

An Integrated SDT-TPB Model of Biogasoline Purchase Behavior: Empirical Evidence from the Vietnamese Market

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Abstract: In recent years, Vietnam has implemented a roadmap to introduce biogasoline into consumption as a key strategy to reduce dependence on fossil fuels and environmental pollution. However, in reality, the rate of consumer acceptance remains relatively low and is trending downwards during the 2018-2025 period. This study aims to understand the mechanisms and factors influencing the biogasoline purchasing behavior of Vietnamese consumers. By integrating the Theory of Planned Behavior (TPB) and the Self-Determination Theory (SDT), the study examines how attitudes, intrinsic green motivations, and extrinsic green motivations influence biogasoline purchasing behavior, both directly and indirectly through purchase intentions. Data was collected through an online survey of 313 consumers from the North, Central, and South regions of Vietnam using a snowball sampling method. The Smart-PLS3 software was used to process survey data and examine the relationships between factors in the research model. The research results show that green extrinsic motivations were identified as the strongest predictor of purchase intention and directly impacted purchasing behavior, while green intrinsic motivations directly influenced purchasing behavior without significantly affecting purchase intention. The study provides practical insights for policymakers and energy providers in designing targeted strategies to promote consumption and support Vietnam's sustainable energy transition.

Keywords: Biogasoline purchasing behavior, green extrinsic motivation, green intrinsic motivation, self-determination theory, theory of planned behavior, integrated SDT-TPB model.

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INTRODUCTION

Context

The use of large amounts of fossil fuels such as coal, oil and natural gas has caused many negative impacts on the environment and human health (Asiamah et al., 2024; Lanzini, Testa, & Iraldo, 2016). The combustion of these energy sources emits large amounts of greenhouse gases, contributing to climate change and global warming (Ahmed, Hou, Yan, Xin, & Zainelabdeen, 2020; Huang, Li, Huang, & Zhou, 2021). Not only that, but fossil fuel exploitation also destroys ecosystems, depletes resources and threatens the sustainable development of countries (Goniewicz, Sarker, & Schoch-Spana, 2023). Therefore, reducing dependence on



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fossil fuels and shifting to renewable energy sources, including biogasoline, is becoming an inevitable trend globally (Deo & Prasad, 2024).

For developed countries such as the US and the European Union, biofuel development aims to diversify fuel sources to reduce dependence on fossil fuels and reduce environmental pollution (Sangroya & Nayak, 2017). For developing countries, countries with agricultural economies such as Brazil, India, Indonesia, Malaysia, etc., in addition to the above goals, biofuel development also has the important purpose of socio-economic development and job creation for farmers (Goniewicz et al., 2023; Paladino & Pandit, 2019). Among the types of biofuels, bioethanol is widely applied in the transportation sector through blending with mineral gasoline to form biogasoline. Biogasoline is produced by blending anhydrous ethanol with regular gasoline in a specific ratio. For example, E5 gasoline consists of 5% ethanol and 95% regular gasoline, while E10 gasoline contains 10% ethanol (Hassan, Sani, Aziz, Sulaiman, & Daud, 2015). This product is called biogasoline because “the ethanol used in blending is processed through the fermentation of organic products such as starch, cellulose, and lignocellulose, usually from grains like corn, cassava, wheat, soybeans, or from tree bark and sugarcane bagasse. The ethanol obtained after distilling fermented grains is a mixture of water and ethanol; the water must be separated to obtain anhydrous ethanol before blending with gasoline” (Hassan et al., 2015).

The strategy for developing biogasoline in consumption is considered a significant effort by the Vietnamese Government in realizing the goal of reducing environmental pollution and dependence on fossil fuels (Ministry of Industry and Trade, 2025a). According to studies by the Ministry of Industry and Trade, consumers have insufficient knowledge or are quite concerned about the quality and safety of biofuel gasoline (Ministry of Industry and Trade, 2025b). It is estimated that in 2024, the consumption of biofuel gasoline will only account for about 21% of the total gasoline consumption market share in Vietnam (An, 2025). These figures highlight the urgent need to better understand consumer psychology and purchasing behavior in order to propose effective measures that encourage greater adoption of biogasoline in the future.

In the context of biogasoline consumption, biogasoline can be considered a green product (Turner, Plevin, O'Hare, & Farrell, 2007). Accordingly, purchasing biogasoline can be defined as green consumer behavior (Pagiaslis & Krontalis, 2014). Green purchasing behavior is understood as purchasing environmentally friendly or sustainable products – products that are recyclable and beneficial to the environment, while avoiding products that are harmful to the environment and society (Jaiswal & Kant, 2018).

Research Gap

A large number of studies apply the theory of planned behavior model (TPB) to study green behavior in general and biofuel purchasing behavior of customers in particular (Alzubaidi, Slade, & Dwivedi, 2021; Kumar & Nayak, 2023; Proudlove, Finch, & Thomas, 2020; Pynnönen et al., 2023). TPB is considered an effective conceptual model for explaining a person's behavior due to its ability to understand and predict a wide range of social behavior (Alzubaidi et al., 2021). According to TPB, the occurrence of behavior is influenced by intention, a construct formed by subjective norms, perceived behavioral control and attitude. In this context, attitude is related to a person's evaluation, which can be negative or positive, depending on what the person believes will happen when engaging in a particular behavior (Ajzen, 1991). When an individual perceives his or her action as worthwhile, this may lead to such behavior (Das, van Esch, Jain, & Cui, 2023). Specifically, an individual will tend to have a more favorable attitude if the outcome is evaluated positively and thus, the person will show more eagerness to perform this certain behavior (Huang et al., 2021). In the context of pro-environmental behavior, consumers will be more likely to prefer green products when they display constructive attitudes regarding environmental protection (Liu, Cai, Ma, & Wang, 2023). Several scholars have demonstrated that consumers who are more concerned about environmental protection will show greater eagerness to perform environmental protection-related behaviors (Han, Hampson, Wang, & Wang, 2022; Liu et al., 2023). Previous studies (Ding, Wen, Zuo, & Chen, 2023; Jaiswal & Kant, 2018; Pynnönen et al., 2023) have generally shown that individuals with stronger subjective norms, higher perceived behavioral control, and more positive attitudes demonstrate greater behavioral intentions.

This study applies a parsimonious TPB theoretical framework, focusing primarily on explaining the relationship between attitudes and intentions and behavior in purchasing biofuels. A full TPB model also

includes subjective norms and perceived behavioral control. Many previous studies have shown that the importance of these components varies depending on the field and context of the study (Ajzen, 1991; Kumar & Nayak, 2023; Proudlove et al., 2020). In the context of biogasoline purchasing in Vietnam, decisions are largely personal and frequent, which may reduce the influence of subjective norms. Furthermore, since biofuels are widely available, perceived behavioral control may not be a significant barrier. In addition to the ability to adhere to a wide range of behaviors, the flexibility of TPB allows for the inclusion of additional predictor variables (Ajzen, 1991). In such a context, the author argues that TPB should be combined with other theoretical frameworks to increase its ability to explain behavior.

Self-determination theory (SDT) is a fundamental model of human motivation that has been widely applied to elucidate human intentions and behaviors, with a particular emphasis on pro-environmental behaviour (Ryan & Deci, 2000; Yang & Thøgersen, 2022). SDT proposes that individuals become self-determined in their actions to satisfy three basic psychological needs including the need for autonomy, the need for relatedness, and the need for competence (Pynnönen et al., 2023). When driven by the level of need satisfaction, motivation is divided into three types: intrinsic motivation, extrinsic motivation, and non-motivated motivation (Duong, Nguyen, & Nguyen, 2023; Li et al., 2020). Consumers' pro-environmental behavior usually serves certain goals while non-motivation is considered as a state of lack of intention to behave in a certain way (Chang, Hou, Wang, Cui, & Zhang, 2020). Therefore, in studies, only intrinsic and extrinsic motivations are often identified as antecedents of behavior in general and consumer pro-environmental behavior in particular (Duong et al., 2023).

Thus, SDT helps to understand the distinct psychological needs of an individual reflected in intrinsic and extrinsic motivations and plays a pivotal role in maintaining their overall enjoyment and engagement with a product (Deci & Ryan, 2015; Rai & Narwal, 2025). Meanwhile, TPB deals with the predictive aspects of consumer decision-making and their behavioral intentions that can be influenced by factors including subjective attitudes (Ajzen & Kruglanski, 2019). In other words, the TPB model plays an important role in helping to identify the mechanisms by which motivational constructs from SDT lead to future behavior, while SDT provides a foundation for establishing belief-based constructs from TPB (Duong et al., 2023; Selvamani, Dhillip, Divyalakshmi, Lakshmi, & Krishna, 2024). In fact, SDT and TPB have been integrated to overcome the shortcomings of each theory and establish a more complete description of human behavior (Luqman, Masood, & Ali, 2018). Specifically, this study focuses on highlighting attitudinal mechanisms as the central predictor of intention and behavior in purchasing biofuels, while motivational constructs derived from SDT are incorporated to explain the underlying psychological motivations shaping consumer attitudes. With the above arguments, integrating TPB and SDT to establish a conceptual model to study the relationship between attitude (AT), green intrinsic motivation (GIM), green extrinsic motivation (GEM) with purchase intention (PI) and purchase behavior (PB) is expected to be meaningful, especially in the field of biofuel, specifically biogasoline with the research context in the Vietnamese market.

LITERATURE REVIEW AND HYPOTHESES

In the field of green consumer behavior in general and renewable fuel consumption in particular, the TPB model is considered one of the popular theoretical frameworks for explaining consumer buying behavior based on awareness and purchase intention. In TPB, intention plays a crucial role in directly predicting behavior. However, in the context of consuming essential, frequently used products, consumers tend to make repeat purchases with little consideration before buying. This can reduce the usual linear relationship between intention and purchase behavior. In Vietnam, gasoline purchasing behavior is often strongly influenced by consumption habits, travel routes, and the presence of sales points. Therefore, consumers with strong green attitudes, intrinsic motivations, and extrinsic motivations not only form the intention to buy biogasoline but also directly shape consumer purchasing behavior. This suggests that combining TPB with SDT could help to more fully explain the mechanisms behind the formation of biofuel purchasing behavior in the context of emerging economies like Vietnam.

Attitude, Purchase Intention, and Purchase Behavior

The theory of planned behavior (TPB) was developed and completed by Ajzen (1991) based on the theory of reasoned action (TRA) of Fishbein and Ajzen (1975). In the TPB model, attitude toward the behavior plays a particularly important role. This is an individual's positive or negative assessment of performing the behavior (Gauthier, Guertin, & Pelletier, 2022).

Purchase behavior (PB) is a topic of interest to many scholars with relatively uniform definitions in nature. According to Kotler and Keller (2016) consumer behavior is the process by which individuals or groups select, purchase, use and dispose of products, services or experiences to satisfy needs. Similarly, Engel, Blackwell, and Miniard (1995) considered consumer behavior as the decision-making process related to the selection and use of goods and services to satisfy needs. Solomon (2020) emphasizes the research aspect of psychological and social processes in consumer behavior. Although the expressions are different, the definitions agree that buying behavior is a decision-making process to satisfy individual or group needs. According to TPB (Ajzen, 1991) behavior is determined by behavioral intention, and this intention is influenced by three main factors: attitude toward the behavior, subjective norms, and perceived behavioral control (Paladino & Pandit, 2019). Attitude reflects the consumer's positive or negative evaluation of the purchase behavior; subjective norms refer to social influence from relatives or the community; and perceived control represents the consumer's level of confidence in the ability to perform the purchase behavior (Ajzen, 1991).

Green Motivation and Biogasoline Purchasing Behavior

Self-determination theory (SDT) refers to the factors that motivate human behavior and motivate them to act, as well as how their behavior is regulated in different areas of life (Deci & Ryan, 2015). This theory uses human cognition, emotions and needs as the main factors to predict behavioral changes, development and experience (Ryan & Deci, 2000). As a key theory of motivation in interdisciplinary research in social sciences, self-determination theory (SDT) is widely used in consumer motivation research, especially in studies related to green consumption (Liu et al., 2023). SDT suggests that intrinsic motivation is when individuals act for self-worth and satisfaction, while extrinsic motivation is related to rewards or avoiding punishment (Ryan & Deci, 2000). Intrinsic motivation is linked to three basic psychological needs: autonomy, competence, and social affiliation, which play an important role in maintaining positive behaviors, including green behaviors. In the context of increasing environmental issues and pressure for sustainable development, individuals' green motivation has become a key factor explaining the formation of environmentally friendly consumption intentions and behaviors. SDT theory has been applied by many scholars to explain environmental behaviors such as recycling, using green technology, and reducing plastic waste (Koo, Chung, & Nam, 2015). Building on SDT theory, Li et al. (2020) extended SDT to the environmental field and introduced two new constructs: green intrinsic motivation (GIM) – derived from the feeling of satisfaction when acting for the environment and green extrinsic motivation (GEM) – to achieve environmental performance such as saving resources or reducing emissions. These are two specific forms of motivation, explaining why individuals choose green behaviors in both consumer and organizational contexts. Many recent studies have confirmed that both GIM and GEM positively influence green behavioral intentions, thereby leading to actual environmentally friendly behaviors (Chang et al., 2020; Selvamani et al., 2024).

Green behavior is often defined as a set of direct actions that positively impact the environment (Duong et al., 2023; Ogiemwonyi, 2022). These include recycling, consuming organic foods, cycling, using stairs instead of elevators, planting trees, reducing paper use, and conserving energy and water (Ogiemwonyi, 2024). To explain consumer green behavior, many empirical studies have used the TPB model as a theoretical foundation. Empirical evidence also shows that consumers tend to commit to green behavior based on their overall psychological preferences for environmentally friendly products, rather than through rational evaluation. However, there is still much disagreement regarding how to influence, promote, and sustain responsible green consumer behavior at the individual level, especially in developing countries. Biogasoline, which is partly derived from renewable energy, is considered an environmentally friendly product if the negative impacts in production are effectively controlled (Farrell et al., 2006; Turner et al., 2007). The consumption of biogasoline

can be classified as a green consumer behavior (Pagiaslis & Krontalis, 2014), contributing to environmental protection and towards sustainable development (Chikandiwa & Mutambara, 2023; Ghorbani, Zhang, Nwaila, Bourdeau, & Rose, 2024).

Attitudes (AT) towards a behavior are defined as an individual's positive or negative feelings when performing a target behavior (Fishbein & Ajzen, 1975). According to Ajzen (1991) attitudes towards a behavior are determined by an individual's dominant belief that the behavior leads to certain outcomes. TPB theory also suggests that the stronger the attitude towards a behavior, the more likely it is that the customer will have a purchase intention, which in turn leads to their purchase behavior (Ajzen, 1991; Ajzen & Kruglanski, 2019). In other words, purchase intention plays a mediating role in the relationship between attitudes towards a behavior and actual behavior of customers. Several studies have suggested that individuals are more likely to behave responsibly towards the environment if they have a positive attitude towards the behavior and are given the opportunity to act accordingly (Cheung & To, 2019; Jaiswal & Kant, 2018; Sangroya & Nayak, 2017). In the context of green consumption, customers' attitudes towards green products are found to be a significant predictor of their purchasing behavior (Ogiemwonyi, 2024).

D'Souza, Taghian, Hall, and Plant (2023) study found that in the area of eco-friendly fuels, consumers' willingness to pay increases when they have a positive attitude towards eco-friendly energy. In addition, a series of studies conducted in various contexts have assessed and made assertions about the relationship between attitude towards purchase intention and purchase behavior towards green products (Jaiswal & Kant, 2018; Rama & Susanto, 2024; Wang, Zhao, & Pan, 2024). These papers show that consumers with a more positive attitude towards green products in general are expected to have a higher level of involvement in the decision to purchase those products (Cheung & To, 2019). In addition, Ogiemwonyi (2024) asserted that attitude directly affects customers' green purchase behavior. Therefore, the present study attempts to examine attitudes towards biogasoline with purchase intentions and purchase behavior in the context of the Vietnamese market.

Based on the Theory of Planned Behavior, attitudes toward a behavior play a central role in shaping both behavioral intention and actual behavior. In the context of green consumption, previous studies consistently show that favorable attitudes toward environmentally friendly products increase consumers' willingness to purchase and their likelihood of engaging in green purchasing behavior. Accordingly, the following hypotheses are proposed.

H₁: AT has a positive impact on PI.

H₂: AT has a positive impact on PB.

Green Intrinsic Motivation and Biogasoline Purchasing Behavior

Green intrinsic motivation (GIM) and green extrinsic motivation (GEM) are two constructs developed by Li et al. (2020) from SDT theory to explain human consumption behavior. In which, green intrinsic motivation (GIM) is described as a state in which individuals perform environmentally friendly behaviors stemming from joy, satisfaction and self-passion for environmental protection; it reflects the internal drive to engage individuals in green actions for a sense of meaning and natural satisfaction (Li et al., 2020; Ryan & Deci, 2020). In contrast, GEM refers to individuals engaging in green behavior for external reasons, such as rewards, recognition, or the desire to avoid environmental penalties (Li et al., 2020). Recent studies have highlighted that both GIM and GEM play an important role in promoting pro-environmental attitudes and behaviors (Ali, Ashfaq, Begum, & Ali, 2020; Duong et al., 2023; Li, Yang, Zhang, Li, & Chen, 2021; Mamun, 2023; Saini, Jena, Gupta, & Mahale, 2025; Wang et al., 2024). At the organizational level, GIM has been shown to increase employees' green attitudes and green behaviors due to the intrinsic satisfaction of engaging in sustainable activities (Mamun, 2023). In the consumer sector, GIM is considered a strong driver of green purchase intention because consumers feel enjoyment, excitement, and attachment to green consumption experiences (Ali et al., 2020; Wang et al., 2024). Studies have also shown that consumers with intrinsic green motivation tend to maintain green purchase intentions and behaviors even when faced with barriers such as high prices, inconvenience, or doubts about the authenticity of green products (Ali et al., 2020; Duong et al., 2023). Intrinsic motivation reflects consumers'

enjoyment and appreciation of the shopping experience itself, rather than extrinsic benefits. In other words, people who truly enjoy the shopping process are more likely to form a higher intention to purchase green products (Wang et al., 2024). In fact, green intrinsic motivation plays an important role in shaping the overall consumer shopping experience (Ryan & Deci, 2020). In the context of biogasoline consumption in the Vietnamese market, green intrinsic motivation reflects the satisfaction and intrinsic motivation of each consumer when participating in environmentally responsible purchasing behavior. With these arguments, the following research hypotheses are proposed:

H₃: GIM has a positive impact on PI.

H₄: GIM has a positive impact on PB.

Green Extrinsic Motivation and Biogasoline Purchasing Behavior

GEM refers to the external outcome-driven motivation of consumers, including rewards, social recognition, price incentives, or avoidance of criticism for environmentally harmful behavior (Deci & Ryan, 2015; Li et al., 2020). According to Li et al. (2020) when individual consumers perceive benefits from a green behavior, GEM can help promote that behavior. In fact, GEM emerges when consumers engage in green shopping activities when they receive coupons, promotions, gifts, or simply social recognition (Wu, Wu, Wen, Cai, & Li, 2019). However, it should be emphasized that in many cases the impact of GEM may be less sustainable than GIM due to dependence on external factors. There are still many studies affirming the positive influence of GEM on green consumer intention (GPI) and green consumer behavior (GPB) (Duong et al., 2023). When consumers receive specific benefits from green behavior, they tend to be more strongly inclined to consider and perform environmentally friendly consumption behaviors.

Unlike intrinsic motivation, green extrinsic motivation is driven by external rewards and social recognition. Prior studies suggest that such motivation plays a particularly important role in shaping planned consumption decisions, especially in emerging markets. Accordingly, the following hypotheses are proposed.

H₅: GEM has a positive impact on PI.

H₆: GEM has a positive impact on PB.

Purchase Intention and Purchase Behavior

The current literature shows that GIM and GEM play an important role in forming green intentions and behaviors, but GIM is more sustainable and has a deeper impact because it comes from internal human values. At the same time, the combination of GIM and GEM can bring additional effects in the context of promoting green consumption (Ali et al., 2020; Duong et al., 2023). Therefore, the author wishes to examine the impact of GEM on customers' purchase intentions and behaviors in the context of Vietnamese biogasoline consumption. From the above arguments, the study proposes the following hypotheses:

Purchase intention (PI) is the degree of willingness of consumers to purchase a particular product and is considered an important indicator to predict actual consumption behavior (Ajzen, 1991; Fishbein & Ajzen, 1975). Studies have shown that behavior is closely correlated with intention, especially when both are measured at the same specific level and over a relatively short period of time (Ajzen, 1991). Biogasoline, which is partly derived from renewable energy, is considered an environmentally friendly product if the negative impacts in production are effectively controlled (Farrell et al., 2006; Turner et al., 2007). The consumption of biogasoline can be classified as green consumer behavior (Pagiaslis & Krontalis, 2014) contributing to environmental protection and sustainable development (Chikandiwa & Mutambara, 2023; Ghorbani et al., 2024). Therefore, the intention to purchase biogasoline reflects the consumer's commitment to green choices and environmentally friendly behavior. In the context of green consumption, green purchasing behavior is understood as the conscious choice of customers to prioritize environmentally friendly products, while avoiding products that have negative impacts on society and nature (Bhardwaj, Sreen, Das, Chitnis, & Kumar, 2023; Wang et al., 2024). Research practice shows that this behavior is often approached through green product purchase intention, which is likely to be converted into actual purchase decision, thereby contributing to promoting environmental sustainability (Ishaq, Baloch, Raza, & Ahmad, 2025). Therefore, it can be affirmed

that green purchase intention plays a role as a basic indicator of green purchase behavior (Wang et al., 2024). In addition, the study of Duong et al. (2023) affirms that green purchase intention is the most important predictor of green purchase behavior in the research context in Vietnam, and green purchase intention has a significant impact on the individual and combined effects of external and internal green motivations on environmentally friendly consumption behavior.

Within the TPB framework, purchase intention is widely regarded as the most immediate antecedent of actual behavior. Empirical evidence in green consumption research also confirms this relationship in the Vietnamese context. Therefore, the following hypothesis is proposed.

H₇: PI has a positive impact on PB.

Research Model

Based on the theoretical arguments and hypotheses developed in the previous sections, a research model is proposed to examine biogasoline purchasing behavior in the Vietnamese context. The model integrates the Theory of Planned Behavior and Self-Determination Theory to explain how cognitive evaluations and motivational mechanisms jointly influence consumer behavior. Besides indirect impacts through purchase intentions, the model also proposes direct impacts of intrinsic and extrinsic green motivations on purchasing behavior. This assumption reflects the habitual nature of fuel purchasing. In reality, consumers may make repetitive and frequent purchasing decisions based on intrinsic and extrinsic motivations without much careful consideration and evaluation. The proposed model is presented in Figure 1.

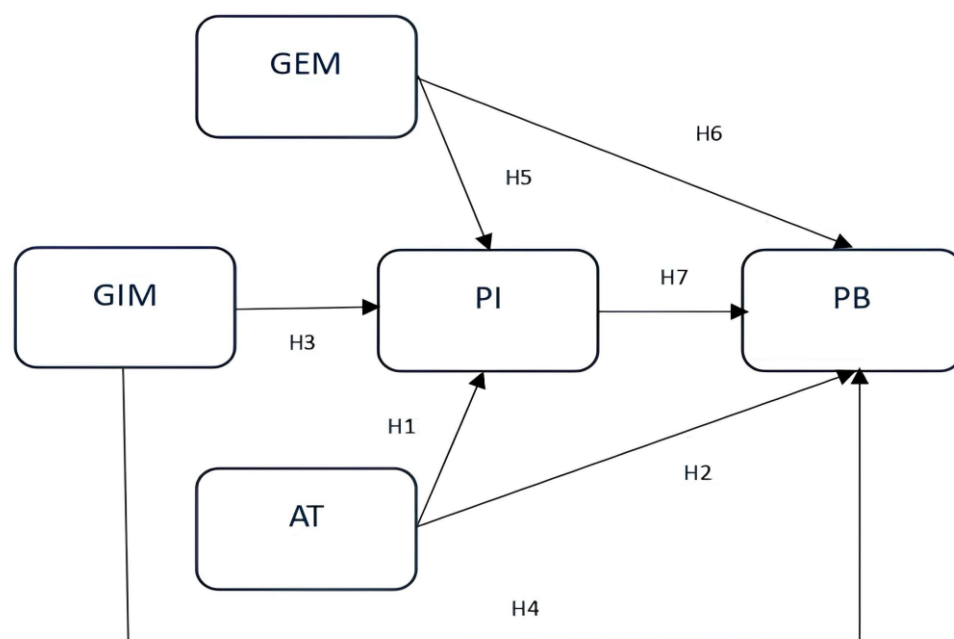


Figure 1: Proposed conceptual model

MATERIALS AND METHODS

To evaluate the research model and proposed hypotheses, this study employed a quantitative research method through a survey with a specific sample size. Data were collected from individual consumers who had experience using biogasoline in Vietnam. The quantitative approach was considered appropriate as it allows for the examination of relationships among latent constructs and the assessment of both direct and indirect effects within a theoretically grounded model.

Measurement and Scales

All latent variables in the model were measured using a 5-point Likert scale, in which the score ranged from 1 (completely disagree) to 5 (completely agree), reflecting the level of agreement of the respondents with each statement. Specifically, consumers' intention to buy biogasoline was inherited and adjusted from the study of Fu, Li, Wang, Luan, and Dai (2021) reflecting the level of willingness to choose and use biogasoline in the future. Biogasoline purchasing behavior was measured through statements adapted and adjusted from the study by Kanchanapibul, Lacka, Wang, and Chan (2014) and Li et al. (2021) reflecting consumers' actual actions in buying and using biogasoline. Two groups of factors, green intrinsic motivation and green extrinsic motivation, were adapted and inherited from the research of Ali et al. (2020). Finally, the variable of consumer attitude towards biogasoline was inherited from Van Tonder, Fullerton, De Beer, and Saunders (2023) including four statements, reflecting the level of positive or negative evaluation of consumers towards the use of biogasoline.

Sampling and Data Collection

The study was conducted to approach people who have been using biogasoline products in the Vietnamese market. Using TPB theory aims to identify the mechanisms by which motivational structures from SDT lead to future behavior. At the same time, applying SDT provides a foundation for establishing belief-based structures from TPB (Duong et al., 2023; Wang et al., 2024). Therefore, the study focuses on consumers with relatively diverse personal characteristics. To ensure the representativeness of the sample, the author conducted a survey in the North, Central and South of Vietnam. Previous studies have suggested that for retail market research, the most effective data collection method is to distribute questionnaires directly to consumers at the point of sale of biogasoline. However, due to the nature of gasoline purchases and sales at retail points, which often take place quickly, it is difficult to conduct direct surveys using questionnaires. Therefore, the author uses an online interview (Google Form) to collect data.

To facilitate the approach to the target survey subjects to serve the official quantitative research, the author uses non-probability sampling techniques, specifically snowball sampling. The snowball sampling technique starts with the first respondents (first layer) selected with some specific characteristics suitable for the research objectives based on existing relationships (Griffith, Morris, & Thakar, 2016; Wright & Stein, 2005). These respondents will continue to introduce other survey subjects in their circle of friends or social relationships (next layers) with the criterion of ensuring the sociological diversity of the interviewees (Stivala, Koskinen, Rolls, Wang, & Robins, 2016). To ensure survey participants have practical experience using biofuels, a screening question is included at the beginning of each survey. Respondents are asked: "Have you purchased or used biogasoline (E5) in the past three months?" Respondents who answer "Yes" are allowed to proceed with the rest of the questionnaire. Additionally, participants are asked to indicate how often they have purchased biogasoline in the past three months to further confirm their experience. Besides, to ensure that the respondents have a correct and unified understanding of biogasoline, during the interview process, the authors provided clear instructions to the respondents on the concept of biogasoline and how to answer the questions. Respondents were informed about the purpose of the study as well as the importance of objectivity in their responses. They were also informed that there were no right or wrong answers to the questions posed. Therefore, the authors could promote honest answers from respondents and reduce potential social desirability bias.

Based on the variables and scales identified from the research overview, the authors constructed a questionnaire consisting of three parts: (1) an introduction introducing the purpose, meaning and commitment to confidentiality; (2) a content part with statements measuring the level of consumer agreement with factors influencing biogasoline purchase behavior; and (3) a section on respondent demographic information. The scales were inherited from previous studies, the authors translated and calibrated through the opinions of two experts to ensure semantic and content accuracy. The official survey was conducted with a sample of 385 consumers in the North, Central and South of Vietnam. There were 313 eligible questionnaires for analysis with Smart PLS3 software.

In terms of age structure, the sample has a very high proportion of people aged 45 and under, accounting for 77%. Descriptive statistics of the sample show that in terms of gender, 52.7% of respondents are male and

47.3% are female, showing a fairly balanced gender structure. In terms of age, the majority of survey participants are under 45 years old (over 80% of the sample), of which the 18-25 age group accounts for the highest proportion (31.3%), followed by the 36-45 age group (26.8%) and the 26-35 age group (23.3%). The research sample has a relatively high level of education, with 89% of the survey respondents having a college degree or higher. This feature is due to the survey being conducted in major cities/urban areas across the country. Regarding occupation, the survey sample included respondents from various professional groups, such as engineers (19.5%), freelancers (15.3%), students (11.5%), and sales staff (10.9%). The highest income group in the sample was recorded as earning between 10 and under 20 million VND (27.8%), while only 6.1% of respondents earned more than 60 million VND per month. In terms of transportation, motorbikes remained the primary mode of transport (61.7%), followed by private cars (38.3%). Overall, the survey sample reflects diversity in the research sample; however, young and highly educated respondents predominated. This reflects the characteristics of urban areas in Vietnam.

Data Analysis

The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 3. This method was selected because the study aims to predict consumer behavior and involves several latent constructs. PLS-SEM is also appropriate for data that may not follow a normal distribution. The data analysis followed a two-step approach. First, the measurement model was assessed by examining indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Second, the structural model was evaluated by analyzing path coefficients, t-values, p-values, effect sizes (f^2), and coefficients of determination (R^2). The significance of the structural paths was assessed using the bootstrapping procedure with 5,000 subsamples, as recommended by Sarstedt, Ringle, and Hair (2017). A two-tailed test with a significance level of 5% was applied.

RESULTS

Measurement Model Evaluation

According to Sarstedt et al. (2017) measurement evaluation includes: (1)- assessing the quality of observed variables. (2)- checking the reliability of the structure using Cronbach's Alpha coefficient (≥ 0.7) and composite reliability (CR) (≥ 0.7) of all latent variables. (3)- examining convergent validity using Outer loading (≥ 0.7) and total variance extracted (AVE) (≥ 0.5). (4)- assessing discriminant validity using HTMT (≤ 0.9). In the first data run, the AT4 variable was removed from the model due to its small Outer loading. The author ran the data a second time. At this time, all variables met the requirements of Outer loading and all latent variables qualified for the requirements of Cronbach's Alpha, CR and AVE.

Table 1: Assessment of reliability and convergence of variables

Code	Items and Constructs	Outer loading	Cronbach's Alpha	CR (Rho_A)	CR (Rho_C)	AVE
AT	Attitudes		0.791	0.795	0.878	0.706
AT1	I think buying biogasoline is good for the environment	0.810				
AT2	I think buying biogasoline is beneficial	0.866				
AT3	I think biogasoline has many advantages over regular gasoline	0.843				
GEM	Green extrinsic motivation		0.859	0.866	0.905	0.704
GEM1	I feel encouraged by the recognition that people give me when using biogasoline	0.833				
GEM2	I often think about discounts, gifts and prizes when buying biogasoline	0.901				

Code	Items and Constructs	Outer loading	Cronbach's Alpha	CR (Rho_A)	CR (Rho_C)	AVE
GEM3	I have to feel like I am saving something by buying and using biogasoline	0.807	0.853	0.869	0.893	0.625
GEM4	I am worried about how others will react to my use of biogasoline	0.811				
GIM	Green intrinsic motivation					
GIM1	I enjoy embracing new green ideas and products, including biogasoline	0.761				
GIM2	I enjoy solving environmental problems through the use of biogasoline	0.803				
GIM3	I enjoy finding completely new biogasoline products	0.798	0.755	0.802	0.869	0.689
GIM4	I enjoy contributing ideas to improve existing biogasoline products	0.794				
GIM5	I feel excited when shopping for biogasoline	0.797				
PI	Purchase intention					
PI1	I prefer biogasoline to regular gasoline	0.872				
PI2	I would consider buying biogasoline because it is less polluting	0.868	0.838	0.839	0.902	0.755
PI3	I buy biogasoline because I care about our planet	0.745				
PB	Purchase behavior					
PB1	I regularly buy biogasoline when refueling my car	0.868				
PB2	I bought biogasoline last month	0.875				
PB3	I will introduce biogasoline to my friends and family	0.864				

Table 1 presents the reliability and convergent validity assessment of the constructs. The loading coefficients of the indicators are all greater than 0.70. Specifically, the values range from 0.745 to 0.901. The Cronbach alpha coefficient ranges from 0.755 to 0.859, while the composite reliability value ranges from 0.869 to 0.905, indicating satisfactory internal consistency. In addition, all AVE values are above 0.50, confirming convergent validity. Therefore, the measurement model exhibits acceptable reliability and convergent validity.

In addition, the discrimination of the variables shown in Table 2 shows that the HTMT index < 0.9, all meet the requirements (Sarstedt et al., 2017).

Table 2: Assessment of discrimination between variables

Constructs	AT	GEM	GIM	PB	PI
AT	-				
GEM	0.455	-			
GIM	0.287	0.217	-		
PB	0.587	0.438	0.456	-	
PI	0.423	0.534	0.197	0.512	-

Note: Diagonal elements are not applicable because HTMT values are calculated only between different constructs.

Structural Model Assessment

First, the research team check multicollinearity and common method bias through the VIF score. According to Sarstedt et al. (2017) a VIF score < 5 indicates no multicollinearity. Additionally, according to Kock (2015) a VIF value score < 3.3 indicates that common method bias is ensured. The results in Table 3 show that all VIF score

ranged from 1.079 to 1.354, indicating that the model did not encounter problems with multicollinearity or common method bias.

Table 3: Assessment of multicollinearity and Common method bias in the model

Predictor constructs	AT	GEM	GIM	PB	PI
AT	-	-	-	1.256	1.212
GEM	-	-	-	1.354	1.181
GIM	-	-	-	1.083	1.079
PB	-	-	-	-	-
PI	-	-	-	1.305	-

Note: Blank cells indicate that no VIF value is estimated because the corresponding predictor–criterion relationship is not specified in the structural model.

Next, the relationship between the variables in the model was investigated. According to Sarstedt et al. (2017) it is necessary to examine the Path coefficients, P values, T values and standard deviations. The results of the structural model evaluation are presented in Table 4 and Figure 2.

The results of the structural model analysis show that most of the hypotheses are supported. Specifically, consumer attitudes (AT) are proven to have a positive influence on both their intention (PI) and their biogasoline purchase behavior (PB). The estimation results show that hypotheses H1 ($\beta = 0.185$, $p = 0.003$, $T = 3.010$, $f^2 = 0.037$) and H2 ($\beta = 0.297$, $p = 0.000$, $T = 5.979$, $f^2 = 0.114$) are both statistically significant. When consumers have a more positive attitude towards biogasoline, they will not only have higher purchase intentions but also actually demonstrate more biogasoline purchase behavior. The results also show that green intrinsic motivation (GIM) and green extrinsic motivation (GEM) have different influences on consumers' biogasoline purchase intentions and behavior. Specifically, hypothesis H3 ($\beta = 0.058$, $p = 0.291$, $T = 1.057$) is not statistically significant ($p > 0.05$), while hypothesis H4 ($\beta = 0.269$, $p = 0.000$, $T = 6.283$, $f^2 = 0.109$) is the opposite, reflecting that consumer with green intrinsic motivation tend to translate that perception into actual behavior, even when the intention is not clearly formed.

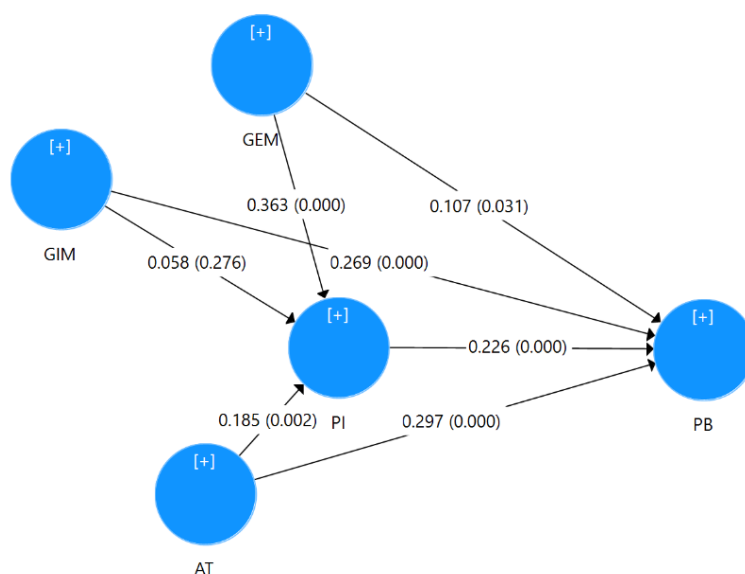


Figure 2: Structural model evaluation

In contrast, GEM plays a prominent role in shaping the intention to buy biogasoline. The results show that hypothesis H5 ($\beta = 0.363$, $p = 0.000$, $T = 6.854$, $f^2 = 0.146$) represents the strongest relationship in the model. In addition, GEM also has a direct, albeit small, impact on biogasoline purchase behavior (H6: $\beta = 0.107$, $p = 0.034$, $T = 2.128$, $f^2 = 0.014$). This result confirms that GEM does not stop at the level of awareness or intention but can also be transformed into practical action. Finally, the relationship between purchase intention (PI) and purchase behavior (PB) was confirmed with coefficient $\beta = 0.226$ ($p = 0.000$, $T = 4.998$, $f^2 = 0.063$), supporting hypothesis H7. This result reinforces the assertion that purchase intention plays an important mediating role connecting psychological factors (AT, GEM, GIM) with actual consumer behavior.

Table 4: Structural model evaluation results

Hypotheses	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values	f ²	CI		Results
							2.5%	97.5%	
H1: AT -> PI	0.185	0.186	0.061	3.010	0.003	0.037	0.065	0.299	Supported
H2: AT -> PB	0.297	0.301	0.050	5.979	0.000	0.114	0.203	0.398	Supported
H3: GIM -> PI	0.058	0.064	0.055	1.057	0.291	0.004	-0.042	0.175	Not Supported
H4: GIM -> PB	0.269	0.271	0.043	6.283	0.000	0.109	0.191	0.358	Supported
H5: GEM -> PI	0.363	0.363	0.053	6.854	0.000	0.146	0.254	0.464	Supported
H6: GEM -> PB	0.107	0.107	0.050	2.128	0.034	0.014	0.014	0.209	Supported
H7: PI -> PB	0.226	0.220	0.045	4.998	0.000	0.063	0.130	0.306	Supported

In addition, the analysis results show that (R^2) of purchase behavior reaches 0.385, the intention to buy biogasoline explains 38.5% of the variation in customers' biogasoline purchase behavior. In addition, (R^2) of purchase intention reaches 0.234, showing that the factors of attitude, green intrinsic motivation, green extrinsic motivation explain 23.4% of the variation in consumers' intention to buy biogasoline. To assess the predictive fit of the model, a blindfolded procedure was used to calculate the Q^2 values. The results showed that both purchasing behavior ($PB = 0.281$) and purchase intention ($PI = 0.153$) had Q^2 values > 0 , indicating that the model had predictive fit. According to Sarstedt et al. (2017) these values indicate a moderate level of predictive accuracy. Overall, the structural model showed acceptable explanatory and predictive capabilities.

Table 5: R^2 and Q^2 value

Endogenous Constructs	PB	PI
R^2	0.385	0.234
$\bar{R}^2$	0.377	0.226
Q^2	0.281	0.153

Table 5 shows that the model explains 23.4% of the variance in purchase intention (PI) and 38.5% of the variance in purchase behavior (PB). The Q^2 values of 0.153 for PI and 0.281 for PB are greater than zero, indicating that the model has predictive relevance for both constructs.

In addition to the model's explanatory and predictive capabilities, its overall fit was also assessed using the SRMR metric. The model's SRMR value was $0.062 < 0.08$, indicating that the model met the overall fit requirements.

DISCUSSION

The research results provide empirical evidence for the validity and effectiveness of integrating the Theory of Planned Behavior (TPB) and the Theory of Self-Determination (SDT) to explain biofuel purchasing behavior in the Vietnamese market.

For the TPB model, consumer attitudes towards biofuels not only directly impact purchasing behavior but also indirectly through the mechanism of purchase intention. This result further reinforces previous studies suggesting that if consumers have positive attitudes and assessments towards biofuels, they will be more willing to make their consumption choices. In Vietnam, positive attitudes reflect consumers' perceptions of biofuels. Specifically, they consider them beneficial products, thereby facilitating both the formation of intentions and actual behavior. This underscores the importance of solutions aimed at increasing positive consumer perceptions of biofuels through the provision of comprehensive and reliable information and an enhanced consumer experience. A key contribution of this study is clarifying the distinct roles of intrinsic and extrinsic motivations in green consumer behavior. The results show that intrinsic motivation does not significantly influence purchase intention, but directly impacts the actual purchase behavior of biofuels. This suggests that some consumers may make purchasing decisions based on pre-established environmental values without necessarily considering each purchase. Given the repetitive and habitual nature of fuel purchases, those with strong environmental motivations tend to act directly when product access is convenient. Conversely, extrinsic motivations have a clear influence on purchase intention and also contribute to actual purchase behavior, highlighting the role of factors such as economic benefits, social incentives, and green consumption promotion programs in Vietnam. These findings imply that relying solely on moral appeals or environmental awareness campaigns may be insufficient to promote widespread biogasoline adoption. For consumers with strong intrinsic environmental values, reducing practical barriers and improving access to biogasoline may be more effective than additional persuasion efforts. Meanwhile, for consumers primarily influenced by extrinsic motivations, economic incentives, promotional programs, and visible social endorsement can play a critical role in strengthening purchase intention and converting it into actual behavior. More broadly, the study demonstrates the value of integrating TPB and SDT in explaining renewable energy consumption. By combining planned behavior and motivational perspectives, the proposed framework offers a more nuanced understanding of how attitudes and motivations jointly influence consumer decisions. These insights are particularly relevant for policymakers and energy providers seeking to design differentiated strategies that align with diverse motivational profiles and support Vietnam's transition toward sustainable energy consumption.

Although the study provides valuable empirical evidence on biogasoline purchasing behavior in Vietnam, it is limited by the fact that the survey sample mainly consists of young, highly educated consumers living in urban areas. This characteristic may reduce the generalizability of the results for older consumers or those living in other areas where access to, environmental awareness levels, and biogasoline consumption habits may differ. Therefore, future studies need to expand the survey scope to improve sample representativeness and increase the generalizability of the research results.

CONCLUSIONS

This study aims to identify factors affecting consumers' biogasoline purchasing behavior, especially in the context of the Vietnamese market. By applying the combination of the theory of planned behavior (TPB) and self-determination theory (SDT), a research model has been proposed to assess the impact between attitudes, green intrinsic motivation, green extrinsic motivation on consumers' biogasoline purchasing intention and behavior. The quantitative research was conducted through a survey of 313 consumers in the three regions of North, Central, and South of Vietnam. The research results, on the one hand, help to consolidate some statements of previous scholars, on the other hand, show the differences in the field of biofuel and research context. Specifically, attitude is affirmed to be a factor that helps to form purchase intention and promote consumers' biogasoline purchasing behavior. From a motivational perspective, green intrinsic motivation is determined to have a direct and strong impact on purchasing behavior, however, the author has not found a relationship between this factor and consumers' intention to buy biogasoline. On the contrary, evidence shows that green extrinsic motivation has a strong relationship with Vietnamese consumers' intentions and biogasoline purchasing behavior.

Based on the research results, some recommendations have been made for petroleum businesses to promote the formation of purchase intentions and actual purchase behavior of customers. In practice, gasoline retailers should implement reward point programs, cashback, or price incentives for customers using biofuels. This is a crucial foundation for fostering external incentives toward environmental protection (GEM), thereby encouraging repeat purchases. Additionally, businesses need to implement communication campaigns that emphasize environmental value, social responsibility, and individual contributions to sustainable development to strengthen intrinsic incentives (GIM) among consumers. Furthermore, when conducting post-purchase satisfaction surveys, gasoline retailers should include assessments related to intrinsic incentives to identify groups of green consumers with a high level of commitment, thereby developing more appropriate customer retention and communication strategies for this group. Despite its theoretical and practical contributions, this study is subject to several limitations that should be acknowledged and addressed in future research. First, the data were collected using a cross-sectional survey design, which restricts the ability to capture changes in consumers' motivations and purchasing behavior over time. Green consumption behavior, particularly in the context of renewable energy adoption, is likely to evolve as market conditions, policy incentives, and public awareness change. Future studies may therefore adopt longitudinal or panel data approaches to better examine the dynamic nature of biogasoline purchasing behavior and the stability of motivational effects.

Second, the study relies on self-reported measures of purchase intention and purchasing behavior, which may be influenced by social desirability bias or respondents' subjective perceptions. Although procedural remedies were applied during data collection, future research could complement survey data with behavioral or transactional data, such as actual purchase records or experimental designs, to strengthen the robustness of the findings. Third, the research focuses on the Vietnamese context, which may limit the generalizability of the results to other countries with different levels of economic development, energy infrastructure, and cultural attitudes toward environmental protection. Comparative studies across countries or regions could provide valuable insights into how institutional and cultural factors moderate the relationships between attitudes, motivation, and renewable energy consumption behavior.

Finally, while this study integrates the Theory of Planned Behavior and Self-Determination Theory, the proposed model does not account for other potentially relevant factors, such as perceived product quality, trust in energy providers, price volatility, or policy awareness. Future research could extend the current framework by incorporating moderating or mediating variables to further explore the complex mechanisms underlying green energy consumption. In particular, examining the interaction or potential crowding-out effects between green intrinsic and extrinsic motivations may offer a more nuanced understanding of how different motivational forces jointly shape consumer behavior.

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INSTITUTIONAL REVIEW BOARD STATEMENT: The study involved minimal risk and followed ethical guidelines for social science fieldwork. Formal approval from an Institutional Review Board was not required under the policies of the Institute for Research Ethics Committee of Thuongmai University, Vietnam. Informed verbal consent was obtained from all participants, and all data were anonymized to protect participant confidentiality.

TRANSPARENCY: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

COMPETING INTERESTS: The authors declare that they have no competing interests.

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