SSRG International Journal of Electrical and Electronics Engineering
ISSN: 2348-8379/ https://doi.org/10.14445/23488379/IJEEE-V12I4P105

Volume 12 Issue 4, 72-90, April 2025

Original Article

Research on Factors Influencing Energy-Saving Behavior in Industrial Enterprises - A Case Study in Industrial Enterprises in the North of Vietnam

Tang Cam Nhung[1], Ngo Tuan Kiet[2], Nguyen Thanh Tung[3], Do Anh Tuan[4,5]*

[1]*Thai Nguyen University of Technology, Thai Nguyen, Viet Nam.*
[2]*Electric PowerUniversity, Ha Noi, Viet Nam.*
[3]*University of Engineering and Technology, Ha Noi, Viet Nam.*
[4]*Dai Nam University, Ha Noi, Viet Nam.*
[5]*A Chau Industrial Technology Joint Stock Company, Viet Nam.*

**Corresponding Author : doanhtuan@dainam.edu.vn*

Received: 03 February 2025 Revised: 05 March 2025 Accepted: 06 April 2025 Published: 29 April 2025

Abstract *- Global energy crises have been leading to serious consequences for world economic growth and competitiveness among countries. The economical and efficient use of energy has become an irreversible trend in the world and Vietnam in particular. Energy saving not only helps reduce production costs improve profits and competitiveness of businesses, but also contributes to reducing pressure on the national energy system. This study synthesizes the results of 686 responses on energy-saving behavior from 49 enterprises in various industries in Vietnam; 49 were answered by company leaders, middle managers answered 146, and 491 were answered by employees conducting the survey. The study uses the exploratory factor analysis method and SEM linear regression equation analysis. Smart-PLS and SPSS software are used to perform the analysis. To determine the factors influencing energy usage behavior in industrial enterprises, the author proposed the research model based on the Theory of Planned Behavior (TPB) combined with Institutional Theory. 13 influencing factors have been considered in the following direction: 1) a group of factors related to promoting the construction of an energy-saving culture in enterprises; 2) a group of factors related to institutions and regulations to promote energy saving in enterprises; 3) a group of influencing factors coming from outside the business. The analysis results show that subjective benchmark factors, behavioral control and energy-saving attitude are significant positive predictive factors for energy-saving intention). Organizational interventions positively impact subjective standards, behavior control, and attitudes. In particular, the financial factor plays an important role, not only directly affecting energy-saving behavior but also significantly affecting the management factor (TMP). However, cultural factors, TMP, and cooperation did not show a significant influence on energy-saving behavior. We propose energy-saving measures at different levels to promote energy-saving implementation in Vietnamese industrial enterprises based on the research results.*

Keywords *- Enterprise energy saving behavior, Energy-saving, Industrial energy efficiency.*

1. Introduction

The history of economic development has shown that many global economic crises originate from energy crises. Economic growth coupled with increasing consumer demand has led to the overexploitation of fossil fuels, causing a decline in energy resources and exacerbating environmental degradation. Countries around the world have invested more and more in improving their capacity, understanding, and practical actions for energy conservation and environmental protection. In addition, the COVID-19 pandemic has created a severe global economic recession, directly affecting business operations, increasing unemployment and promoting inflation. After the pandemic, the world economy has shown signs of recovery but is facing a serious shortage of energy and fuel [1, 2]. After the pandemic, the world economy has made prosperous steps, but it is facing a serious shortage of energy and fuel. This is partly due to armed conflicts between countries and partly due to the depletion of fossil fuels [3]. Development history has proven that many world economic crises stem from energy crises. Economic development in countries and increased consumer demand have led to an excessive increase in the extraction and use of fuels, leading to the depletion of energy resources and environmental degradation. Developed countries, especially the European Union, have taken various measures to reduce energy consumption to cope with price fluctuations and minimize

environmental impacts [6]. In Japan, it has promoted the economical and efficient use of energy in 2 directions: 1) promulgating energy management policies, including gasoline tax and oil tax [4], 2) supporting investment in renewable energy systems [5]. Some Asian countries, such as Singapore and the Philippines, have been at the forefront of industry energy efficiency measures [7]. Malaysia and China have adopted the implementation of green buildings and energy efficiency, which shows that the countries' governments are increasingly interested in sustainable socio-economic development activities in the region [8].

Vietnam is a developing country. Vietnam's GDP growth in 2023 is about 5.05%, and the commercial electricity rate will increase by 4.08% [9]. Energy consumption demand in the industrial sector accounts for more than 50% of the total national energy consumption [10, 11]. It can be seen that industrial enterprises are the main driver of GDP growth and also a large force in energy consumption. Therefore, energy efficiency in the industry plays a very important role in helping the Vietnamese government towards the goal of net zero by 2050, as committed at the climate change summit (COP 26) taking place in Glasgow, Scotland, United Kingdom [9].

Economical and efficient use of energy in a business is not simply about using less energy but also reducing energy intensity or, in other words, reducing energy consumption per unit of output value. Enterprises need to apply technical measures, operation management, and supervision in all stages, from exploitation to storage, transportation, processing, and use, to achieve the purpose of energy saving. Studying energy saving in industrial enterprises, many scholars believe that analyzing the factors affecting the energy use behavior of industrial enterprises is one of the measures to reduce energy consumption [12-14]. Several studies have investigated the barriers to energy efficiency in industry. The results show that public finance and external factors significantly influence the use of environmental protection by enterprises, for example, increasing energy prices and imposing or increasing fees on the types of resources consumed and polluting emissions. Besides, businesses also have a positive attitude towards energy-saving technology, which can bring long-term benefits and prove that they are willing to take radical measures [15].

The operating environment of enterprises has many influencing factors. It can be divided into 2 main groups of factors: 1) Group of macro-environmental factors: socio-cultural, political, legal, science and technology, ecological environment, economic environment, population and demographic factors; 2) The group of elements of the microenvironment including the direct public, suppliers, intermediaries, competitors, customers. Some scholars divide the influencing factors into groups of external influencing factors and groups of internal influencing factors [16, 17].

In a recent study on the energy-saving behavior of industrial enterprises in China, scholars based on the strategic legitimacy theory, the institutional theory, and the adaptive legitimacy theory divided the influencing factors into two groups of influencing factors: 1) a group of external factors: marketization, media attention, government environmental supervision according to the Adaptive Legitimacy Theory; 2) Group of internal factors including green technology reserves, financial slack, characteristics of the Top Management Team.". The results show that market factors can significantly affect many corporate environmental protection behaviors, while media attention can only significantly reduce the ability of enterprises to emit pollutants. Green technology reserves have a positive and significant impact on a number of environmental protection behaviors; while financial flexibility promotes products that are beneficial to the environment and green offices but restrains other environmental practices. In particular, in this study, the authors found that the proportion of women in senior management has a positive effect on the company's environmental performance behaviors [18]. Some other scholars focus on the psychology of employees in performing energy-saving behaviors [19, 20].

Instead of focusing only on the overall or macro factors as before, the highlight of this study is the analysis of influencing factors from the micro level. The model includes the main survey objects, which are the internal elements of the business, such as finance, senior management, and technologies. This helps increase the practicality of applying energy-saving measures and, at the same time, promotes more efficiency in achieving the energy-saving goals of businesses. Another novelty is that we build a research model that combines both institutional and behavioral theories intended to explain the psychological problems of employees in their readiness to take energy-saving measures. From the business management perspective, the model focuses on analyzing the drivers of profit and cost, helping to explain better the economic factors that affect business decisions. From the perspective of intentional behavior theory, the model helps predict the behavioral choices of businesses when faced with the choice between saving and not saving energy. Together, these factors influence the energy-saving behavior of businesses, allowing us to look at this behavior from many different perspectives, creating a complex and practical model for research and application.

2. Theory and Hypothesis

2.1. Institutional Theory

Max Weber was one of the founders of institutional theory, which studied organizational activities and regulations. He said that an organization not only exists to maximize benefits but also must comply with social rules and norms [21]. Institutional theory plays an important role in understanding energy-saving behaviors in businesses by assessing the effects of external pressures and internal motivations. Institutional theory holds that organizations are often affected by pressures

from the external environment, such as policy factors, the competitive environment, and socio-cultural issues [18, 22]. These pressures will motivate businesses to implement and comply with social norms, as well as the principles and rules that society expects to be able to survive in the market.

Some scholars focus on developing strategies and activities to change employees' energy-saving behavior in the workplace. These measures include setting goals, creating an environment where employees can easily implement energy-saving behaviors, and changing the work environment will promote these behaviors [23]. In particular, the active involvement of management not only focuses on infrastructure but also on changing the organizational structure and corporate culture is a decisive factor in achieving sustainable behavior changes [24]. Building on previous studies, Xie et al. (2021) expanded the study by examining in more detail the effects of Organizational Interventions (OIs) on psychological factors such as attitudes to energy-efficient behaviors, subjective norms, and cognitive behavioral control. Other scholars argue that organizational interventions rely not only on individual employee efforts but also require widespread organization-wide change and investment in energy-efficient technology [25]. Subjective norms refer to employees' perceptions of social pressures from the environment, colleagues, and leadership in implementing energy-saving behaviors. Initiatives from the organization not only improve personal awareness but also help strengthen social awareness of the importance of environmental protection behaviors [26]. Pressures from the leadership environment and colleagues will make employees act positively in conserving energy [20]. Support from the organization creates positive pressure, encouraging employees to implement sustainable behaviors to comply with social standards and expectations from colleagues [27]. Therefore, we propose a hypothesis.

Hypothesis H1: Organizational interventions have a positive impact on employees' subjective norms of energy-saving behavior.

In an organization or a business, activities or initiatives often bring positive effects, which change the attitude of employees, especially in the case of employees' attitudes towards energy conservation [28]. In another study, the results showed that when employees were aware of the economic and environmental benefits of the organization's initiatives, their attitudes towards implementing energy efficiency improved significantly [29]. For example, education and training programs for employees associated with activities such as Earth Hour will help them form a more positive attitude toward energy-saving activities. Some other scholars argue that information and education to increase knowledge about energy conservation can improve employees' attitudes toward implementing energy-saving behaviors [14, 20, 30]. Therefore, we propose a hypothesis.

Hypothesis H2: Organizational Interventions (OI) have a positive impact on employee attitudes toward energy-saving behavior.

Behavioral control perceptions reflect how easy employees can perform energy-saving behaviors [31]. For example, when implementing energy-saving competitions in a business, if the organization provides specific, detailed instructions on implementing activities, it will help employees feel easier when carrying out those activities. Clear guidelines on how to save energy will increase employees' awareness of controlling behavior, helping them feel more confident in contributing to the business's energy-saving efforts. When employees feel they have control and are provided with the appropriate tools, energy-saving behavior becomes more effective [32]. Several studies on promoting energy-saving behaviors in businesses have confirmed that support from organizational initiatives makes it easier for employees to implement energy-saving behaviors [22, 31]. Therefore, we propose a hypothesis.

Hypothesis H3: Organizational Initiatives have a positive impact on employees' behavioral control perceptions of energy-saving behavior.

2.2. Theory of Planned Behavior

According to the Theory of Planned Behavior (TPB), human behavior, specifically in the context of this study, is the energy-saving behavior of individuals in enterprises, which is influenced by three main factors: Energy-Saving Attitude (EA), Subjective Norm (SN) and Perceived Behavior Control (PC) [33]. Subjective standards for energy saving have a significant impact on forming the energy-saving intention of employees in industrial companies. In an industrial environment, employees' intentions to implement energy savings, and the opinions of colleagues and leaders often strongly influence whether or not they implement energy-saving behaviors [34]. In addition, research has shown that observing the actions of others enhances the impact on social norms, leading to employees complying with regulations on energy efficiency [35]. Another study found that when business leaders encourage and appreciate energy-saving behaviours, employees are more likely to participate because they see benefits in career development [23, 36]. Thus, social pressure from key individuals in the organization not only encourages energy-saving behavior, but also reinforces this behavioral intent in the context of industrial enterprises. Therefore, we propose the hypothesis that:

Hypothesis H4: Subjective standards positively influence energy-saving intentions.

A positive or negative attitude towards energy conservation is formed based on the knowledge of energy consumption and the belief of the business about the benefits of this behavior. Behavioral attitudes are the determining

factors of an individual's behavioral intent. The expected outcome of the behavior and the evaluation of that outcome will shape the individual's behavioral attitude. When individuals tend to support a certain behavior, their awareness and thoughts about that behavior become stronger. They will look for various reasons and explanations for their behavior [28, 37]. As subjective attitudes and norms become more positive, along with a clear perception of behavioral control, an individual's behavioral intent strengthens. Especially under normal conditions, this can reduce the short-term benefits of the business. Therefore, we propose the hypothesis that:

Hypothesis H5: Employee frugal attitudes have a positive impact on energy-saving intentions

Behavioral control awareness refers to a business's ability to implement energy savings, including financial resources and support from technology. Behavioral control perceptions have a significant impact on behavioral intent, especially in situations where employees find it easy or convenient to perform this behavior [33]. Person-organization fit and person-job fit all play an important role in influencing employees' willingness to engage in energy-saving behaviors [38]. When employees feel a good fit for the organization and their specific role, they tend to get involved and make an effort to implement energy savings. On the other hand, when employees feel they do not have enough control, such as a lack of support from management, a lack of necessary equipment or technology, or facing obstruction from their peers, they may develop negative perceptions of their ability to control, resulting in impaired energy saving intentions [39]. In addition, the impact of cognitive factors controlling behavior can become complex in an industrial enterprise environment when both technical and human factors act simultaneously. Employees may intend to engage in energy-efficient behavior, but if they feel they lack supportive factors, such as access to technology or an unfavourable work environment, they may not engage in this behavior even if they have strong intentions [23]. Therefore, we propose the hypothesis that:

Hypothesis H6: Employee behavior control perception has a positive impact on employees' intention to save energy

According to Theory of Planned Behavior (TPB), behavioral intent is seen as a direct predictor and readiness to transform into behavior [33]. The intention of an employee to conserve energy is formed from a combination of a favorable attitude toward energy conservation, subjective norms, and perceived behavioral control. When employees have a strong intention to save energy, it is easier for them to act [40]. Industrial enterprises can enhance the energy-saving behavior of employees by encouraging positive intentions, such as setting clear goals and providing an environment that supports energy-saving behavior [37]. In addition, the role of corporate culture and incentive policies is also indispensable, and the organizational culture that supports energy-saving initiatives and incentive policies will reinforce employee intentions and behaviors [41]. Therefore, we propose the hypothesis that:

Hypothesis H7: Employees' energy-saving intentions have a positive impact on energy-saving behavior

2.3. External and Internal Factors of the Enterprise

The relationship between businesses and the market is a continuous relationship: the market has a good influence and has negative impacts that make it difficult for businesses. The operating environment of enterprises is divided into 2 main groups of factors: 1) Macro-environmental factors, including socio-cultural, political, legal, scientific and technological factors, ecological environment, economic environment, population and demographic factors; 2) factors of the microenvironment, including the public, suppliers, intermediaries, competitors, customers [42].

With the goal of maximizing profits, it is necessary to implement energy saving for businesses. Many scholars have analyzed the factors that affect the energy efficiency of enterprises, some of which focus on analyzing the factors that affect the energy-saving behavior of enterprises. A study on energy-saving and emission-reducing behaviors of industrial enterprises has classified factors affecting energy-saving behaviors into 2 groups: 1) a group of external factors, including markets, media, and support from the government; 2) The group of internal impact factors, including green technology reserves, financial flexibility, characteristics from managers [18]. A survey on energy-saving activities of Korean industrial enterprises also divides the factors affecting energy-saving behavior into 2 groups: 1) External drivers: coercive, normative, mimetic; 2) Internal faCEor: energy-saving strategy orientation, top support, and Learning capacity [43].

Corporate finance is a critical factor in implementing energy-saving measures. The lack of financing is one of the biggest barriers to energy-saving measures in industrial enterprises [44]. However, when businesses have abundant financial resources, they may be willing to invest in energy-efficient technologies with high initial costs but long-term benefits [45]. A recent study further reinforced this view when they found a positive relationship between financial surplus and corporate energy-saving behavior through financial support for energy activities [22]. Therefore, we propose the hypothesis:

Hypothesis H8: Financial factors have a positive impact on the energy-saving behavior of industrial enterprises

Leaders or senior managers in an enterprise are those who directly affect the interests of the enterprise; managers have a decisive role in the implementation of energy-saving behaviors of the whole collective. Some scholars believe that the energy-saving activities of employees in the company will be more active if there is the participation and commitment of the

leadership [46, 47]. The survey results in China show that senior managers in companies have great pressure to influence the performance of employee behaviors, and leaders will create a favorable environment to be able to perform these behaviors. For example, communicating information from the company's strategies so employees realize the value of those actions [22]. In addition, investing in new equipment or technology requires a lot of money, which can also affect managers' consideration of implementing energy-saving behaviors. Therefore, in this study, we consider the hypothesis of the relationship between leaders and the energy-saving behavior of businesses.

Hypothesis H9: Leaders in the company have a positive influence on the energy-saving behavior of industrial enterprises.

In industry, effective and potential energy-saving measures still depend heavily on advancing science, engineering, and technology. The advancement of science and technology will help reduce energy consumption and optimize the production process [48]. Advances in science, technology, and technology can fundamentally change the current economic growth model, prompting businesses to improve their energy use in production. The support of science and technology for energy saving of industrial enterprises is mainly reflected in the improvement of the overall level of energy efficiency - the application of economic technology and the level of research in the procurement and transportation of raw materials in the process of product production, finished product preservation, packaging and transportation of finished products, issues related to energy consumption and production. A study has shown that improving science and technology will help businesses improve efficiency and reduce carbon emissions [49]. Therefore, we propose the hypothesis that:

Hypothesis H10: Technology factors have a positive impact on energy-saving behavior in industrial enterprises

Abundant financial resources are the basis for business leaders to decide on investment plans for energy-saving equipment and technologies [50], ensuring feasibility when implemented, which is a condition for promoting energy-saving behaviors [15]. Therefore, we believe that the financial factor is especially important for senior management in industrial enterprises, which is the basis for promoting energy-saving behavior. Therefore, we propose the following hypothesis:

Hypothesis 11: Financial factors have a positive impact on senior management

Each region and region will have unique characteristics related to cultural life, behaviors and habits that have evolved over many periods and stood the test of time. This context is called the socio-cultural environment. Some of the sociocultural factors in this study include consumer attitudes, consumer perceptions, local people's religious beliefs, environmental protection issues, and the company's production processes (Oksman, Reda, Karjalainen, Rehman, & Fatima, 2021). The socio-cultural environment influences energy-saving behavior, and cultural values play an important role in shaping employees' attitudes and behavioral intentions (Duong, 2023). Therefore, we hypothesize the following

Hypothesis H12: Socio-cultural factors have a positive impact on the energy-saving behavior of enterprises.

Cooperation between industrial enterprises and universities is the prototype of industry-university research cooperation. In the process of training students, colleges and universities mainly consolidate theoretical knowledge for students but have not fully fostered students' business capacity and practical ability. At the same time, frontline workers in industrial enterprises have little theoretical knowledge. The level of production can only be increased at the beginning, and it is difficult to raise to a new level at a later stage if the knowledge is not updated. Therefore, the collaboration between the university and industry is of great significance. In order to build an energy-saving foundation for industrial enterprises, colleges and universities can provide extensive human resources and a solid theoretical basis for building an energy-saving foundation for enterprises. Through application in business, they can combine theory and practice to promote energy saving in industrial enterprises. The building of the platform also provides a testing ground for colleges and universities to cultivate talent. The cooperation between industrial enterprises and universities will help businesses further develop in the field of energy saving, and development will also encourage businesses to exploit their potential further and expand their market share. Therefore, we hypothesize the following:

Hypothesis H13: Cooperative factors have a positive impact on the energy-saving behavior of enterprises

The competitive environment of an enterprise refers to the level of participation and competition in the industry in which the enterprise operates and its competitors, and to a certain extent, reflects the level of entry into the industry [51]. Competitors will use the behavior of imitating, improving or upgrading products to reduce the competitive advantage of the business in terms of product ownership. The competitive environment and the basic nature of the enterprise are to achieve the maximum possible profit, which is the goal of the enterprise to continuously improve its products, including technology and management methods in the production process for healthy and sustainable development [52]. Energy consumption accounts for a large proportion of the cost of enterprises' products. Adopting energy-saving technologies and promoting energy-saving behavior can improve energy efficiency and reduce energy consumption levels and costs, especially non-renewable energy, thereby reducing product costs and improving product competitiveness in the market

[12]. The competitive environment of energy saving for industrial enterprises greatly impacts awareness of energy saving and improving production and products. If the level of competition is low, the awareness of competition innovation and enterprise reform of enterprises will be weak, and the awareness of product improvement and energy saving in the process of product production will not be strong enough; On the contrary, if the competitive environment where the enterprise is located has a high degree of change, the enterprise will need to adjust according to competitive conditions. Therefore, we hypothesize the following:

Hypothesis H14: Competitive environmental factors have a positive impact on the energy-saving behavior of enterprises.

The government's energy-saving policies are based on the current state of economic development in general and industry in particular, and come from the perspective of sustainable development, circular economy, green economy, towards economic development combined with environmental protection and energy saving. In addition, policies to support energy saving are the key to encouraging and stimulating industrial enterprises to implement energy-saving projects [53]. The policy to support energy saving starts from the perspective of capital incentives for enterprises implementing energy-saving activities. These supportive policies have a positive impact on the owners and managers of industrial enterprises and greatly affect saving decisions and building an energy-saving foundation for industrial enterprises. It is worth noting that the more detailed the government's energy-saving goals, the easier they are to implement and the more appreciated they are, the more beneficial they are for implementing energy efficiency by businesses. Therefore, we hypothesize the following:

Hypothesis H15: Government support has a positive impact on the energy-saving behavior of enterprises.

These hypotheses lay the foundation for examining how organizational interventions can effectively promote energy-saving behaviors, contributing to improved energy efficiency and sustainable development in businesses. The combination of institutional theory and behavioral theory is expected to help explore the psychology of the person who performs the behavior to the factors affecting the development of the business, including internal and external factors. Figure 1 shows a model of factors affecting the energy-saving behavior of industrial enterprises, and Figure 2 shows the research logic

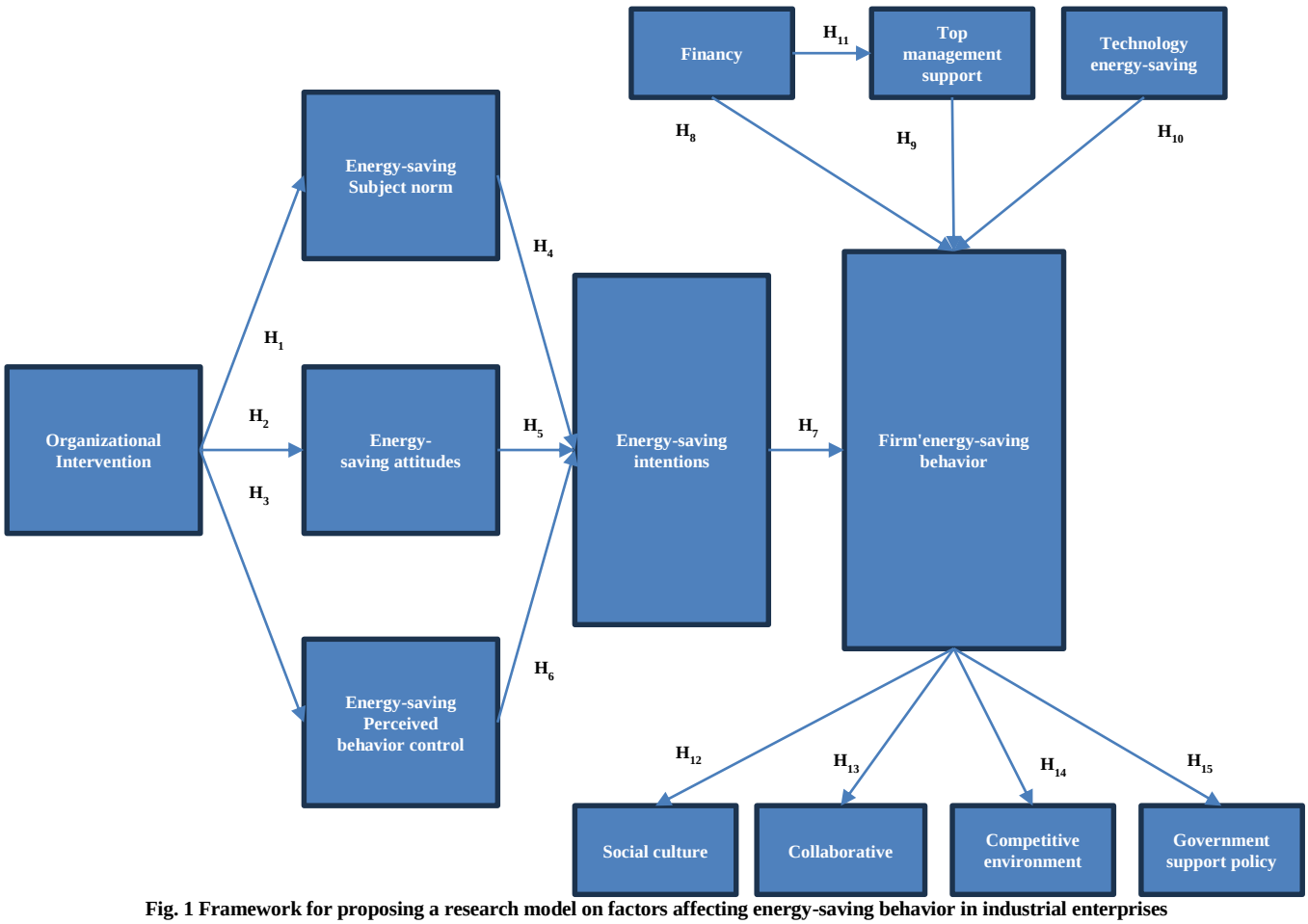

Fig. 1 Framework for proposing a research model on factors affecting energy-saving behavior in industrial enterprises

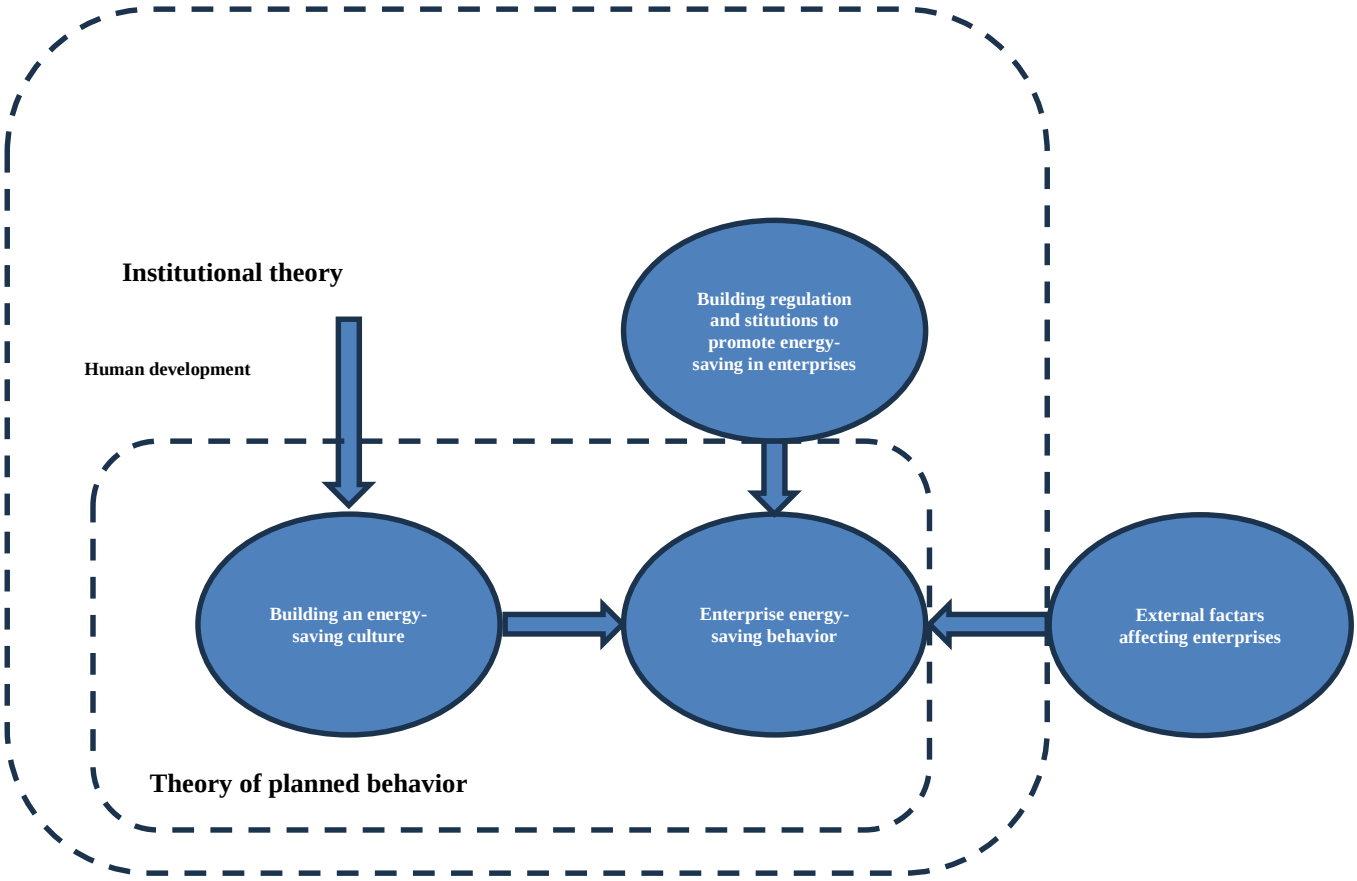

Fig. 2 Logic of this study

3. Methodology

3.1. Survey Locations

The survey information board is mainly carried out in Thai Nguyen province, north of Vietnam. This province has many industrial parks and large and small enterprises across the country, with the strong development of energy-consuming industries. In 2022, there are about 50 key energy-consuming enterprises in the province (according to the Law on Economical and Efficient Use of Energy, the unit consumes > 1000 TOE). The energy consumed is mainly coal and electricity. Cao Ngan and An Khanh thermal power plants consume about 800,000-1,000,000 tons of coal per year, creating a large amount of emissions (Cao Ngan Thermal Power Plant emits 4,500,000 m^3/h and An Khanh Thermal Power Plant emits 5,000,000 m^3/h).

In addition, steel, beer, paper and plastic producers also consume large amounts of electricity and coal, contributing to increased pressure on the environment ("Thai Nguyen: Industrial manufacturing enterprises participate in saving electricity," 2023). Thai Nguyen is facing a major challenge in improving energy efficiency and shifting to renewable energy sources to minimize environmental impact and ensure sustainable development in the future. Figure 3 shows the map of the distribution of industrial parks and clusters concentrated in Thai Nguyen province, Vietnam.

3.2. Data Collection

The sampling objects in our study are industrial enterprises, mainly energy-intensive manufacturing enterprises. The production and management processes related to energy saving in enterprises are relatively complicated due to the government's energy-saving policies, the increasing consumer demand for green products and green energy saving, and the constant changes in competitive products, causing businesses to apply energy-saving measures. Data related to corporate energy consumption is often not clearly statistical and public, so when researching the main influencing factors, we collect it through questionnaire surveys.

We use 3 main ways to distribute survey questionnaires: 1) distribute questionnaires directly to employees or managers of the enterprise; 2) Send a link to the survey questionnaire to the employees and managers of the companies; 3) Conduct direct interviews by phone with employees and managers of companies.

Sample selection method: The first 100 survey forms are randomly distributed. Then, we collect and calibrate. For the second time, we distributed 1000 votes to businesses. The survey took place for 3 months. The results obtained were 315 samples that did not meet the conditions, and 686 samples were included in the synthesis, analysis and evaluation.

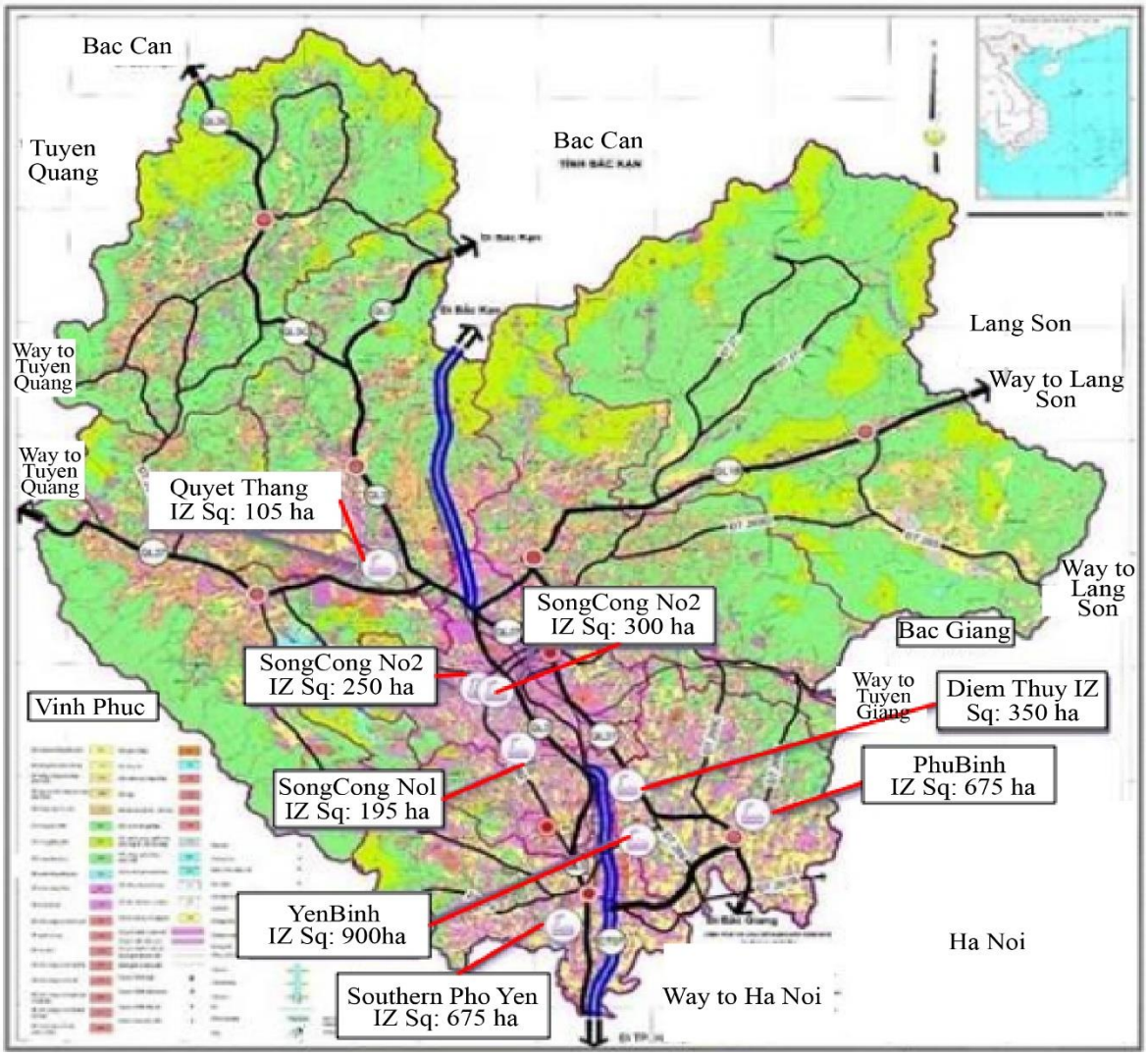

Fig. 3 Map of distribution of industrial parks in Thai Nguyen province, Vietnam

Table 1. Demographic profile of participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	502	73,2	73,2	73,2
	Female	184	26,8	26,8	100,0
	Total	686	100,0	100,0	
Age	> 24	220	32,1	32,1	32,1
	25 -35	287	41,8	41,8	73,9
	> 35	179	26,1	26,1	100,0
	Total	686	100,0	100,0	
Educational qualifications	Junior middle school graduate	204	29,7	29,7	29,7
	Senior middle school graduate	236	34,4	34,4	64,1
	Bachelor's degree	198	28,9	28,9	93,0
	Master's degree	48	7,0	7,0	100,0
	Total	686	100,0	100,0	
Business scale	Large enterprise	368	53,6	53,6	53,6
	Medium-sized enterprise	177	25,8	25,8	79,4
	Small-sized enterprise	141	20,6	20,6	100,0
	Total	686	100,0	100,0	

Statistical analyses are performed using SPSS and Microsoft Excel software. The 5-point Likert scale, which is commonly used in behavioral studies, has been designed to be used as a questionnaire scale. Descriptive statistics are performed by SPSS software, and model validation analyses are performed by Smart PLS-SEM software. Table 1 shows the basic characteristics of industrial enterprises.

The percentage of males participating in the survey accounted for 73.2%, while females only accounted for 26.8%. This shows that employees in local industrial enterprises are mainly men. In terms of age, the age group from 25-35 accounted for 41.8%, followed by the group under 24 years old (32.1%) and the group over 35 years old accounted for the lowest percentage (26.1%). In terms of education, 34.4% of the participants had a high school degree, followed by 29.7% with a junior high school degree and 28.9% with a university degree. The percentage of highly qualified employees is not much; only 7% of participants have a master's degree.

Large enterprises (with an employee size of over 300 people) account for about 53.6%, while the rest are small and medium-sized enterprises (the employee size does not exceed 200 people). This shows that large enterprises tend to play a leading role in participating in activities related to energy saving.

3.3. Measures

In this study, we built a questionnaire with variables evaluated on a 5-point Likert scale. The level of escalation is from 1 -5, with 1 = completely disagree, 2= disagree, 3= neutral, 4= Agree, 5= strongly agree (Gao et al., 2017), (Murdoch, 2022). Measurement items are developed and referred to in detail in Table 2.

Table 2. Measurement items of other constructions

Potential Variables	Observation Variables	Measurement Items
Organizational Interventions (OI)	OI1	Your business regularly applies interventions such as organizing training or seminars to raise awareness about energy efficiency [54]
	OI2	Businesses regularly implement interventions to encourage employees to participate in energy-saving programs [25]
	OI3	Your business has developed rules, rewards, and penalties for employees' energy use [55]
Subjective Norms (SN)	SN1	Your employees feel pressure from colleagues and superiors to implement energy-saving measures in the workplace [54]
	SN2	Your business has policies that encourage energy-saving behavior because it is expected by society and the business community [31]
	SN3	Employees always comply with regulations and expectations for energy savings due to pressure from colleagues [31]
Attitudes (AT)	AT1	Employees believe that energy-saving measures will bring economic and environmental benefits to the business [54]
	AT2	Employees are ready to take energy-saving actions at work when they are aware of its importance for sustainable development [56]
	AT3	Your business encourages employees to be aware of and implement energy-saving behaviors through training programs [57]
Perceived Behavioral Control (PC)	PC1	Employees believe they have the skills and knowledge to implement energy-saving measures in the workplace [33]
	PC2	Employees have the right to take the initiative in decision-making on the implementation of energy-saving measures [58]
	PC3	Employees feel they have the tools and resources to implement energy-saving behaviors [30]
Energy-saving Intentions (NO)	EI1	You intend to adopt energy-saving measures to minimize energy costs [35]
	EI2	Businesses set specific goals to encourage employees to implement energy-saving behaviors [59]
	EI3	Your business often tracks and evaluates employees' energy-saving intentions and behaviors [35]
Firm's Energy-saving Behavior (FEB)	FEB1	Businesses regularly adopt new processes or technologies to reduce energy consumption [54]
	FEB2	Businesses regularly organize education or training programs to raise awareness of energy saving for employees [30]
	FEB3	Employees regularly engage in energy-saving behaviors, such as turning off lights and appliances when not in use [33]
	FEB4	Businesses regularly monitor and evaluate energy consumption indicators [59]
Finance	F1	Your business has enough financial resources to invest in energy-efficient technologies [54]

(F)	F2	Businesses always receive financial support or incentives from government policy programs for energy-saving projects [60]
	F3	The company considers energy-saving costs in the investment decision-making process [60]
Top management Support (TMP)	TMP1	Senior management regularly encourages and commits to energy-saving initiatives [61]
	TMP2	The Board of Directors is directly involved in the decision-making of investment in energy-saving technology projects [61]
	TMP3	The management provides sufficient resources and finance to implement energy-saving measures [22]
Energy-saving Technology (EST)	EST1	Does your business use energy-efficient technology (e.g., automated control systems, smart lighting, or energy management technology) to reduce energy consumption [62]
	EST2	Businesses actively invest in new energy technologies, such as renewable energy or advanced energy management systems, to optimize energy efficiency [60]
Social Culture (SC)	SC1	Does your business promote awareness of social responsibility and environmental protection so that employees are more aware of energy saving [27]
	SC2	The socio-cultural values of energy efficiency are integrated into the company's development strategy [63]
Collaborative (C)	C1	Your business encourages collaboration between departments to find energy-saving solutions [64]
	C2	Businesses have initiatives to collaborate with external partners, such as suppliers or government agencies, to enhance energy efficiency [18]
Competitive Environment (CE)	CE1	Your business feels pressure from competitors to adopt energy-saving measures [64]
	Third grade	Your business finds that the adoption of energy-efficient technology improves its competitive advantage in the market [65]
	CE3	Businesses participate in industry energy-saving programs or initiatives to stay competitive in the market [37]
Government Support Policy (GSP)	GSP1	Businesses receive support from government policies related to energy efficiency [66]
	GSP2	Businesses can take advantage of incentives from government policies to invest in energy-saving technology [67]
	GSP3	Businesses participate in government programs to promote sustainable development and reduce energy consumption [66]

Note: All items are measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Structural Equation Modeling (SEM) allows for factor analysis and regression, the study of accurately modeling complex relationships between latent variables and observed variables in behavioral psychology research.

The structural equation model has advantages over traditional statistical analysis methods: (1) It can process many dependent variables simultaneously; (2) Factor relationships and factor structures can be estimated simultaneously; (3) based on allowing the measurement model to be more flexible, it is possible to estimate the suitability of the whole model; (4) Allowing the correlation between independent variables can better solve the multi-collinear problem. The structural equation model is divided into a measurement model and a structural model. The measurement model used to describe the relationship between potential variables and indicators is represented by the following two equations:

$$x = \Lambda x\xi + \delta$$

$$y = \Lambda yn + \varepsilon$$

$x=\Lambda x\xi+\delta$ describes the relationship between the observed variables x and the latent variable ξ with the factor load matrix Λx and the measurement error δ The structural model is used to describe the relationship between potential variables, which is usually expressed by the following formula:

$$h=B\eta+\Gamma\xi+\zeta$$

In which:

η are vectors of endogenous latent variables,

B is the regression coefficient matrix between dependent potential variables,

Γ is a regression coefficient matrix between exogenous latent variables and dependencies,

ξ is a vector of independent latent variables,

ζ\zetaζ is the vector of errors.

The relationship between endogenous latent variables is represented by B, which denotes the relationship or influence of exogenous latent variables on endogenous latent variables. The structural model is an important part of the structural equation model, which describes the relationships between potential variables.

4. Results and Discussion

4.1. Measurement Model Analysis

To assess the reliability of the scale, Cronbach's alpha coefficients must all be greater than 0.6 (acceptable) and the correlation coefficient between variables (item-total) greater than 0.3. Variables with a total correlation coefficient of less than 0.3 are excluded from the factor and are considered "garbage variables" [68-69]. Composite Reliability (CR) is a composite metric used to measure the overall reliability of scales. A CR value of 0.7 or more is considered good. The smallest CROI coefficient reached 0.795, and the CRSC coefficient reached the largest value of 0.917, the results of which are shown in Table 3 [70].

Table 3. Validity and reliability analysis result

	Cronbach's Alpha	rho_A	Composite Reliability (CR)	Average Variance ExtraCEed (AVE)
AT	0.716	0.787	0.835	0.633
C	0.698	0.710	0.868	0.767
THAT	0.753	0.759	0.859	0.671
NO	0.788	0.791	0.876	0.702
EAST	0.668	0.669	0.858	0.751
F	0.800	0.835	0.881	0.711
FEB	0.795	0.808	0.867	0.621
GSP	0.811	0.813	0.888	0.726
HI	0.654	0.817	0.795	0.570
PC	0.786	0.788	0.875	0.700
SC	0.820	0.820	0.917	0.847
SN	0.835	0.837	0.901	0.752
TMP	0.703	0.702	0.834	0.626

Note: AT: energy-saving attitudes, SN: energy-saving subjective norms, PC: energy-saving perceived behavioral control, OI: organizational intervention, EI: energy-saving behavioral intention, CR: composite reliability, AVE: average variance extracted, FEB: Firm's Energy-saving Behavior (FEB), TMP: Top management support, F: Financial; EST: Energy-saving technology; GSP: Government support policy; SC: Social culture; C: Collaborative; CE: Competitive environment

Table 4 shows the results of the discriminant validity analysis of the factors. By comparing the quadratic root index of Average Variance Extracted (AVE) with the correlations between variables to ensure that those variables are sufficiently distinguishable from each other, i.e., measuring different concepts. The values on the diagonal line that represent the square root value of the AVE for each variable must be greater than all the correlated values between that variable and other variables in the same row and column (Fornell & Larcker, 1981).

Table 4. Discriminant validity result

	AT	C	THAT	NO	EAST	F	FEB	GSP	HI	PC	SC	SN	TMP
AT	0.795												
C	0.355	0.876											
THAT	0.509	0.436	0.819										
NO	0.584	0.361	0.568	0.838									
EAST	0.361	0.501	0.545	0.619	0.867								
F	0.111	0.246	0.188	0.088	0.208	0.843							
FEB	0.586	0.424	0.566	0.731	0.501	0.185	0.788						
GSP	0.509	0.351	0.519	0.575	0.485	0.140	0.555	0.852					
HI	0.185	0.309	0.293	0.208	0.284	0.555	0.182	0.196	0.755				
PC	0.684	0.344	0.575	0.657	0.432	0.162	0.614	0.553	0.210	0.837			
SC	0.357	0.270	0.438	0.403	0.301	0.082	0.358	0.299	0.171	0.359	0.921		
SN	0.669	0.373	0.635	0.663	0.450	0.168	0.696	0.631	0.216	0.711	0.422	0.867	
TMP	0.555	0.663	0.471	0.615	0.409	0.139	0.661	0.510	0.169	0.588	0.354	0.628	0.791

The values on the diagonal are greater than the corresponding correlation values in each column, indicating that the variables in the model are sufficiently differentiated, meaning that each variable measures a concept that is distinct and does not overlap with other variables.

4.2. Structural Equation Modeling

The analysis results examined 15 hypotheses related to factors affecting the energy-saving behavior of industrial enterprises. Figure 4 shows that out of 8 hypotheses of Factors that directly affect the Energy-Saving Behavior (FEB) of industrial enterprises, five factors are statistically significant

(P-value less than 0.05); the Energy-Saving Intention Factor (EI) had the greatest direct influence with the impact coefficient β = 0.417 and P-value = 0.000, accepting the H7 hypothesis. The TMP factor directly impacts with an impact coefficient of β = 0.314, P-value = 0.000, accepting the H9 hypothesis. The Competitive Environment Factor (CE) is statistically significant and has a direct influence with β = 0.142, P-value = 0.000, accepting the H14 hypothesis. The Government Support Policy Factor (GSP) has a direct and small impact on FEB β = 0.086, P-value = 0.019. The financial Factor (F) has the least direct impact on the FEB factor with β = 0.077 P-value = 0.001. Accept the H15 hypothesis (see Figure 4, details shown in Table 5)

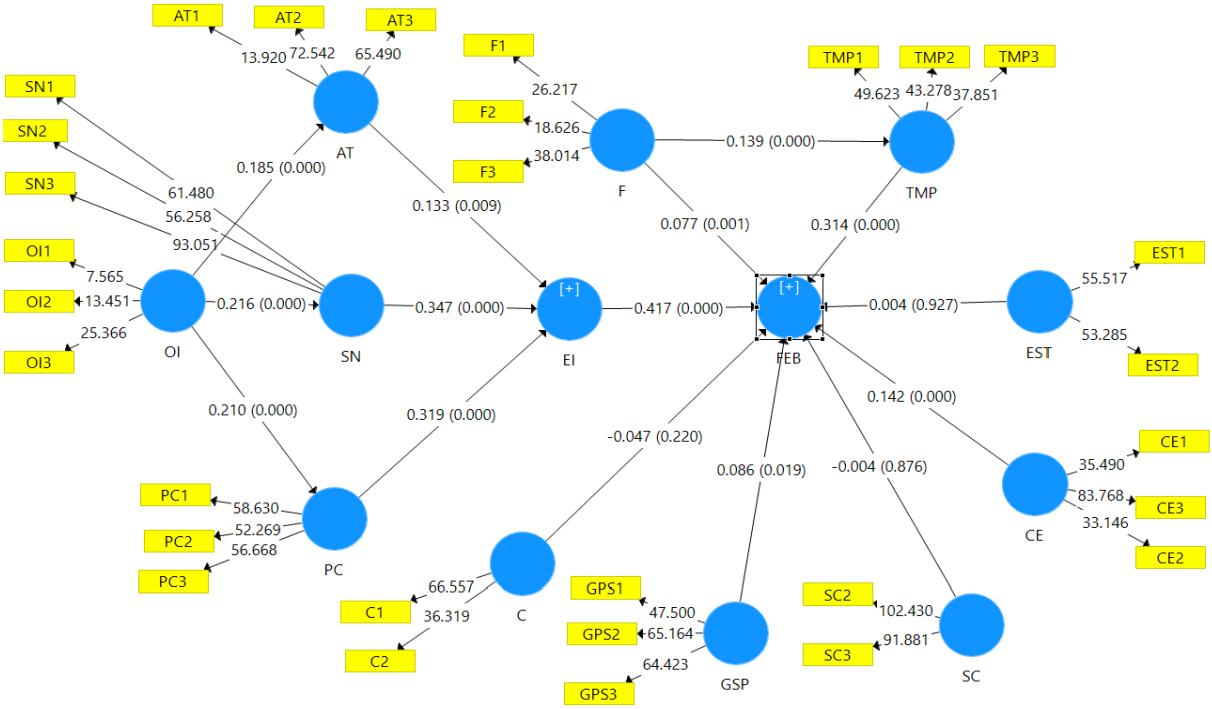

Fig. 4 Results of SEM structural equation model analysis (Smart PLS)

Some factors that fail to achieve a P-value < 0.05 are factors that are not statistically significant for the energy-saving behavior of enterprises, including SC, C, and EST factors.

Table 5. Hypotheses testing results

	Original Sample (β)	Sample Mean (M)	Standard Deviation (SATEV)	T StatistiGSP (|O/SATEV|)	P Values
AT -> EI	0.133	0.133	0.051	2.629	0.009
C -> FEB	-0.047	-0.046	0.041	1.151	0.250
CE -> FEB	0.142	0.144	0.035	4.051	0.000
EI -> FEB	0.417	0.417	0.047	8.868	0.000
IS -> FEB	0.004	0.002	0.042	0.084	0.933
F -> FEB	0.077	0.078	0.023	3.304	0.001
F -> TMP	0.139	0.142	0.034	4.031	0.000
GSP -> FEB	0.086	0.087	0.037	2.331	0.020
OI -> AT	0.185	0.189	0.037	5.064	0.000
OI -> PC	0.210	0.213	0.040	5.218	0.000
OI -> SN	0.216	0.220	0.037	5.900	0.000
PC > NO	0.319	0.320	0.049	6.551	0.000
SC -> FEB	-0.004	-0.004	0.027	0.159	0.874
SN > NO	0.347	0.350	0.041	8.546	0.000
TMP -> FEB	0.314	0.314	0.047	6.645	0.000

Note: AT: energy-saving attitudes, SN: energy-saving subjective norms, PC: energy-saving perceived behavioral control, OI: organizational intervention, EI: energy-saving behavioral intention, CR: composite reliability, AVE: average variance extracted, FEB: Firm's energy-saving behavior (FEB), TMP: Top management support, F: Financial; EST: Energy-saving technology; GSP: Government support policy; SC: Social culture; C: Collaborative; CE: Competitive environment

4.3. Indirect Factor

Table 6 shows that the indirect relationships are statistically significant (p-value < 0.05). The indirect impact of Intervention Factors (OI) through mediating factors such as Subjective Norms (SN) and Perceived Behavioral Control (PC) has been tested with high statistical significance. Specifically, the indirect influence of OI on Energy-Saving Intentions (EI) through SN showed the strongest influence, with a coefficient of β = 0.075 and t-statistics = 4.725, proving that subjective factors of individuals related to social cognition play an important role in promoting energy-saving intentions.In addition, the indirect impact of Subjective Norms also exerts a substantial influence on enterprises' energy-saving behavior through EI, with a coefficient of β = 0.145 and t-statistics = 5.561, emphasizing the role of social norms in the working environment.

The relationship between Perceived Behavioral Control and the Firm's Energy-saving Behavior (FEB) through EI was also demonstrated with a large degree of influence (β = 0.133, t-statistics = 5.744), confirming that when employees feel capable of controlling energy-saving behavior, they will easily translate this intention into actual action. Indirect impact through multiple steps such as from OI → SN → EI → FEB also shows significance (β = 0.031, t-statistics = 3.051), although the overall effect is smaller than other pathways, which suggests that intervention from the organization can go through multiple levels to impact the final behavior. The relationship between finance and FEB is also supported by the support of senior managers (TMPs) with β = 0.044, t-statistics = 3.451). That shows that finance has the potential to help businesses carry out behaviors, and it is even more obvious when there is decision-making participation from leaders.

Table 6. Indirect factor

	Original Sample (β)	Sample Mean (M)	Standard Deviation (SATEV)	T StatistiGSP (|O/SATEV|)	P Values
OI -> AT-> EI	0.025	0.025	0.011	2.199	0.028
OI -> PC -> EI	0.067	0.068	0.017	3.951	0.000
OI -> SN -> EI	0.075	0.077	0.016	4.725	0.000
AT-> -> FEB	0.056	0.055	0.023	2.473	0.014
OI -> AT -> HIS -> FEB	0.010	0.011	0.005	2.116	0.035
PC -> HIS -> FEB	0.133	0.133	0.023	5.744	0.000
OI -> PC -> HIS -> FEB	0.028	0.028	0.007	3.874	0.000
SN -> EI -> FEB	0.145	0.146	0.026	5.561	0.000
OI -> SN -> EI -> FEB	0.031	0.032	0.008	4.055	0.000
F -> TMP -> FEB	0.044	0.044	0.013	3.451	0.001

Note: AT: energy-saving attitudes, SN: energy-saving subjective norms, PC: energy-saving perceived behavioral control, OI: organizational intervention, EI: energy-saving behavioral intention, CR: composite reliability, AVE: average variance extracted, FEB: Firm's energy-saving behavior (FEB), TMP: Top management support, F: Financial; EST: Energy-saving technology; GSP: Government support policy; SC: Social culture; C: Collaborative; CE: Competitive environment

5. Analysis

The research results have demonstrated the influential role of various factors through building a model based on the Theory of Planned Behavior (TPB) and Institutional Theory. of the 15 proposed hypotheses, 12 were accepted, and 3 were rejected. Below are the key discussions on the model's analytical results.

5.1. Organizational Interventions Play an Initiating Role in Affecting Psychological Factors (Attitudes, Subjective Norms, Perceived Behavioral Control), which then Shape Intentions and Lead to Energy-Saving Behaviors in Industrial Enterprises

The research results have revealed complex relationships, originating from organizational interventions to energy-saving behaviors through the mediating role of psychological factors. Organizational Intervention (OI) is shaped based on Lewin's (1951) theory of organizational change, which states that any organizational change must begin with purposeful intervention. This is the starting point for all changes in enterprises [71]. The research results show that organizational intervention has positive effects on attitudes (β = 0.185, p-value < 0.000), subjective norms (β = 0.216, p < 0.000), and perceived behavioral control (β = 0.210, p-value < 0.000).

The research findings align with many previously published scientific works on the role of organizational intervention in energy-saving behavior in enterprises. Specifically, their study on the "Mediating effect of managers' environmental concern" demonstrated the direct impact of organizational intervention and indirect effects through managerial concern, confirming both the temporal stability of the relationship and the universal nature of organizational intervention's role [72]. Additionally, Liu et al. (2014), in "A survey study of energy saving activities", showed a 25-30% improvement in energy-saving behavior through intervention programs, with awareness training accounting for 15%, incentive systems at 10%, and management procedures 5% [17]. This provides an important quantitative basis for interventions and helps enterprises set specific targets.

Particularly, when comparing organizational intervention research results with [14], notable similarities and differences emerge. Both studies identify organizational intervention as a crucial initiating factor in promoting energy-saving behavior; however, their approaches differ significantly. While Xie et al.'s study delve into psychological mechanisms and the internalization process of organizational interventions among employees, our approach examines the issue from a broader organizational perspective, considering organizational intervention through its impact on attitudes, subjective norms, and perceived behavioral control while incorporating additional factors like financial and management support.

Both results emphasize the role of psychological mechanisms in transmitting the impact of an organizational intervention to final behavior. However, Xie et al.'s research focuses on clarifying the transformation process from external intervention to employees' internal motivation while we develop and implement effective intervention strategies at the organizational level. This combination suggests that for organizational intervention to be truly effective, a comprehensive approach is needed, focusing both on building appropriate systems, policies, and procedures while considering psychological aspects and employee motivation [73]. Currently, in Vietnam, according to the Ministry of Industry and Trade's report (2023), energy costs account for 20-40% of total production costs across many industries. Particularly in energy-intensive sectors like steel, cement, and textiles, implementing organizational intervention programs has helped reduce energy costs by 15-25% [74]. Thus, organizational intervention plays a major role in helping businesses promote energy-saving measures and efficient energy use.

5.2. Energy-Saving Intention Plays a Crucial Role in Forming Energy-Saving Behaviors in Industrial Enterprises

The relationship between Energy-saving Intention (EI) and Final Energy-saving Behavior (FEB), with an impact coefficient of $\beta = 0.417$, p-value = 0.000, reflects a positive and statistically significant effect. In practice, energy-saving intention plays the most important role in encouraging enterprises to implement energy-saving activities. These results align well with previous research by Zhang et al. (2013) in their study of small and medium-sized manufacturing enterprises in China, highlighting the role of two important factors: corporate culture and social interaction [75]. Notably, in industrial environments requiring high coordination, peer pressure is identified as an important transmission mechanism reinforcing the relationship between intention and behavior. Most notably, Liu and Zhang's (2018) research on industrial enterprises in China indicated that the stability of the intention-behavior relationship depends on the intensity of organizational intervention programs and leadership commitment [22]. In a recent study, Carrus et al. (2021) emphasized the role of corporate culture in maintaining the stability of the relationship between energy-saving intentions and behaviors [76]. This consistency across studies confirms the universality of planned behavior theory in the context of enterprise energy savings. It provides a solid foundation for designing intervention programs focused on strengthening energy-saving intentions within organizations.

This result is particularly significant in the context of Vietnam's implementation of the National Program on Energy Efficiency and Conservation 2019-2030, where Vietnamese industrial enterprises have the potential to save 20-30% of total energy consumption [77]. Currently, Vietnamese industrial enterprises face increasing pressure from energy costs due to continuous electricity price increases in recent years. Energy costs account for 20-40% of total production costs across many industries. Particularly, sectors like steel, cement, and chemicals have energy cost proportions reaching 35-40%. Additionally, environmental standard requirements in new-generation free trade agreements like EVFTA and CPTPP are creating additional pressure on businesses to improve energy efficiency. Therefore, implementing energy-saving behaviors is both appropriate and effective. However, the gap between intention and actual behavior remains significant, and worker awareness is still low, especially in small and medium enterprises that are less bound by energy-saving regulations, leading to fewer implemented behaviors. Furthermore, investment in energy-saving equipment purchases is also a major barrier due to the weak financial capacity of small and medium enterprises. This raises an urgent need for synchronized solutions to narrow this gap.

5.3. Direct Impacts from Internal and External Environment

Our findings reveal significant positive effects from senior leadership support ($\beta = 0.314$, $p < 0.001$) and financial resources ($\beta = 0.139$, $p < 0.001$). This aligns with Zhang et al.'s 2018 research on promoting corporate energy-saving behaviors, which examined institutional pressure, top management support, and financial constraints. Their work highlighted leadership's pivotal role in driving industrial energy conservation [22]. Leaders shape regulations, allocate resources, and motivate staff participation in energy-saving initiatives. They also create indirect effects through goal-setting, strategy development, resource allocation, and fostering an energy-conscious culture. Top management backing remains crucial for successful energy conservation measures [58]. Our study specifically explores how senior management support mediates between financial factors and corporate energy-saving behaviors [78]. When funds are available, strong leadership can enhance the effectiveness of energy conservation investments. Companies with robust finances and excellent top-level guidance can implement both short-term projects and expand their scope over time [44]. Energy management performance comparisons show that businesses with strong leadership support achieve remarkable results - 25-30% reduction in energy consumption and 40% higher initiative success rates. Yet challenges persist: leaders' technical knowledge gaps, short-term profit pressures,

performance measurement difficulties, and organizational inertia. Solutions include comprehensive capacity building through energy management training, technology updates, expert networking, establishing energy-saving KPIs, and developing appropriate reward systems.

In Vietnam's context, industrial enterprise development highlights the importance of these factors. The Ministry of Industry and Trade's 2023 report indicates that about 70% of industrial enterprises use technology 2-3 generations behind global standards, mainly due to financial and management constraints. SMEs particularly struggle with technology investment funding, with only 30% accessing bank loans. Leadership energy management capabilities remain limited - only 15% of businesses have dedicated energy management staff. This situation demands a holistic approach to enhance leadership capacity and financial resources. Additionally, key energy-consuming industrial enterprises demonstrate clear efficiency improvements when implementing ISO 50001 energy management systems, which require top leadership commitment to energy conservation.

The Financial Factor (F) directly impacts corporate energy-saving behavior with $\beta = 0.077$ and P-value = 0.001. Financial capacity is crucial for business survival and growth, enabling investments in energy-saving measures and high-efficiency technology. This aligns with previous research showing financial constraints as the biggest barrier to energy conservation [79, 80]. Finance helps companies overcome initial capital investment and develop long-term strategies [78]. World Bank surveys indicate Vietnamese industrial enterprises need $10-12 billion for energy-efficient technology by 2030 [81], yet only 30% can access such loans. Main barriers include high interest rates, lack of collateral, and complex bank approval processes. The Vietnam Environmental Protection Fund meets only 5% of energy-saving project capital needs, suggesting the need for green bonds, credit guarantee funds, and expanded state interest support programs. Government Support Policy (GSP) shows a modest positive impact ($\beta = 0.086$, P-value = 0.019), reflecting the gap between policy and implementation. Despite key legislation like the Energy Efficiency Law and National Target Program 2019-2030, effectiveness remains limited, mainly focusing on key energy consumers. Monitoring systems primarily focus on statistics and encouragement rather than strict oversight.Cooperation relationships, socio-cultural factors, and energy-saving technology did not directly impact energy-saving behavior. While some companies have adopted ISO 50001 and ESCO models, collaboration remains limited due to competition concerns and high investment costs. Vietnamese business culture typically prioritizes short-term profits over sustainability [82]. Social awareness about energy conservation has not deeply penetrated the business community [83]. Technology's lack of direct impact may stem from high initial costs and unclear short-term benefits [84, 85]. Many Vietnamese companies, especially smaller ones, hesitate to invest in new technologies due to financial risks and technical knowledge gaps [86].

6. Conclusion

The study uses the exploratory factor analysis method and SEM linear regression equation analysis. Smart-PLS and SPSS software are used to perform the analysis. The proposed research model is developed based on TPB theory combined with institutional theory (Institutional theory). 13 influencing factors have been considered in the following direction: 1) a group of factors related to promoting the construction of an energy-saving culture in enterprises; 2) a group of factors related to institutions and regulations to promote energy saving in enterprises; 3) a group of influencing factors coming from outside the business. The analysis results show that Subjective Benchmark Factors (SN), Behavioral Control (PC) and Energy-Saving Attitude (AT) are significant positive predictive factors for Energy-Saving Intention (EI). Organizational Interventions (OIs) have a positive impact on subjective standards, behavior control, and attitudes. In particular, the Financial Factor (F1) plays an important role, not only directly affecting energy-saving behavior (FEB) but also significantly affecting the management factor (TMP). However, cultural factors (SC), TMP, and Cooperation (C) did not show a significant influence on energy-saving behavior. Based on the research results, we propose energy-saving measures at different levels to promote the implementation of energy-saving in Vietnamese industrial enterprises. The research results have demonstrated the influential role of various factors through building a model based on the Theory of Planned Behavior (TPB) and Institutional Theory. Of the 15 proposed hypotheses, 12 were accepted, and 3 were rejected. Model's analytical results give three energy saving: Organizational interventions play an initiating role in affecting psychological factors (attitudes, subjective norms, perceived behavioral control), which then shape intentions and lead to energy-saving behaviors in industrial enterprises; Energy-saving intention plays a crucial role in forming energy-saving behaviors in industrial enterprises; Direct Impacts from Internal and External Environment.

Acknowledgment

The authors thank the Thai Nguyen University of Technology, Vietnam.

References

[1] Norman Loayza, and Steven Michael Pennings, "*Macroeconomic Policy in the Time of COVID-19: A Primer for Developing Countries*," World Bank Research and Policy Briefs, no. 147291, pp. 1-9, 2020. [Google Scholar] [Publisher Link]

[2] Saira Naseer et al., "COVID-19 Outbreak: Impact on Global Economy," *Frontiers in Public Health*, vol. 10, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[3] Peterson K. Ozili, and Ercan Ozen, *Global Energy Crisis: Impact on the Global Economy*, The Impact of Climate Change and Sustainability Standards on the Insurance Market, pp. 439-454, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[4] Junko Ogawa, Fuyuhiko Noda, and Yukari Yamashita, "*Fact-Finding Study on Japan's Energy Management Policies- Fact-finding Study on Japan's Energy Management Policies*," *IEEJ Energy Journal*, pp. 1-29, 2011. [Google Scholar] [Publisher Link]

[5] Tomiwa Sunday Adebayo, and Dervis Kirikkaleli, "Impact of Renewable Energy Consumption, Globalization, and Technological Innovation on Environmental Degradation in Japan: Application of Wavelet Tools," *Environment, Development and Sustainability*, vol. 23, no. 11, pp. 16057-16082, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[6] Cornelis Marine, "Energy Efficiency, The Overlooked Climate Emergency Solution," *Economic Policy*, vol. 15, no. 2, pp. 48-67, 2020. [Google Scholar] [Publisher Link]

[7] Sharifah Aishah Syed Ali et al., "Assessing the Energy Efficiency of Fossil Fuel in ASEAN," *International Journal of Renewable Energy Development*, vol. 12, no. 6, pp. 1008-1017, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[8] R.A. Browne Esq, "Green Building and Energy Efficiency of Select Countries in East and Southeast Asia: Malaysia, Vietnam, Singapore, and China," *SSRN*, pp. 1-27, 2015. [CrossRef] [Google Scholar] [Publisher Link]

[9] The World Bank In Viet Nam, World Bank Group, 2024. [Online]. Available: https://www.worldbank.org/en/country/vietnam/overview

[10] P. Ozoh et al., "A Comparative Analysis of Techniques for Forecasting Electricity Consumption," *International Journal of Computer Applications*, vol. 88, no. 15, pp. 8-12, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[11] Viết Cường Võ et al., "Econometric Model for Forecasting Electricity Demand of Industry and Construction Sectors in Vietnam to 2030," *VNUHCM Journal of Engineering and Technology*, vol. 3, no. 1, pp. 316-325, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[12] Qiong Wu et al., "Analysis and Prediction of Industrial Energy Consumption Behavior based on Big Data and Artificial Intelligence," *Energy Reports*, vol. 9, pp. 395-402, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[13] McKenna Patterson, Prashant Singh, and Heejin Cho, "The Current State of the Industrial Energy Assessment and its Impacts on the Manufacturing Industry," *Energy Reports*, vol. 8, pp. 7297-7311, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[14] Chengyang Xie et al., "Exploring the Psychological Mechanism Underlying the Relationship between Organizational Interventions and Employees' Energy-Saving Behaviors," *Energy Policy*, vol. 156, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[15] Enrico Cagno, and Andrea Trianni, "Exploring Drivers for Energy Efficiency within Small-and Medium-Sized Enterprises: First Evidences from Italian Manufacturing Enterprises," *Applied Energy*, vol. 104, pp. 276-285, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[16] Xianbing Liu et al., "A Survey Study of Energy Saving Activities of Industrial Companies in Taicang, China," *Journal of Cleaner Production*, vol. 26, pp. 79-89, 2012. [CrossRef] [Google Scholar] [Publisher Link]

[17] Xianbing Liu, Ryuichi Yamamoto, and Sunhee Suk, "A Survey Analysis of Energy Saving Activities of Industrial Companies in Hyogo, Japan," *Journal of Cleaner Production*, vol. 66, pp. 288-300, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[18] Yixiang Zhang, Weiyi Zhou, and Meiling Liu, "Driving Factors of Enterprise Energy-Saving and Emission Reduction Behaviors," *Energy*, vol. 256, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[19] Fang Wang et al., "Environmental Behavior Research in Resources Conservation and Management: A Case Study of Resources, Conservation and Recycling," *Resources, Conservation and Recycling*, vol. 141, pp. 431-440, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[20] Xiaojing Xu et al., "Energy Saving at Work: Exploring the Role of Social Norms, Perceived Control and Ascribed Responsibility in Different Office Layouts," *Frontiers in Built Environment*, vol. 6, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[21] Max Weber, *The Theory of Social and Economic Organization*, Simon and Schuster, 2009. [Google Scholar] [Publisher Link]

[22] Yixiang Zhang, Yimin Wei, and Guanghui Zhou, "Promoting Firms' Energy-Saving Behavior: The Role of Institutional Pressures, Top Management Support and Financial Slack," *Energy Policy*, vol. 115, pp. 230-238, 2018. [CrossRef] [Google Scholar] [Publisher Link]

[23] Sam C. Staddon et al., "Intervening to Change Behaviour and Save Energy in the Workplace: A Systematic Review of Available Evidence," *Energy Research & Social Science*, vol. 17, pp. 30-51, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[24] Alex Burdorf, "How to Improve Intervention Research on the Psychosocial Work Environment?," *Scandinavian Journal of Work, Environment & Health*, vol. 49, no. 5, pp. 311-314, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[25] Luis J. Camacho et al., "Examining the Role of Organizational Culture on Citizenship Behavior: The Mediating Effects of Environmental Knowledge and Attitude Toward Energy Savings," *Administrative Sciences*, vol. 14, no. 9, pp. 1-22, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[26] Roger W. Schmenn, "Manufacturing, Service, and their Integration: Some History and Theory," *International Journal of Operations & Production Management*, vol. 29, no. 5, pp. 431-443, 2009. [CrossRef] [Google Scholar] [Publisher Link]

[27] Yue Zhang et al., "Can Organizations Shape Eco-Friendly Employees? Organizational Support Improves Pro-Environmental Behaviors at Work," *Journal of Environmental Psychology*, vol. 93, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[28] Fatoki Olawale, "Antecedents of Workplace Energy Saving Behaviour: An Integration of the Theory of Planned Behaviour and Norm Activation Model," *International Journal of Energy Economics and Policy*, vol. 13, no. 4, pp. 394-403, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[29] Olawale Fatoki, "Determinants of Employee Electricity Saving Behavior in Small Firms: The Role of Benefits and Leadership," *Energies*, vol. 15, no. 9, pp. 1-20, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[30] Chien-fei Chen, and Kyle Knight, "Energy at Work: Social Psychological Factors Affecting Energy Conservation Intentions within Chinese Electric Power Companies," *Energy Research & Social Science*, vol. 4, pp. 23-31, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[31] Chun-Hsi Vivian Chen, and Yu-Cheng Chen, "Assessment of Enhancing Employee Engagement in Energy-Saving Behavior at Workplace: An Empirical Study," *Sustainability*, vol. 13, no. 5, pp. 1-18, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[32] Ting Yue, Ruyin Long, and Hong Chen, "Factors Influencing Energy-Saving Behavior of Urban Households in Jiangsu Province," *Energy Policy*, vol. 62, pp. 665-675, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[33] Icek Ajzen, "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes*, vol. 50, no. 2, pp. 179-211, 1991. [CrossRef] [Google Scholar] [Publisher Link]

[34] Amanda R. Carrico, and Manuel Riemer, "Motivating Energy Conservation in the Workplace: An Evaluation of the Use of Group-Level Feedback and Peer Education," *Journal of Environmental Psychology*, vol. 31, no. 1, pp. 1-13, 2011. [CrossRef] [Google Scholar] [Publisher Link]

[35] Sascha Heib, Jan Hildebrand, and Timo Kortsch, "Energy Saving Behavior in University Organizations: The Value of Norm Constructions in a "Rational Choice" Action Model," *Frontiers in Psychology*, vol. 14, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[36] Caroline Leygue, Eamonn Ferguson, and Alexa Spence, "Saving Energy in the Workplace: Why, and for Whom?," *Journal of Environmental Psychology*, vol. 53, pp. 50-62, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[37] Lan Gao et al., "Application of the Extended Theory of Planned Behavior to Understand Individual's Energy Saving Behavior in Workplaces," *Resources, Conservation and Recycling*, vol. 127, pp. 107-113, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[38] Zhenya Tang, and Le Wu, "Investing the Impact of Person-Environment Fit and Normative Factors on Employees' Energy-Saving Behavior in the Workplace," *International Journal of Energy Sector Management*, vol. 18, no. 6, pp. 2275-2291, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[39] Julia K. Day, and William O'Brien, "Oh Behave! Survey Stories and Lessons Learned from Building Occupants in High-Performance Buildings," *Energy Research & Social Science*, vol. 31, pp. 11-20, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[40] Tuan Le-Anh et al., "Energy Saving Intention and Behavior Under Behavioral Reasoning Perspectives," *Energy Efficiency*, vol. 16, no. 2, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[41] Zhenya Tang, Merrill Warkentin, and Le Wu, "Understanding Employees' Energy Saving Behavior from the Perspective of Stimulus-Organism-Responses," *Resources, Conservation and Recycling*, vol. 140, pp. 216-223, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[42] James E. Post, *Business, Society, and the Environment*, The Oxford Handbook of Business and the Natural Environment, Oxford University Press, pp. 537-555, 2012. [CrossRef] [Google Scholar] [Publisher Link]

[43] Sunhee Suk, Xianbing Liu, and Kinichi Sudo, "A Survey Study of Energy Saving Activities of Industrial Companies in the Republic of Korea," *Journal of Cleaner Production*, vol. 41, pp. 301-311, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[44] Andrea Trianni, Enrico Cagno, and Stefano Farné, "Barriers, Drivers and Decision-Making Process for Industrial Energy Efficiency: A Broad Study Among Manufacturing Small and Medium-sized Enterprises," *Applied Energy*, vol. 162, pp. 1537-1551, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[45] Jean-Christian Brunke, Maria Johansson, and Patrik Thollander, "Empirical Investigation of Barriers and Drivers to the Adoption of Energy Conservation Measures, Energy Management Practices and Energy Services in the Swedish Iron and Steel Industry," *Journal of Cleaner Production*, vol. 84, pp. 509-525, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[46] Scott R. Colwell, and Ashwin W. Joshi, "Corporate Ecological Responsiveness: Antecedent Effects of Institutional Pressure and Top Management Commitment and their Impact on Organizational Performance," *Business Strategy and the Environment*, vol. 22, no. 2, pp. 73-91, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[47] Vered Blass et al., "Top Management and the Adoption of Energy Efficiency Practices: Evidence from Small and Medium-sized Manufacturing Firms in the US," *Energy*, vol. 65, pp. 560-571, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[48] Jun Liu et al., "Can Artificial Intelligence Improve the Energy Efficiency of Manufacturing Companies? Evidence from China," *International Journal of Environmental Research and Public Health*, vol. 19, no. 4, pp. 1-18, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[49] Yuanquan Lu, Li Chen, and Yuan Meng, "How Does Science and Technology Innovation Improve Carbon Productivity?-Evidence at China's Province Level," *Environmental Science and Pollution Research*, vol. 30, no. 45, pp. 101296-101316, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[50] Christian Stenqvist, and Lars J. Nilsson, "Energy Efficiency in Energy-Intensive Industries-An Evaluation of the Swedish Voluntary Agreement PFE," *Energy Efficiency*, vol. 5, pp. 225-241, 2012. [CrossRef] [Google Scholar] [Publisher Link]

[51] Qin Guohe, "Analysis of the Influence of the External Environment Factors on the Enterprises Competitiveness Formation," *Herald of Khmelnytskyi National University, Economic Sciences*, vol. 320, no. 4, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[52] Klaus North, and Gregorio Varvakis, *Competitive Strategies for Small and Medium Enterprises, Increasing Crisis Resilience, Agility and Innovation in Turbulent Times*, 1st ed., Springer International Publishing, pp. 1-281, 2016. [Google Scholar] [Publisher Link]

[53] Chunyan Li et al., "Can Energy Saving and Emission Reduction Policies Promote Green Transformation of Industrial Enterprises-The Case of China," *Plos One*, vol. 19, no. 5, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[54] Xinyuan Zhang et al., "Who Will Save Energy? An Extension of Social Cognitive Theory with Place Attachment to Understand Residents' Energy-Saving Behaviors," *Sustainability*, vol. 16, no. 1, pp. 1-21, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[55] Kerrie L. Unsworth, Alina Dmitrieva, and Elisa Adriasola, "Changing Behaviour: Increasing the Effectiveness of Workplace Interventions in Creating Pro-Environmental Behaviour Change," *Journal of Organizational Behavior*, vol. 34, no. 2, pp. 211-229, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[56] Xuan Liu et al., "Psychological and Demographic Factors Affecting Household Energy-Saving Intentions: A TPB-based Study in Northwest China," *Sustainability*, vol. 12, no. 3, pp. 1-20, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[57] Wouter Poortinga, Linda Steg, and Charles Vlek, "Values, Environmental Concern, and Environmental Behavior: A Study into Household Energy Use," *Environment and Behavior*, vol. 36, no. 1, pp. 70-93, 2004. [CrossRef] [Google Scholar] [Publisher Link]

[58] Kine Reegard, and Asgeir Droivoldsmo, "An Empirical Investigation of Factors Influencing Energy Saving Behavior in the Workplace," *International Conference on Applied Human Factors and Ergonomics*, USA, pp. 119-126, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[59] K. Mahesh et al., "Design of 20 kwp Solar PV System with Different Tracking Systems Using PVsyst and Sketch-Up," *Smart Energy and Advancement in Power Technologies*, pp. 607-620, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[60] Hari Prasanna Das et al., "Machine Learning for Smart and Energy-efficient Buildings," *Environmental Data Science*, vol. 3, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[61] Mehdi Bensouda et al., "The Role of Top Management Commitment in Enhancing Energy Efficiency through Artificial Intelligence," *International Conference on Digital Technologies and Applications*, pp. 414-423, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[62] Moe Soheilian, Géza Fischl, and Myriam Aries, "Smart Lighting Application for Energy Saving and User Well-being in the Residential Environment," *Sustainability*, vol. 13, no. 11, pp. 1-17, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[63] Lanlan Li et al., "The Impact of Policy Factors and Users' Awareness on Electricity-Saving Behaviors: FROM the Perspective of Habits and Investment," *Sustainability*, vol. 12, pp. 1-23, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[64] Maozhi Chen et al., "Impact of Technological Innovation on Energy Efficiency in Industry 4.0 Era: Moderation of Shadow Economy in Sustainable Development," *Technological Forecasting and Social Change*, vol. 164, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[65] N.M.P. Bocken et al., "The Front-End of Eco-Innovation for Eco-Innovative Small and Medium Sized Companies," *Journal of Engineering and Technology Management*, vol. 31, pp. 43-57, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[66] Chuanfei Li, and Luguang Qi, "Can Government Environmental Attention Improve Corporate Carbon Emission Reduction Performance?-Evidence from China A-Share Listed Companies with High-Energy-Consumption," *Sustainability*, vol. 16, no. 11, pp. 1-22, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[67] Kelvin O. Yoro, and Michael O. Daramola, "CO_2 Emission Sources, Greenhouse Gases, and the Global Warming Effect," *Advances in Carbon Capture*, pp. 3-28, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[68] Fionn Murtagh, and Andre Heck, *Multivariate Data Analysis*, 1st ed., Springer Dordrecht, Netherlands, pp. 1-224, 1987. [CrossRef] [Google Scholar] [Publisher Link]

[69] Joe F. Hair Jr et al., "Partial Least Squares Structural Equation Modeling (PLS-SEM): An Emerging Tool in Business Research," *European Business Review*, vol. 26, no. 2, pp. 106-121, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[70] Claes Fornell, and David F. Larcker, "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research*, vol. 18, no. 1, pp. 39-50, 1981. [CrossRef] [Google Scholar] [Publisher Link]

[71] Alannah E. Rafferty, and Mark A. Griffin, *Organizational Change*, The SAGE Handbook of Organizational Behavior, vol. 1, pp. 602-621, 2008. [CrossRef] [Google Scholar] [Publisher Link]

[72] Bin Zhang, Zhaohua Wang, and Kee-hung Lai, "Mediating Effect of Managers' Environmental Concern: Bridge between External Pressures and Firms' Practices of Energy Conservation in China," *Journal of Environmental Psychology*, vol. 43, pp. 203-215, 2015. [CrossRef] [Google Scholar] [Publisher Link]

[73] Jonathan Campos Martins et al., "Energy Efficiency Decision-Making in Non-Energy Intensive Industries: Content and Social Network Analysis," *Production*, vol. 32, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[74] Ha Vy, Energy Saving in Industries: Technology and Policy Issues, Ministry of Industry and Trade of the Socialist Republic of Vietnam, 2024. [Online]. Available: https://moit.gov.vn/tin-tuc/tiet-kiem-nang-luong-trong-cac-nganh-cong-nghiep-bai-toan-cong-nghe-va-chinh-sach.html

[75] Yixiang Zhang, Zhaohua Wang, and Guanghui Zhou, "Antecedents of Employee Electricity Saving Behavior in Organizations: An Empirical Study based on Norm Activation Model," *Energy Policy*, vol. 62, pp. 1120-1127, 2013. [CrossRef] [Google Scholar] [Publisher Link]

[76] Giuseppe Carrus et al., Psychological Predictors of Energy Saving Behavior: A Meta-Analytic Approach," *Frontiers in Psychology*, vol. 12, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[77] Phuong Hoang Kim, National Program on Energy Saving and Efficiency for the Period 2019 - 2030: An Important Factor Contributing to Ensuring Vietnam's Energy Security in the New Development Stage, Ministry of Industry and Trade of the Socialist Republic of Vietnam, 2020. [Online]. Available: https://moit.gov.vn/phat-trien-ben-vung/chuong-trinh-quoc-gia-ve-su-dung-nang-luong-tiet-kiem-va-hie.html

[78] Enrico Cagno et al., "Drivers for Energy Efficiency and their Effect on Barriers: Empirical Evidence from Italian Manufacturing Enterprises," *Energy Efficiency*, vol. 10, pp. 855-869, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[79] Peter Lunt, Peter Ball, and Andrew Levers, "Barriers to Industrial Energy Efficiency," *International Journal of Energy Sector Management*, vol. 8, no. 3, pp. 380-394, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[80] Marlene Arens, Ernst Worrell, and Wolfgang Eichhammer, "Drivers and Barriers to the Diffusion of Energy-efficient Technologies-A Plant-level Analysis of the German Steel Industry," *Energy Efficiency*, vol. 10, pp. 441-457, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[81] Sustainable Energy Transition in Vietnam, World Bank Group, 2022. [Online]. Available: https://www.worldbank.org/vi/news/speech/2022/01/24/towards-a-just-energy-transition-in-vietnam

[82] Quan Hoang Vuong, "Impacts of Geographical Locations and Sociocultural Traits on the Vietnamese Entrepreneurship," *SpringerPlus*, vol. 5, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[83] P.V. Nguyen, and K.T. Tran, "Explicating Energy Saving Intention from the Prospect of Small Medium Enterprises," *Entrepreneurship and Sustainability*, vol. 8, no. 2, pp. 716-734, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[84] Jun Wei Chuah, Anand Raghunathan, and Niraj K. Jha, "An Evaluation of Energy-Saving Technologies for Residential Purposes," *IEEE PES General Meeting*, Minneapolis, MN, USA, pp. 1-8, 2010. [CrossRef] [Google Scholar] [Publisher Link]

[85] R.D. Van Buskirk et al., "A Retrospective Investigation of Energy Efficiency Standards: Policies may have Accelerated Long Term Declines in Appliance Costs," *Environmental Research Letters*, vol. 9, no. 11, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[86] Cristyn Meath, Martina K. Linnenluecke, and Andrew Griffiths, "Barriers and Motivators to the Adoption of Energy Savings Measures for SMEs," *Academy of Management Proceedings*, vol. 2013, no. 1, 2013. [CrossRef] [Google Scholar] [Publisher Link]