Drivers of Green Trust and Green Citizenship Behavior in Promoting Biofuel Adoption: Evidence from E10 Bio-gasoline in Vietnam

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ABSTRACT

The transition toward low-carbon energy systems has positioned biofuels as an important short- to medium-term solution for reducing greenhouse gas emissions in the transportation sector, particularly in emerging economies. In Vietnam, the forthcoming mandatory adoption of E10 bio-gasoline raises concerns regarding consumer acceptance due to past challenges in earlier biofuel programs. This study investigates the psychological mechanisms through which functional attributes of E10 influence consumers' adoption intentions. Drawing on the Stimulus–Organism–Response (S-O-R) framework, social exchange theory, and the theory of planned behavior, this study examines the effects of price value, perceived product quality, and facilitating conditions on green trust and green citizenship behavior, and their subsequent impact on intention to use E10 bio-gasoline. A cross-sectional survey using convenience sampling was conducted with 482 consumers in Ho Chi Minh City, Vietnam. The proposed model was analyzed using partial least squares structural equation modeling (PLS-SEM). The results reveal that price value, perceived product quality, and facilitating conditions significantly enhance green trust and green citizenship behavior. In turn, both green trust and green citizenship behavior exert strong positive effects on consumers' intention to use E10, acting as critical mediating mechanisms. This study extends the biofuel adoption literature by emphasizing the role of trust-based and civic-oriented mechanisms in promoting sustainable energy consumption under a mandatory policy context, and offers practical implications for policymakers and energy providers in emerging economies.

Keywords: Price Value, Perceived Product Quality, Facilitating Conditions, Green Trust, Green Citizenship Behavior, Usage Intention, E10 Bio-gasoline
JEL Classification: Q42, Q48, D12, D91, Q56

1. INTRODUCTION

Climate change and environmental degradation driven by carbon dioxide (CO_2) emissions and greenhouse gas accumulation have emerged as major global challenges, posing serious risks to economic stability, public health, and long-term energy security. In response, the transition toward a green economy has become an unavoidable policy imperative rather than a voluntary option. International frameworks such as the United Nations' Sustainable Development Goals (SDGs) have reinforced stricter environmental standards, particularly in energy-intensive sectors such as transportation, which remains one of the largest sources of global emissions (International Energy Agency [IEA], 2021; Intergovernmental Panel on Climate Change [IPCC], 2022).

Within this transition, biofuels have been widely recognized as a pragmatic and cost-effective pathway for reducing emissions while maintaining fuel supply stability, especially in developing and emerging economies. Compared with capital-intensive alternatives, low-blend biofuels such as E10 bio-gasoline can

be integrated into existing fuel infrastructure with relatively low technological and economic barriers (Demirbas, 2009; Timilsina and Shrestha, 2011). Empirical evidence from countries including the United States, Brazil, China, and Thailand suggests that E10 adoption can contribute to emission reduction without requiring immediate large-scale structural changes in the transport sector (Zhang et al., 2013; IEA, 2019; IEA, 2021).

Vietnam, as a rapidly developing economy experiencing rapid urbanization and rising energy demand, has committed to achieving net-zero emissions by 2050, as announced at COP26. To operationalize this commitment, the government has issued a series of policies aimed at greening the national energy system, with transportation identified as a priority sector due to its substantial carbon footprint. Alongside the promotion of electric vehicles, bio-gasoline has been positioned as a transitional energy solution aligned with Vietnam's current technological capacity and economic conditions.

Drawing on international experience, Vietnam has established a clear roadmap for the introduction of E10 bio-gasoline, including pilot implementation in major cities prior to nationwide rollout. However, previous attempts to promote biofuels — most notably E5 gasoline — revealed significant challenges. Consumer skepticism regarding product quality, price fairness, and usage convenience constrained market acceptance, despite strong policy support (Gillingham et al., 2013; Steg et al., 2015). These experiences underscore a persistent gap between policy intentions and consumer behavioral responses in energy transitions.

Existing energy economics literature suggests that regulatory mandates alone may be insufficient to ensure the successful adoption of green energy products. Instead, consumer trust, perceived value, and voluntary pro-environmental behavior play a crucial role in shaping acceptance and sustained use (Liu et al., 2020; Sharma et al., 2021). Recent evidence from Southeast Asia further emphasizes that trust-building mechanisms and supportive institutional environments are central to public acceptance of policy-driven low-carbon energy transitions (Techa-Erawan et al., 2024). Nevertheless, empirical studies examining the behavioral mechanisms underlying biofuel adoption in emerging economies remain limited, particularly in contexts characterized by mandatory policy implementation.

To address this gap, this study integrates the Theory of Planned Behavior (Ajzen, 1991), Social Exchange Theory (Blau, 1964), and the Stimulus–Organism–Response (S–O–R) framework (Mehrabian and Russell, 1974) to examine how functional stimuli: namely price value, perceived product quality, and facilitating conditions that influence consumers' intention to use E10 bio-gasoline. It is argued that these effects are not purely direct but are mediated by green trust and green citizenship behavior, which represent key psychological and social mechanisms in energy transition contexts.

Using survey data collected from consumers in Ho Chi Minh City, one of Vietnam's major economic centers and a pilot area for E10 implementation, this study provides empirical evidence

on the drivers of biofuel adoption. By highlighting the mediating roles of green trust and green citizenship behavior, the findings contribute to the energy economics and policy literature by demonstrating how behavioral mechanisms can complement regulatory measures. The results offer practical implications for policymakers and energy providers seeking to promote biofuel adoption through trust-building and citizen engagement rather than coercive enforcement.

2. LITERATURE REVIEW

2.1. Theoretical Foundations
This study builds an integrated theoretical foundation to explain consumer behavior under a policy-driven energy transition context. Drawing on the Stimulus–Organism–Response (S–O–R) framework, social exchange theory (SET), and the theory of planned behavior (TPB), the study develops a coherent mechanism linking economic and institutional stimuli to green trust, green citizenship behavior, and biofuel adoption intention.

2.1.1. Stimulus – organism – response (S-O-R) framework
The S-O-R model (Mehrabian and Russell, 1974) posits that external environmental stimuli affect individuals' internal psychological states, which subsequently shape behavioral responses. In energy and sustainability research, S-O-R is particularly useful for capturing how policy instruments and product attributes influence consumer behavior through mediating cognitive and moral mechanisms.

In this study, the framework is operationalized as follows. Stimulus (S) consists of policy- and market-related factors, including price value, perceived product quality, and facilitating conditions. These variables represent key levers through which governments and energy suppliers influence consumer evaluations. Organism (O) reflects internal psychological states, captured by green trust and green citizenship behavior. Green trust represents consumers' confidence in the safety and environmental benefits of E10, while green citizenship behavior reflects a sense of moral responsibility toward national environmental objectives. Response (R) is measured by intention to use E10 bio-gasoline, which is appropriate in a pre-mandatory implementation phase.

2.1.2. Social exchange theory (SET)
Social exchange theory (Blau, 1964) provides the underlying logic for the formation of green citizenship behavior. According to SET, individuals tend to reciprocate when they perceive fair treatment or benefits from institutions. In the biofuel context, favorable pricing, reliable quality, and convenient access to E10 are interpreted as forms of institutional support. Consumers may reciprocate by voluntarily supporting biofuel adoption, not only through trust but also through civic-oriented, pro-environmental behavior. This reciprocal mechanism is critical for enhancing public acceptance and long-term effectiveness of energy transition policies.

2.1.3. Theory of planned behavior
Consistent with the theory of planned behavior (Ajzen, 1991), behavioral intention is considered the most direct predictor of

actual behavior. As E10 bio-gasoline had not yet been fully mandated nationwide at the time of data collection, intention to use is a suitable and policy-relevant outcome variable. It captures consumers' readiness to adopt biofuels once regulatory enforcement becomes effective.

2.2. Related Concepts

2.2.1. E10 Bio-gasoline
E10 bio-gasoline is a blended fuel consisting of 90% conventional gasoline (RON 92 or RON 95) and 10% bioethanol by volume. From a technical perspective, E10 is classified as a cleaner fuel with a higher octane rating, enabling more complete combustion and reducing harmful emissions such as CO, HC, and particularly CO_2 (IEA, 2021). In this study, E10 is not treated merely as a commercial fuel product but as a strategic policy instrument within Vietnam's energy transition pathway, aiming to reduce fossil fuel dependence and improve urban air quality.

2.2.2. Price value
Price value refers to consumers' cognitive trade-off between perceived benefits and monetary costs, rather than the absolute price paid (Zeithaml, 1988; Venkatesh et al., 2012). In the context of E10 bio-gasoline, it reflects whether the price differential relative to conventional gasoline is justified by functional performance and environmental benefits. Prior studies show that favorable value perceptions significantly increase consumers' willingness to adopt biofuels (Zailani et al., 2019). Recent IJEEP research further supports this view. Park et al. (2024) find that positive cost–benefit evaluations enhance acceptance of energy technologies, while Le and Nguyen (2024) confirm perceived value as a key driver of behavioral intentions toward energy-efficient products. Thus, when the economic and environmental trade-off of E10 is perceived as favorable, price value becomes a critical stimulus influencing adoption decisions.

2.2.3. Perceived product quality
Perceived product quality is defined as consumers' subjective assessment of a product's overall excellence or superiority relative to alternatives (Zeithaml, 1988). As biofuels such as E10 are largely credence goods, whose quality cannot be immediately verified, consumers rely heavily on expectations regarding technical standards, performance stability, and engine safety. In this study, perceived quality reflects consumers' beliefs that E10 can deliver smooth vehicle operation, comparable fuel efficiency, and minimal risk of engine damage, which are critical determinants of acceptance (Chen and Chang, 2012; Chen and Chang, 2013).

2.2.4. Facilitating conditions
Facilitating conditions refer to the extent to which consumers believe that adequate technical, organizational, and institutional infrastructure is available to support the use of a new product or system (Venkatesh et al., 2012). In this research, facilitating conditions are conceptualized broadly to include institutional support, such as fuel availability at stations, transparency in product labeling, access to technical information, and risk-compensation or warranty policies provided by authorities and fuel suppliers. These conditions play a crucial role in lowering perceived adoption barriers and uncertainty.

2.2.5. Green trust
Green trust is defined as consumers' willingness to rely on a product, service, or institution based on beliefs regarding its environmental credibility, benevolence, and competence in fulfilling green commitments (Chen, 2010). Within the S–O–R framework, green trust represents a core internal state (Organism), reflecting consumers' confidence that E10 genuinely delivers environmental benefits and that regulatory bodies effectively monitor fuel quality. Green trust thus serves as a psychological filter that translates technical claims into perceived assurance.

2.2.6. Green citizenship behavior
Green citizenship behavior originates from the concept of organizational citizenship behavior (OCB) and refers to voluntary, discretionary actions that go beyond immediate self-interest to support environmental protection and sustainable development (Organ, 1988; Luu, 2019). In this study, GCB reflects consumers' sense of civic responsibility, whereby the use of E10 is motivated not solely by economic incentives but by moral obligation and willingness to support national environmental objectives, even at the cost of minor personal inconvenience.

2.2.7. Intention to use
According to the Theory of Planned Behavior, behavioral intention is the most direct and robust predictor of actual behavior (Ajzen, 1991). Given that E10 adoption in Vietnam is still in a transition phase, this study employs intention to use as the primary outcome variable. A higher level of intention indicates a stronger likelihood that consumers will adopt E10, thereby supporting the effective implementation and long-term success of biofuel policies.

2.3. Hypotheses Development

2.3.1. Price value and green trust
In green consumption, price represents not only monetary cost but also perceived value relative to environmental benefits. When green products are perceived as fairly priced and economically justified, consumers are more likely to develop trust in the product and the institutions promoting it. Prior studies show that green perceived value significantly enhances green trust by strengthening credibility and reducing perceived risk (Chen and Chang, 2012; Konuk, 2018). In the biofuel context, value-based evaluations — particularly functional and conditional values — have been shown to positively influence adoption willingness (Zailani et al., 2019). Recent evidence further confirms that green perceived value strengthens green trust and subsequent behavioral intentions (Liu et al., 2020). Accordingly, this study proposes that:

H_1: Price value positively affects consumers' green trust toward E10 bio-gasoline.

2.3.2. Perceived product quality and green trust
Perceived product quality is a key antecedent of green trust, particularly for environmentally friendly products that involve technical uncertainty. When E10 bio-gasoline is perceived as safe, stable, and technically reliable, consumers are more likely to trust both producers and regulatory authorities. Prior research consistently demonstrates that perceived green quality enhances green trust by reducing performance and safety concerns (Chen and Chang, 2012). Similar evidence shows that perceived product

quality directly strengthens consumer trust in green products and related institutions (Konuk, 2018; Zhang and Zhou, 2022).

H_2: Perceived product quality positively affects consumers' green trust toward E10 bio-gasoline.

2.3.3. Facilitating conditions and green trust

Facilitating conditions, including infrastructure availability, distribution accessibility, and technical support, signal institutional commitment and reduce consumers' perceived risk. Prior studies in sustainable technology and green mobility consistently show that supportive conditions strengthen trust in green systems and products (Khazaei and Tareq, 2021; Higueras-Castillo et al., 2024). In the Vietnamese context, institutional support and external facilitating conditions have been found to play a critical role in shaping consumer trust toward green products (Nguyen et al., 2017). Accordingly:

H_3: Facilitating conditions positively affect consumers' green trust toward E10 bio-gasoline.

2.3.4. Price value and green citizenship behavior

From a social exchange perspective, price value reflects perceived fairness and shared societal benefits rather than mere monetary cost. When consumers perceive E10 bio-gasoline pricing as fair relative to its environmental contribution, they are more likely to reciprocate through voluntary, pro-social behaviors that support collective environmental goals. Foundational research shows that perceived fairness fosters citizenship behaviors through reciprocity mechanisms (Konovsky and Pugh, 1994). Recent empirical studies in green consumption further confirm that fair pricing of green products enhances policy support and voluntary pro-environmental behaviors (Kong et al., 2021). Accordingly:

H_4: Price value positively affects green citizenship behavior.

2.3.5. Perceived product quality and green citizenship behavior

High perceived product quality signals reliability, safety, and institutional responsibility, which fosters positive psychological states such as satisfaction and a sense of moral obligation. When green products are perceived as technically sound and trustworthy, consumers are more likely to reciprocate through voluntary behaviors that support collective environmental goals. Citizenship behavior theory suggests that high-quality resources stimulate discretionary, pro-social actions (Organ, 1988). Empirical evidence in sustainable consumption and green services further confirms that perceived green quality enhances moral responsibility and green citizenship behavior (Luu, 2020; Han et al., 2020). Accordingly:

H_5: Perceived product quality positively affects green citizenship behavior.

2.3.6. Facilitating conditions and green citizenship behavior

Facilitating conditions reflect the accessibility, reliability, and institutional support surrounding green product use. When consumers perceive that adequate infrastructure, transparent policies, and technical support are in place, they are more likely to reciprocate through voluntary pro-environmental and citizenship-oriented behaviors. Empirical evidence from biofuel adoption and green technology contexts confirms that facilitating conditions strengthen behavioral commitment and encourage discretionary

green behaviors beyond personal utility (Zailani et al., 2019; Higueras-Castillo et al., 2024).

H_6: Facilitating conditions positively affect green citizenship behavior.

2.3.7. Green trust and green citizenship behavior

Trust reduces perceived uncertainty and encourages individuals to act beyond immediate self-interest. In environmental and energy-transition contexts, green and institutional trust have been consistently shown to foster voluntary, citizenship-oriented pro-environmental behaviors. When individuals trust green products and governing institutions, they are more willing to support environmental goals through discretionary actions that benefit society (Chen, 2013; Han et al., 2021; Zhang et al., 2020).

H_7: Green trust positively affects green citizenship behavior.

2.3.8. Green trust and intention to use

Green trust is a core antecedent of green product adoption. When consumers trust the safety, reliability, and environmental benefits of E10 bio-gasoline, their intention to use it increases. Prior studies across green consumption and energy-transition contexts consistently confirm that green trust significantly enhances adoption intention (Chen, 2013; Suki, 2016; Asadi et al., 2021).

H_8: Green trust positively affects intention to use E10 bio-gasoline.

2.3.9. Green citizenship behavior and intention to use

Green citizenship behavior reflects voluntary environmental commitment and facilitates the translation of pro-environmental values into consumption decisions. Empirical evidence shows that individuals who engage in green citizenship behavior exhibit stronger intentions to adopt green products, including biofuels and environmentally friendly energy alternatives (Han et al., 2019; Han et al., 2021).

H_9: Green citizenship behavior positively affects intention to use E10 bio-gasoline.

2.4. Research Model

Grounded in the stimulus–organism–response framework, the model posits that economic and contextual stimuli (price value, product quality, and facilitating conditions) influence internal states (green trust and green citizenship behavior), thereby driving consumers' intention to use E10 bio-gasoline. The conceptual framework is derived from the stimulus-body-response theory presented in Figure 1. Specifically, this model posits that economic and contextual stimuli (product value, product quality, and favorable conditions) influence intrinsic states (green beliefs and green citizenship behavior), thereby driving consumer intentions to use E10 biofuel

3. METHODOLOGY

3.1. Research Design

This study employs a cross-sectional survey design to investigate the psychological mechanisms underlying consumers' adoption of E10 bio-gasoline in Vietnam. The research framework integrates the Stimulus–Organism–Response (S–O–R) model, social exchange theory (SET), and environmental behavior theories to

explain how external stimuli influence internal psychological states and behavioral intentions.

A cross-sectional design is appropriate because E10 bio-gasoline was in an early transition stage during data collection, and nationwide mandatory implementation had not yet been fully enforced. This approach captures consumers' perceptions, trust, and civic-oriented responses under emerging policy conditions.

The questionnaire was pilot-tested with 31 consumers at two fuel stations in Ho Chi Minh City to ensure clarity and content validity.

3.2. Sampling and Data Collection
Data were collected using a convenience sampling approach, which is appropriate for exploratory research in contexts where a formal sampling frame is unavailable and the target behavior is still emerging. During the pre-mandatory phase of E10 bio-gasoline adoption, no official user registry existed, making probability sampling impractical. Similar sampling strategies have been widely applied in prior green consumption and energy transition studies.

The questionnaire was administered via Google Forms and distributed through both offline and online channels in Ho Chi Minh City, including fuel stations, universities, workplaces, public facilities, and community dining locations. A total of 482 valid responses were obtained. Participation was voluntary, and anonymity and confidentiality were assured. Ho Chi Minh City was selected as the study site because it is Vietnam's largest economic center and one of the first localities designated to pilot the E10 fuel program, making it well suited for capturing early consumer responses and for assessing consumer-side behavioral feasibility of biofuel policies prior to nationwide implementation.

3.3. Sample Size Adequacy
The final sample of 482 respondents satisfies the requirements for PLS-SEM analysis. According to Hair et al. (2017), the minimum sample size should be at least 10 times the maximum number of structural paths directed at any construct. Given the model complexity and 22 observed indicators, the sample exceeds the recommended threshold and is sufficient for testing hypotheses H1–H9.

3.4. Data Analysis Method
Hypotheses were tested using partial least squares structural equation modeling (PLS-SEM), which is appropriate for theory-driven models with multiple latent constructs and mediating relationships, robust to non-normal data distributions, and suitable for moderate sample sizes (Hair et al., 2017).

The analysis followed a two-step approach. First, the measurement model was evaluated by examining indicator loadings, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and discriminant validity using the HTMT criterion. Second, the structural model was assessed in terms of explanatory power (R^{2s}), predictive relevance (Q^2), effect sizes (f^2), and collinearity diagnostics (VIF) (Hock and Ringle, 2010; Tenenhaus et al., 2005; Hair et al., 2017).

3.5. Measurement Scales
All constructs were measured using five-point Likert scales ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Measurement items were adapted from well-established studies and slightly modified to fit the Vietnamese context.

Price value and facilitating conditions were adapted from Venkatesh et al. (2012). Perceived product quality was adapted from Chen and Chang (2012). Green trust was measured using items from Chen (2010). Green citizenship behavior was adapted from Tuan (2019). Intention to use was adapted from Venkatesh et al. (2012).

3.6. Common Method Bias
Potential common method bias was assessed using Harman's single-factor test. Exploratory factor analysis showed that the first factor accounted for <50% of the total variance, indicating that common method bias was unlikely to be a serious concern (Harman, 1967; Podsakoff et al., 2003).

3.7. Ethical Considerations
The study followed standard ethical guidelines. Participation was voluntary, informed consent was obtained, and respondents' anonymity and confidentiality were ensured. No personally identifiable information was collected.

4. FINDINGS

4.1. Descriptive Statistics of Research Data
Table 1 summarizes the demographic characteristics of the survey participants. Overall, the survey sample mainly consists of urban consumers over 18 years old, primarily using motorcycles and

Table 1: Sample characteristics

Variable	Category	Frequency	%
Gender	Female	236	49.0
	Male	246	51.0
Age	18-25 years old	121	25.1
	26-40 years old	204	42.3
	41-55 years old	119	24.7
	56 and above	38	7.9
Occupation	Student	111	23.0
	Office employee/worker	217	45.0
	Self-employed/business owner	98	20.3
	Retired	21	4.4
	Other	35	7.3
Average monthly income	<10 million VND	124	25.7
	10-19 million VND	229	47.5
	20-30 million VND	118	24.5
	Above 30 million VND	11	2.3
The type of vehicle you use daily	Motorcycles with gears (Wave, Dream, etc.)	89	18.5
	Scooter motorcycles (SH, Air Blade, .)	222	46.0
	Personal car	81	16.8
	Service vehicles (Grab/Taxi, etc.)	90	18.7
The age of the vehicle	Under 5 years	141	29.3
	From 5 to 9 years	285	59.1
	Over 10 years	56	11.6

Source: Survey data

4-seater cars that are <10 years old, which aligns with the target user group for E10 bioethanol in Vietnam.

4.2. Measurement Model Evaluation

Table 2 presents the results of the measurement model, including: Outer loading coefficients; Cronbach's alpha coefficient; Composite reliability (CR) and extracted mean variance (AVE). All normalized loading coefficients exceed the recommended threshold of 0.70, indicating that each index strongly represents its underlying structure (Hair et al., 2017). The values of Cronbach's alpha and CR are both higher than the acceptable minimum of 0.70, confirming consistent internal reliability across all structures (Nunnally and Bernstein, 1994; Hair et al., 2017). Furthermore, the AVE value ranges from 0.633 to 0.732, exceeding the 0.50 threshold (Fornell and Larcker, 1981), thus supporting convergent validity. Overall, these results provide strong evidence that the measurement model is both reliable and valid, offering a solid foundation for subsequent structural model analysis.

Discriminative efficacy was primarily assessed using the HTMT criterion, which has been shown to be more reliable than traditional methods (Henseler et al., 2015). All HTMT values from Table 3 were found to be below the recommended threshold, indicating satisfactory discriminative validity.

Table 2: Construct reliability and validity test

Construct	Item	Outer loading	Cronbach's alpha	Composite reliability	AVE
Price value (PV)	PV1	0.806	0.807	0.873	0.633
	PV2	0.828			
	PV3	0.761			
	PV4	0.786			
Perceived product quality (PQ)	PQ1	0.802	0.834	0.890	0.668
	PQ2	0.819			
	PQ3	0.851			
	PQ4	0.798			
Facilitating conditions (FC)	FC1	0.832	0.851	0.900	0.691
	FC2	0.824			
	FC3	0.848			
	FC4	0.822			
Green trust (TR)	TR1	0.858	0.817	0.891	0.732
	TR2	0.856			
	TR3	0.852			
Green citizenship behavior (CB)	CB1	0.811	0.840	0.843	0.676
	CB2	0.829			
	CB3	0.812			
	CB4	0.836			
Intention to use (IU)	IU1	0.866	0.802	0.810	0.716
	IU2	0.838			
	IU3	0.833			

Source: Authors' calculation

Table 3: HTMT index analysis results

	FC	CB	IU	PQ	PV	TR
FC						
CB	0.468					
IU	0.471	0.471				
PQ	0.442	0.311	0.325			
PV	0.404	0.374	0.383	0.384		
TR	0.518	0.473	0.487	0.398	0.393	

Source: Authors' calculation

4.3. Structural Model Evaluation Results

The results of the data analysis from Table 4 and Figure 2 show that: Hypothesis H1 is supported, PV has a positive impact on TR, with a beta coefficient of 0.161 (P < 0.05). Hypothesis H_2 is supported, PQ has a positive impact on TR, with a beta coefficient of 0.159 (P < 0.05). Hypothesis H_3 is supported, FC has a positive impact on TR, with a beta coefficient of 0.321 (P < 0.05). Hypothesis H_4 is supported, PV has a positive impact on CB, with a beta coefficient of 0.138 (P < 0.05). Hypothesis H_6 is supported, FC has a positive impact on CB, with a beta coefficient of 0.232 (P < 0.05). Hypothesis H_7 is supported, TR has a positive impact on CB, with a beta coefficient of 0.228 (P < 0.05). In the case of H_5, PQ had a very low influence on CB and it was not statistically significant, with a beta coefficient of 0.057 (P > 0.05).

The structural model exhibits satisfactory explanatory and predictive performance. The R^2 values for green trust (TR = 0.443), green citizenship behavior (CB = 0.440), and intention to use (IU = 0.603) indicate moderate explanatory power, suggesting that the proposed model captures key drivers of E10 bio-gasoline adoption. From an economic perspective, these results imply that consumer decisions are shaped by a combination of value perceptions, facilitating conditions, and trust-related mechanisms rather than a single dominant factor.

Predictive relevance is supported as all Q^2 values are positive (0.152-0.172), indicating adequate out-of-sample predictive capability. The f^2 estimates further suggest that price value, perceived product quality, facilitating conditions, and green trust exert meaningful incremental effects on downstream behavioral constructs. Collinearity diagnostics show that all VIF values range from 1.181 to 1.374, well below the recommended threshold, confirming the absence of multicollinearity and ensuring the robustness and interpretability of the structural relationships.

Table 5 presents the results of the structural model evaluation, including explanatory power (R^2), predictive relevance (Q^2), effect size (f^2), and multicollinearity diagnosis (VIF): The structural model exhibits satisfactory explanatory and predictive performance. The R^2 values for green trust (TR = 0.443), green citizenship behavior (CB = 0.440), and intention to use (IU = 0.603).
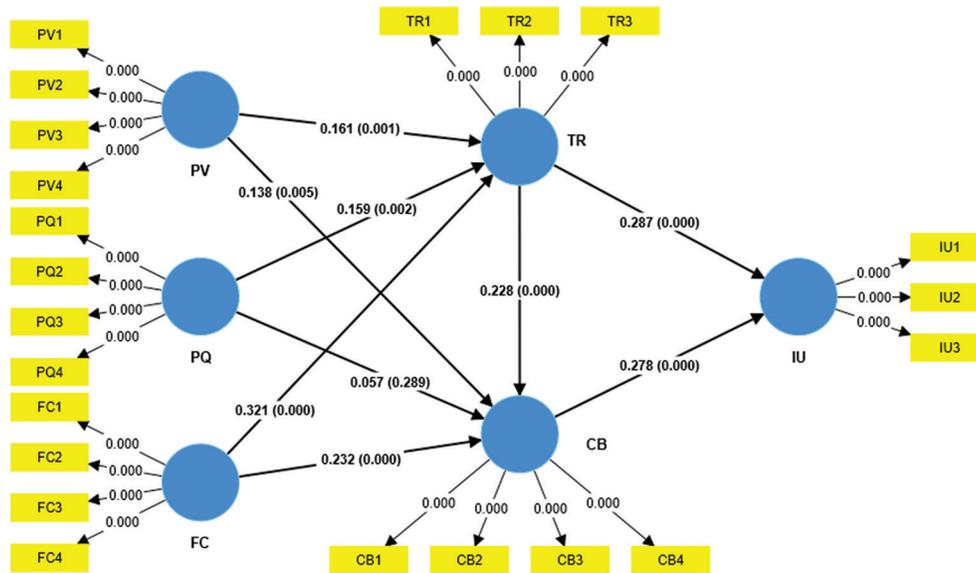
4.4. Mediation Analysis

Using a bootstrapping procedure, this study examined the direct, indirect, and total effects to assess the mediating roles

Figure 1: Research model
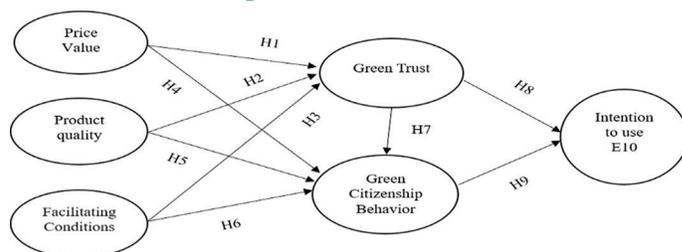
Source: Authors' compilation

Figure 2: Results of the SEM diagram

Source: Authors' calculation

Table 4: Results of hypothesis testing

Interrelationships among the factors	Beta (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P-values	Estimating thehypothesis
H_1: PV -> TR	0.161	0.163	0.048	3.350	0.001	Support
H_2: PQ -> TR	0.159	0.160	0.051	3.135	0.002	Support
H_3: FC -> TR	0.321	0.322	0.050	6.458	0.000	Support
H_4: PV -> CB	0.138	0.139	0.050	2.785	0.005	Support
H_5: PQ -> CB	0.057	0.057	0.054	1.059	0.289	Non Support
H_6: FC -> CB	0.232	0.233	0.055	4.191	0.000	Support
H_7: TR -> CB	0.228	0.229	0.050	4.520	0.000	Support
H_8: TR -> IU	0.287	0.289	0.052	5.480	0.000	Support
H_9: CB -> IU	0.278	0.280	0.053	5.301	0.000	Support

Source: Authors' calculation

Table 5: Summary of R^2 and Q^2 results

Items	R^2	R^2 adjusted	Q^2
Green trust (TR)	0.443	0.439	0.172
Green citizenship behavior (CB)	0.440	0.433	0.154
Intention to use (IU)	0.603	0.601	0.152

Source: Authors' calculation

of green trust (TR) and green citizenship behavior (CB) in the proposed model. Following Hair et al. (2017), the Variance Accounted For (VAF) criterion was employed to evaluate mediation strength.

As shown in Table 6, the sequential mediation of TR and CB partially explains the effects of price value and facilitating conditions on intention to use E10, with VAF values of 21% and 38%, respectively. In contrast, although the indirect effect of perceived product quality is statistically significant, its VAF value (4%) indicates a negligible mediating role.

Overall, the results suggest that trust-based and civic-oriented mechanisms play a meaningful mediating role in translating economic and institutional stimuli into behavioral intention, particularly for price value and facilitating conditions.

5. DISCUSSION

This study examines the determinants of intention to use E10 bio-gasoline by integrating economic, institutional, and behavioral perspectives within a green consumption framework. Overall, the findings confirm that trust-based and civic-oriented mechanisms play a central role in shaping early-stage biofuel adoption in a policy-driven energy transition context.

First, price value, perceived product quality, and facilitating conditions were found to have significant positive effects on green trust (H1-H3 supported). These results are consistent with prior studies emphasizing that perceived fairness, functional credibility, and institutional support are critical antecedents of trust in green products (Chen and Chang, 2012; Konuk, 2018). Notably, facilitating conditions emerged as the strongest predictor of green trust, highlighting the importance of infrastructure availability, policy clarity, and institutional assurance in reducing perceived risks associated with alternative fuels. From an economic perspective, this finding underscores that trust in emerging energy products is shaped less by individual cost–benefit calculations alone and more by the broader institutional environment governing market adoption.

Table 6: Results of the mediating roles of TR and CB

Relationship	Total impact	Direct impact	Indirect impact	P-value	VAF (%)	Mediation Type
PV -> TR -> CB -> IU	0.175	0.012	0.037	0.015	21	partial mediating
PQ -> TR -> CB -> IU	0.093	0.010	0,036	0.018	4	No substantive mediation
FC -> TR -> CB -> IU	0.306	0.020	0.073	0.006	38	partial mediating

Source: Authors' calculations

Second, price value and facilitating conditions positively influenced green citizenship behavior (H_4 and H_6 supported), while perceived product quality did not show a significant effect (H_5 not supported). This suggests that voluntary, pro-environmental civic behaviors are more responsive to perceived economic fairness and enabling conditions than to technical product attributes. While perceived quality has been shown to stimulate green behaviors in organizational or service contexts (e.g., Luu, 2020), the present result aligns with energy transition literature indicating that civic engagement in fuel choice is primarily driven by collective responsibility and institutional trust rather than product performance alone. In the context of E10 adoption, consumers may view quality as a baseline expectation, whereas supportive policies and cost transparency are more salient in motivating pro-social environmental actions.

Third, green trust was found to significantly enhance both green citizenship behavior and intention to use E10 (H_7 and H_8 supported). This finding reinforces the role of trust as a pivotal psychological mechanism that translates policy signals and institutional arrangements into individual behavioral responses, consistent with prior green energy and sustainable consumption studies (Chen, 2013; Han et al., 2019). Trust reduces uncertainty and perceived risk, which is particularly important in early phases of alternative fuel diffusion when consumer familiarity remains limited.

Finally, green citizenship behavior exerted a strong positive effect on intention to use E10 bio-gasoline (H_9 supported), confirming that voluntary environmental commitment acts as a direct behavioral driver of green fuel adoption. This result supports the notion that consumers who internalize environmental responsibility are more willing to align their consumption choices with sustainability-oriented energy policies (Sharma, 2021). Economically, this implies that fostering civic-oriented environmental norms can complement price and infrastructure policies by strengthening demand-side support for biofuel programs.

Overall, these findings suggest that successful E10 biofuel adoption requires not only competitive pricing and product availability but also trust-building institutional mechanisms and policies that encourage green citizenship. By empirically demonstrating the intertwined roles of economic value, institutional support, trust, and civic behavior, this study contributes to the growing literature on consumer-centered energy transitions in emerging economies.

6. CONCLUSION AND POLICY IMPLICATIONS

This study investigates consumers' intention to use E10 bio-gasoline in Vietnam by examining the roles of price value, perceived product quality, and facilitating conditions through green trust and green citizenship behavior. Based on survey data from 482 consumers and PLS-SEM analysis, the results show that these functional and institutional factors influence adoption intention primarily via trust-based and civic-oriented mechanisms, with facilitating conditions playing a dominant role.

The study contributes to energy economics by extending the S–O–R framework to a policy-driven biofuel transition, demonstrating that behavioral and institutional mechanisms complement regulatory mandates in shaping energy adoption. From a policy perspective, the findings highlight the need for transparent pricing, reliable fuel quality, and supportive infrastructure to strengthen public trust and voluntary engagement, thereby enhancing the effectiveness of mandatory biofuel policies in emerging economies.

6.1. Policy Implications

The findings yield several policy implications for promoting the adoption of E10 bio-gasoline in emerging economies. First, facilitating conditions exert the strongest influence on both green trust and green citizenship behavior, highlighting the critical role of institutional and infrastructural support in policy-driven energy transitions. Investments in fuel distribution infrastructure, consistent technical standards, and supply reliability can substantially reduce perceived risk and enhance institutional credibility. Policymakers should therefore prioritize nationwide availability, stable fuel quality, and transparent certification systems, in line with recent evidence emphasizing institutional facilitation as a prerequisite for successful energy policy implementation (Techa-Erawan et al., 2024).

Second, the significant effect of price value indicates that pricing strategies should emphasize perceived fairness and long-term collective benefits rather than relying solely on short-term subsidies. Gradual price adjustments, accompanied by clear communication about environmental benefits and energy security objectives, can strengthen green trust and foster voluntary consumer support, thereby improving policy acceptance and compliance.

Third, the mediating roles of green trust and green citizenship behavior underscore the importance of trust-based governance mechanisms. Regulatory agencies should enhance information disclosure, public communication, and stakeholder engagement to encourage citizens' voluntary participation in green energy transitions, particularly under mandatory or semi-mandatory policy regimes.

Overall, effective biofuel policies should integrate economic incentives, institutional facilitation, and behavioral mechanisms to ensure a socially accepted and sustainable energy transition.

6.2. Limitations and Future Research Directions

This study has several limitations that should be acknowledged. First, the use of a cross-sectional survey and a city-based sample may limit the generalizability of the findings beyond the study context. Future research could employ larger and more diverse samples, including users of biofuels in public transportation and other mobility sectors, to enhance external validity.

Second, this study did not examine potential differences across demographic subgroups. Given that energy-related attitudes and pro-environmental behaviors may vary by age, income, or occupation, future studies could apply multi-group or longitudinal analyses to better capture heterogeneity in green citizenship behavior and energy adoption. Such extensions would provide deeper insights for designing more targeted and effective sustainable energy policies.

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