FACTORS ASSOCIATED WITH ATTITUDE
TOWARDS PURCHASING INTENTION ON INVERTER AIR CONDITIONER
AMONG THAI CONSUMERS

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A Thesis Submitted in Partial Fulfillment of the Requirements
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ปัจจัยเกี่ยวเนื่องกับทัศนคติที่มีต่อความตั้งใจซื้อเครื่องปรับอากาศ
ระบบอินเวอร์เตอร์ของผู้บริโภคไทย

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เรกะ ยาสุนากะ : **ปัจจัยเกี่ยวเนื่องกับทัศนคติที่มีต่อความตั้งใจซื้อเครื่องปรับอากาศระบบอินเวอร์เตอร์ของผู้บริโภคไทย** (Factors Associated with Attitude towards Purchasing Intention on Inverter Air Conditioner among Thai Consumers) **อ.ที่ปรึกษาวิทยานิพนธ์หลัก**: รศ. ดร. ดาวัลย์ วิวรรธนะเดช, 62 หน้า

ในการศึกษานี้ได้ทำการสำรวจปัจจัยเกี่ยวเนื่องกับทัศนคติที่มีต่อความตั้งใจซื้อเครื่องปรับอากาศประสิทธิภาพสูงของผู้บริโภคชาวไทย โดยเริ่มจากการศึกษาปัจจัยนิยมและคุณลักษณะของผู้บริโภคที่ซื้อเครื่องปรับอากาศในช่วง 5 ปีที่ผ่านมาด้วยการวิเคราะห์เชิงพรรณนา ตามด้วยการใช้เทคนิคการสร้างโมเดลสมการโครงสร้าง (SEM) ทำการวิเคราะห์ความสัมพันธ์ระหว่างความตระหนักของลูกค้าที่มีต่อ 3 ประเด็น ได้แก่ ระบบอินเวอร์เตอร์ ข้อมูลบนฉลากพลังงาน และข้อมูลระยะเวลาคืนทุน กับ ทัศนคติการซื้อเครื่องปรับอากาศประสิทธิภาพสูง โดยใช้ข้อมูลจากผู้ตอบแบบสอบถามจำนวน 202 คนที่มีเพศ อายุ ระดับการศึกษา และรายได้ครอบครัวที่แตกต่างกัน

ผลการศึกษาพบว่าปัจจัยที่ผู้บริโภคนิยมพิจารณาขณะซื้อเครื่องปรับอากาศ 5 อันดับแรก ได้แก่ ราคา ขนาดบีทียู คุณภาพ แบรนด์ และประสิทธิภาพพลังงาน ตามลำดับ หากพิจารณาเปรียบเทียบคุณลักษณะของผู้ซื้อเครื่องปรับอากาศในช่วง 5 ปีที่ผ่านมาพบว่าผู้บริโภคชายมีสัดส่วนการซื้อเครื่องปรับอากาศแบบอินเวอร์เตอร์สูงกว่าเพศหญิง และส่วนใหญ่มีการศึกษาระดับปริญญาตรีขึ้นไป ขณะที่ช่วงอายุ รายได้ครัวเรือน และความรู้พื้นฐานด้านสิ่งแวดล้อม มีผลต่อการตัดสินใจซื้อเครื่องปรับอากาศแบบอินเวอร์เตอร์ค่อนข้างน้อย

ส่วนผลการวิเคราะห์ด้วยเทคนิคการสร้างโมเดลสมการโครงสร้าง พบความสัมพันธ์เชิงบวกระหว่างความตระหนักของลูกค้าที่มีต่อประเด็นทั้งสามกับทัศนคติการซื้อเครื่องปรับอากาศประสิทธิภาพสูง ขณะที่ความรู้ที่เกี่ยวข้องกับระบบอินเวอร์เตอร์และข้อมูลบนฉลากพลังงานมีความสัมพันธ์กับทัศนคติการซื้อเครื่องปรับอากาศประสิทธิภาพสูงน้อยมาก อย่างไรก็ตามการให้ความรู้ควบคู่กับการปลุกให้ผู้บริโภคตระหนักถึงความสำคัญของระบบอินเวอร์เตอร์และข้อมูลบนฉลากพลังงาน น่าจะเป็นแนวทางหนึ่งที่ช่วยกระตุ้นการซื้อผลิตภัณฑ์ประสิทธิภาพสูง และ/หรือ ผลิตภัณฑ์สีเขียวอย่างมีประสิทธิผล

สาขาวิชา สิ่งแวดล้อม การศึกษา และความยั่งยืน	ลายมือชื่อนิสิต................................
ปีการศึกษา 2561	ลายมือชื่อ อ.ที่ปรึกษาหลัก................

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REIKA YASUNAGA: FACTORS ASSOCIATED WITH ATTITUDE TOWARDS PURCHASING INTENTION ON INVERTER AIR CONDITIONER AMONG THAI CONSUMERS. ADVISOR: ASSOC. PROF. DAWAN WIWATTANADATE, Ph.D.,62 pp.

Factors associated with Thai Consumers' attitude towards purchasing intention on higher efficiency Air conditioner (AC) was investigated in this study. Consumers' current preference factors on AC purchasing as well as characteristics of consumers who bought AC during the recent 5 years were firstly investigated by descriptive analysis. Relationship between consumers' purchasing attitude towards higher efficiency AC and their concern on three issues (inverter, information on energy label, and payback period) as well as their knowledge on two issues (inverter and information on energy label) was then analyzed by structural equation modeling (SEM) using data collected from 202 Thai consumers having characteristic difference in gender, age, education level, and income level.

The findings indicate that price, size (cooling capacity in BTU/hour), quality, brand, and energy efficiency are top-five priorities that the respondents would consider when buying AC. Up on characteristic comparisons of respondents who bought inverter and non-inverter AC, it was found that higher portion of respondents who bought inverter AC are males and most of which are those having high education with bachelor degree upward. Meanwhile, age, income level, and background on environmental issues appear to exhibit low impact on decision to buy inverter AC. In SEM analysis, positive relationships between the concerns of three issues and the purchasing attitude toward higher efficiency AC were confirmed; while no significant impact of knowledge factors was observed in this study. The results imply that key purchasing factors on higher efficiency household AC in Thailand are consumers' concern on inverter, information on energy label, and payback period information. However, encouraging consumers to have both concern and knowledge on key related issues would be an effective way to enhance purchasing green products and/or energy efficient products.

Field of Study: Environment Development and   Student's Signature………………………

                 Sustainability   Advisor's Signature………………………

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Acknowledgement

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CHAPTER 1

Introduction

Air conditioner (AC) is one of energy intensive household electric appliances, and its penetration trend in Thai household is expected to increase with economic growth and resulting in rapidly increasing electricity in residential sector. Encouragement to adopt high efficiency, especially inverter-type, AC would be an effective way to decouple the electricity consumption with the AC penetration trend in Thailand. Hence, factors influencing on purchasing high efficiency AC would be firstly investigated.

1.1. Electricity Consumption of Household AC in Thailand

According to Thailand's Ministry of Energy, energy consumption in residential sector accounted for 16% of the total consumption in 2012, and the growth rate of which was the second highest of 9.2% following the commercial sector having growth rate of 11.7% as shown in figure 1.1 (Vongsoasup, 2012). In addition, it is reported that electricity consumption in the residential sector contributed by air conditioner was up to 46% as shown in figure 1.2 (Sangsawang, 2010). Figure 1.3 shows trend of electricity consumption by AC in Thailand estimated from 46% annual electricity consumption in the residential sector (EPPO, 2015). This trend indicates massive growth of electricity consumption by AC in Thailand. Meanwhile, its penetration or ownership rate in 2014 was only 22% when compared with the other three main home appliances as shown in figure 1.4. This implies that the energy consumption of AC in Thai household as well as its environmental impacts would grow even further with the increasing ownership rates (MICT, 2014)
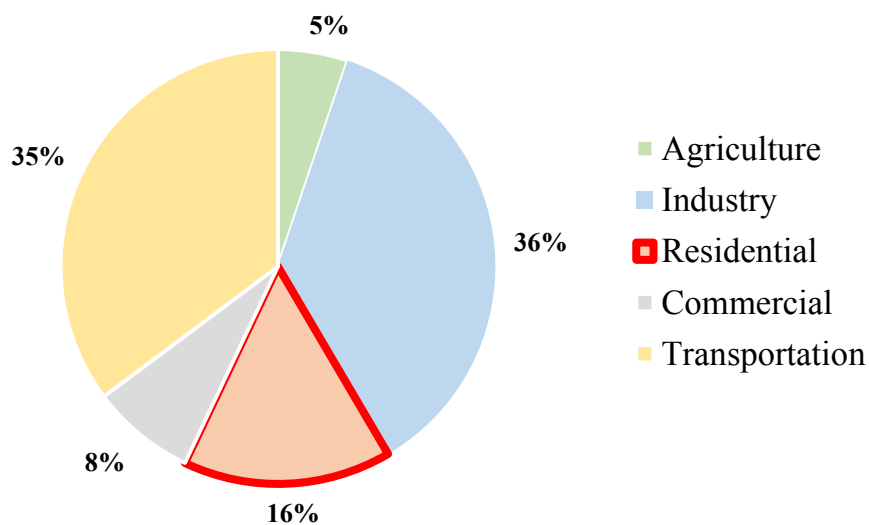
Figure 1. 1 Thailand's electricity consumption in Thailand by sector

Source: (Vongsoasup, 2012)
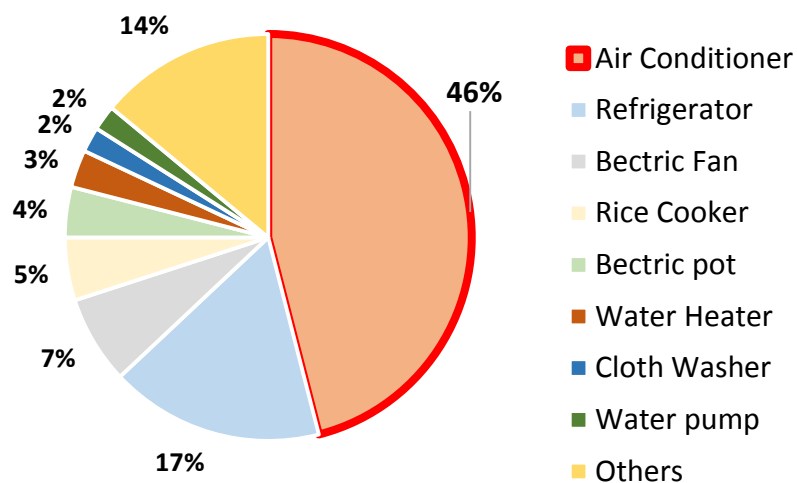
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Source: (Sangsawang, 2010)
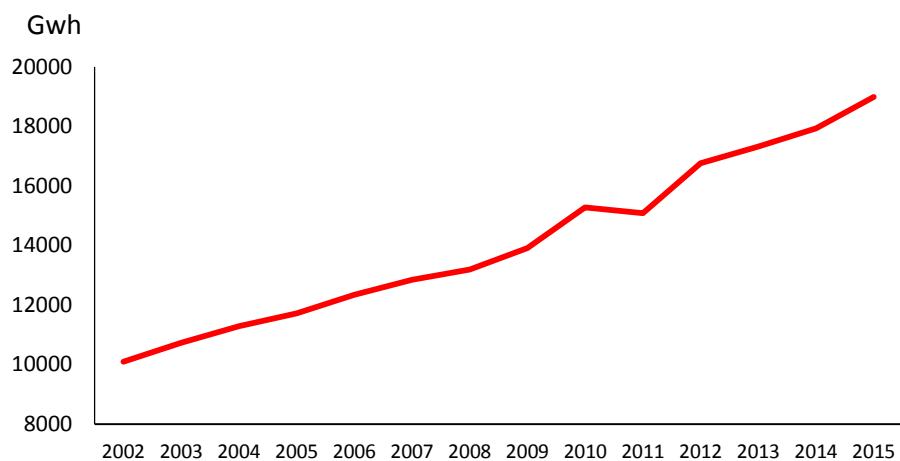
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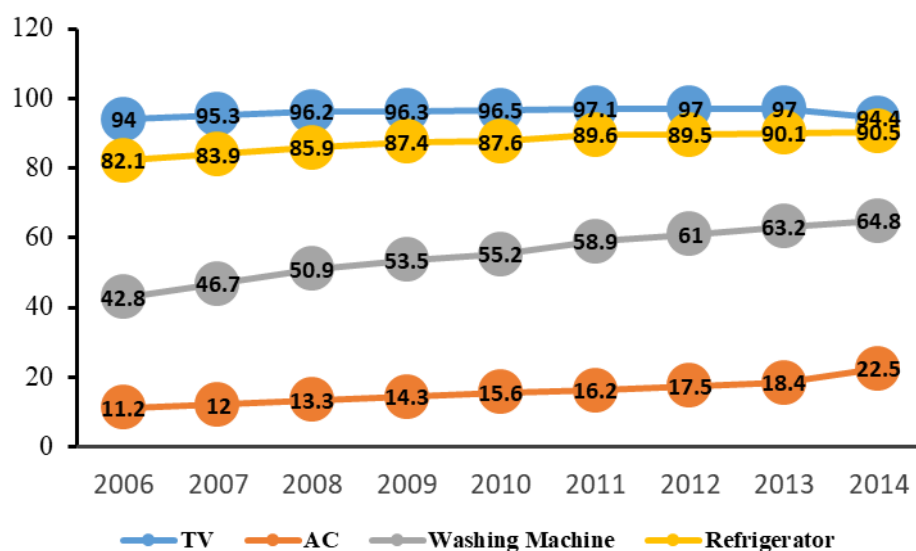
Figure 1. 4 Penetration or ownership rates (%) of home appliances in Thailand

Source: (MICT, 2014)

1.2. Characteristics of AC's market in Thailand

According to UNEP's report, sales number of AC in Thailand achieved over 2.5 million units in 2013, and its average sales growth during 2009 - 2013 has been 16% per year (UNEP, 2015). Most (up to 43%) of the AC sold in 2013 was those cooling capacity between 2.5-4.4 kW as shown in figure 1.5, and most of which (up to 84%) are non-inverter type as shown in figure 1.6.

Operation efficiency (in term of Energy Efficiency Ratio, EER) of AC available in the market has been improved year by year as shown in figure 1.7. The models with lower cooling capacity tend to have better performance and higher improvement rate.

The most popular models (cooling capacity 2.5-4.4 kW) showed average 3% improvement during 2009-2013. Yet the EERs are still low compared with the EER in developed countries, for example, the average EER (W/W) in Japan was over 5.0 during the period.
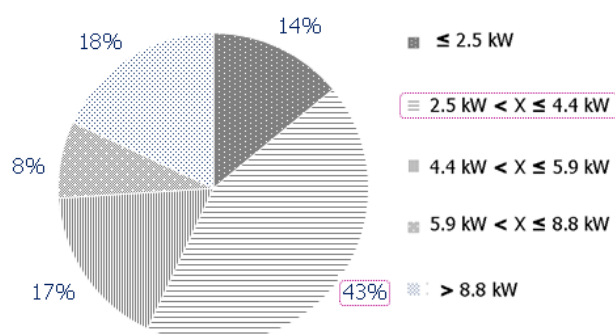
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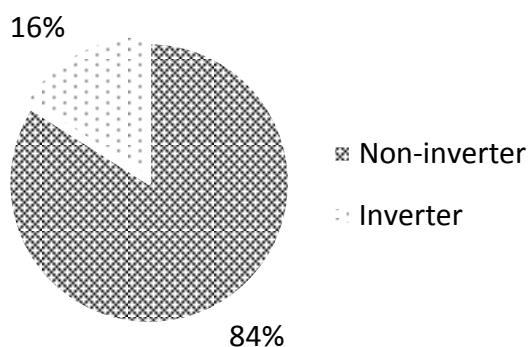
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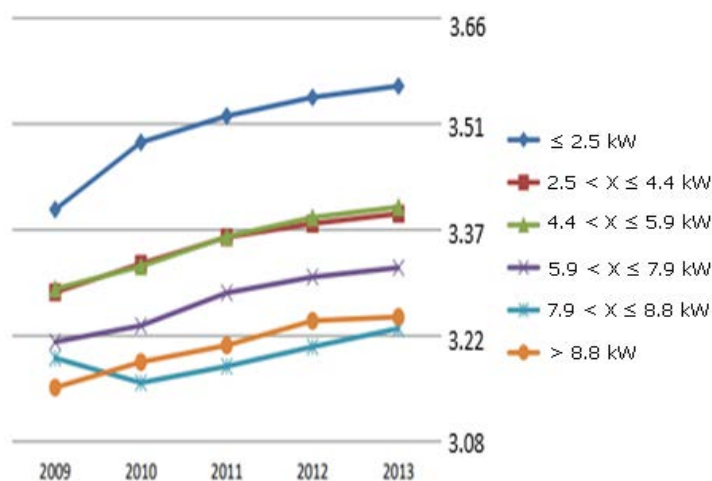
Figure 1. 7 Average EER (W/W) by cooling capacity of non-inverter AC sold during 2009-2013
Source: (UNEP, 2015)

1.3 Contribution of EER on Energy Consumption Reduction

Since AC consumes huge energy during operation stage and normally utilized many years, there is no doubt that promoting AC with higher EER would contribute to not only energy but also environmental conservation. According to Tangthai (2011), 99% of total CO_2 emission of the AC life cycle came from the using stage. Also according to the report by ECCJ, if the EER of AC improves from 2.82 to 5.45, the annual electricity consumption would be halve, which is equivalent to approximately 277 kiloliters of crude oil and would reduce annual CO_2 emission by 407.48 kg per unit (ECCJ, 2018). Hence, switching to the best technology on the market, a huge potential saving in electricity consumption could be achieved.

Figure 1.8 shows the difference of future total energy consumption of household ACs in Thailand by the different EER improvement. This prediction was calculated by the author. The calculation method is shown in appendix 1, where average EER of ACs used in Thai whole household improved by 0.01 per year for scenario 1, and improved by 0.04 per year for scenario 2. The calculation conditions (e.g. ownership number, the life-time, annual operation hours, cooling capacity ratio) are the same except the scenarios of EER improvement.
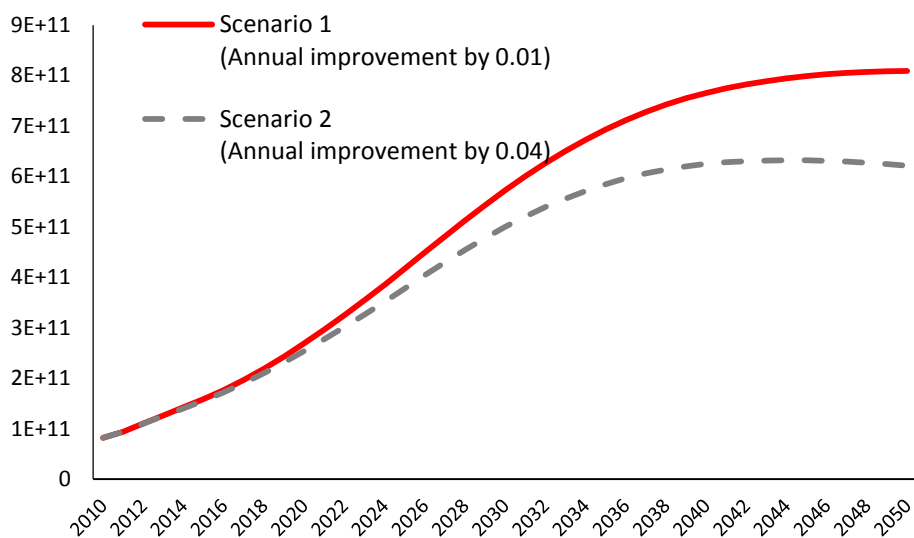
**Figure 1. 8 Future energy consumption of AC in whole Thai household
by the different EER improvement (MJ)**

The estimated result shows that the rising average EER of AC used in Thai household would reduce energy consumption significantly. The 0.03 difference in average EER improvement of AC in household would cause the difference of 200 billion MJ (56TWh) in annual energy consumption from household AC in 2050. 56 TWh is more than 5 times as much as a nuclear power plant with 100 KW. In other words, if the average EER of AC in household improves by 0.04 per year, total energy consumption of AC in Thailand would reduce by 56 TWh in 2050, compared to by 0.01. Therefore, adoption of higher efficiency AC in household is an urgent requirement.

Actually, there are already some policies in Thailand to enhance adoption of higher efficiency AC in household. It will be described in the next section.

1.4 National Policy for Reducing Energy Consumption

Thai government proposed "Thailand Energy Efficiency Development Plan (2011-2036)" under national energy policy with the aim to reduce energy intensity (EI) up to 30% by 2036 compared with the EI in 2010, and to reduce the final energy consumption by 30% (crude oil equivalent: 51,700 ktoe) compared with the reference forecast consumption in 2036. It is expected that 7,641 ktoe (or 89,672 GWh) would come from electricity.

Furthermore, in electricity saving target, 26% (or 23,760 GWh) would be achieved by labeling policy to improve energy efficiency of electric appliances in market and resident (Energy, 2016b). It is also expected that AC would have potential to make energy saving by 12,576 GWh if improving the existing low efficiency (EER = 8) to the higher efficiency (EER = 13) in household and market (Energy, 2016a). Thus, it is considered that enhancing adoption of higher efficiency AC would play significant and important role in achieving Thailand's Energy Efficiency Development Plan.

In order to achieve this goal, the government is attempting three energy saving measures for improving energy efficiency of AC; labeling policy, MEPS (Minimum Energy Performance Standard), and HEPS (High Energy Performance Standard). The purposes of the labeling policy, promoted by EGAT since September 1994, are to spread higher efficiency products for household, to make the market saturated with high efficiency products, and to make people understand the importance of energy saving. Figure 1.9 shows label sticker for electric home appliances. The label informs not only the efficiency level but also electricity cost, the amount of electricity use, and efficiency. The label indicator is divided into 5 ranks decided by EER (COP), and the rank 5 means the most efficiency products in the market. The share of rank 5 in AC accounts for 80%, and there is very few AC with less than rank 5 in the market. However, the average EER of AC available in the market is still low as mentioned above.

Figure 1. 9 Label stickers electric appliances, including AC, under EGAT labeling program

It seems that the labeling policy has a certain effect; meanwhile the incentive to adopt higher efficiency AC in the market is still weak. MEPS and HEPS are also introduced in order to improve the energy efficiency of electric products available in the market. MEPS, which are mandatory standard, dispose of products with less than minimum standard by compulsion. On the other hand, HEPS is no legal binding force due to the voluntary standard. HEPS gives the products only with high energy efficiency the NO. 5 label. EGAT reported that these three energy saving measures could reduce annual electricity consumption of AC by 21% from 1995 to 2009, yet, its effect is lower than refrigerator 41% (JICA, 2010).

1.5 Problem Statement

In order to promote ACs with higher efficiency in household, whether the price is reasonable or not would be possible important factor. However, continue promoting higher efficiency AC at a low price (under subsidy) is not realistic and possible. There is a limit to sell ACs at a low price because AC is output of commodity economy. There are also other factors except the price when people buy or replace with a new AC. Encouraging people to buy AC with higher EER by other strategies such as labeling policy or improving the attitude toward environment or any other key buying factors except the price would be effective way.

One of the other strategies, except the price, is to enhance people's awareness on energy label, the meaning and information on the label, and necessity of saving energy via efficiency concerns. If people recognize the importance of energy saving, the meaning of labeling policy and the energy efficiency (EER/SEER), the willingness to pay for higher efficiency AC, there would be a high possibility to be able to promote buying AC with higher efficiency without price lowering measure. Not only what labeling policy has been introduced, but also it is important to understand whether the policy is recognized among people, how much people understand the meaning of the labeling policy and EER/SEER, whether the policy influences on people's decision making process when they buy or replace with new products. In addition, more effective way to influence on people's buying decision making should be considered.

1.6 Objectives of the study

As mentioned above, the adoption of higher efficiency AC in household would be necessity even further from now on because the impact of AC on environment would be getting huge as the demand of AC in Thailand is increasing at an accelerated rate. Hence, in order to enhance the adoption of higher efficiency AC in Thai household, this study conducted a survey focusing on consumer purchasing behavior in AC. This study aims to investigate the current conscious of Thai consumers to higher efficiency AC and how the factors associate with attitude towards energy efficiency AC influencing on their purchasing intention. In this study, the higher energy efficiency AC was referred to inverter-type AC, while the lower efficiency one was referred to non-inverter or fixed speed type AC.

Objectives;
1) To investigate current situation of Thai consumer's consciousness to AC with higher efficiency AC
2) To investigate the relationship between consumers' concern, knowledge related to AC and purchasing attitude towards energy efficiency AC
3) To propose policy recommendation to enhance Thai consumers' awareness on higher efficiency AC

1.7 Research Questions

Key research question in this study is "What factors would influence on consumers purchase decision making?" In addition, the sub-research questions to support the research question are designed as follows.

(1) What would be characteristics of the consumers who are more likely to buy higher efficiency AC?

(2) How do consumers' knowledge and concern on higher efficiency AC influence on consumers purchasing intention?

(3) How can government enhance consumers' awareness other related factors (i.e. concern, knowledge, attitude) on Inverter AC?

1.8 Scope of the Study

The study mainly focuses on factors influencing on consumers purchasing attitude towards purchasing intention on energy efficiency AC. By the way, the respondents were selective only those who can access with internet due to online survey were conducted in this study. In addition, most questions in the questionnaire require understanding on the energy and environment issues, the respondents were selective only those who have relatively understood energy efficiency at a certain degree.

CHAPTER 2

Literature Review and Hypothesis Development

The present study aims to investigate factors affecting attitude towards purchasing intention on higher efficiency household air-conditioner in Thailand. Various researches concerning consumers' consciousness on environment and energy efficiency as well as factors influencing on purchasing behavior have been reviewed and summarized in this chapter. Key hypothesis were also developed and summarized in this chapter as well.

2.1 Energy Efficiency Ratio in Thai AC market

As mentioned in chapter 1, Thai government is promoting higher energy efficiency AC to consumers with energy label. On the energy label for AC, the type of appliance, EER (Energy Efficiency Ratio), electricity use, electricity cost are presented. Figure 2.1 shows specific labels for AC in Thailand.
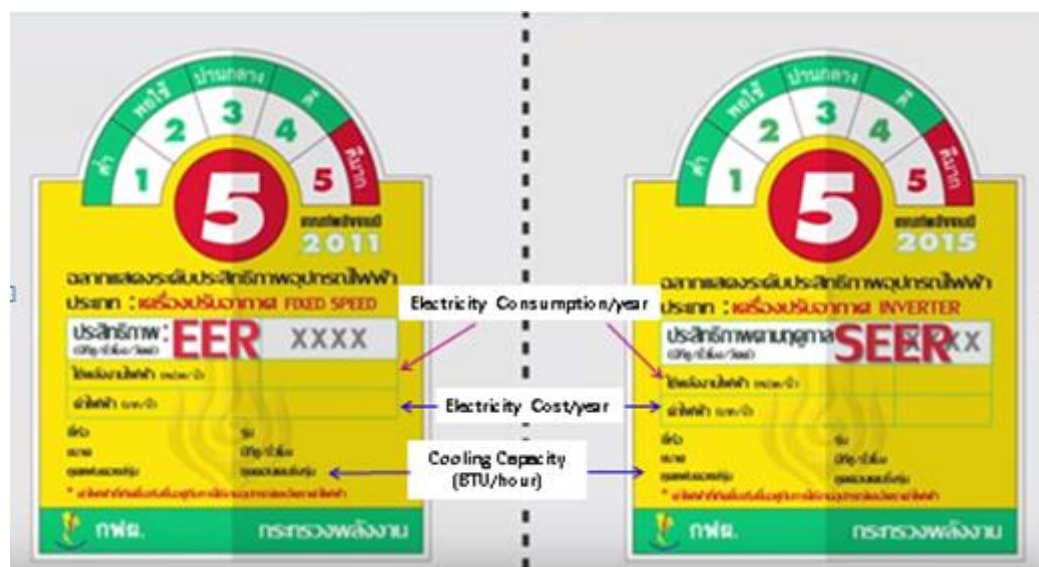
Figure 2. 1 Label stickers for inverter and non-inverter AC under EGAT labeling program

The EER of a particular air conditioner is calculated by dividing the input electrical power by the amount of cooling created under a single set of conditions. The difference between EER and SEER is the 'S', which means seasonal. Rather than measuring the energy efficiency of AC at one operating temperature, SEER can calculate the energy efficient of AC during the cooling season at varying temperatures. The EER is calculated using a steady outside temperature of 95°F, while the SEER is calculated using a range of outside temperatures ranging from 65°F to 104°F. In Thailand, SEER has been used on the energy label for AC since 2015.

2.2 Conscious Survey on Energy Efficiency in Thai Consumers

There are some reports investigating Thai consumer's consciousness on labeling policy. According to the comparison survey to investigate the effect of labeling policy for appliances between U.S and Thai (Pont, 1998), the label policy in Thailand was more found to be more effective on making consumers distinguish efficient model than that in US. It was also found that more than 60% of Thai consumers asked about the label at the store, while only 20% for the US consumers. Furthermore, energy efficiency was the fifth priority in Thai appliance consumers, while it was the ninth rank in U.S. consumers.

Sirijad (2001) survey about Thai consumer's perception on Label No.5 of energy-efficiency and found that most Thai consumers recognized the meaning of the number five label but having fair knowledge of the main goal of the energy efficiency (Srijad, 2001). She also reported that there was significant difference in understanding and attitude towards the number five label by the difference of gender, age, education and income. Furthermore, the energy efficiency was the sixth highest priority in the decision process of buying electric appliances. The top 3 popular influential factors in the decision process of buying electrical appliances in Bangkok included durability, price, and brand name, respectively.

Though there was a study on Thai consumers' consciousness on energy efficiency of electric appliances, focusing on how Thai consumer's concern and knowledge influence on their attitude toward purchasing higher efficiency AC statistically has not been studied yet.

2.3 Consumers' Green Purchasing Behavior

Consumers' purchase behavior has been deemed based on the theory of planned behavior (TPB) that proposes an interrelationship between subjective norm, perceived behavioral control, attitude, intention, and behavior. On the basis of TPB model, the most proximal determinant of actual behavior is behavioral intention, and the behavioral intention is determined by three factors; attitude toward behavior, subjective norm, and perceived behavioral control, as shown in figure 2.2 (A. Fishbein et al., 1975; Ajzen, 1991). *Attitude toward behavior* (personal factor) is defined as "a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object (A. Fishbein et al., 1975). *Subjective norm* (social factor) is the perceived social pressure to perform or not to perform in a behavior (Ajzen, 1991, p. 188). *Perceived behavioral control* (control factor) refers to people's perceptions of their ability to perform a given behavior. All behavioral intention to actual behavior consists of the three factors, and numerous studies have supported the validity of the TPB model.

The model have been also utilized as an backbone of theoretical framework on the researches of pro-environmental behavior and green purchase behavior such as energy saving behavior, environmental friendly behavior, and purchase of energy efficient appliance as the backbone of the theoretical framework (Chan, 1998; Chen et al., 2014; Tan et al., 2017; Youl et al., 2012; Nguyen, Lobo, 2017).
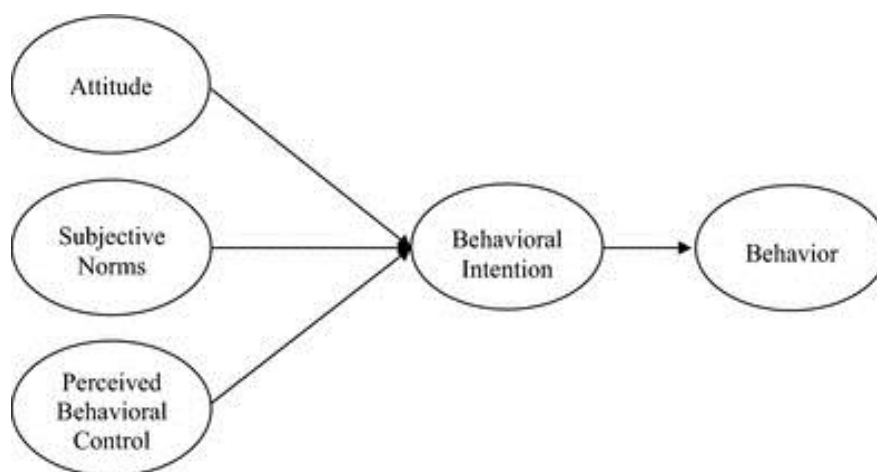
Figure 2. 2 The theory of planned behavior model (Ajzen, 1991)

The studies, for example, have found that purchasing intention for green products is the most significant determinant of actual green purchase behavior and have established the attitude toward green products is the most relevant predictors of purchasing intention (Grob, 1995; Jaiswal et al., 2018; Nguyen, Lobo, Greenland, 2017; Nguyen, Lobo, Nguyen, 2017; Schlegelmilch et al., 1996; Tan et al., 2017). In addition, they have investigated what factors have impact on the attitude toward purchasing green products.

Two factors, concern and knowledge on the green product, have been mainly considered as important factors influencing on the attitude toward purchasing green products. Either positive or negative impact of the two factors on attitude was found both in developed and developing countries. In case of knowledge factor, it was confirmed that the environmental knowledge has no significant impact on attitude and intention toward green products in both India and China (Chan, 2001; Jaiswal et al., 2018), while the researches in South Korea found that knowledge about energy efficient appliances has a positive impact on the attitude toward green products of young consumers in Vietnam and in Hong Kong (Hong-Youl, 2011; Ninh Nguyen, 2017; Lee, K, 2011). As for concern factor, Chin (2017) pointed out that environmental concern has no impact on purchasing intention for energy efficient appliance in Malaysia, while the positive relationship between environmental concern and attitude toward green products was observed in some studies (Aditi et al., 2017; Jaiswal et al., 2018; Tan et al., 2017).

In the field of green purchase behavior, relationship between some factors like concern, knowledge and attitude towards green products have been widely validated based on conventional consumer behavior model. This study also investigated the relationship between concern, knowledge and attitude toward purchasing higher efficiency AC in order to understand how to enhance consumers' attitude toward purchasing higher efficiency AC. Key hypotheses were developed based on the previous research as presented in following section.

2.4 Hypothesis Development

6 Hypotheses on effects of some factors like concern, knowledge and attitude toward purchasing intention on higher efficiency AC were developed and considered in this study.

➢ **Effect of Attitude**

Attitude is defined as "a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object (A. Fishbein et al., 1975). In the field of green purchase behavior, attitude toward purchasing green products is the most significant relevant factor to enhance the intention for purchasing green products in the three factors mentioned in TPB model. That is to say, positive attitudes toward green products is more likely to perform actual green purchase action as confirmed in previous studies (Aditi et al., 2017; Chan, 2001; Jaiswal et al., 2018; Nguyen, Lobo, Greenland, 2017; Tan et al., 2017). There are no research that found the negative relationship between attitude and intention. Chin-Seang (2017) proved the strongly positive relation between attitude towards energy efficiency products and purchasing intention for high energy efficiency products (Tan et al., 2017). Youl (2012) mentioned that consumer may choose AC as cheap as possible when they buy new one in general, but there is possibility that consumer decides on a more costly AC with high energy efficiency if the impact of the attitude towards energy efficiency products is significantly strong (Youl et al., 2012). It is also found in our life that our decision doesn't always depend on only price or financial matter. Taken together, "the attitude toward energy efficient AC would have positive effect on purchasing intention for energy efficient AC" is hypothesized in this study. In this study, purchasing attitude towards higher efficiency AC is defined based on as 'a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to higher efficiency AC'. Purchasing intention is defined as 'a plan to purchase higher efficiency AC.'

H1: Purchasing attitude towards higher efficiency AC would have positive effect on purchasing intention on higher efficiency AC.

In order to understand consumer attitude toward energy efficient products, it may be of great importance to investigate how the attitudes are formed (Youl et al., 2012). Hence 3 hypotheses influencing on the attitude toward purchasing higher efficiency AC are constructed as follows.

➢ **Concern and Knowledge on 'Inverter'**

As mentioned in section 1, energy efficiency of AC is significantly depends on whether the AC includes inverter or not. Although both non-inverter and inverter ACs are sold in Thai market, almost is non-inverter type. Hence this study considers that if consumers understand about inverter technology or have concern over inverter, they are likely to buy inverter AC (higher efficiency AC) because understanding the inverter technology means understanding the advantage of inverter such as lower electric cost in use stage. Acknowledgement of inverter would give consumers good impression. This study investigates how much their understanding or concern have impact on their attitude toward purchasing higher efficiency AC.

In terms of concerns, Robert (1997) found concern related to environment has strong positive relation with recycling behavior, energy saving behavior, and green purchase behavior in US, and noted individuals with a higher level of environmental concern should be more likely to perform environmental conscious behavior (Roberts et al., 1997). Recent studies also observed the positive relation between environmental concern and green purchase behavior (Chen et al., 2014; Jaiswal et al., 2018; Tahir et al., 2013). Inverter concern is considered to be positively related to the attitude toward energy efficiency AC directly. In this study, inverter concern is defined as "a general concept that can refer to feelings about inverter technology", referring to the definition of environmental concern by Minton (1997). Take together; the followings are hypothesized in the present study.

H2: Concern on 'Inverter' would have positive effect on attitude towards energy efficiency AC

In extant literature, the positive relation between knowledge and behavior has been reported generally (J. Hoch et al., 1989; Lin et al., 2006; Marija, 2005). On the other hand, in the research of environmental behavior, it cannot be confirmed clearly that the positive relation between environmental knowledge and environmental behavior. Hence this research also investigates the relationship between knowledge and attitude.

In general, it can be said that consumer who have relatively high environmental knowledge are more likely to perform environmental-friendly behavior (Nguyen, Lobo, Greenland, 2017). Furthermore, Anderson (1982) found that lower level of knowledge in environment would be a barrier for consumers to choose energy efficient appliance (Anderson et al., 1982). Hence we assume that knowledge, especially related to the object strongly, have impact on purchasing attitude toward energy efficiency AC, Taken together, the following hypothesis is set in the present study.

H3: Knowledge on 'Inverter' would have positive effect on attitude towards energy efficiency AC

➢ **Concern and knowledge on 'Energy Label Information'**

Label on a product is one of the tools that consumers make their choices based on symbols or information on labels. People may decide some products they want to buy such as foods, appliances, vehicles, and dairy goods after considering the information on label. In addition, they may change their mind from one to the others due to influenced by the information on label at shop even if they don't have intention to buy the others before seeing the information. Many researchers have investigated the impact of label information on consumer behavior. Thomas (2004) found that environmental label has a significant effect on the choice of toilet paper in Denmark (Bjørner et al., 2004).

Labeling policy for electric appliances has been implemented in many countries including Thailand, in order to reduce energy consumption. Energy label plays important role on their process of choice for purchasing electric appliances. In Switzerland, it is found that the energy label is an important and meaningful factor on their purchasing decision in electric appliances (Sammer et al., 2006). Shen (2009) also concluded that energy label had a significant effect on the choice of air conditioners and refrigerators in China (Shen et al., 2009).

In Thailand, the energy label includes the information of the efficiency level with 5 stars, EER or SEER (Energy Efficiency Ratio), the amount of electricity use (kWh), electricity cost, and appliance type. These information indicates the efficiency level of a product so that buyers who refer the information on the label may decide to purchase AC with higher energy efficiency.

Hence, referring that some researchers have observed the effect of label information on their purchase behavior for energy efficient appliances, this research assumes that how significant the label information effects on their purchase behavior for higher efficient AC is depending on their strength of concern and knowledge about the energy label information. Taken together, the following hypothesis will be set in the present study.

H4: Concern on 'energy label information' would have positive effect on attitude towards energy efficiency AC

H5: Knowledge on 'energy label information' would have positive effect on attitude towards energy efficiency AC

➤ **Concern about 'payback period'**

Payback period in the present study means the length of time required to recover the higher price of inverter AC, when compared with the non-inverter AC as mentioned in chapter 1. Considering the payback period of the inverter AC (higher efficient AC) is more reasonable and attractive because AC is used over 9 years in general. However, in the actual AC market in Thailand, information of the payback period is not shown both in the energy label and at the selling point. Showing the information of payback period would be an effective way to enhance purchase intention on energy efficient AC. In order to confirm effect of payback period information on attitude towards buying energy efficient AC, this study investigated the relationship between 'concern on payback period' and 'purchasing attitude on energy efficient AC'. It is assumed that the more consumer concerning on payback period the more favorable purchasing attitude on energy efficient AC. Hence, the following hypothesis was investigated in the present study.

H6: Concern on 'payback period' would have positive effect on attitude towards

energy efficient AC

With reference to the foregoing literature reviews, a conceptual model for the present study was proposed in figure 2.3.
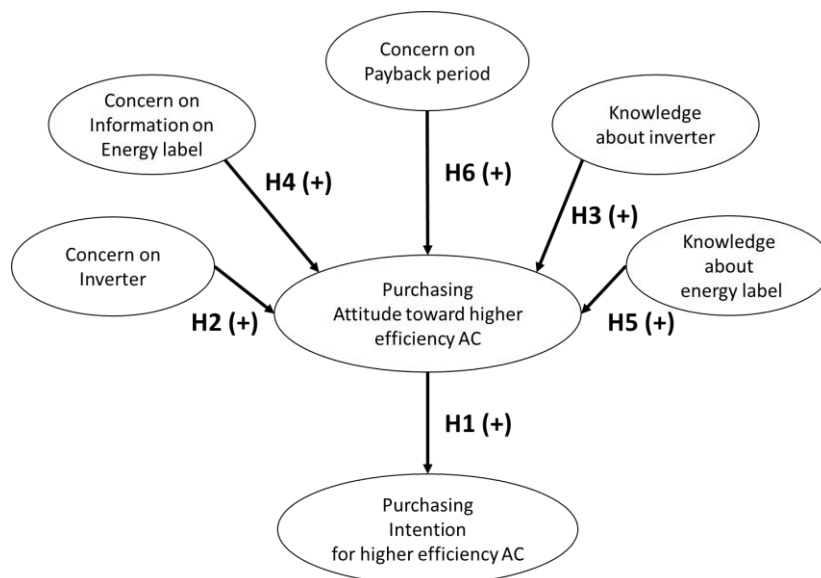
Figure 2. 3 Proposed model for the present study

CHAPTER 3

Methodology

As previously mentioned, the adoption of higher efficiency AC in household would be necessity even further from now on because the environmental impact from AC utilization would be getting huge as the demand of AC in Thailand is increasing at an accelerated rate. In order to enhance the adoption of higher efficiency AC in Thai household, this study conducted a survey focusing on consumers' attitude towards purchasing intention on higher efficiency household AC with the following research design and methodology.

3.1 Research design

The research plan was constructed as shown in figure 3.1. The research firstly started by literature reviews in order to find issues, appropriate research methodology, and the focus of the study. Secondly, data collection, using purposive sampling method, was conducted via online questionnaire referring to previous studies. Thirdly, the collected data was analyzed with two methods, descriptive analysis and structural equation modeling analysis. Finally, results findings, discussion, and conclusion of the study were presented.
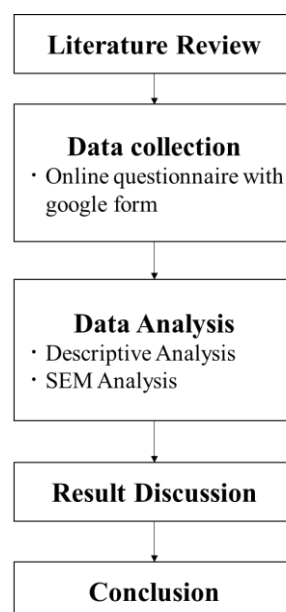
Figure 3. 1 Research Design Chart

3.2 Methodology

In this study, a purposive sampling method was use for questionnaire survey, and two main methods: Cross-tabulation analysis and Structural equation modeling (SEM), were used for data analysis.

3.2.1 Purposive Sampling

A purposive sampling is a type of nonprobability sample. The main objective of a purposive sample is to produce a sample that can be logically assumed to be representative of the population. This is often accomplished by applying expert knowledge of the population to select in a nonrandom manner a sample of elements that represents a cross-section of the population. In this study, most questions in the questionnaire require understanding on the energy and environmental issues, the respondents would be limited to consumers who have relatively understood energy efficiency at a certain degree because relationship between knowledge as well as concern associated with energy efficiency AC and their purchasing attitude was investigated. Therefore, a purposive sampling method was used in this study.

3.2.2 Cross-tabulation analysis (Descriptive analysis)

According to some literatures, Thai people seem to understand the meaning of labeling information, but not energy efficiency concern. By the way, the researches were conducted 20 years ago (Peter, 1998; Sirikamol, 2001). Therefore, current consumer conscious to higher efficiency AC, their preference for buying AC was firstly investigated with cross tabulation analysis at different age, gender, education, income.

In question 1, the priority factors considering when buying a new AC was surveyed. In questions 2-4, their experience buying AC in the recent 5 years and their plan to buy in the future 5 years were surveyed. Questions 5-6 investigated the possibility whether they change their mind to buy an inverter type or not after considering the information of payback period.

Clare (2006) found that there appears to be a relationship between "price sensitivity" and "always reading labels" as well as indicating that there is "sufficient information" on product labels to make informed purchase decisions (Clare et al., 2006).

In the present study, information of payback period of an inverter AC, compared with the non-inverter AC, was expected to be an effective way to enhance buying inverter type AC. Therefore, respondents were questioned their choice between inverter and non-inverter AC with the information of price, EER (in question 7), and with electricity cost (in question 8), and payback period in addition to the information shown in question 4 in order to compare the difference in their choice. The payback period means the length of time required to recover the higher price of inverter AC, when compared with the non-inverter AC. The payback period was calculated under the same conditions with annual operation of 2920 hours (8h per day), electricity cost at 3 THB/kWh, using products made by Daikin (Japanese), Career (USA), and Star Aire (Thailand).

3.3.2 Structural Equation Modeling

The Structural Equation Modeling (SEM) was used to depict the relationships among those factors quantitatively on the proposed model. SEM is a very general statistical modeling technique widely used in the behavioral sciences and is known as the combination of factor analysis and multiple regression analysis among latent constructs which cannot be measured directly such as intelligence, concern, and belief. Specifically, a theoretical model can be tested in SEM that hypothesizes how sets of variables define constructs and how these constructs are related to each other (Randall et al, 2010).

As mentioned in section 1.6, it has been found that actual purchasing intention for green products is determined by attitude for green products which is influenced by some factors. Hence, this study investigated how these other factors such as (1) concern on inverter (2) concern on the information on the energy label (3) concern on payback period influence (4) knowledge about inverter (5) knowledge about information on the energy label, influence on purchasing attitude for higher energy efficient AC.

The SEM was selected for the study because this study asked consumers their concern and knowledge by a self-administrated questionnaire so that the factors consist of latent variables. All constructs on the study were measured via seven-point Linkert scales since many past literatures have adopted it as the measurement method. Respondents were asked to indicate their level of agreement for each of the items by indicating numbers ranging from 1 representing "strongly disagree" to 7 representing "strongly agree". The measurement items for each latent variables and its abbreviation are shown in Table 3.1.

Domain	Measurement items	Abbreviation	Ref.
Attitude	I have a favorable attitude toward purchasing an inverter-type AC.	PA1	(Youl et al., 2012) + Author
	If I can choose between inverter and non-inverter AC, I prefer inverter one.	PA2	(Youl et al., 2012) + Author
Intention	The probability that I will buy an inverter-type AC is very high.	PI1	(Youl et al., 2012) + Author
	I will buy an inverter AC in a more effective way	PI2	(Youl et al., 2012) + Author
Concern on inverter	I concern on Inverter AC	CI1	(Urban et al., 2012) + Author
	I would care whether AC is inverter or not when I buy AC	CI2	(Jaiswal et al., 2018) + Author
Concern on energy label	I care about the energy label information when I buy new AC.	CE1	Author
	The information of energy label is important for me when I buy AC.	CE2	Author
Concern on payback period	I would care about the information of payback period when I buy AC	CP1	Author
	I want to see the information of payback period on the energy label.	CP2	Author
Knowledge about inverter	I understand about Inverter technology	KI1	Author
	Inverter technology can contribute to energy saving	KI2	Author
Knowledge on energy label	I understand the meaning of label on a product	KE1	Author

| I understand the meaning of energy efficiency (EER/SEER) on the Label? | KE2 | Author |

Table 3. 1 14 latent variables and the abbreviations

The SEM is also known to be combined essentially path model and confirmatory factor model (CFA). Numerous studies have used the SEM to test the relationships among observed or latent variables in predicting actual consumer purchasing behavior.

First step for SEM is CFA. In this study, two measurement items were constructed for each latent factor. The CFA was approached to test the significance of the proposed factor model, and whether the collected data confirm that latent factors, as presented in Table 1 and figure 3.2.

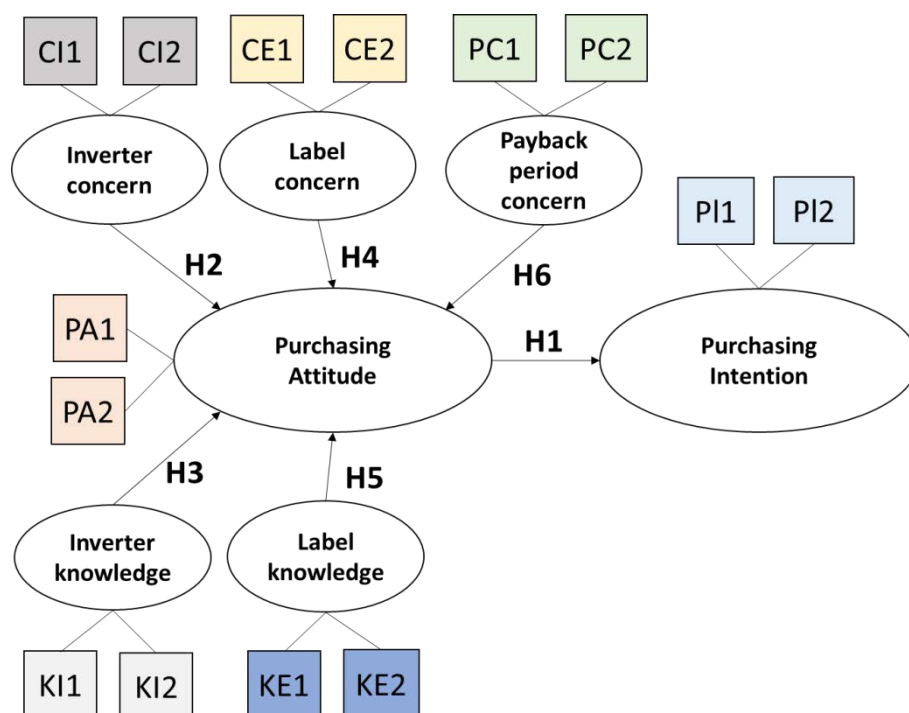**Figure 3. 2. Each measurement items for each latent factors**

The CFA can evaluate statistically the reliability and validity of the measurement model (Randall et al, 2010; Hair et al., 2015; Ho, 2014). In CFA, construct validity and convergent validity were checked based on previous research. Construct validity, which is the confidence level of how well the measurement items taken from a sample represent the

actual true score in the population, was checked with factor loadings (Hair et al., 2014; Tan et al., 2017). It is said loading above 0.50 is significant. Convergent validity which dictates the degree to which multiple items measuring the same construct are in agreement was measured with composite reliability (CR) and average variance extracted (AVE).

The method to calculate AVE and CR is as follows. According to Hair et al (2014) and Tan et al (2017), AVE should be greater than 0.5 at least, CR should be greater than 0.7 suggested by Hair et al (2014) and Tan et al (2017) (Hair et al., 2014; Tan et al., 2017). The method to calculate AVE and CR is as follows.

$$AVE = \frac{\sum_{i=1}^{k} \lambda_i^2}{n} \qquad (1)$$

$$AVE: Average\ Variance\ extract$$
$$\lambda_i: The\ standardized\ factor\ loading$$
$$n: The\ number\ of\ items$$

$$CR = \frac{\left(\sum_{i=1}^{n} \lambda^2{}_{ij}\right)^2}{\left(\sum_{i=1}^{n} \lambda_{ij}\right)^2 + \sum_{i=1}^{\beta} Var(\varepsilon_i)} \qquad (2)$$

$$CR: Indicates\ composite\ reliability$$
$$\lambda_i: The\ standardized\ factor\ loading$$
$$Var(\varepsilon_i): The\ Variance\ due\ to\ the\ measument\ error$$

In order to test internal reliability and the consistency of the measurement items, Cronbach's alpha (CA) is most common traditional method. However, recent researches have argued that CA has several limitations (Hair et al., 2014; Tan et al., 2017). In the study, composite reliability (CR) was used as an alternative measurement method to test internal reliability.

Second step for SEM is to analyze the relationships between each factors and . The fit of the proposed model was tested with the Chi square (χ^2), the Goodness of Fit Index

(GFI), Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA). The model fit is good when χ^2/df <3.0, and the values of GFI as well as CFI>0.90. In terms of RMSEA, it is very good if less than 0.08 and unacceptable if higher than 0.1 (Nguyen et al, 2016; Hu and Bentler, 1999). The proposed model was analyzed with SPSS (Statistical Package for Social Science) and AMOS (Analysis of Moment Structure) software.

CHAPTER 4

Result and Discussion

Results of the study are described and discussed in this chapter starting with profile of respondents, characteristics of consumers who bought inverter type AC during the recent 5 years, awareness level of the word 'inverter', preference factors in purchasing AC, impact of payback period information, characteristics of consumers' concern, and then results of SEM analysis.

4.1 Profile of Respondents

This study was conducted by online questionnaire survey using Google Form in May 2018 among Thai consumers. The respondents are totally 202 Thai people over 18 years old. The self-administered questionnaire was issued via either direct or indirect distribution to students, working adult, their family and friends. The number of 202 respondents are acceptable in SEM analysis to investigate 7 latent factors.

To ensure the respondents understand context of the study, important information likes definition of energy efficiency AC, which referred to inverter AC in this study, the meaning of payback period, and the picture of current energy label implemented in Thailand, were presented at the beginning of the questionnaire form. Contents of the questionnaire are shown in appendix 2. The questionnaire of this study was designed to contain three parts. Part 1: respondent's demographic information. Part 2: simple questions to survey their important factors consideration to buy AC, their experience and plans to buy AC, and their conscious to payback period. Part 3 measures the latent variable to investigate relationship between the proposed factors in each hypothesis and purchasing

attitude for energy efficient AC.

Detail characteristics of the respondents are shown in Table 1. Almost all respondents' education levels are bachelor degree upward. Meanwhile, no large deviation in gender and income level among the respondents was observed. Regarding environmental background of the respondents, it is found that 73% of which have ever studied environmental issues.

This ensures that respondents would have a certain level of knowledge and interested in energy and environmental impacts. This would confirm the power of the self-report method in predicting purchasing behavior.

Among 104 respondents who bought AC during the recent 5 years, 62% of which bought inverter type AC. About half of the respondents (102 persons) plan to buy new AC during the next 5 years, and up to 84% of which plan to buy inverter type AC. This confirms that most of the respondents understand how important of buying high energy efficient inverter type AC.

Table 4. 1 Demographic data of the respondents

Variable	Frequency	%
Gender		
Male	95	47.0
Female	107	53.0
Age		
18-27	68	33.7
28-37	35	17.3
38-47	49	24.3
48-57	31	15.3
58-67	17	8.4
68-77	2	0
Older than 77	0	0
Education		
Less than secondary school	0	0
High school	0	0
college	3	0
Bachelor degree	78	38.6
Master degree	86	42.6

|		
Ph.D. Degree	35	17.3
Ever studied about environmental issues		
Yes	148	73.3
No	54	26.7
Household income (per year)		
THB 0 - THB 299,999	53	26.2
THB 300,000 - THB 699,999	59	29.2
THB 700,000 – THB 999,999	35	17.3
Higher than THB 999,999	55	27.2
Bought AC in the recent 5 years		
Yes	104	51.5
No	98	48.5
The AC type		
Inverter	65	62.5
Non-inverter	28	26.9
Did not remember	11	10.6
Plan to buy new AC during the next 5 years		
Yes	102	50.5
No	68	33.7
Not yet decide	32	15.8
The AC type		
Inverter	86	84.3
Non-inverter	0	0
Not yet decide	16	15.7

4.2 Descriptive Analysis

4.2.1 Characteristics of consumers who bought inverter type AC

Characteristics of respondents who bought inverter type AC during the recent 5 years were analyzed based on each variable comparison. Among half of the respondents (104 of total 202 persons) who bought AC during the recent five years, 61% (63 persons) of which bought inverter type, 27% bought non-inverter AC, and the rest (12%) could not remember.

In comparison between inverter group and non-inverter group as shown figures 4.1 - 4.3, some different characteristics were observed. Up on gender comparison, males are dominant (62% of the 63 respondents) in the inverter group, while females are dominant (61% of the 41 respondents) in the non-inverter group. Meanwhile, both age and income levels appear to have no significant impact difference among the inverter group and non-inverter group. However, it is surprising that up to 78% of the respondents who bought non-inverter type AC are those who have relative high annual income of THB 300,000–999,999.

This indicates that the higher income levels do not always influence on consumers' purchasing decision to buy inverter AC with higher price. On the other hand, the findings presented the respondents with higher education level tend to buy inverter type more than those with lower education level. All respondents who bought inverter type AC have education level bachelor degree upward. Hence, it can be said that education level has influence on consumers' decision making on choosing inverter or non-inverter. In case of knowledge or background on environmental issues, it was found that respondents who have ever studied environmental problem are dominant both in the inverter and non-inverter groups. This implies that knowledge or background on environmental issues appears to exhibit low impact on decision to purchase inverter type.
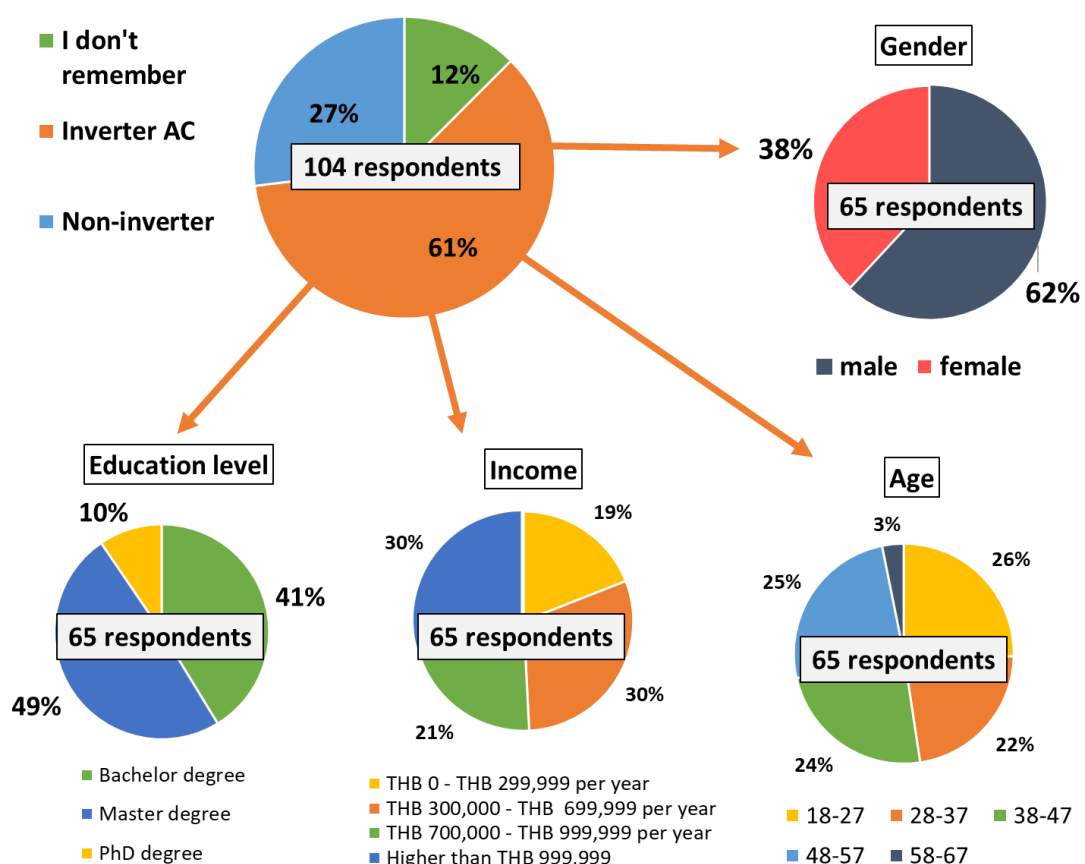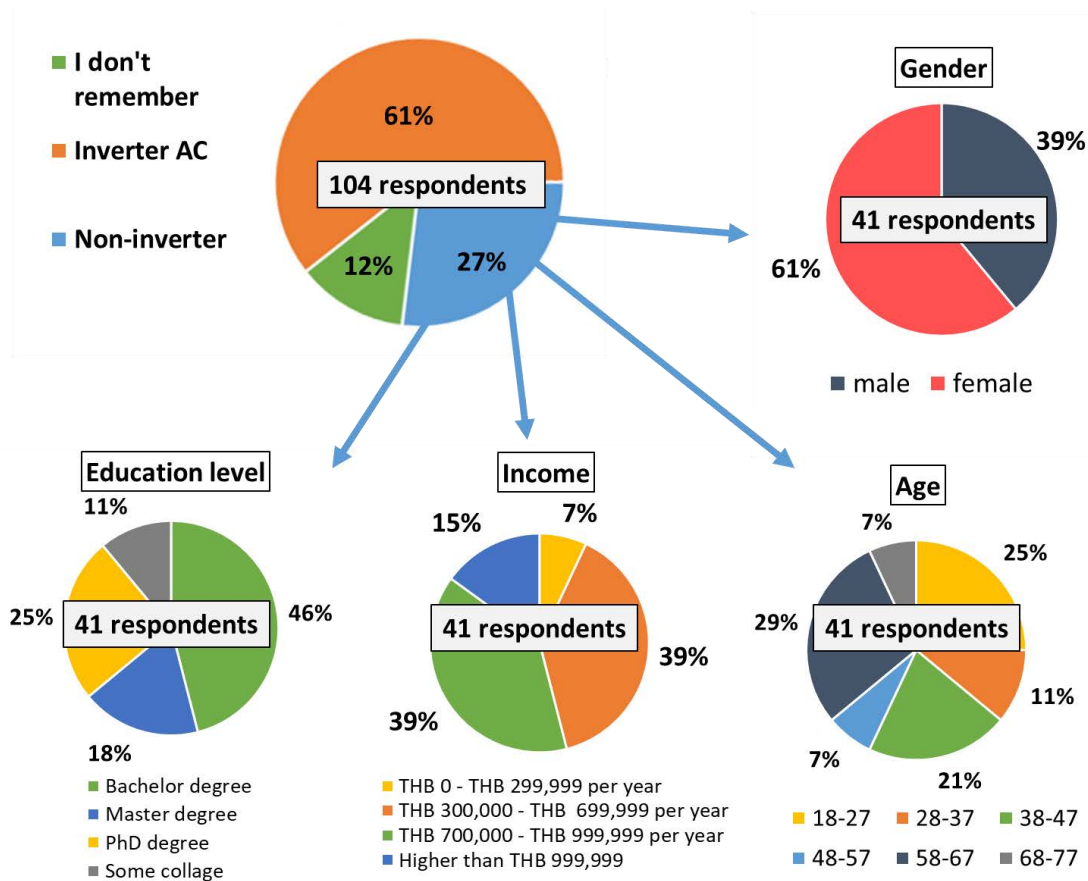
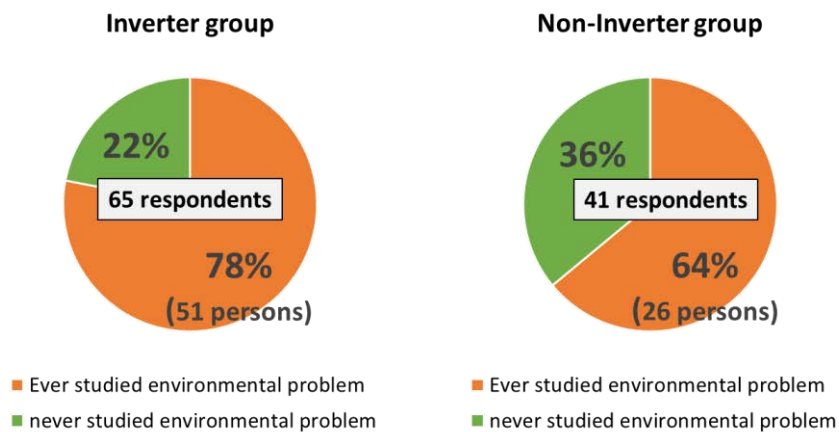**Figure 4. 2 Characteristics of consumers who bought NON-Inverter AC**

Figure 4. 3 Comparison between inverter and non-inverter by background

Summary of the above findings,

- Higher portion of respondents who bought inverter type AC are males.

- No significant impact of age difference has been observed from the present respondent group.

- No significant impact of income level difference has been observed from the present respondent group.

- Consumers with relative high education tended to purchase inverter type AC.

- Higher portion of respondents who bought inverter type AC are tend to be those who have knowledge or background on environmental problem (ever studied environmental problem). However, respondents who have ever studied environmental problem are dominant both in the inverter and non-inverter groups. Hence, knowledge or background on environmental issues appears to exhibit low impact on decision to purchase inverter type.

4.2.2 Awareness level of the word 'inverter'

Respondents' level of familiarity to the word 'inverter' was investigated in this study. Up to 92% (185 people) of all respondents are familiar or have ever heard the word 'inverter' (see also figure 4.4). Recognition on "Inverter" among those with and without environmental background was then comparatively investigated. The results as shown in figure 4.5 indicate that the respondents having environmental background tend to have more recognition on "Inverter" than those without environmental background. However, the recognition ratio was higher than 80% in the both groups. This implies that environmental background has low impact on recognition of the word 'Inverter'.

It was also found that all of the 8% who never heard the word have not yet buying AC during the recent 5 years. Therefore, they would have some chance to hear the word in their daily life or at some selling points, regardless of education background. Surprisingly, all respondents who bought AC during the recent 5 years, either inverter or non-inverter, are familiar or ever heard the word 'inverter' as shown in figure 4.6. It is noticed that even familiar with the word 'Inverter', they still bought non-inverter type. This implies that

familiarity with the word 'Inverter' is not key buying factor for the inverter AC. There would be other factors to be concerned.
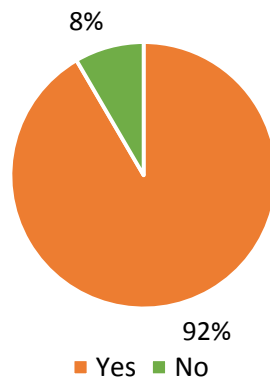

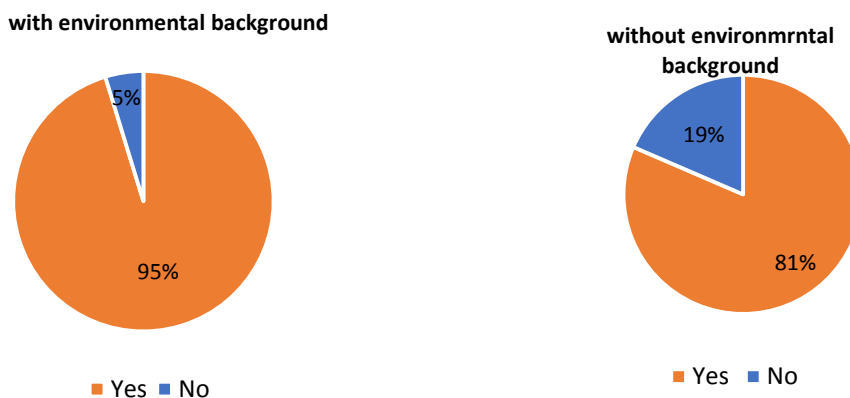**Figure 4. 4 Respondent's familiarity on "Inverter"**

Figure 4. 5 Respondent's recognition on "Inverter"

Figure 4. 6 Familiarities on "Inverter" between AC buyers of the both group

However, there were many people who acknowledge about inverter technology in the respondents who recognize the word 'Inverter'. Figure 4.7 shows the result of the self-assessment response to the question "I understand about inverter technology" by ranking from 1 (strongly disagree) to 7 (strongly agree). The findings depicted more than half of the respondents indicating above '5'. This implies that most respondents have not only heard the word 'Inverter' but also acknowledged about inverter technology.
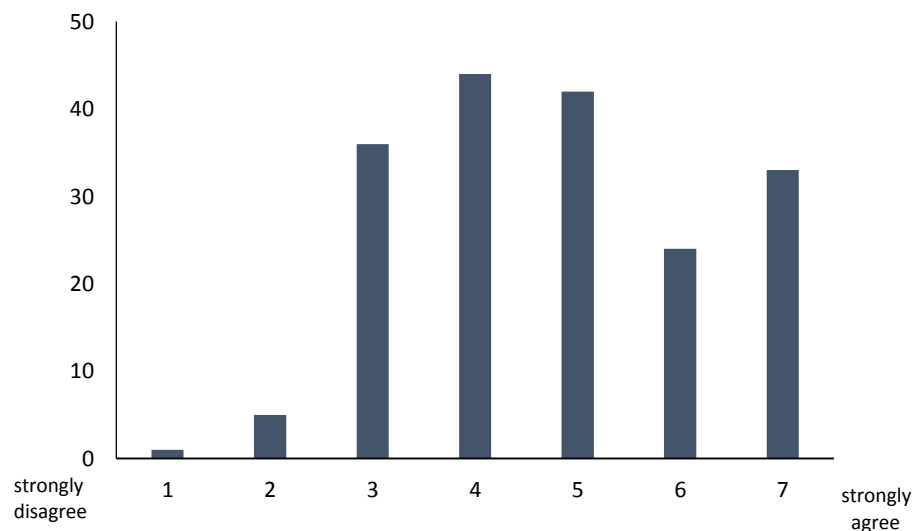

Figure 4. 7 Respondents' acknowledgement on inverter technology

Here the findings in the section are summarized up as follows,

● More than 90 % of the respondents have heard the word 'inverter'

● Comparing recognition on Inverter, it was found that he respondents who have ever studied environmental problem exhibit slightly higher recognition ratio than those never studied.

● Either customers who bought inverter type or non-inverter type are all familiar on the word 'inverter'.

● Most respondents not only recognize but also acknowledge on inverter technology.

4.2.3 The preference factors in purchasing AC

Consumers' preferring factors in purchasing AC were investigated from the 202 respondents. The results as shown in figure 4.8 indicate that the top 5 factors that respondents considered in the first priority are size (cooling capacity in BTU/hour), price, quality, brand, and energy efficiency, respectively. While the top 5 factors being considered in the second priority are price, brand, quality, energy efficiency, and size, respectively. Similarly, the top 5 factors being considered in the third priority are price, brand, size, energy efficiency, and quality, respectively. It is noticed that all top 5 factors being considered in all 3 priorities are the same, just different in sequent order. In addition, size or cooling capacity of the AC seems to be the most preferable factor to be considered first, followed with price and brand. Meanwhile, other factors like design, color, innovative technology, durability, and guarantee are not preferably considering factors.
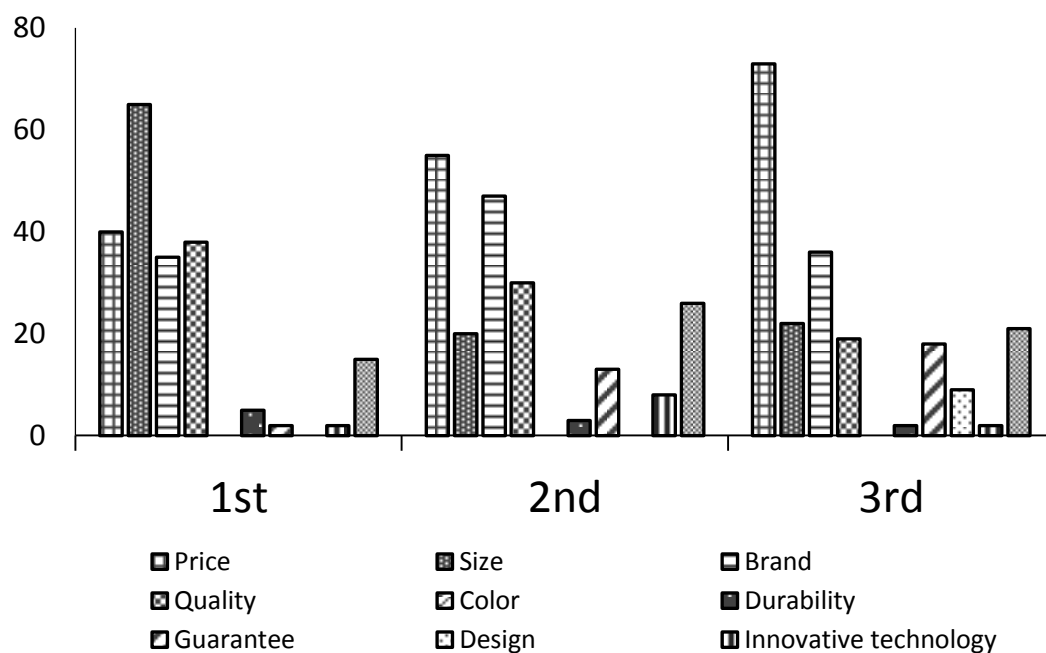

Figure 4. 8 Respondent's preference factors in purchasing AC

Previous survey (Pont, 1998) conducted in 1988 to Thai consumers presented 'brand' was the most considered factor, followed with price, color, quality, energy efficiency, respectively. Table 4.2 shows the comparison between previous results and the present results.

Table 4. 2 Comparison of top 5 factors being considered in the first priority

between the previous research and the present study

TOP 5 Order	The previous result (conducted in 1998)	The present result (conducted in 2018)
1	Brand	Size (capacity in BTU)
2	Price	Price
3	Color	Quality
4	Quality	Brand
5	Energy efficiency	Energy efficiency

Results comparisons as shown in Table 4.2 implies that about 20 years ago, most Thai consumers mainly relied on product brand, meanwhile at present all product brands must comply with either international or government standards as well as energy label. In addition, most Thai consumers have become more understanding on product technical issues and can access more information than before. Hence, most consumers tend to firstly consider size or cooling capacity of the AC that is suitable with the room areas, while the product brands become being considered at the 4th priority. Surprisingly, even energy efficiency is in the top 5 factors to be considered, most Thai customers still ranked it in the 5th priority both in 1998 and 2018. Therefore, it is recommended that raising awareness on energy efficiency would be widely and continuously implemented. This would be one of policy recommendations for Thai government.

Next, preference factor characteristics differentiated by gender, age, and income level were analyzed. Ten preference factors (size, price, brand, quality, energy efficiency, innovation technology, durability, guarantee, color, and design) were asked to prioritize in the survey, and then calculated with weighting approach to show preference factor characteristics based on each variable as shown below.

$$The\ ratio\ of\ x_j\ in\ x_{all}\ (\%) = \frac{3 \cdot x_{j(1)} + 2 \cdot x_{j(2)} + 1 \cdot x_{j(3)}}{\sum_j \{3 \cdot x_{j(1)} + 2 \cdot x_{j(2)} + 1 \cdot x_{j(3)}\}} \times 100 \qquad (3)$$

Where x_j: Factor j in category x

x is the category such as female, male, 18-27, 28-37, etc. j is the factor such as price, size, brand, etc. "The ratio of x_j in x_{all} (%)" indicates the prefer degree of the j for category x in all factors. Here x_j means factor j in category x, and $x_{j(1)}$ indicates the sum of x_j which ranks the 1st priority. $x_{j(2)}$ & $x_{j(3)}$ mean the sum of x_j which respectively ranks the 2nd and 3rd priority. The score of x_j is calculated by pulsing $x_{j(1)}, x_{j(2)}$ and $x_{j(3)}$. Then the ratio of x_j in all factors is obtained by dividing the sum of $x_{j(1)}$ and $x_{j(2)}$ and $x_{j(3)}$ by the sum score of all factors. In addition, in order to make a difference between the 1st, 2nd, and 3rd ranks, each total value $(x_{j(1)}, x_{j(2)}, x_{j(3)})$ is weighted by using a weighting coefficient. The value ranked the 1st $(x_{j(1)})$ is multiplied by 3, the value ranked the 2nd $(x_{j(2)})$ is multiplied by 2, and the 3rd one $(x_{j(3)})$ is multiplied by 1. By using this weighting equation, the ratio of each x_j in all factors was calculated.

The calculation results are presented in figures 4.9 - 4.11. Figure 4.9 indicated that males prefer considering brand, while females prefer considering quality as an important factor. However, no significantly different trend was observed for the other factors. Regarding differentiation based on respondents' age, as shown in figure 4.10, it was found that senior respondents (68-77 years old, but only 2 persons) prefer considering or paying more attention on energy efficiency and price, while the younger respondents prefer considering on size, brand, and quality. Upon differentiation based on respondents' family annual income, as shown in figure 4.11, it was revealed that the respondents having income higher that 999,999 THB/year prefer considering on size and brand, while the respondents having lower income prefer price consideration as the first priority.
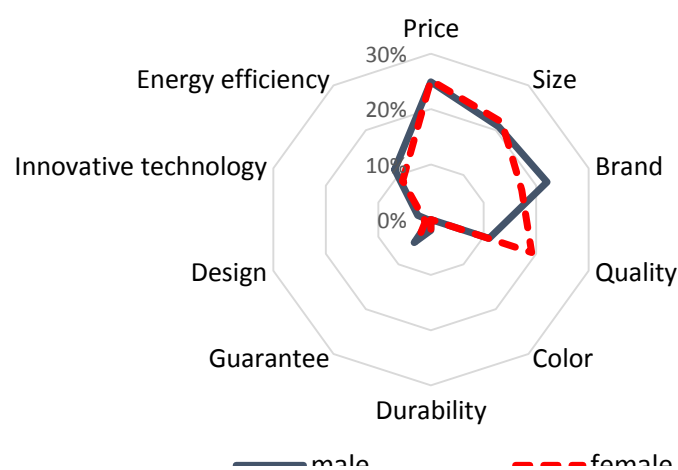

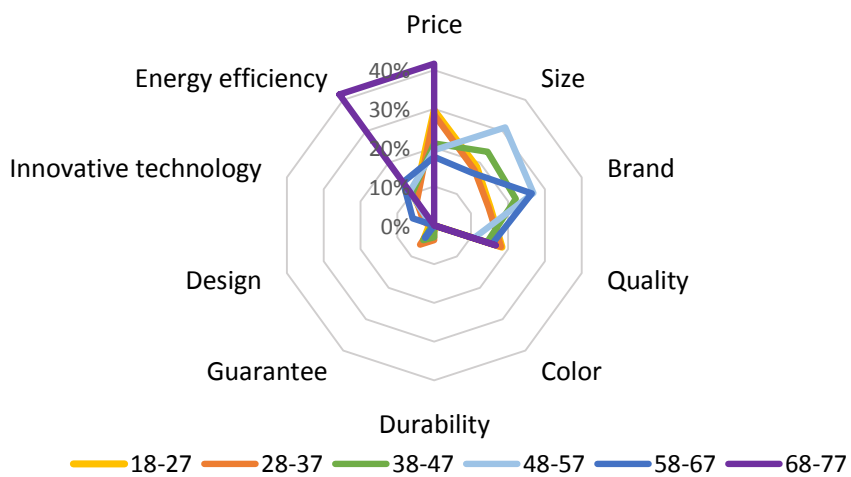**Figure 4. 9 Preference factors differentiation based on gender**

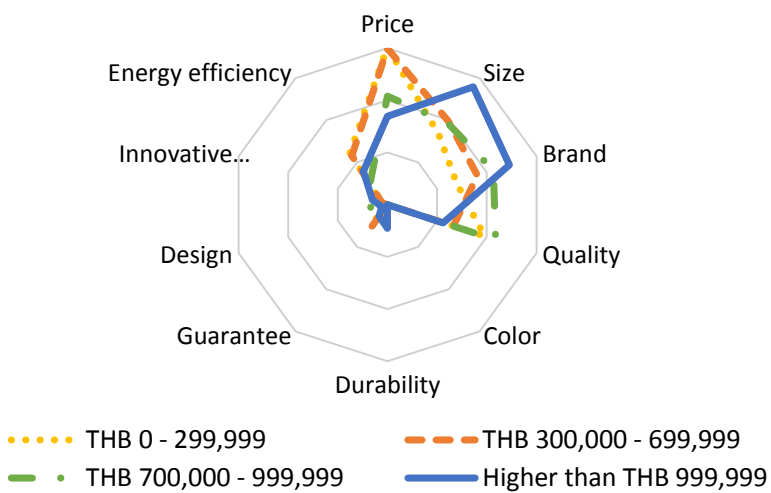**Figure 4. 10 Preference factors differentiation based on age**

Figure 4. 11 Preference factors differentiation based on family annual income

Summary of the findings on the section is as follows,

- Size, price, quality, brand, and energy efficiency were the top 5 factors being considered by the respondents.

- Brand was the first priority being considered by the respondents in 1998, while dropped to the fourth priority in this study (2018).

- Energy efficiency factor was the fifth priority both in 1998 and 2018

- Males prefer considering brand, while females prefer considering quality as an important factor.

- Senior respondents (68-77 years old, but only 2 persons) prefer considering or paying more attention on energy efficiency and price, while the younger respondents prefer considering on size, brand and quality.

- Respondents having income higher that 999,999 THB/year prefer considering on size and brand, while the respondents having lower income prefer considering on price as the first priority.

4.2.4 Impact of showing payback period information

Payback period of the higher price but lower energy consumption is expected to be important information to encourage or enhance buying an inverter-type AC. Impact of showing payback period information either on the energy label or on the product brochure was investigated in this study. As mentioned in 2.2, the higher price of inverter AC can be recovered within 2 years or less in almost AC selling in Thai markets at present, while AC is usually used longer than 8 years. This information would be attractive with high impact to encourage buying an inverter-type AC. However, in the actual AC market in Thailand, the information of payback period is not shown either on the energy label or on the product brochure. In addition, in Thai market even non-inverter AC shows No 5 on the label. Therefore, most consumers couldn't distinguish the merit of buying inverter AC. Even though, there is information of both amount of electricity consumption and electricity cost per year shown on the energy label, only few consumers would calculate the payback period. Therefore, showing the information of payback period would be an effective way to enhance purchase behavior for energy efficient AC.

In order to find the effectiveness of showing the information of payback period, two information, AC information (product specification and price) were shown in the questionnaire survey, first with AC information without payback period and then followed with AC information with payback period. The respondents were asked for their degree of buying intention for inverter AC after reading each information set. The product specification and price with and without payback period information are shown in Tables 4.3-4.4.

Table 4. 3 Product specification and price without payback period information

Brand	Model	Inverter	Price (THB)	SEER
Daikin	Smash	×	19490	12.06
	Sabai	○	22490	16.91
	Super Smile	○	24900	19.8
	Smart	○	28900	21.81
Career	HEF	×	18900	13.46
	TVGS	○	21900	19.38
Star Aire	CE12	×	13900	12.13
	CE125 IV	○	18900	19.31

Table 4. 4 Product specification and price with payback period information

Brand	Model	Inverter	Price (THB)	SEER	Electricity Cost (THB/Year)	Payback Peroid (to non-inverter type)
Daikin	Smash	×	19490	12.06	10478	
	Sabai	○	22490	16.91	8398	1.4 years
	Super Smile	○	24900	19.8	7740	1.8 years
	Smart	○	28900	21.81	7322	2.8 years
Career	HEF	×	18900	13.46	9418	
	TVGS	○	21900	19.38	7833	1.9 years
Star Aire	CE12	×	13900	12.13	10499	
	CE125 IV	○	18900	19.31	7813	1.8 years

*The information was accessed from website of each brand as of April 2018

After reading information in Table 4.3, the respondents were asked "Will you buy inverter AC or not?" by ranking from 1 (strongly disagree) to 5 (strongly agree). Then, the respondents were asked again after reading information in Table 4.4 with the same question. The results as shown in figure 4.12 indicate that showing information of payback period exhibits positive impact for the respondents having high (4-5) degree of purchasing intention, but no impact for those having low-medium (1-3) degree of purchasing intention. However, the respondents having high degree of purchasing intention are much higher than those having low-medium (1-3) degree of purchasing intention. This implies that most respondents already have their intention to buy inverter AC, but some enhancement with payback period information was also observed.
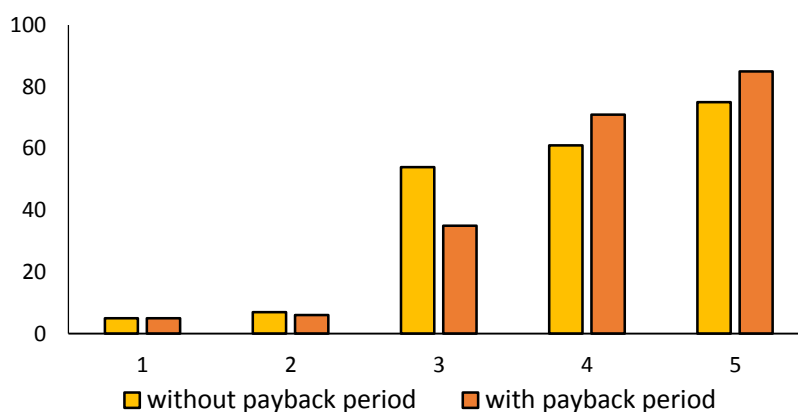
Figure 4. 12 Respondent's degree of purchasing intention for inverter AC

4.2.5 Characteristics and degrees of respondents' concern on energy label, payback period, and the word 'Inverter'

The respondents were asked by self-reporting "Do you concern on the issues of energy label, payback period, and the word 'Inverter'?" by ranking from 1 (strongly disagree) to 7 (strongly agree). The results indicate that more than half of the respondents reported their highly concern on the three issues, with ranking above 6, as shown in figure 4.13. The results also indicate that respondents tend to have the highest degree of concern on energy label, followed with payback period, and the word 'Inverter', respectively.
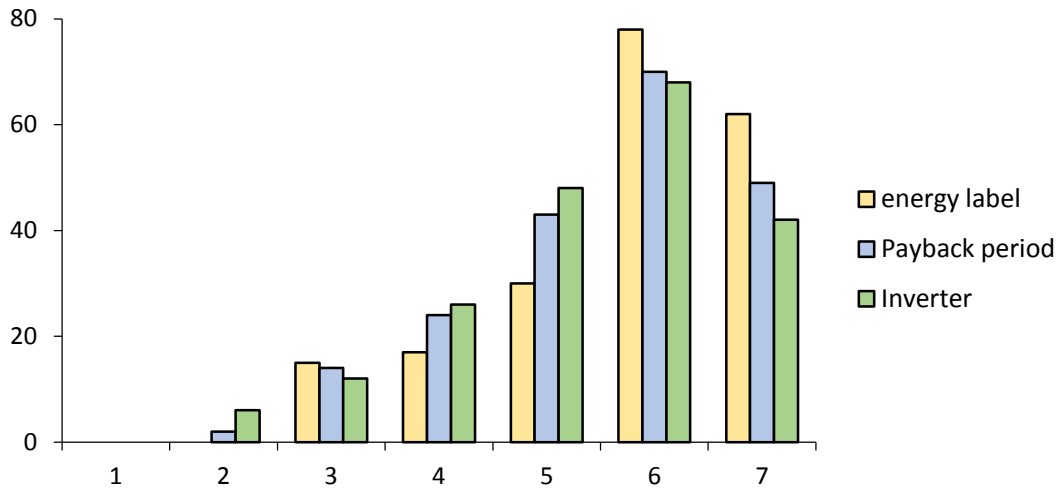
Figure 4. 13 Degrees of the respondents' concern on energy label, payback period, and the word 'Inverter'

Concern characteristic based on respondents' gender, age, family annual income, and environmental issue experience are shown in figures 4.14-4.17. The concern characteristic based on gender, as shown in figure 4.14, indicate that either males or females concern the three issues nearly the same ratio. Hence, no gender differentiation was observed for the three issues concern.
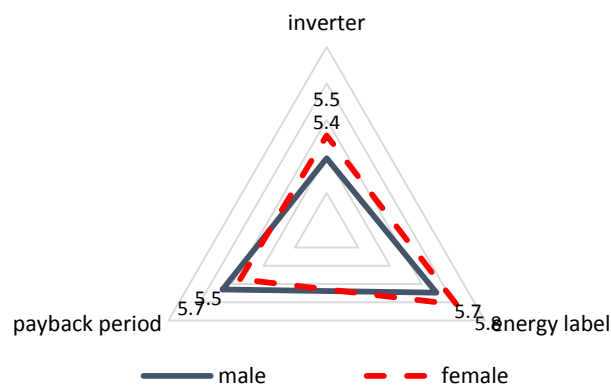

Figure 4.14 Concern characteristic based on gender
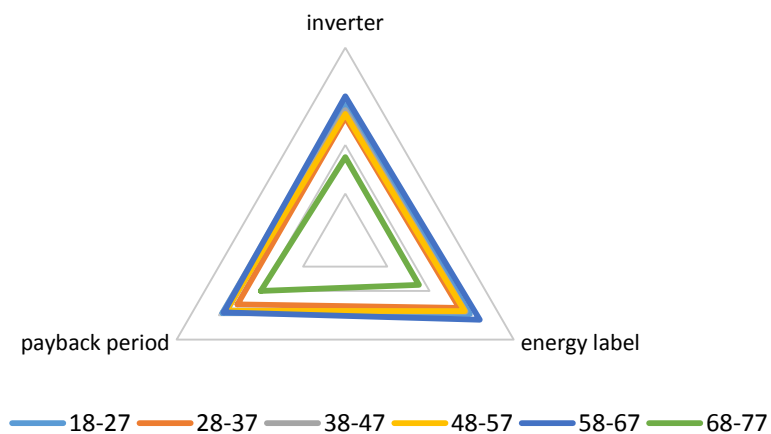
Figure 4. 15 Concern characteristic based on age
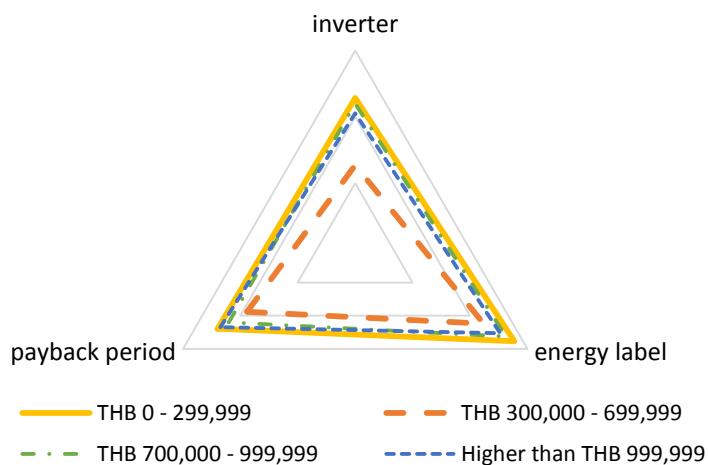
Figure 4. 16 Concern characteristic based on family annual income
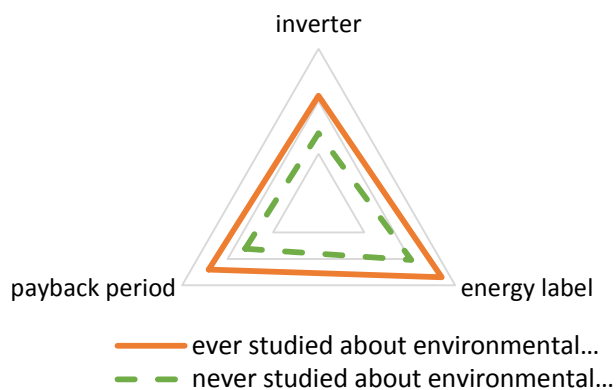
Figure 4. 17 Concern characteristic based on environmental issues experience

Similarly, results shown in figure 4.15 indicate no characteristic differentiation based on age was observed, except the respondents older than 68 years old tend to have lower degree of concern on the three issues. However, it would not be good representative because there are only 2 respondents in this age range.

Results shown in figure 4.16 indicate no characteristic differentiation based on family annual income was observed, except the respondents having income 300,000-699,999 THB/year tend to have lower degree of concern on the three issues.

Regarding the respondents' experience or background on environmental issues, the results as shown in figure 4.17 indicate that respondents having experience or background on environmental issues (ever studied about environmental problem) have higher degree of concern on the three issues. This implies that understanding environmental issues is important to encourage or enhance buying an inverter or higher efficient AC.

The summary in this section is as following,

- More than half of the respondents significantly concern with inverter, energy label, and payback period
- The difference based on gender was not significant
- Senior respondents' concern was lower than the youngers
- No characteristic differentiation based on family annual income was observed, except the middle income of 300,000-699,999 THB/year tend to have lower degree of concern on the three issues.
- Respondents having background on environmental issues (ever studied about environmental problem) have higher degree of concern on the three issues

4.3 Result of Structural Equation Modeling (SEM) Analysis

4.3.1 Confirmatory factor analysis

The CFA measurement model indicates a good fit of data to the model as shown in Table 4.5. In construct validity, factor loadings of all variables exceeded 0.5 and were significant at the 1% level in the collected data. In convergent validity, AVE valued higher than 0.80 so that the construct explains more than half of the variance of its indicators. The result of reliability test with CR shows all values ranging from 0.897 to 0.950, where greater than 0.7 as suggested by Hair et al (2014) and Tan et al (2017). Hence the measurements in the study indicated adequate internal consistency reliability.

Table 4. 5 Result of construct validity and convergent validity measures

Variables		Mean	SD	CR	AVE	Loadings
Purchasing attitude		5.748	1.266	0.944	0.895	
	PA1					0.839
	PA2					0.853
Purchasing intention		5.710	1.274	0.950	0.906	
	PI1					0.868
	PI2					0.835
Concern on inverter		5.295	1.387	0.938	0.884	
	CI1					0.918
	CI2					0.862
Concern on energy label		5.839	1.138	0.911	0.837	
	CE1					0.902
	CE2					0.880
Concern on payback period		5.639	1.174	0.927	0.863	
	CP1					0.937
	CP2					0.821
Knowledge on inverter		4.68	1.475	0.939	0.885	
	KI1					0.918
	KI2					0.863
Knowledge on energy label		4.908	1.371	0.897	0.814	
	KE1					0.890
	KE2					0.799

Note: CR=Composite Reliability, AVE=Average Variance Extracted

4.3.2 Hypothesis analysis

Next, in the fitness of the proposed model was tested with the Chi square (χ^2), the Goodness of Fit Index (GFI), Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA), the result was as follows: χ^2 = 143.329 (df = 67, p< 0.01, χ^2/df=2.139), GFI = 0.912, CFI = 0.975, RMSEA of 0.075.

While p-value for chi-square was less than 0.01, it is highly sensitive to sample size, so various alternative values such as GFI, CFI, and RMSEA for checking fitness have been used so far.

Results of the standardized path loadings are shown in Table 4.6. The squared multiple correlations for the structural equations were 0.835 for purchasing attitude on higher efficiency AC, and 0.855 for purchasing intention on higher efficiency AC.

Table 4.6 and figure 4.18 illustrate the results of hypothesis analysis. Each latent factor was constructed by two measurement factors, and the good fit of data to each factor was confirmed with CFA as mentioned in 4.3.1. Relationship between purchasing attitude towards higher efficiency AC and its intention (**H1**) was strongly positive and significant (β=0.924; p<0.001). The proposed relationship between concern on inverter and purchasing attitude towards higher efficiency AC (**H2**) was also supported in the study (β=0.384; p<0.001); however, the proposed relationship between knowledge on inverter and purchasing attitude toward energy efficiency AC (**H3**) was not statistically significant (β=-0.19; p>0.05). Similarly, while the predicting positive relationship between concern on energy label and purchasing attitude toward higher efficiency AC (**H4**) was confirmed (β=0.34; p<0.001). While the knowledge on information of energy label (**H5**) did not convert into a significantly positive effect on purchasing attitude toward energy efficiency AC (β=0.04, p>0.05). In addition, a significant relationship between concern on payback period and purchasing attitude toward higher efficiency AC (**H6**) was confirmed (β=0.238; p<0.005). Furthermore, the positive relationship among the three concerns and the two issues of knowledge were found. However, the result demonstrated no positive relationship between concern and knowledge (KE and KI; 0.683, CI and CP; 0.790, CI and CE; CE and CP; 0.706, CI and KI; 0.039, CE and KE; 0.090).

Taking together, the result indicates that consumers' concern on the three issues: 'inverter', 'energy label information', and 'payback period' have positive impact on their purchasing attitude, while their purchasing attitude have positively influence on purchasing intention on higher efficiency AC.

Table 4. 6 Results of path coefficients and hypothesis testing

			β	p-value	Supported
PA	→	PI	0.924	<0.001	**H1**: Yes
CI	→	PA	0.384	<0.001	**H2**: Yes
KI	→	PA	-0.19	>0.05	**H3**: No
CE	→	PA	0.372	<0.001	**H4**: Yes
KE	→	PA	0.044	>0.05	**H5**: No
CP	→	PA	0.238	<0.005	**H6**: Yes

*** P<0.001; ** P<0.01, * P<0.05. β Standardized regression coefficient of path relationship
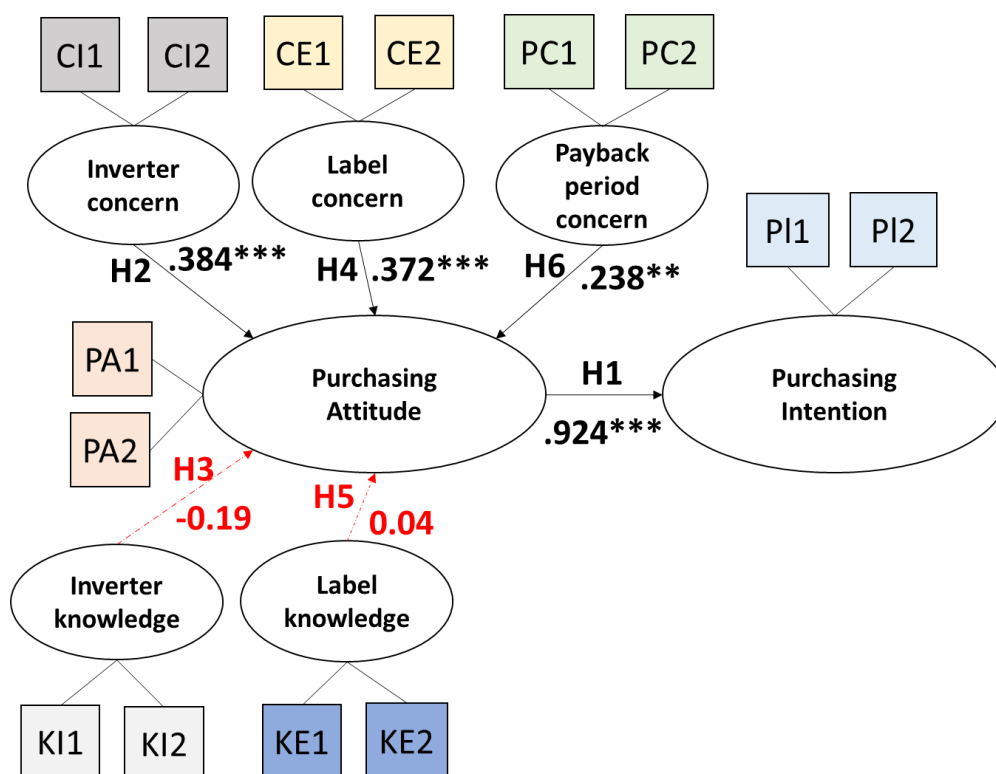
*** P<0.001; ** P<0.01, * P<0.05. β Standardized regression coefficient of path relationship

Figure 4. 18 Result of hypothesis analysis

4.2.3 Discussion

Firstly, consumers' purchasing attitude towards higher efficiency AC was found to have strongly positive relationship with consumers' purchasing intention on high efficiency AC (**H1**), which in turn highly correlated with consumers' actual purchasing behavior. Hence, the result implies that consumers having favorable purchasing attitudes towards higher efficiency AC would generally tend to purchase the higher efficiency AC. This finding was supported by previous studies in consumer purchase behavior toward energy efficiency appliances (Ha and Janda, 2012; Tan et al., 2017; David et al., 2011). Based on the respondent profile, 73.3% of the total respondents (n=202) have ever studied environmental issues, and more than 60% of which have high education with master or PhD degree. This suggests that consumers with high education and/or having background on environmental issues basically demonstrate favorable attitudes towards purchasing energy efficiency AC. Thus, it is considered that making consumers favorable attitude towards purchasing energy efficiency AC would encourage actual purchase behavior to energy efficiency AC.

By the way, how can we enhance such favorable attitude towards energy efficiency AC? This study analyzed that whether the three issues of concerns (inverter, energy label information, and payback period) as well as the two issues of knowledge (inverter and energy label) have positive relationship with favorable attitude towards purchasing energy efficiency AC in Thai consumes with relative high education level.

The relationship between concern on environment and actual environmental behavior (purchasing eco-friendly products for example) have been paid attention in the field of consumer purchase behavior and many studies have demonstrated its positive relationship (Chan et al., 2014; Chen and Tung, 2014; Hartmann el at, 2012). This study also exhibited positive relationships between the three concerns (inverter, energy label information, and payback period) and the purchasing attitude towards higher efficiency AC. Specifically, consumers who have concern on inverter are prone to have favorable attitude towards purchasing higher efficiency AC with inverter. The findings indicate that the respondents having concern on inverter seem to know what inverter contributes to energy saving, even though they don't understand the detail of inverter technology.

In addition, consumers having concern with information on the energy label also tend to have favorable attitude towards purchasing higher efficiency AC. Hence, it is assumed that current information (degree of efficiency with No 5, electricity consumption and cost, EER/SEER, etc.) on the energy label would have some effect on purchasing higher efficiency AC. Even if consumers don't acknowledge energy efficiency ratio (EER/SEER), they seem to be influenced by the variables of the information on the label when they buy AC. This result was consistent with the previous study that confirmed the positive relationship between attitude to energy label and purchase intention to high efficiency electric products in South Korea (Jung Ah Hwang, 2016). Furthermore, consumers having concern about payback period tend to have favorable attitude toward purchasing higher efficiency AC. It appears that consumers who consider payback period understand well on the cost-effectiveness of energy efficiency AC. In other words, consumers may consider private benefit in the cost that they have to pay in total. Therefore, the information of payback period would promote or enhance purchasing inverter type to consumers.

The study found that the degree of knowledge about either inverter or energy label information doesn't have any positive impact on their attitude towards purchasing energy efficiency AC. Even though positive relationship between knowledge related to environment and purchasing attitude or intention has been demonstrated in South Korea and young consumers in Hong Kong (Hong-Youl, 2011; Ninh Nguyen, 2017; Lee, K, 2011). Meanwhile, some previous studies in India and China (Chan, 2001; Jaiswal et al., 2018) reported no significant impact of knowledge related to energy efficiency AC on consumers' attitude towards energy efficiency AC which is similar result as the present study. It is proposed that even if consumers understand the inverter technology in detail or understand about the meaning of information on the energy label such as EER (energy efficiency ratio), it cannot confirm that only knowledge on related issues would enhance consumers to buy energy efficiency products. However, encouraging consumers to have both concern and knowledge on key related issues would be an effective way to enhance purchasing energy efficiency and/or green products.

4.2.4 Policy Recommendation

The implication of these findings is that not only giving knowledge on inverter and energy label but also strengthening consumer's concern on inverter, energy label, and payback period would enhance consumers' favorable purchasing attitude toward higher efficiency AC. By the way, how can these concerns are enhanced in Thailand?

Firstly, in order to enhance the Inverter concern to Thai consumers, not only approaching to consumers directly at the place of sales, information on such big advantages of the inverter AC would be continuously campaigned either via mass media, social media, or education system. In addition, big promotion program is needed.

Secondly, in addition to continuing effort to gain publicity of the energy label, increasing the frequency of updating and revising the standards on the label are also important. As presented in the result, some consumers who are interested in energy label may be influenced by information on the label for their decision to purchase high efficiency AC, even if they cannot understand the detail in the label such as the meaning of EER/SEER. At present, most Thai consumers understand and recognize No 5 on the energy label very well. They always buy products with Label No 5. However, both inverter and non-inverter AC in Thai market at presents are all No 5 on the label, even different efficiency ratio. In order to make the energy label more effective tool to enhance buying higher energy efficiency products, increasing the frequency of updating the standards of NO.5 and revising the assessment standard for Label No 5 is recommended. "5+, 5++, and 6" for instance should be made for the Inverter AC in order to make consumers easy to understand to distinguish and to influence consumers' decision making to buy AC. Furthermore, informing how the number of each information influence on consumer is essential to enhance their interest to higher efficiency AC.

Thirdly, based on the finding that concern on the payback period have influenced positively on purchasing higher efficiency AC, showing the information of payback period at the selling place via small signboard, paper, or voce is the simplest way. Consumers always consider economic advantage preferentially. Therefore, purchasing inverter AC needs to be more advantageous than purchasing non-inverter AC.

Actually inverter AC is more reasonable than non-inverter if considering electricity use, even though price is higher. Therefore, payback period information showing how many years that consumers can recover the different price they pay for the inverter would help them to understand private benefits.

CHAPTER 5

Conclusion

This study focused on consumer purchasing attitude towards intention to buy higher efficiency AC due to the significant increase in electricity consumption of household AC in Thailand. An online questionnaire survey was conducted to investigate two research questions; (1) current situation of Thai consumer's consciousness on higher efficiency AC, and (2) relationship between consumers' concern, knowledge related to AC, and purchasing attitude towards energy efficiency AC. The data collected from 202 respondents having relatively high education levels and middle to high income was analyzed by both descriptive analysis and structural equation modeling analysis.

In descriptive analysis based on the 202 respondents, the findings can be divided into 5 categories.

- Firstly, in the characteristics of consumers who bought inverter type AC are found to be higher ratio of males, younger consumers, and having environmental background. Whereas, no significant relationship between income level and consumers' decision making on whether to buy inverter or non-inverter.

- Secondly, as for the consumers' awareness level of the word 'inverter', although the results show that more than 90 % of the respondents have heard 'inverter' as a whole, the recognition ratio of consumers who ever studied about environmental issues was slightly higher than those never studied. In addition, either consumers who bought inverter AC or non-inverter AC had recognized 'inverter' so that consumers didn't choose non-inverter without recognizing 'inverter'. Furthermore, most respondents may have not only recognition but also acknowledge about inverter.

- Thirdly, in terms of consumers' preference factor to buy AC, size, price, quality, brand, and energy efficiency were found to be top 5. It was also found that size and quality became more preferable factors when compared to the study in 1998.
  - ➤ Based on gender consideration, males prefer considering brand, while female prefer considering quality as important factor.

> ➢ Based on age consideration, younger consumers prefer considering price as the most preference factor, conversely, senior consumers, except people over 68 years old, considered size and brand rather than price.
>
> ➢ Based on income level consideration, consumers with low to middle income prefer considering price, while those with higher income prefer considering size, brand, and quality rather than price. Consumers with lower income also considered energy efficiency as important factor.

- Fourthly, in the investigation of impact of showing payback period information between inverter and non-inverter, the effectiveness of showing payback period was found.

- Finally, in the characteristics of consumers concern on inverter, information on energy label, and payback period, there is no significant difference by gender, more ratios of senior consumers, consumers with middle income, and consumers with environmental background illustrate more concern on the three issues.

In structural equation modeling (SEM) analysis, the mainly finding was that while positive relationships between concern on inverter, energy label, payback period and consumers' purchasing attitude towards higher efficiency AC were demonstrated, there was no significant relationship between knowledge on inverter, information on the energy label and the attitude in this study. Based on the results of present study, it is suggested that policy maker should consider not only giving knowledge to people but also making people to have more concern on key related issues would be an effective way to enhance purchasing either energy efficiency products or green products.

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Appendixes

APPENDIX A: The Contents of Questionnaire

Number	Contents	Answer	
Part 1			
Q1	Gender	Female/Male	
Q2	How old are you?	o 18-27 o 28-37 o 38-47 o 48-57 o 58-67 o 68-77 o Older than 77	
Q3	o 18-27 o 28-37 o 38-47 o 48-57 o 58-67 o 68-77 o Older than 77	o Less than the secondary school o High school o Some college o Bachelor degree o Master Degree o Ph.D. degree	
Q4	Education 2	o I have studied about environmental problem at school o I never studied environmental problem	
Q5	Household income	o THB 0 - 299,999 per year o THB 300,000 - 699,999 per year o THB 700,000 - 999,999 per year o Higher than THB 999,999	
Part2			
Q6	Before buying AC, which factor will you consider the first (1st), second (2nd), and third	o Price o Size o Brand o Quality	o Durability o Guarantee o Design o Energy Efficiency

	(3rd)?	o Color	o Innovative Technology
Q7	Have you heard about inverter AC?	o Yes o No	
Q8-A	Did you buy AC in the last 5 years?	o Yes o No	
Q8-B	If you bought AC in the last 5 years, which type did you buy?	o Inverter o Non-Inverter o I don't know	
Q9-A	Do you have a plan to buy new AC during the next 5 years?	o Yes o No	
Q9-B	If you plan to buy AC in the next 5 years, which type did you buy?	o Inverter o Non-Inverter o I don't know	
Q10	After seeing this information, I will buy inverter AC	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

Brand	Model	Inverter	Price (THB)	SEER
Daikin	Smash	×	19490	12.06
	Sabai	O	22490	16.91
	Super Smile	O	24900	19.8
	Smart	O	28900	21.81
Career	HEF	×	18900	13.46
	TVGS	O	21900	19.38
Star Aire	CE12	×	13900	12.13
	CE125 IV	O	18900	19.31

Q11	After seeing the information of payback period, I will buy inverter AC.	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
	Note: Payback period means the length of time required to recover the higher price of inverter AC, when compared with the non-inverter AC. For example in Daikin, you can recover the difference of price between		

		Sabai (Inverter) and Smash (non-inverter) within 1.4 years by the difference of electricity cost.

Brand	Model	Inverter	Price (THB)	SEER	Electricity Cost (THB/Year)	Payback Peroid (to non-inverter type)
Daikin	Smash	×	19490	12.06	10478	
	Sabai	○	22490	16.91	8398	1.4 years
	Super Smile	○	24900	19.8	7740	1.8 years
	Smart	○	28900	21.81	7322	2.8 years
Career	HEF	×	18900	13.46	9418	
	TVGS	○	21900	19.38	7833	1.9 years
Star Aire	CE12	×	13900	12.13	10499	
	CE125 IV	○	18900	19.31	7813	1.8 years

Part 3	This section will ask about your concern or knowledge. Please answer truly for investigating current situation correctly.
Q12	I have a favorable attitude toward purchasing an inverter type AC. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q13	If I can choose between inverter and non-inverter AC, I prefer inverter one. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q14	I understand about inverter technology ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q15	Inverter technology can contribute to energy saving ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q16	Inverter AC is higher efficiency than non-inverter AC ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

Q17	I understand the meaning of label on a product.	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q18	I understand the meaning of energy efficiency (EER/SEER) on the Label?	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q19	I concern about inverter AC	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q20	I would care whether AC is inverter or not when I buy AC	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q21	I care about the energy	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

	label information when I buy new AC	
Q22	The information of energy label is important for me when I buy AC	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q23	I would care about the information of payback period when I buy AC	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q24	I want to see the information of payback period on the energy label	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q25	The probability that I will buy an inverter-type AC is very high.	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7
Q26	I will buy an inverter AC in a more effective way	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

VITA

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