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Article

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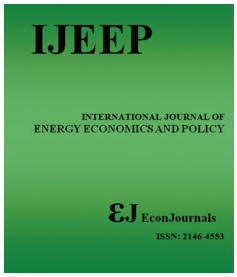

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Energy Efficiency: Determinants and Roles on Sustainable Development in Emerging Country

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ABSTRACT

Energy efficiency (ENE) is a growing issue in emerging countries. This study aims to evaluate the impact of ENE on sustainable development (SDE). By this research, we have developed constructed variables that contribute to energy efficiency such as usage behavior (UBE), energy resources (ERE), construction design (CDE), appliances, equipment (AEQ), and maintenance (MCE). We use quantitative technique such as Smart PLS SEM to analyze the data of the small and medium size enterprises (SMEs) of Vietnam in the year 2020. The findings suggest a positive and significant impact of energy efficiency on sustainable development. This contribution has also confirmed the contribution of usage behavior (UBE), energy resources (ERE), construction design (CDE), appliances, equipment (AEQ), and maintenance (MCE) affecting to energy efficiency in emerging country. This study contributes to the literature of energy efficiency and sustainable development of SMEs in emerging country context. The outcomes of this study can be used by entrepreneurs, top management as an attempt to boost the performance of the SMEs in emerging markets by applying energy efficiency measures for sustainable development as a value-added contribution to this research.

Keywords: Determinants of Energy Efficiency, Energy Efficiency, Renewable Energy, Sustainable Development, Emerging Country
JEL Classifications: Q21, Q25, Q43

1. INTRODUCTION

Energy is an important factor and an integral power of the socioeconomic growth. However, how to make sustainable development is of great concern to stakeholders including economists, entrepreneurs, investors, executives and policymakers and so on. According to Ku-Hsieh et al. (2020), "Energy effciency has long been an important issue to the global economic and political theaters." Besides, Solnørdal and Foss (2018) argued that climate change is one of the most pressing themes of the 21st century. It challenges the very structure of our global society and covers issues like economics, politics, business management and each individual's lifestyle choices. According to EIA (2017), the generally recognized relationship between energy consumption, greenhouse gas (GHG) emissions and climate change has brought energy efficiency into political agendas around the world (UNFCCC, 2015). Cristescu et al. (2017) proposed that "the concept of energy efficiency (or optimization of energy consumption) has currently become one of the main concerns of mankind across the globe." Currently, world economy heavily relies on energy from non-renewable resources such as coals and oils while those are the main causes that negatively affect the environment, heat up the earth and cause climate change as greenhouse gas emission and pollutants created by use. According to Asarpota and Nadin et al. (2020), world's energy demand is estimated to increase by around 1.3% per year through 2040, while energy efficiency decreases and emissions increase. Globally, energy use is the most important contributor to greenhouse gas (GHG) emissions (Intergovernmental Panel on Climate Change, 2014). Approximately two thirds of GHG emissions come from energy production and consumption, making it a central issue in climate change mitigation activities (International Energy Agency, 2019). Efficient use of energy is

considered as one of the important solutions to reduce greenhouse gas emissions in the energy sector. Economical and efficient use of energy help reduce pressure on the exploitation, processing and supply of energy types, helping to improve the efficiency of the economy, and at the same time helping conserving national energy resources, protecting the environment and reducing greenhouse gas emissions, contributing to the mitigation of the impacts of global climate change thereby, solving existing relevant challenges. Reducing energy use contributes to lower energy costs and can save consumers financial costs. In addition, reducing energy use is also seen as a major solution to the problem of reducing greenhouse gas emissions. Improving energy efficiency in buildings, industrial processes, and transportation could reduce world energy demand by about a third by 2050 while also helping control energy efficiency in buildings, industrial processes and transportation that control of global greenhouse gas emissions (Sophie, 2006). Another approach by Bill et al. (2007) that energy efficiency and renewable energy are believed to be the twin pillars of sustainable energy policy. In many countries, energy efficiency is also assessed as having national security benefits because it can be used to reduce energy imports from abroad and contribute to reducing the rate of depletion of energy resources. Both strategies must be developed at the same time to stabilize and reduce CO_2 emissions. Energy efficiency is essential to slowing the growth of energy demand in order to increase the supply of clean energy, possibly reducing the use of fossil fuels. If the use of energy increases too quickly, the likelihood of developing renewables decreases. Likewise, unless a clean energy supply becomes rapidly, slowing growth in energy demand will start to reduce total carbon emissions, reducing the carbon content of energy sources is also needed. A sustainable development of economy therefore requires commitment to energy efficiency and renewable energy. Efficient use of energy has been shown to be an economical and efficient strategy in developing an economy without necessarily increasing the cost of energy consumption. Energy efficiency and conservation goals should be integrated into economic restructuring plans, national technological innovation strategic plans and developing strategies to meet the country's sustainable development requirements. Additionally, according to Eisenmenger et al. (2020), countries around the world are more and more dynamic and pay a high attention to sustainable development by aligning development goals for improving well-being, society and economy with ecological goals. The sustainable development goals (SDGs) were adopted in 2015, succeeding the Millennium Development Goals (MDGs). Accordingly, MDGs focused on improving well-being in the developing world while "17 SDGs address all countries and aim at reconciling economic and social with ecological goals." According to UN (2015), UN Agenda 2030 is perceived as "the most comprehensive global political effort towards achieving sustainable development." The existing challenges for global sustainability such as climate change and biodiversity loss are considered as key drivers of global policy initiatives. Climate change and biodiversity loss are current challenges of the global sustainability that call for urgent action and lay grounds for international policy (IPCC, 2018; IPBES, 2019).

Energy efficiency is globally perceived important because of its important contributions to society, economy and environment those are the key aspects of national sustainable development. Energy efficiency generally offers many benefits such as reducing greenhouse gas emissions, reducing the need for energy imports and reducing costs at the household level and across the economy. As European Climate Foundation (2016), the "Paris Agreement has addressed a clear signal to stakeholders and investors that the global transition to a low-carbon economy and clean energy is here to stay." Furthermore, driving towards a low carbon economy is a clear opportunity for global economy, jobs and sustainable growth. There are numerous studies related to energy efficiency but the approaches, perspectives and contexts are very diverse such as Mrówczyńska et al. (2018) with "Social and infrastructural conditioning of lowering energy costs and improving the energy efficiency of buildings in the context of the local energy policy" for building sector; Chwieduk and Chwieduk (2020) with "determination of the energy performance of a solar low energy house with regard to aspects of energy efficiency and smartness of the house" which typically household sector; Dato (2018) "investment in energy efficiency, adoption of renewable energy and household behavior" for household sector; Cini et al. (2017) "Energy Efficiency Projects of Budget Beneficiaries And Its Impact On Regional Economy" for economic related; Strielkowski et al. (2019) with "innovative policies for energy efficiency and the use of renewables in households" for household sector; Cristescu et al. (2017) with "increasing energy efficiency and optimizing the operation of systems that produce clean energy from renewable sources"; Stagnitta et al. (2020) with "A complementary approach to traditional energy balances for assessing energy efficiency measures in final uses: The case of space heating and cooling"; Lenzi et al. (2013) with "From energy balance to energy efficiency indicators including water losses"; Benavente-Peces (2019) with "On the energy efficiency in the next generation of smart Buildings Supporting technologies and techniques" for building sector; Han et al. (2017) with "measuring energy efficiency in China's transport sector" for transport sector. However, research on specific factors affecting energy efficiency are still unclear. Furthermore, there is a gap between existing studies and the need for a practical understanding of the role that energy efficiency plays in national sustainable development especially in the context of emerging countries like Vietnam, according to the best knowledge of the authors. It is therefore essential to have a holistic study related to energy efficiency to provide a comprehensive understanding to the interested parties of what factors drive energy efficiency and how energy efficiency plays a role in national sustainable development. Moreover, this study focuses on the manufacturing sector with expect that deliverable of this study can address specifically relevant issues of a certain sector, moreover, implications can be practical and applicable for a certain sector to generate certain values. According to EIA (2017), the energy consumed by the manufacturing sector accounts for about 50% of the world's energy consumption therefore the manufacturing sector is seen as a core force to focus on improving energy efficiency to mitigate climate change issues. Moreover, reduced energy costs are crucial for industrial companies to maintain competitive advantage for sustainable development (Hart, 1995; Worrell et al., 2009). Moreover, at the national perspective, using energy efficiently brings significant environmental, economic and social benefits by reducing greenhouse gas emissions and other pollutants, limiting climate change, limiting risks due to uncertainties can occur due to

fluctuations in fuel prices and exhaustion those enable sustainable development of a nation (Soroka et al., 2019). Therefore, this is once again confirmed that a comprehensive study of the factors affecting energy efficiency for manufacturing sector is essential. In addition, research that covers the role of energy efficiency in sustainable development is crucial for business operators and policy-makers towards sustainable development. This research is expected to make significant contributions to theory and practice. Accordingly, from the theory point of view, authors expect that this study's contribution is inclusive of (1) Comprehensive knowledge of energy efficiency; (2) Determinants of energy efficiency in manufacturing sector in emerging country; (3) Influencing level of each factor to energy efficiency of manufacturing firm; (4) The importance of energy efficiency for economy, society and environment; (5) Prospects of energy efficiency to the sustainable development at the firm perspective and national perspective; Additionally, from the practice point of view, contributions of this study is expected to be inclusive of (1) For management level of manufacturing firms to have practical and clear strategy for energy management and (2) appropriate actions and behaviors based on the defined determinants of energy efficiency for improving energy efficiency; (3) For policy makers to have appropriate policies to encourage manufacturing enterprises to improve energy efficiency in their production and business activities; (4) For economists, investors or business owners to understand the value of improving energy efficiency for businesses, society and environment to make the necessary investment towards sustainable development. These contributions are perceived very important for sustainable development in many ways.

The objectives of this study are therefore subjected to these research questions (1) "*What are the determinants for energy efficiency in emerging country like Vietnam context?*" (2) *"How does each factor effect on energy efficiency?"* (3) *"How to enhance energy efficiency in Vietnam?"* (4) *"How energy efficiency impacts sustainable development in Vietnam?"* and (5) *What are the practical applications to be implemented for achieving the defined values in emerging countries like Vietnam?*

This study structure starts with abstract which is designed as a condensed content of this research. Followed by introduction part which presented overall about the research scope and the reasons for this study. The main body of this study includes different sections presented in order such as literature review for reviewing relevant studies, research model and hypothesis, research methodology, results and discussion, conclusion and limitation. The last part is the references.

2. LITERATURE REVIEW

2.1 Energy Efficiency (ENE)

The concept of energy efficiency is diverse depending on perspectives, approaches, contexts and characteristics of research subjects. According to Ku-Hsieh et al. (2020), "Energy efficiency is a conceptual term that is commonly used across a wide range of areas such as engineering, architectural design, production activities, management, organization, economics, and numerous important policy design and development initiatives". In addition, EIA (2017) defined that "energy efficiency is the use of technologies that require less energy to perform the same function". Considering energy efficiency, according to International Energy Agency (2014), it can be said that energy consumption is more efficient if more services produced with the same energy input or similar services generated with less energy input. Accordingly, energy efficiency measures are conceptually divided into two main categories include "energy-consumption-efficacy-indicator "(ECEI) and "energy-economic-efficiency-estimate" (EEEE). Additionally, Stagnitta et al. (2020) defined that energy efficiency describes the ratio between the benefits gained and the energy used. Irrek et al. (2020) distinguish different approaches concerning energy efficiency such as macro-economic; energy conversion between supply and provision and end use on the demand side and energy efforts of the human body in household production of the caring economy. Oikonomou et al. (2009) define effciency as the ratio between energy input and output services that can be modified with technical improvements (e.g., technology substitution) and differentiate it from the concept of energy saving, linked to human behavior. Furthermore, Patterson (1996) defined set of indicators used to measure energy efficiency from a physical and economic perspective, focusing on the energy consumption caused by each segment of the national economy, concluding that more attention needs to be given by policy analysts to manage this concept. While Tanaka (2008) explored different ways to measure energy efficiency performance: absolute energy consumption, energy intensity and the discusion of a specific energy-saving technology or thermal efficiency. Besides that, Haas (1997) defined energy efficiency indicators for the residential sector, considering key factors for their normalization and comparison, concluding the need for more disaggregated indicators and lifestyle studies. In that sense, Pérez-Lombard et al. (2012) revised the main methodological problems for the construction of energy effciency indicators and propose a sequence of actions to tackle these problems in an ordered fashion: establishing the service quality, identifying aggregation levels on the effciency pyramid, defining a magnitude for consumption measurement and choosing a suitable magnitude to quantify the service provided. The most widespread energy efficiency indicator is the energy intensity of a country, defined as the primary energy needed to generate a unit of gross domestic product (International Energy Agency, 2018). Moreover, according to Solnørdal and Foss (2018), energy efficiency can be achieved from "technological improvements" (Wang et al., 2017), "improved supply chain management" (Marchi and Zanoni, 2017), "implementation of environmental management systems (EMS)" (Zobel et al., 2016), "environmental regulation" (Lin et al., 2017), and "economic motives" (Worrell et al., 2009)".

2.2 Factors that Impact on Energy Efficiency

According to Chwieduk and Chwieduk (2020), design and construct of building are perceived as important for saving energy or use energy efficiently. The cleverness of the building's design and architecture demonstrates its ability to optimize the ambient surrounding to minimize energy demands for space heating or space cooling, simultaneously being able to utilize renewable energy and waste heat available to the building. It can be said that intelligence is achieved through the combination of passive and active energy saving methods, participating in the aspects of architecture, civil

engineering and engineering energy. Additionally, construction materials, electrical equipment and utilities also play a very important role in achieving energy efficiency. Avoiding energy needs is the best way to save energy. Energy saving is implied to be associated with environmental improvement through the reduction of greenhouse gas emissions as the main contributor to environmental pollution and climate change. Greenhouse gas emissions generated during the process of energy production using traditional energy sources which is known as fossil fuels. The EU directive promotes the idea of using near-zero energy for new buildings and stimulates the transformation of existing refurbished buildings into near-zero ones. Energy savings in buildings have been supported by other EU regulatory frameworks, mainly under the EU directive on energy efficiency. The near-zero energy buildings (NZEB) conceptually use almost no energy so they are very energy efficient. The low amount of energy that these buildings require for their efficient use comes mainly from the use of renewable energy sources (Energy Efficiency Directive, 2012). In addition, any installation must always be adapted to certain climate conditions, simultaneously reliable and high efficient energy and equipment installation, including the heat recovery ventilation system to optimize complementarities for maximizing efficiency. Such measures have caused significant reduction of the final energy demand. In addition, adoption of renewable energy systems has also reduced the consumption of fossil fuel-based primary energy. Another important aspect that is necessary for achieving energy savings is the intelligence of users. Energy consumption generally depends on user behavior. It can be said that users basically want to save energy as it's related to the cost of using that directly effecting to them on the economic point of view from both personal perspectives and corporate perspectives whose are majorly related to energy consumption. From a personal point of view on costs, saving energy helps to save living costs, thereby reducing financial pressure and improving the quality of life. While from a business point of view on economic efficiency, energy efficiency improves firm's performance as a way of increasing operational efficiency by using fewer resources but still achieving the set goals. In addition, saving the cost of production and cost of business operation can help reduce the cost of products and services, increase profitability or achieve price competition against competitors (Masoso and Grobler, 2010).

In addition, Mrówczyńska et al. (2018) defined that energy efficiency depends on many factors, such as climate, building design, materials, technology, energy carriers, how heat is applied and the tightness of bulk heads, but also depends on national and local policies (Gorbacheva and Sovacool 2015). The determinants of energy use vary depending on perceptions of each user, however, in general it can be said that financial factor play an important role in influencing behavior of energy use, thus it should be considered in any strategy for increasing energy efficiency. Simultaneously, it is important to consider public awareness and willingness to change their behavior in a more positive way to gain efficient use of energy (Asadi et al., 2014). Moreover, according to Dato (2018), there are different ways to improve energy efficiency such as (1) "innovation can lead to the equal or greater output with less energy"; (2) "cutting out wasted energy reduces energy needed while maintaining output" and (3) "heating technologies, such as heat pumps, can deliver greater output for less supplier energy". Energy-saving actions can also be cut measures (Jansson et al., 2009), referring to behavior changes such as scheduling, turning off lights, cutting down on heating or air conditioning and turn off standby. Saving energy helps reduce greenhouse gas emissions. In an International Energy Agency (IEA, 2008a) policy scenario, 72% of global CO_2 emissions reductions between 2010 and 2020 will come from improved energy efficiency (Knittel et al., 2014). Energy efficiency measures associate with renewable energy adoption in the sense that the former reduces energy demand of fossil fuels so that the latter can further cut future GHG emissions (RENS21, 2014). Gerpott et al. (2010) found that environmental and social attitudes have a strong influence on consumers and their tendency to use green electricity.

Moreover, Strielkowski et al. (2019) had another approach on energy efficiency by determining that "renewable energy sources (RES) are gradually becoming one of the key elements in the process of achieving energy efficiency worldwide". Energy efficiency measures is perceived to reduce energy consumption and save on electricity bills, as well as to reduce the negative environmental impact of electricity generation (Schandl et al., 2016; Kuzmin et al., 2019). Reducing energy consumption will reduce costs and could lead to financial savings for consumers if the energy savings offset the additional costs associated with implementing energy efficient technologies. In many countries, energy efficiency is also recognized as a national security benefit, as it can be used to reduce energy imports from abroad and can slow the rate of energy consumption when domestic energy is running depleted (Strielkowski et al., 2019). Furthermore, according to Stagnitta et al. (2020), three considerable and possible scenarios for energy efficiency are (1) heating, ventilation and air conditioning (HVAC) appliance efficiency upgrading; (2) wall and ceiling insulation; and (3) a combination of both (1) and (2). Accordingly, the results show that scenario one helps save 52% of energy by improving equipment efficiency and substitute energy carrier; scenario two generates 38% saving of energy by improving efficiency by wall and ceiling insulation while scenario three saves 47% by combining equipment efficiency improvement, energy carrier substitution and wall and ceiling insulation. Another approach was taken by Solnørdal and Foss (2018) for the motivating drivers for energy efficiency. The findings was majorly organizational related; economic related; market related and policy instruments related. According to Boyd and Curtis (2014), management practices in general impact the energy efficiency of manufacturing firm. Moreover, according to Martin et al. (2012) and Bloom et al. (2010), management practices includes two categories which are "generic management practices" and "climate friendly management practices" that both has positive impact on energy efficiency of firms. From the firm-level perspective, both the individual manager's involvement and management practices influence firms' energy efficiency. This includes managers' perception and sensitivity to environmental problems (Kostka et al., 2013); their ambitions (Thollander et al., 2008) and commitment (Chiaroni et al., 2016). It is also important for top managers to participate in energy efficiency projects because without such individual involvement, managers can consider energy efficiency improvement is secondary in

comparison to other investments (Apeaning and Thollander, 2013). In addition, firm with a clear energy strategy can stimulate energy efficiency in firm (Cagno et al., 2015). Furthermore, it is possible that those with a dedicated environmental manager will be more likely to enter into voluntary environmental agreements, through their energy goals and monitor their energy use compared to firm who do not have environmental manager (Martin et al., 2012).

The above reviews show that researches on energy efficiency have been taken approach in a diverse way. However, for the Vietnam context, authors hypothesized the determinants of energy efficiency and its relationships with energy efficiency as follows:

H_1: Using energy efficient technologies positively impact on energy efficiency

H_2: Energy consumption initiatives positively impact on energy efficiency

H_3: Construction and design positively impact on energy efficiency

H_4: Appliances and equipment positively impact on energy efficiency

H_5: Management practices positively impact on energy efficiency .

2.3 Energy Efficiency (ENE) and Sustainable Development (SDE)

Sustainable development was defined as "the development that meets the needs of the present without compromising the ability of future generation to meet their own needs" (World Commission on Environment and Development, 1987). Energy efficiency is globally perceived very important to national sustainable development. According to Soroka et al. (2019), energy efficiency offers significant benefits for environment, economy and society by reducing greenhouse gas emissions and other pollutants, limiting climate change, limiting risks due to uncertainties that may happen due to fuel's price fluctuations and source depletion those are for driving national sustainable development. In addition, according to REN21 (2016), "There is growing recognition worldwide that energy efficiency can play a key role in reducing energy-related emissions and that it can provide multiple economy-wide benefit– such as enhanced energy security, reduced fuel poverty and improved public health". Moreover, Dato (2018) determined that energy efficiency can play a key role in reducing the energy intensity of economic activity, avoiding the need for significant new supplies, while reducing dependence on imported fuels and potential fluctuations in energy prices (UNEP, 2009). While Ku-Hsieh et al. (2020) defined that "Energy e□ciency is undoubtedly a critical issue concerning the sustainability of civilization". According to IEA (2012), energy efficiency have significant potential effects on outputs between 0.8% and 1.3% of GDP.

The relationship between energy efficiency and sustainable development is therefore hypothesized as follow:

H_6: Energy efficiency positively impact on sustainable development.

2.4 Sustainable Development (SDE)

According to Dasgupta (2007), "sustainable development is an economic programme along which average well-being of present and future generations, taken together, does not decline over time". While Moure-Eraso (2003) had different approach for sustainable development by uncovering the concept of sustainable development model which include three aspects such as (1) state power; (2) social power and (3) necessity of a concrete roadmap for action. Accordingly, state power is conceptually defined towards political perception while social power is conceptually defined where "social community and environmental factors are considered simultaneously and with the same priority of economic factors, cultural transformation"; and roadmap for action is conceptually defined as "The premium that all societies place in living in a clean environment is indeed global. Poor and rich countries consider it an imperative. The United Nations has understood this human desire and has been able to articulate through documents and declarations this universal desire (Brundtland, 1987; UNEP, 1992)." Moreover, Strandberg and Brandt (2001) defined that the concept of sustainable development is quite complex as it interacts with at least four separate systems includes (1) "ecosystem function and change"; (2) "economic performance and change"; (3) "technological performance and change" and (4) "social performance and change". In overall, it's existing in current literature that energy efficiency has positive significant impact on sustainable development at both organizational and national perspectives, however, in this study, authors focus on national level as a macro approach on sustainable development.

Table 1 below sets out the findings and limitations of recent studies on energy efficiency related.

Table 2 presents the theories related to energy efficiency and sustainable development in this research context.

3. RESEARCH MODEL AND HYPOTHESIS

As shown in the Table 1, studies on energy efficiency were taken from different perspectives, different context and different prospect expectations. However, it mainly focused on either energy efficiency and sustainable development or ways for increasing energy efficiency of drivers for energy efficiency. None of these studies specifically focused on a holistic model that accounts for determinants for energy efficiency and the effects of energy efficiency on sustainable development. In addition, there is a lack of studies for manufacturing sector while the manufacturing sector is seen as a core force to focus on improving energy efficiency to mitigate climate change issues, especially in emerging country. Moreover, reduced energy costs are crucial for industrial companies to maintain competitive advantage for sustainable development (Hart, 1995; Worrell et al., 2009) and at the national perspective of sustainable development (Soroka et al., 2019). In overall, authors perceive that it's crucial to have a holistic research on factors that impact on the energy efficiency and the roles of energy efficiency on sustainable development. Thus, the research model of this paper is identified as Figure 1 below. This model used to explore the relationships between energy efficiency (ENE) and sustainable development (SDE), importantly with the variables as factors that impact on ENE includes (1) Using optimal technologies (UBE); (2) Energy resource alternative (ERE); (3) Construction design (CDE); (4) Appliances and equipment

Table 1: Studies on energy efficiency

Author	Context	Methodology	Findings/Contributions	Limitation
Iazzolino et al. (2016)	Research topic was carried out for energy efficiency and sustainable development. Focuses on the financial reliability of Energy Service Companies (ESCO) industry in Italy by using the Z" score model and observing the trend of Z" values from the year 2010 to the year 2014.	Empirical research on a sample of 68 Italian ESCOs, analysis was carried out on the balance sheet indicators based.	Efficient instrument to promote energy savings. This study provides an important description of the energy service companies (ESCO) industry in Italy from a financial standpoint, results highlight the importance of their work to promote sustainable development in the territory and strives for contribution related to a still new field in Italy.	ESCOs industry in Italy so the finding might not be able to represent for other industries and other regions.
Bianca et al. (2019)	Research topic was carried out for energy efficiency actions and their contributions to sustainable development. Focuses recent actions of energy efficiency implemented by University of Passo Fundo, a higher education institution located in the south of Brazil, and their contributions to Goal 7.	The analysis is based on collected energy data and information of energy efficiency actions applied at the university.	Possible contributions of energy efficiency towards sustainable development. Initiatives of University of Passo Fundo towards energy efficiency focused in lightening, photovoltaic solar power generation and free energy market.	Focused approach in only three initiatives towards energy efficiency at UPF in Brazil.
Yang et al. (2017)	Research topic was about energy efficiency, ownership structure and sustainable development. Focuses on the impact of difference energy investment behaviors between China's state-owned entities and non-state-owned business on China's Total Factor Energy Efficiency (TFEE) and sustainable development from 2003 to 2014.	Empirical analysis was conducted using the DEA-SBM Model to estimate the Total Factor Energy Efficiency (TFEE) of investment by entities with different ownership structures (state-owned and non-state-owned)	TFEE of energy investment by state-owned and non-state-owned economics is found low from optimal level. Moreover, it's different from cities, provinces in China, especially the most developed cities, provinces with the most strict environment regulation have kept an optimal record of TFEE which represents the highest energy efficiency level in China.	Using single-factor energy efficiency indicators, in China.
Chwieduk and and Chwieduk (2020)	Focuses on determining the energy efficiency of a low solar home based on energy saving and smart home aspects.	Adopted standard methods of determination of the energy performance of buildings.	Determinants for energy efficiency associated to home smartness factors.	Focused approach, household sector
Mrówczyńska et al. (2018)	Focuses on social and infrastructure conditions to reduce energy costs and improve energy efficiency of buildings in the context of the local energy policy.	Data were obtained from standardized interviews with Zielona Góra, Poland inhabitants and the Town Energy Audit documentation. The data were analyzed using an artificial neural network	Contribution to current knowledge demonstrates the ability to invest hierarchically, varying for buildings and neighborhoods, allowing for fair public funding.	Focused approach, household sector.
Dato (2018)	Focuses on investing in energy efficiency, renewable energy adoption and household behavior from organization for economic development (OECD) countries.	Adopted empirical analysis with information collected by survey on household characteristics (age, income, education), environmental attitudes (environmental concerns), and perceptions, etc., using an internet-based questionnaire.	The first findings is that there are alternative or complementary relationships between the decisions on energy efficiency investment and renewable energy adoption depending on the threshold of the cross-effect involved in the consumer's environmental motivation. The second one shows that the two decisions are positively related because the unobserved characteristics determine both decisions. The third findings presents the different effects of energy poverty, the issue of incentive division, housing characteristics, commitment and confidence in the two decisions. Finally, household characteristics that have a significant effect on the co-adoption of renewable energy technologies and energy efficiency.	Focused approach, household sector.

(Contd...)

Table 1: (*Continued*)

Author	Context	Methodology	Findings/Contributions	Limitation
Strielkowski et al. (2019)	Focuses on innovative policies on energy efficiency and household use of renewable energy.	Employed empirical analysis, the data was obtained from a consumer household survey conducted by the Customer-Led Revolution (CLNR). The survey used a smart meter to monitor 199 households in the North of England over a two-year period (known as the "CLNR project"). CLNR data includes records of the electrical usage or various devices obtained from smart watches from October 2012 to July 2014. This data included 155 households with solar PV conducted between June 2012 and March 2014.	Energy efficiency depends on a smooth transition to a low-carbon future. This transition can be enhanced by an increased awareness of environmental and sustainability issues, as well as a transition to renewable energy sources.	Focused approach, household sector.
Cristescu et al. (2017)	Focuses on increasing energy efficiency which is mentioned at INOE 2000-IHP Institute in the field of energy efficiency and functional optimization of systems that obtain clean energy from renewable resources.	Adopted analysis of methods for increasing energy efficiency and optimizing the operation of clean energy production systems from renewable sources, presented some practical examples in the field of wind energy and hydraulic energy of flowing water.	Directions in relation to techniques, methods and ways in terms of structure and operation for increasing energy efficiency and optimizing the renewable energy conversion system.	Focused renewable energy source.
Solnørdal and Foss (2018)	Focuses on energy efficiency gap and systematic evaluation of empirical articles on factors that promote energy efficiency in manufacturing enterprises.	Adopted an evidence-based review methodology which is a critical and systematic review of the empirical literature on drivers to energy efficiency in manufacturing firms at the firm level. The systematic literature review (SLR) is based on peer-reviewed articles published between 1998 and 2016.	First, economic and organizational dynamics are the most prominent stimulus to energy efficiency. Second, the firm's size has a positive effect on energy efficiency of firms. Third, these constraints imply a potential mismatch between energy policymakers and energy managers who understand which factors are most important for achieving higher energy efficiency in manufacturing firms.	Studies are mainly carried out in the US and Western European countries, despite the fact that energy demand will increase in the future outside of these regions.
Ku-Hsieh et al. (2020)	Focuses on energy efficiency, its indicators, estimation and new ideas for finding a concise and vivid metric for energy efficiency that remains a controversial and intriguing topic.	Adopted empirical analysis using sample taken from the World Bank's World Development Indicators database, covers 20 Organization for Economic Co-operation and Development (OECD) economies and covers the period 1992–2014.	Clarity to the concept of energy efficiency and propose a new metric for it.	The idea proposed in this article is more suitable for analyzing economic, commercial and managerial issues at an aggregate level, such as region or country level. It is less applicable for the assessment of the energy capability of specific products or equipment.

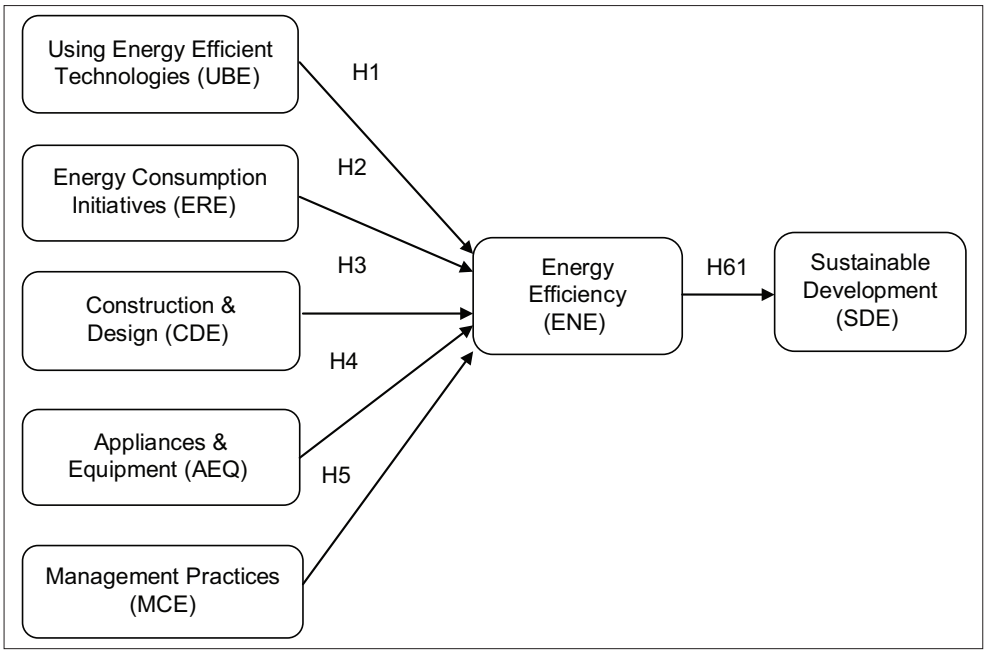
Source: Author's Review

Table 2: Previous theories related to energy efficiency and sustainable development

Source	Theory	Definition and brief explanation
Leibenstain (1978)	Theory of X-efficiency	Particular interest to attract additional sources of energy and increase the motivation of workers in energy efficient production and business.
Nelson and Winter (1973)	Evolutionary theory	This theory has great potential to study problems of energy saving and energy consumption.
Aoki (1986)	Information theory of firms	Provisions on special use of different information to reduce energy dependence and enhance energy security of firms.
Michael and William (1976)	Firm's managerial theory	Energy consumption and energy efficiency are areas of manager's activity and are an integral part of the planning and forecasting of activities.
[60] Heider (1944, 1958)	Attribution theory	It's about analysis of actions like wanting, trying and "can" which is majorly relative to environment quality and social life quality. It's important because it means that "what an actor believes the other is, thinks the other will do and what the actor does are all effected". Attribution is the process of assigning qualities to the environment, including persons. "We must attribute to provide necessary stability in our psychological environment".
Deci and Ryan (2002)	Self-determination theory	Distinguishes between external sources of motivation (pay/punishment) and those of internal motivation, such as desire for autonomy and competence.
Ajzen (1985)	Theory of Planned Behaviour	Behavioural intentions are predicted by attitudes, which in turn are influenced by knowledge, beliefs and awareness.

Source: Author's Review

Figure 1: Conceptual Model



Source: Author's Construct

(AEQ) and (5) Management practices (MCE). In overall, this model consists of five independent variables include UBE; ERE; CDE; AEQ and MCE, one meditating variable which is ENE and one dependent variable which is SDE.

The variables of this study were constructed that UBE has 4 items, ERE has 5 items, CDE has 4 items; AEQ has 4 items and MCE has 4 items; ENE has 4 and SDE has 4. In overall, this model has 5 independent variables, 1 mediwwow summarizes the constructs of this model.

Finally, this model is hypothesized as following:

H_1: Using energy efficient technologies positively impact on energy efficiency

H_2: Energy consumption initiatives positively impact on energy efficiency

H_3: Construction and design positively impact on energy efficiency

H_4: Appliances and equipment positively impact on energy efficiency

H_5: Management practices positively impact on energy efficiency

H_6: Energy efficiency positively impact on sustainable development

Table 3 summarizes constructs of the proposed research model of this study.

4. RESEARCH METHODOLOGY

This study uses a combination of qualitative and quantitative methods to take advantage of both research methods to comprehensively evaluate the relationship of the variables of the

Table 3: Constructs

Constructs	Items	Description	References
Using Energy Efficient Technologies (UBE)	UBE1	Employ the latest energy efficient technology for direct manufacturing activities.	Singh (2019); Omer (2014); Strielkowski et al. (2019); Kuzmin et al. (2019); Masoso and Grobler (2010); Chwieduk and Chwieduk (2020); Pérez-Lombard et al. (2012); Stagnitta et al. (2020); Mrówczyńska et al. (2018); Gorbacheva and Sovacool (2015); Solnørdal and Foss (2018); Boyd and Curtis (2014); Kostka et al. (2013); REN21 (2016); IEA (2014); EIA (2017); Dasgupta (2007)
	UBE2	Employ the latest energy efficient technology for general operating activities.	
	UBE3	Employ technology for being able to use renewable energy.	
	UBE4	Employ windows and building envelope technology for energy saving.	
Energy Consumption Initiatives (ERE)	ERE1	Promote renewable energy applications.	
	ERE2	Increase in share of renewable energy consumption on the total energy consumption.	
	ERE3	Optimize passive cooling by natural ventilation.	
	ERE4	Optimize passive lighting by the light of nature.	
	ERE5	Improve behavior of energy users to be efficient-oriented.	
Construction and Design (CDE)	CDE1	Building design to optimize natural ambient resources such as ventilation, light and heat.	
	CDE2	Building orientation to save energy.	
	CDE3	Construction materials used to save energy.	
	CDE4	Building design to allow adoption of renewable energy technology.	
Appliances and Equipment (AEQ)	AEQ1	Use low energy equipment and appliances.	
	AEQ2	Upgrade equipment efficiency.	
	AEQ3	Perform periodic maintenance.	
	AEQ4	Replace energy carriers cyclically.	
Management Practices (MCE)	MCE1	Perception of leaders about environment and society related issues.	
	MCE2	Sensibility of leaders about climate change, pollutants, greenhouse emissions and biological imbalance.	
	MCE3	Engagement of leaders in projects related to energy efficiency improvement.	
	MCE4	Consistent behavior of leaders on energy efficiency related issues.	
Energy Efficiency (ENE)	ENE1	Consume less energy inputs for the same outputs.	
	ENE2	Consume same energy inputs for higher outputs.	
	ENE3	Increase renewable energy consumption.	
	ENE4	Sustain stable source of energy to serve manufacturing and business activities.	
Sustainable Development (SDE)	SDE1	Increase Gross Domestic Products (GDP) per capita	
	SDE2	Reduce greenhouse gas emissions (GHG)	
	SDE3	Reduce dependence on source and price fossil fuels because of importing related.	
	SDE4	Human Development Index (HDI).	

Source: Author's construct

research model. Qualitative research allows us to access insights and details about the perspectives of the determinants of energy efficiency (ENE) and the relationship of ENE and sustainable development (SDE). In addition, qualitative research in the form of in-depth expert interviews in a face-to-face model allows the authors to collect different attitudes and behaviors that are likely to lead to the same action or decision. The authors have prepared open-ended interview questions to encourage the interviewees to answer in the most comfortable, practical way and not limited to a certain framework. The types of respondents chosen to interview are economists and experts, firms' executives and entrepreneurs. There are 50 respondents, of which, there are 15 economists and experts, 27 executives and 8 entrepreneurs. The expected outcome of this stage is the final questionnaire relevant to the research context and ready for quantitative research. The questionnaire constructed using the Likert 7 scale indicates that the score range from 1 (strongly disagree) is gradually increasing to 7 (strongly agree).

Two data types were used in this study which are classified as primary and secondary. In this study, secondary data are collected related to energy consumption, energy efficiency, energy policy and incentives, related to global agreement, etc. Primary data was collected by questionnaire survey with initial sample size of 520. Hair et al. (2010) proposed that the principal allow the sample size calculation based on the number of items of the proposed research model. Accordingly, the sample size should be calculated 5-10 times as much as the items identified in the study. This study has a total of 29 items, so the required sample size is 290. However, in order to avoid potential risks that can occur during the survey such as missing answers from target respondents, unsatisfied answers and so on, authors decided to initially proceed with 520 samples at the simple method of collecting random probability samples. Survey subjects include experts (about 20%), firms' executives (about 45%), and management levels (about 35%) in the South of Vietnam, with no age limit for respondents. The survey was implemented by distributing questionnaires to the target respondents through email and direct delivery. The collected questionnaires were screened and selected the satisfied questionnaires. As a result, there was 491 met the specification as indicated criteria. Those data were then used for analysis using Partial Least Squares (PLS).

5. RESULTS AND DISCUSSION

5.1. Assessing Reliability of the Scale

Reliability assessment is to check the consistency levels between multiple measurements of a variable (Hair et al., 2010). This study assesses the consistency of the entire scale and its overall reliability of each factor of productivity values by simultaneously using Cronbach's Alpha and composite reliability indexes with expect to bring all necessary basis into consideration for the most appropriate conclusion

to the study context. The analysis results show that Cronbach's Alpha coefficient of all variables are greater than 0.8 from 0.804 of UBE, 0.821 of CDE, 0.847 of MCE; 0.852 of SDE, 0.858 of ENE, 0.877 of ERE and 0.907 of AEQ. Thus, it can be concluded that the measurement scale of this research model is good. However, authors would like to continue further investigation to strongly affirm the reliability of the scale, therefore composite reliability value was used for this purpose. The analysis result show that all composite reliability values are greater than 0.8 from 0.863 of UBE, 0.881 of CDE, 0.897 of MCE, 0.901 of SDE and ERE, 0.904 of ENE and 0.935 of AEQ. According to Hair et al. (2016), the aggregate reliability between 0.7 and 0.95 represents a satisfactory level of reliability. Therefore, in overall, these results confirm that the reliability of this scale is good and acceptable. Table 4 below is summary of these results.

In addition, the indicator reliability was checked by assessing outer loading' results. Table 5 below shows the results of outer loading where all values are greater than 0.7. It means that all individual indicators are reliable.

Table 4: Cronbach's alpha and composite reliability results

Variables	Cronbach's alpha	Composite reliability
AEQ	0.907	0.935
CDE	0.821	0.881
ENE	0.858	0.904
ERE	0.877	0.901
MCE	0.847	0.897
SDE	0.852	0.901
UBE	0.804	0.863

Source: Authors' analysis

Table 5: Results of outer loading

Variables	AEQ	CDE	ENE	ERE	MCE	SDE	UBE
AEQ1	0.867						
AEQ2	0.900						
AEQ3	0.891						
AEQ4	0.878						
CDE1		0.815					
CDE2		0.775					
CDE3		0.800					
CDE4		0.831					
ENE1			0.847				
ENE2			0.852				
ENE3			0.869				
ENE4			0.780				
ERE1				0.834			
ERE2				0.833			
ERE3				0.859			
ERE4				0.718			
ERE5				0.768			
MCE1					0.826		
MCE2					0.864		
MCE3					0.821		
MCE4					0.799		
SDE1						0.860	
SDE2						0.884	
SDE3						0.872	
SDE4						0.712	
UBE1							0.785
UBE2							0.753
UBE3							0.765
UBE4							0.824

Source: Authors' analysis

5.2. Assessing Validity

Hair et al. (2010) defined that the purpose of assessing validity is to determine how well is the construct explained the variables under the construct. In addition, it's to assess practicality of the data collected and its reflection on the study context. According to Anderson et al. (1988), the validity of research concepts includes convergent validity and discriminant validity of scales.

5.3. Convergent Validity

According to Fornell and Larcker (1981), the convergence value is used to illustrate the full convergence of the measurement items on their respective structures. While Hair et al. (2010) suggested that the AVE index should be over or equal to 50%, the extracted factors could be more explainable than any other extract combinations. Table 6 shows the results of EVA and external loading factors. In which external loading factors values are all greater than 0.7 and EVA are all greater than 0.5. These values exceed the level mentioned, it indicates a sufficient degree of convergent validity, which means that a specific latent variable explains more than half of the variance in comparison to their corresponding indicators (Hair et al., 2011). Accordingly, we can conclude that the observed variables are focused on the research concept that it is involved in or convergent validity is supported.

5.4. Discriminant Validity

HTMT was assessed to reaffirm the discriminant validity of the measurement model. HTMT is a shorty written form of Heterotrait-Monotrait Ratio which is a new criterion to assess discriminant validity. According to Kline (2011), HTMT value closes to 1 indicate a lack of discriminant validity. Its threshold value should be 0.85. It means that if HTMT value of research model is smaller than 0.85 then it can be concluded that discriminant validity of the research model is established. In this study, HTMT values are all <0.85 so discriminant validity is supported. Table 7 summarizes the HTMT results of this study.

5.5. Evaluation of Structural Model

According to Falk and Miller's (1992), the model is called good when the R^2 index is satisfactory, meaning that the R^2 index are greater than 0.1. Table 8 below shows the results that both R^2 values

Table 6: Convergent validity

Variables	External loading factors	AVE
AEQ	0.867-0.900	0.782
CDE	0.775-0.831	0.649
ENE	0.780-0.869	0.702
ERE	0.718-0.859	0.647
MCE	0.799-0.864	0.685
SDE	0.712-0.884	0.697
UBE	0.753-0.824	0.612

Source: Authors' analysis

Table 7: Heterotrait-monotrait results

Variables	AEQ	CDE	ENE	ERE	MCE	SDE
CDE	0.378					
ENE	0.569	0.402				
ERE	0.042	0.409	0.081			
MCE	0.544	0.411	0.652	0.223		
SDE	0.492	0.377	0.476	0.112	0.397	
UBE	0.188	0.251	0.356	0.144	0.190	0.393

and R^2 adjusted values are greater than 0.1. In which, R^2 value and R^2 adjusted values of energy efficiency (ENE) respectively are 0.476 and 0.470; R^2 value and R^2 adjusted values of sustainable development (SDE) respectively is 0.165 and 0.164 which are satisfied. Therefore, the structural model is considered satisfactory.

The next step of process is analyzing model-of-fit to determine its fitness and its validity. This analysis was conducted by assessing certain indices such as SRMR. Those values in this study satisfied the defined acceptance thresholds of the previous authors of the relevant studies. Table 9 below summarizes the model-of-fit indices with full name, the acceptance thresholds and results. Overall, it can be concluded that this model is fit and valid.

In addition, Table 10 shows path coefficients of variables of the research model. It indicates that all the defined determinants for energy efficiency (ENE) have positive significant impact on ENE. Results show that among five variables that impact on ENE, MCE has strongest impact on ENE at 0.399, the next one is AEQ at 0.222, followed by ERE at 0.219, UBE at 0.203 and CDE at 0.161. Results also show that ENE has positive significant relationship with SDE at 0.407 as coefficient. The results indicated that for manufacturing firms in Vietnam context, determinants for energy efficiency defined are (1) Using energy efficient technologies; (2) Energy consumption initiatives; (3) Construction and design; (4) Appliances and equipment and (5) Management practice. It implies that for manufacturing firms for achieving efficient use of energy for manufacturing and overall operation activities, those fields are determined that firms should prioritize such as upgrade technologies; promote initiatives on energy use; design building for utilizing ambient surroundings as passive energy use for instance ventilation, heat and so on; use low efficient appliances and equipment and period maintenance; role of leadership in energy consumption management and energy efficiency projects. Regarding relationship between ENE and SDE, results show that ENE plays a very important role in achieving sustainable development (SDE). It implies that each unit of energy used effectively will contribute to sustainable development including economy, society and environment.

Figure 2 below is the result analysis of this research model.

Multicollinearity was checked by assessing VIF (variance inflation factors). Collinearity is a condition in which a number of independent variables are highly correlated. The existing literature related to VIF assessment show various threshold for collinearity evaluation (Cenfetelli et al., 2009; Kline, 1998; Petter et al., 2007). It is commonly recommended values are 10, 5, and 3.3; meaning that a VIF equal to or greater than the suggested threshold value then it could be concluded the existence of collinearity among the variables or called in other word multicollinearity. Results of this research show that VIF values are all smaller than 3.3 so it can be concluded that there is no multicollinearity problem among variables of the research model (Petter et al., 2007). Table 11 below summarizes VIF values of this model.

Further, the significance of path coefficient analysis was conducted using Bootstrap method using 1000 emulators. Bootstrapping assigns measures of accuracy (bias, variance, confidence intervals, prediction error, etc.) to sample estimates" (Efron and Tibshirani, 1993). The bootstrapping result shows that the statistical value t >1.96 and p-value <5% which confirm hypotheses of this research model. It can be concluded that the research model of this study and research data is determined suitable, also, hypotheses of this study is confirmed accepted. In conclusion, the positive impacts of UBE on ENE; ERE on ENE; SDE on ENE; AEQ on ENE; MCE on ENE are confirmed in this study. Moreover, ENE has positive significant relationship with SDE is also confirmed in this study.

The below Figure 3 shows bootstrapping results and Table 12 presents bootstrapping values.

Table 12 below shows the resulting indicators of bootstrapping which are satisfactory for hypotheses to be accepted.

In general, through the evaluation process carried out by suitable methods, the results are determined satisfactory and accepted on the basis of the acceptability threshold of the relevant indicators confirmed by previous studies. Therefore, it can be concluded that this research model and structure is reliable, valid and suitable for the research context and confirmed research hypotheses.

The findings of this research coincide with some in the current literature that adoption of improved technologies has positive impact on energy efficiency (Oikonomou et al., 2009; Mrówczyńska et al., 2018); initiatives on energy use has significant impact on energy efficiency (Chwieduk and Chwieduk 2020); construction and design positively drive energy efficiency (Chwieduk and Chwieduk 2020); appliances and equipment has positive effect on energy efficiency (Stagnitta et al., 2020) and management practices of firm positively drive energy efficiency (Boyd and Curtis, 2014; Martin et al., 2012; Bloom et al., 2010). Accordingly, results indicated that management practice plays the most important role for driving energy efficiency. It implies that firms with a strong leadership in energy efficiency projects and high sensitivity with social and

Table 8: R square values

Variables	R^2	R^2 Adjusted
ENE	0.476	0.470
SDE	0.165	0.164

Source: Authors' analysis

Table 9: Model-fit analysis

Model-of-fit indices	Full name	Acceptance thresholds	Values (Saturated model - Estimated model)	Concluded
SRMR	(Standardized root mean squared residual approximation	0.00 < Value < 0.08 (Hu and Bentler, 1999)	0.063-0.079	Good fit

Source: Authors' analysis

Table 10: Path coefficient

Variables	AEQ	CDE	ENE	ERE	MCE	SDE	UBE
AEQ			0.222				
CDE			0.161				
ENE						0.407	
ERE			0.219				
MCE			0.399				
SDE							
UBE			0.203				

Source: Authors' analysis

environmental problems will well promote energy efficiency of firms. Additionally, firms that pay attention to low energy appliances and equipment will remarkably enhance the overall energy efficiency. Besides that, firms those concern on the initiatives on energy consumption and energy use behavior will significantly improve energy efficiency of firms in overall operation. Next is technologies-related and construct and design-related those also significantly contribute to enhancement of energy efficiency of firms.

Table 11: Variance inflation factors values

Variables	VIF values	Variables	VIF values	Variables	VIF values	Variables	VIF values
AEQ1	2.515	CDE4	1.892	ERE3	2.020	SDE1	2.409
AEQ2	2.905	ENE1	2.123	ERE4	2.029	SDE2	2.727
AEQ3	2.813	ENE2	2.161	ERE5	2.229	SDE3	2.675
AEQ4	2.623	ENE3	2.375	MCE1	2.096	SDE4	1.369
CDE1	1.620	ENE4	1.606	MCE2	2.459	UBE1	1.899
CDE2	1.628	ERE1	1.948	MCE3	1.980	UBE2	1.934
CDE3	1.784	ERE2	1.967	MCE4	1.584	UBE3	1.714
						UBE4	1.343

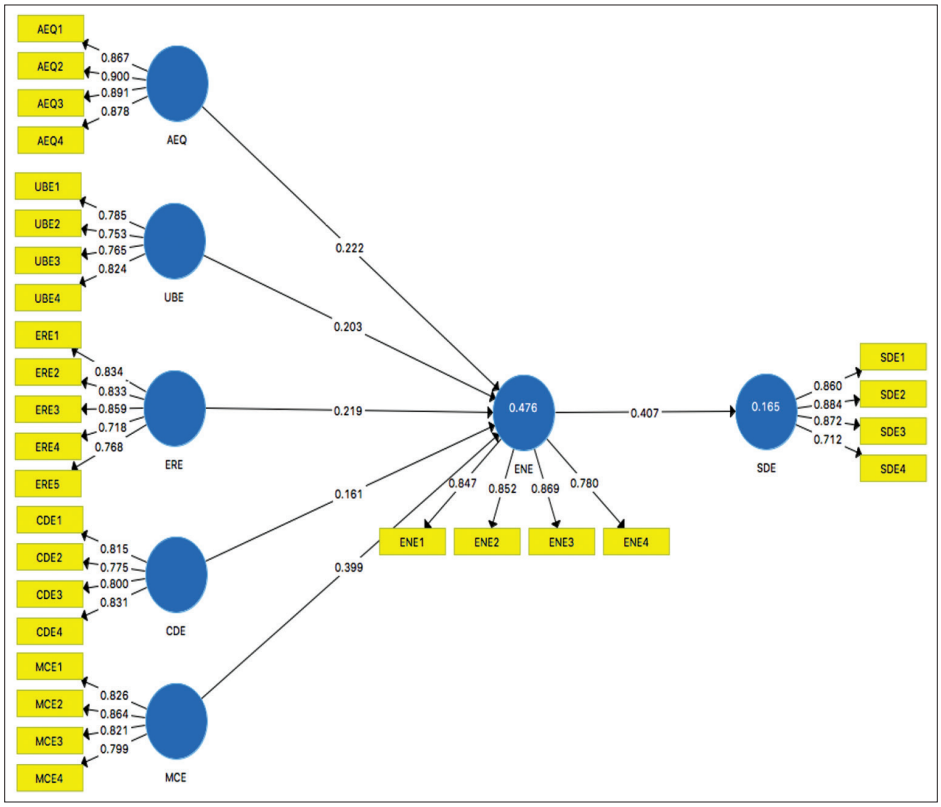
Source: Authors' analysis

Table 12: Bootstrapping's results

Path of variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P-values
AEQ→ENE	0.222	0.227	0.049	4.523	0.000
CDE→ENE	0.161	0.152	0.048	3.379	0.001
ENE→SDE	0.407	0.410	0.045	9.013	0.000
ERE→ENE	0.219	0.198	0.072	3.037	0.002
MCE→ENE	0.399	0.393	0.058	6.880	0.000
UBE→ENE	0.203	0.206	0.034	5.933	0.000

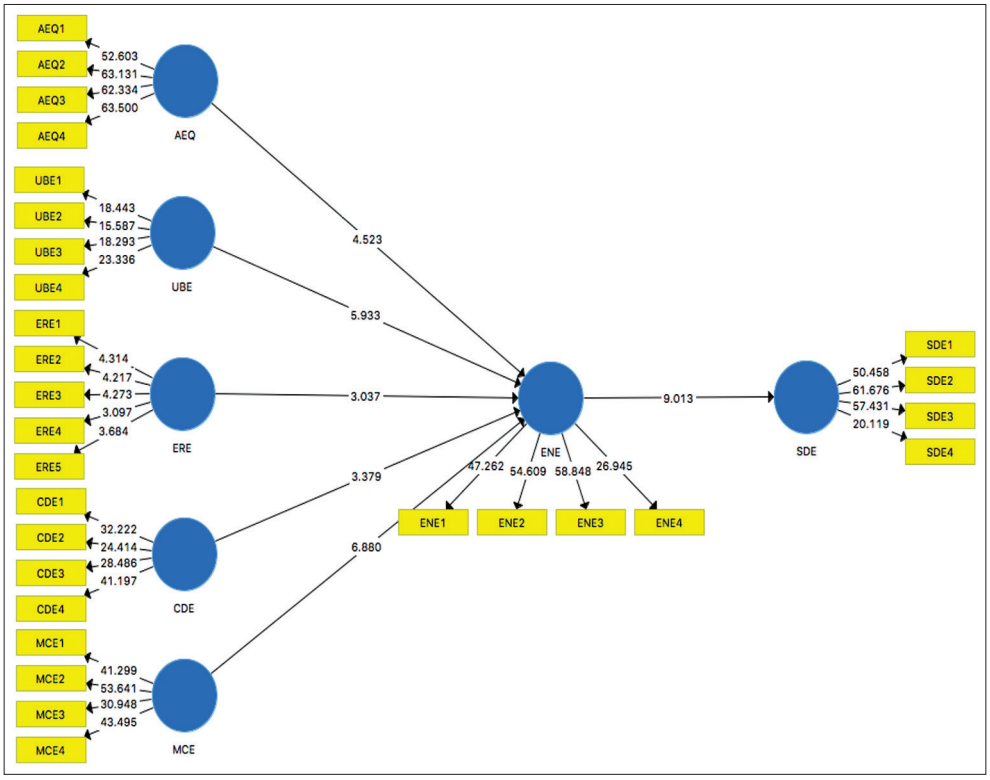
Source: Authors' analysis

Figure 2: Result analysis of research model



Source: Authors' analysis

Figure 3: Bootstrapping's results



Source: Authors' analysis

In addition, the research findings determined that energy efficiency positively significantly drive sustainable development at the national perspective (Soroka et al., 2019; REN21, 2016; Dato, 2018; UNEP, 2009; Ku-Hsieh et al., 2020). It implies that firms that efficiently use of energy significantly contribute to the sustainable development of nation, in this research context, emerging nation as Vietnam.

In overall, the significance of this study is a holistic concept of determinants for energy efficiency and roles of energy efficiency in sustainable development at organizational and national perspectives in manufacturing sector in emerging country like Vietnam. This significant contribution is a novelty in this research context so far in current literature.

6. CONCLUSION

The defined contributions of this study enable conclusion that this research has a significant contribution in theory and practice with this research context. Accordingly, from a theoretical point of view, the contributions are majorly subjected to (1) Comprehensive knowledge of energy efficiency; (2) Factors determining energy efficiency in manufacturing in emerging countries especially Vietnam; (3) The degree of influence of each factor on the energy efficiency of production enterprises; (4) The importance of energy efficiency for the economy, society and the environment; (5) Prospects of energy efficiency for sustainable development from the organizational and national perspectives; In addition, from a practical point of view, the contributions of this study to be subjected to (1) For the management level of manufacturing enterprises to have a realistic and clear strategy for energy management and (2) appropriate actions and behaviors based on identified determinants of energy saving to improve energy efficiency; (3) For policy makers to have appropriate policies to encourage manufacturing enterprises to improve energy efficiency in production and business activities; (4) For economists, investors or business owners to understand the value of improving energy efficiency for businesses, society and the environment to make necessary investments towards sustainable development firm. These contributions are considered to be very important to sustainable development in this way or another ways.

7. LIMITATION

Although this study provides interesting results and insights, it has some limitations. First, this study focuses on manufacturing sector, future study should conduct on other sector which is not available in literature. The second limitation is in relation to data collection which was collected from random chosen companies in manufacturing sector it might be problematic regarding its representativeness if taking into consideration of a specific industry category. The third limitation related to geography that this study was conducted with a selective participants of manufacturing firms operating in industrial zones in the South of Vietnam. As a consequence, its relevant findings might not be representative for the other regions or other participants in different contexts. In general, the findings may not provide the best support for different context essences, or on the other hand, it may be impractical and may apply to different contexts. In general, these limitations provide chances for future researches continue to contribute to the literature of energy efficiency, its determinants and its influence on the sustainable development in different context and different research subject.

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