), H3 (Price → Intention), H4 (Social → Intention), and H6 (Attitude → Intention)—demonstrated significant differences based on area of residence.

The findings of this study complement existing research in the field. Regarding the relationship between quality and intention (H1), our results align with those of Higueras-Castillo, Molinillo, et al. (2019), but they contrast with the findings of studies conducted in different contexts, such as that of Singh and Alok (2022). Similarly, the absence of a significant difference by area of residence (urban vs. rural) between GPV and intention to purchase EVs (H5) underscores the need for further research exploring how contextual factors, such as residential environments, may shape the role of green perceived value in adoption behavior. Conversely, the support for the emotional factor influencing intention (H2) echoes the findings of Jiang (2016) and Li et al. (2023) but contrasts with the conclusions drawn by Han et al. (2017). The association between price and intention (H3) aligns with the results of studies by Krishnan and Koshy (2021), Asadi et al. (2021), and Vafaei-Zadeh et al. (2022). The impact of social factors on intention (H4) contradicts the findings of Wu et al. (2018) but aligns with those of Krishnan and Koshy (2021) and Higueras-Castillo et al. (2020). Lastly, the correlation between attitude and intention (H6) aligns with numerous studies in the context of EV adoption, e.g., Asadi et al. (2021), Higueras-Castillo, Liébana-Cabanillas, et al. (2019), and Jaiswal et al. (2021). These connections highlight consumer behavior's nuanced and multifaceted nature in the context of EV adoption, showing both agreements and discrepancies across different studies and contexts. Our study contributes to this discourse by providing new insights into the moderating role of residential context, as advocated by Zulauf and Wagner (2021), which may have been overlooked in previous studies.

Notably, the results suggest that area of residence moderates four of the six proposed relationships (H2, H3, H4, and H6). Specifically, emotional factors are emphasized among individuals in rural areas. At the same time, urban residents place greater significance on price and social value concerning their intention to adopt EVs. Additionally, the relationship between attitude and intention is notably stronger among urban consumers.

Breaking down the effects based on residence location, the relationship between quality and intention was insignificant across the entire sample. However, the link between emotional factors and intention showed significance, particularly with a more substantial impact among rural residents. The association between price and intention was significant, showing a more pronounced effect in urban settings. Similarly, the connection between social aspects and intention was significant, demonstrating a more pronounced effect in urban areas. Lastly, the association between attitude and intention was significant, notably revealing a more substantial effect among urban residents.

These findings align with those of Zulauf and Wagner (2021), highlighting the importance of understanding the nuanced role of residence location influencing the relationships between perceived factors and intention to adopt EVs. Further studies, such as those by Girard et al. (2019), have also highlighted the importance of this segmentation across different regions, suggesting that consumer preferences vary widely between rural and urban areas. Understanding these distinctions based on urban or rural contexts is crucial in devising targeted strategies tailored to different consumer segments (Degirmenci & Breitner, 2017; Girard et al., 2019; Higueras-Castillo et al., 2021).

5.2. Implications for business and policymakers

Understanding how residence location influences consumer behavior and decision-making processes regarding EV adoption contributes to designing targeted strategies and policies and acknowledging the differing priorities of urban and rural consumers enables companies to tailor marketing campaigns. For instance, emphasizing emotional appeal is more effective in rural areas, while urban areas respond better to messages highlighting price or social benefits. Insights into varying preferences based on residence location can also guide product development. Businesses may consider offering diverse product variations or features that cater to specific urban or rural needs and values. Understanding the more substantial impact of certain factors (such as price or social value) in urban settings may help companies strategize their market penetration efforts in these areas, potentially boosting EV adoption rates.

Governments and policymakers can use this information to create targeted incentives or policies encouraging EV adoption, as tailored incentives based on urban or rural contexts might effectively promote sustainable transportation initiatives. Understanding the different preferences of urban and rural residents can also guide infrastructure planning. For instance, focusing on charging stations in urban areas and differentiating strategies for rural accessibility might enhance overall EV infrastructure. For example, in the Indian context, Gupta et al. (2024) discuss how the lack of charging infrastructure particularly affects rural and semi-urban areas, where this lack is one of the main barriers to EV adoption. The article suggests that building a comprehensive network of charging stations could significantly improve adoption in these less developed regions in terms of infrastructure.

Encouraging EV adoption aligns sustainability goals, and addressing the nuances associated with residence location can expedite the transition to cleaner transportation options, reducing carbon emissions and mitigating environmental impacts. Song et al. (2022) found significant differences in motivations and barriers to adoption between the United States and China (such as cultural characteristics), highlighting the need for context-specific strategies. The study indicates that in China, price and emotional factors are crucial in purchasing, with a focus on economic benefits and social responsibility. In the US, while price is relevant, buyers value perceived quality more. In essence, recognizing and leveraging the nuanced differences in consumer behavior based on residence location not only aids businesses in targeted marketing but also assists society in crafting policies and infrastructure conducive to sustainable practices, fostering a more environmentally conscious and consumer-responsive landscape.

5.3. Implications for research and further studies

Potential avenues for future research considering the study's results include exploring the nuances of urban and rural differences and examining how specific factors unique to each setting may influence EV adoption beyond the broad distinctions highlighted in this study. Second, future research should investigate how evolving perceptions and trends in urban and rural areas impact the adoption of EVs over time. Longitudinal studies could capture changing attitudes and behaviors toward EVs.

Furthermore, future research should evaluate the effectiveness of various policy interventions and infrastructure developments in promoting EV adoption in urban versus rural areas, assessing how tailored policies impact adoption rates. Iit would be interesting to include cultural variables in the study, as they could moderate environmental policies in certain contexts (Souza et al., 2024). Finally, research should be extended beyond this study's specific application domain to sustainable products or services in general to identify how urban and rural contexts influence adoption patterns across various sustainable technologies.

Additionally, there are limitations arising from the data analysis method of fitting the model with composites to the data. PLS-based model fitting is robust and suitable for exploratory research. The cross-sectional nature of the study restricts the ability to infer causality and examine changes over time. Future studies could conduct longitudinal studies to better understand how perceptions and attitudes toward EV adoption evolve. This would allow researchers to assess causal relationships and track shifts in consumer behavior over time. Markov-based mover-stayer models and tobit-based response models can inform us how and why buyers adopt EVs and might change back to combustion engine cars.

The social desirability bias occurs when respondents give answers they think are socially acceptable, especially regarding environmental attitudes and EV adoption. To reduce this bias the authors incorporate anonymous data collection and use questioning techniques that reduce the pressure on respondents to answer in socially desirable ways. Furthermore, potentially a response bias occurs due to question wording. The way questions are phrased can lead to biased responses, particularly if questions are leading or suggest a certain viewpoint. To reduce this bias, the questionnaire was pretested and revised in advance. Furthermore, the authors emphasized using neutral and balanced language throughout the survey to minimize this bias. Notably we tested for a possible common method bias. Statistical analysis confirmed that the results of this study are not affected by a common method bias.

By focusing on these potential directions, future research can enrich our understanding of how residential settings influence consumer behavior concerning EV adoption, enabling the development of more targeted and practical strategies to promote sustainable transportation in diverse settings.

6. Conclusion

This study shows that areas of residence (urban or rural) moderate the relationship between various perceived factors and the intention to adopt electric vehicles. The data reflects that certain factors, such as emotional aspects, price considerations, social influences, and attitudes, have a differential impact on EV adoption intentions between urban and rural residents, underscoring the need for specific approaches according to residential context.

While emotional value had greater relevance in rural areas, price value and social value were more significant for urban residents, reinforcing the idea that the urban context promotes social and status values, while the rural context values the emotional connection to the product. This finding highlights the importance of differentiated marketing strategies tailored to specific consumer contexts.

These results also emphasize that future research should continue to explore these contextual variations for a deeper understanding of appropriate promotional strategies in the sustainable mobility arena. Such an approach would enable more effective implementation of the transition to electric vehicle use.

CRediT authorship contribution statement

Elena Higueras-Castillo: Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Katrin Zulauf:** Writing – review & editing, Writing – original draft, Conceptualization. **Manuel Alonso Dos Santos:** Writing – original draft, Supervision. **Francisco Liébana-Cabanillas:** Validation, Supervision, Investigation. **Ralf Wagner:** Supervision, Investigation, Conceptualization.

Declaration of competing interest

none.

Data availability

Data will be made available on request.

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