FACTORS INFLUENCING RESIDENTS' INSTALL INTENTION TOWARDS SOLAR POWER SYSTEM IN PENANG

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LIST OF ABBREVIATIONS

ATT	Attitude
AVE	Average Variance Extracted
AW	Awareness
BI	Behavioural Intention
BIPV	Building Integrated Photovoltaic
BSA	Business Software Alliance
CAP	Consumer Association of Penang
CFA	Confirmatory Factor Analysis
CR	Composite Reliability
DV	Dependent Variable
EC	Energy Commission
EPU	Energy Unit of Economic Planning Unit
EV	Environment value
GHG	Greenhouse gas
GoF	Goodness-of-fit
H	Hypothesis
IPPs	Independent Power Producers
ITT	Install intention
IV	Independent Variable
LNG	liquefied natural gas
MEGTW	Ministry of Energy, Green Technology and Water
MNC	Multinational Company
MoE	Ministry of Education
MV	Mediating Variable
n	Number of Respondent
OSL	Ordinary Least Square
PB	Perceived benefits
PC	Perceived Cost
PLS	Partial Least Square
PLS	Partial Least Square
PLS-SEM	Partial Least Square-Structural Equation Modeling
PT	Perceived trust
PTM	Pusat Tenaga Malaysia
PV	Photovoltaic
Q^2	Q Square
R^2	R Square
RE	Renewable energy
SE	Standard Error

SEM	Structural Equation Modeling
SESB	Sabah Electricity Sdn. Bhd
SESCO	Sarawak Energy Supply Corporation
SPS	Solar Power System
SPSS	Statistical Package for the Social Sciences
ST	Solar Thermal
TNB	Tenaga Nasional Berhad
TRA	Theory of Reasoned Action
Type I error	Incorrect Rejection of a True Null Hypothesis
UK	United Kingdom
UKM	Universiti Kebangsaan Malaysia
UM	Universiti of Malaya
UPM	University Pertanian Malaysia
US	United State
USM	Universiti Sains Malaysia
UTM	Universiti Technology Malaysia
α	Cronbach's Alpha
β	Beta

ABSTRAK (MALAY)

Kajian ini menunjukkan adaptasi Teori Tindakan Bersebab (TRA) untuk menkaji bagaimana persepsi manfaat dan persepsi kepercayaan mempengaruhi sikap penduduk rumah Malaysia terhadap sistem tenaga solar dan bagaimana sikap, nilai alam sekitar, persepsi kos dan kesedaran mempengaruhi niat memasang sistem tenaga solar penduduk rumah. Soal selidik yang ditadbir sendiri telah direka menggunakan skala mantap. Satu kajian ke atas 248 responden telah dijalankan di Pulau Pinang, Malaysia melalui e-mel, pengedaran secara peribadi di Syarikat Mutinasional dan university awam menggunakan kaedah memintas. Statistical Package for the Social Sciences (SPSS) dan Partial Least Square (PLS) telah digunakan untuk menganalisis data. Persepsi manfaat adalah pengaruh faktor yang kuat untuk mempengaruhi sikap penduduk rumah terhadap sistem tenaga solar, diikuti oleh persepsi kepercayaan. Sikap penduduk rumah terhadap sistem tenaga solar, nilai alam sekitar dan kesedaran mempunyai pengaruh positif terhadap niat memasang sistem tenaga solar. Tetapi, persepsi kos mempunyai pengaruh negative terhadap niat memasang penduduk rumah. DI samping itu, kajian ini adalah terhad kepada penduduk rumah yang berbangsa Cina, dan tidak boleh dianggap secara umum di seluruh Malaysia dan hanya tenaga solar dipertimbangkan. Kawasan geografi, budaya dan kategori tenaga boleh diperbaharui yang lain harus dikaji di masa depan. Kajian ini memberi kefahaman yang mendalam mengenai sikap penduduk rumah Malaysia terhadap sistem tenaga solar. Hasil kajian boleh digunakan untuk membentuk strategi yang berkesan kepada tenaga solar pemaju, pakar teknikal, akademi, pembuat dasar dan badan kerajaan untuk mempromosi tenaga solar boleh diperbaharui dan mewujudkan kesedaran di kalangan penduduk rumah Malaysia terhadap sistem tenaga solar.

ABSTRACT

This study demonstrate the adaptation of Theory of Reasoned Action (TRA) to examine how perceived benefits and perceived trust influence Malaysian residents' attitudes toward solar power system and how attitude, environment value, perceived cost and awareness influence residents' install intention towards solar power system. A self-administered questionnaire was designed using established scales. A survey on 248 respondents was conducted in Penang, Malaysia through email, personally distributed in MNC and public university intercept methods. Statistical Package for the Social Sciences (SPSS) and Partial Least Square (PLS) were used to analyse the data. Perceived benefits is significant positive factors influence residents' attitudes toward solar power system, followed by perceived trust. Residents' attitude towards solar power system, environment value and awareness are positive influence on residents' install intention towards solar power system. However, perceived cost has a negative influence on residents' install intention towards solar power system. In addition, the findings are limited to Malaysian Chinese residents' which cannot generalised across the whole of Malaysia and only solar energy are considered. Other geographic area, cultural and renewable energy categories should be investigates in future research. The research provides an in-depth understanding of Malaysian residents' attitudes toward solar power system. The research findings can be used to design effective strategies for the solar power developer and marketer, technical expert, academia, policy maker and governmental bodies to promote solar energy and create awareness among Malaysian residents towards solar power system

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter works as the foundation for the thesis and begin the research outline which consists of problem statement and elaboration of significant study followed by research objective and research questions. Lastly in the end of the chapter, organizational study of the remaining chapters will be discussed as well. The major emphasis of present reasearch is to identify significantt factors that influence the intention of Penang, Malaysia residents' to install solar power system. In general, solar power system is used as a tool to generate renewable energy electricity. Solar power system will become one of the main contributors to Malaysia economic development in future.

1.2 Background

1.2.1 Overview of Solar Power System

The time of electric power generation in a huge station which powered by steam appears to reach an end (Mekhilef, Safari, Mustaffa, Saidur, Omar and Younis, 2012). Main factor that is driving towards green energy through renewable sources of energy that are free and excessive from conventional climatic hazardous methods is the rising environmental damage fears (Mekhilef, Barimani, Safari and Salam, 2014). Moreover, the demand for energy is growing due to the increase of world population. Therefore the interest towards renewable energy is intensifying.

Solar power system (SPS), including both Solar Thermal (ST) and Photovoltaic (PV) technologies are devices that convert light into electric current using the

photoelectric effect (Chen, 2014). Chua and Oh (2012) defined that "solar energy or solar photovoltaic (PV) electricity generation is a form of renewable energy (RE) which is clean, non-depleting and does not emit any greenhouse gases (GHGs) since it generates energy directly from the sun by means of PV effect." The advantages of developing solar-energy technologies are global (International Energy Agency, 2011), particularly for Malaysia environment, with long sunny days every year.

Chen (2014) found that hardly have any private resident houses in Taiwan have installed solar power system. There are some past researches stated that the situation in other countries seems similar (Natural Marketing Institute, 2009 and Schelly, 2009). According to International Energy Agency (2009), the electricity supply at global level is dominated by natural gas, coal, nuclear, hydro-electric and various oil power plants as these resources generate 20.1, 40.9, 16.4, 20.1, and 14.7 percent electricity respectively. All remaining sources, especially solar energy, still add only an insignificant fraction (Chen, 2014). It was estimated that in 2020 the overall shares of PV electricity will be 11–22 percent, 6–12 percent and 8–16 percent in America, Europe and the Asia-Pacific, respectively (Breyer and Gerlach, 2013).

Solar energy has many advantages as compared to other sources of energy so it is most wanted energy backup (Mekhilef et al., 2012). As this source of energy is available naturally and is very clean source of energy taken directly from sun and can be used for the production of electricity directly (Saidur, 2010). Zero pollutant release, highly reliable, less maintenance cost, high life expectation of almost 20 to 30 years on average made this source of energy very popular in present and in coming future (Saidur and Mekhilef., 2010). Drying, solar water heating and solar photovoltaic technologies are some of its

various applications; but this was introduced for rural telecommunication and electrification (Ibrahim, Jin, Gaghigh, Salleh, Othman and Ruslan, 2009).

1.2.2 Overview of Solar Power in Malaysia

1.2.2.1 Geographical profile in Malaysia

Geographically, Malaysia is located on South China Sea and between (1◦ and 7◦) in North latitude and (100◦ and 120◦) in East longitude (Nugroho, 2010). Malaysia is a country in Southern Asia that consists of Peninsular Malaysia means West Malaysia, Sabah and Sarawak means East Malaysia (Chua and Oh, 2012). The climate of Malaysia except highlands is very humid and has high temperature and level of humidity ranges between 80 to 90 percent (Mekhilef et al., 2012). The temperature in Malaysia varies between 22 ◦C and 33 ◦C (72–91 ◦F) throughout the year with an average temperature of 26.5 ◦C daily (Mekhilef et al., 2012). The level of solar radiation per month is around 400–600 MJ/m2 and it rises in Northeast Monsoon time and decreases in Southwest monsoon (Nugroho, 2010; Jamaludin, 2009).

As the climate of Malaysia is tropical so this is favorable for solar energy development due to excessive sunshine having 1643 kWh/m2 per year on average (Haris, 2008). The market of solar PV has been experiencing boom since last decade and this boom is forecasted to increase even more speedily in the coming years (Chua and Oh, 2012).

1.2.2.2 Current energy situation in Malaysia

From 2010 to 2012, the total primary energy supply in Malaysia has increased by 8.49% from 76,809 ktoe to 83,939 ktoe respectively (Basri, Ramli and Aliyu, 2015). The total final energy demand has increased by 11.21% from 41,476 ktoe to 46,710 ktoe in the same years. (Tan, Maragatahm and Leong, 2013; Malaysia Energy Commission Reports, 2010 & 2012). The total electricity production capacity that is installed in Malaysia was 24,361 MW in 2010 and 29,143 MW in 2012 (Basri, Ramli and Aliyu, 2015). Malaysia electricity consumption has increased by 10.17% from 104,521 GWh to 116,354 GWh in the same duration (Malaysia Energy Commission Reports 2010 & 2012).

As per Ninth Malaysia Plan, Malaysia is gradually changing its fuel consumption and shifting from single to multiple and mix sources of energy such as coal and hydropower sources (Mekhilef et al., 2012). Coal, natural gas and hydro are primary fuels for the generation of power (Basri, Ramli and Aliyu, 2015). The contribution of individual fuel source for electricity generation in 2012 was as follows; 48.3 percent from coal, 39.4 percent from natural gas, 7.4 percent with hydropower, 4.7 percent with fuel (oil and diesel) and only 0.2 percent with renewable energy (Tan, Maragatahm and Leong, 2013; Malaysia Energy Commission Reports 2010 & 2012).

The objective of introduction of Fuel Diversification Policy was to decrease over reliance of Malaysia on a specific single type of fuel and to attain a balanced mix of supply among oil, natural gas, hydropower and coal (Mekhilef et al., 2012). But power production with coal has risen radically from 8.8 percent to 36.5 percent. This strategy of shifting from single to multiple sources of energy generation of Malaysia government will be achieved gradually.

1.2.2.3 Malaysia Population Distribution

As showed in table 1.1, Statistics Department of Malaysia has reported that the population of Malaysia has increased from 30.16 million in year 2014 to 30.64 million in years 2015 Increase in consumption of energy is the result of increased population. The population of Penang was 1.56 Million in years 2014 (Department of Statistics Malaysia, 2014). A huge part of population of Malaysia lives in Peninsular Malaysia that is almost 76 percent of total population of Malaysia (Mekhilef et al., 2012).

Table 1.1 Malaysia Population Distribution

Year	Population	Growth Rate
2010	28 275 835	1.75%
2011	28 758 968	1.71%
2012	29 239 927	1.67%
2013	29 700 748	1.58%
2014	30 168 832	1.58%
2015	30 644 293	1.58%

Source: Statistics Department of Malaysia

Primary consumption of energy globally is anticipated to increase by 1.6 percent annually between 2009 and 2030 and demand of electricity in Malaysia is projected to reach the level of 18,947 MegaWatts in 2020 and 23,092 MegaWatts in 2030 which is almost 35 percent increase from 14, 007 MegaWatts in 2008 (Razak, 2009). Presently, electricity capacity of Malaysia with renewable energy is only at 50 MegaWatts and is anticipated to touch around 2000 MegaWatts by the year 2020 (Chua and Oh, 2012). The vision or viewpoint after 2020 is to increase solar energy to the level where it overtakes all other energy sources in Malaysia.

1.2.2.4 Renewable energy policies in Malaysia

Governments and businesses around the world are increasingly searching for means to decrease the greenhouse emissions from operations and their focus is on the installation and usage of "sustainable renewable energy systems" (Abdelaziz, Saidur and Mekhilef, 2011).

The ministries of Malaysia government and various agencies that are involved in the improvement of energy efficiency are "Energy Unit of Economic Planning Unit" (EPU) of the "Prime Minister's Office", the "Ministry of Energy, Green Technology and Water (MEGTW)", the "Energy Commission (EC)" and "Pusat Tenaga Malaysia (PTM)" or other energy centers of Malaysia. All the ministries and agencies are performing their respective duties persistently and actively for the federal government (Saidur, Atabani and Mekhilef, 2011; Solangi, Islam, Saidur, Rahim and Fayaz, 2011). Ministry of Education (MoE) is responsible for and has been endorsing renewable energy (RE) in various curriculum activities and in course contents of universities, colleges and schools in Malaysia, particularly on the theme of renewable energy curricular activities in different engineering and science subjects (Water and Energy Consumer Association of Malaysia, 2009).

As far as research and development activities are concerned, many research institutions and universities in Malaysia are conducting basic pure and applied research in the field of energy and RE. Universiti Sains Malaysia (USM) has been conducted various training and research programs in energy efficiency and renewable energy. Research activities on solar cell characterization and fabrication, solar thermal systems, off-grid

and grid connected PV hybrid systems and components of PV systems are done in Universiti Kebangsaan Malaysia (UKM) while at UPM- University Pertanian Malaysia, research is focused on biomass and solar energy. Moreover, in Universiti of Malaya (UM), the focus of the research is on "Building Integrated Photovoltaic (BIPV)" in Malaysian climate, energy conservation in industries and alternative fuels, and at Universiti Technology Malaysia - UTM, the generation of alternative fuels, energy conservation in buildings and industries are the prime aspects of research (Saidur et al., 2011; Water and Energy Consumer Association of Malaysia, 2009).

For the time being, Tenaga Nasional Berhad (TNB), Syarikat SESCO Bhd. (formerly Sarawak Energy Supply Corporation (SESCO)) and Sabah Electricity Sdn. Bhd. (SESB) are responsible for the regulation of electricity supply in Malaysia (Mekhilef et al., 2012). These three above stated agencies are responsible for conducting the demand forecast for electricity and are responsible for the supply planning for future as well. Despite the fact that there are large number of "Independent Power Producers (IPPs)" who had previously entered the power supply market, but, TNB is still a single supplier and hold a monopoly power on power distribution and transmission in Peninsular Malaysia, while SESCO and SESB have monopolies in Sarawak and Sabah respectively (Saidur, Rahim, Ping, Jahirul, Mekhilef and Masjuki, 2009). Presently, Sultan Ismail Power Station is the largest power station in Malaysia that is situated in Paka, Terengganu and is owned by TNB and is powered by gas and oil (Water and Energy Consumer Association of Malaysia, 2009). "Consumer Association of Penang (CAP)" has shown their support for the RE by its promotion and encouraging it throughout the

country. But, due to lack of energy policy of the government and budget, the activities of the association are limited (Mekhilef et al., 2012).

1.2.2.5 Solar energy resources distribution in Malaysia

The location of Malaysia has made it ideal for the installation of large scale solar power plant (Mekhilef et al., 2012). According to data summary from PV Industry Handbook, PTM, Malaysia specifies that George Town, Bayan Lepas and Kota Kinabalu get maximum solar radiation in Malaysia. Moreover, Sabah and Penang are the two best points to produce electricity from sunlight (Saidur et al., 2009).

In 2004, GEF together with UNDP approved support for the development of the Malaysia Building Integrated Photovoltaic (MBIPV) project (MBIPV Project). The project was launched for the period of 5 years between 2005 and 2010. It was initiated to encourage the industry sector and householders to employ PV systems for producing electricity and reducing GHG emission. The MBIPV has contributed to the overall energy efficiency in buildings without sacrificing aesthetics. The SURIA1000 project was introduced under the MBIPV program. The target was the residential and commercial sectors. The aim of the project was to provide a direct chance to protect the environment and participate in RE initiatives. The funds for the program were granted by the Malaysia government (Suruhanjaya Tenaga), PV manufacturers and householders.

1.3 Problem statement

Referring to The Star online news in December 2013, the tariff of electricity being raised at an average of around 14.89 percent in Peninsular Malaysia, and around 17 percent in Sabah and Labuan started on 1 Jan 2014. This announcement is made by the minister of Energy, Green Technology and Water, Datuk Dr Maximus Johnity Ongkili. In more details, the electricity tariff in Peninsular Malaysia will raise by 4.99 sen per kWh on average or 14.89 percent from the present average rate of 33.54 sen/kWh to 38.53 sen/kWh. On the other hand, in Labuan and Sabah, the average tariff will increase by 5.0 sen per kWh or 16.9 percent from current average rate of 29.52 sen per kWh to 34.52 sen per kWh. As electricity supply is state owned in Sarawak so rates will not be affected. Unfortunately, six months after the nation saw a tariff hike in electricity rates, Malaysia residents may see another rate increase. The last revision was done in January, 2014 at a 15% hike to 38.53 sen per kilowatt-hour (kWh). Hence, residents' in Malaysia have to pay more for electricity energy and this will definitely burden Malaysian residents' living expenses.

Referring to The Star online news in June 2014, Mr. Abdul Razak who was previously the chief executive officer of MyPower there was an increase in the price of gas and also the price of liquefied natural gas (LNG) has increased. Apart from LNG, the other fuel components that determine the tariff under the FCPT mechanism are the market price of coal and distillates.

Another MyPower senior officer, Azimah Abdul Aziz, noted that between January and June 2014, the price of LNG had gone up by 10%-25% but the price of coal was 10%-15% lower during the period. She explained that a potential hike was needed to

close the gap between the true cost of generating power and current subsidized tariffs. Therefore, in order to minimize the burden of Malaysian living expense, there is a rise demand towards renewable energy such as solar energy which is green and less harm to the environment.

Electricity rate increase in Malaysia will stimulate residents' solar power system install intention as residents' will seek for alternative energy supply beyond petroleum, natural gas and coal. Reason being is because solar energy is free since it allows you to capture free sunlight and convert it into usable power in your home. Besides that, solar energy is infinitely renewable. While nonrenewable energy sources like oil, gas and coal are limited resources, the sun's energy is limitless. Wherever sunlight shines, electricity can be generated.

For all types of electrical services, there is considerable future potential for using solar energy as a supplementary or complete source of electricity (Chen, 2014). However, solar energy projects hardly proceeded despite of its potential in Malaysia (Wong, Ngadi, Abdullah and Inuwa., 2015). Past studies suggest that the environmentally friendly desire does not translate into willingness to pay for extra for renewable energy (Claudy, Michelsen, O'Driscoll and Mullen, 2010; Walters and Walsh, 2011; Wimberly, 2008).

On the other hand, Malaysia government are trying to reduce the dependent on petroleum, oil, natural gas and coal as the main energy supply as these few energy will bring bad impact to environment. For example, "the secret to fossil fuels" ability to produce energy is that they contain a large amount of carbon. This carbon is left over bad impact to environment from plants. Besides that, oil and natural gas are usually the result

of lots of biological matter that settles to the seafloor, where the hydrocarbons (molecules of hydrogen and carbon), including methane gas, become trapped in rocks".

Several studies have been conducted on the solar energy development in Malaysia. For example, Chua and Oh (2010) reviewed on the important agencies and programs in Malaysian energy development since its dependence, while Ahmad, Kadir and Shafie (2011) discussed energy demands and potentials of several renewable energies (RE) in Malaysia. Similar review was also done by Hashim and Ho (2011). On the other hand, Mekhilef et al. (2012); Muhammad-Sukki, Ramirez, Abu-Bakar, McMeekin and Stewart (2011) gave specific attention to the development of solar energy in Malaysia. An extensive review was also done by Chua, Oh and Goh (2011).

However there are research gap on Malaysia resident's install intention towards solar power system. This is because most of the studies in Malaysia are focus on solar energy development, renewable energy benefits and future of solar power system, research topic which focus on Malaysia resident's install intention towards solar energy are limited and created high interest to the researcher.

Hence, Malaysia electricity tariffs increased twice in year 2014, limited study on resident's install intention towards solar power system and all consequences and environment impact by adopting petroleum, oil, natural gas and coal as energy supply which mentioned above had raise a message to Malaysia residents' on the importance of solar power system adoption. The solar power is very clean and this can be used to cool or heat the homes and it has almost no negative effect on the global climate. To increase residents' solar power install rate by identify and understand those factors which influencing residents' solar power install intention. This will help Malaysia government

to promote solar power system and increase awareness among residents' toward solar power system.

1.4 Research Objectives

The objective of this study is to understand the Malaysia residents' install intention who willing to adopt solar power as energy source. Thus, specific objectives of the research study (RO) are as follows:

RO 1: To examine whether perceived benefit and perceived trust influences residents' attitude towards solar power system.

RO 2: To investigate the relationship between residents' attitude towards solar power system and install intention towards solar power system.

RO 3: To determine whether environmental value, perceived cost, awareness influences residents' install intention towards solar power system.

1.5 Research Question

The research questions that will be answered in this study are as follows:

RQ 1: Does perceived benefit and perceived trust influences residents' attitude towards solar power system?

RQ 2: Does residents' attitude towards solar power system influence install intention towards solar power system?

RQ 3: Does environmental value, perceived cost, awareness influences residents' install intention towards solar power system?

1.6 Definition of key term

Following are the definitions of the key concepts and terms that will be frequently used in this research study for better comprehension:

1.6.1 Solar power system (SPS)

Solar power system is one of the renewable energy technologies, which are the devices that convert light into electric (Chen, 2014).

1.6.2 Perceived Benefits (PB)

Perceived Benefits relates to the extensive use of renewable energy sources and the processing technologies in producing usable energy (Kim, Park, Kwon, Ohm and Chang, 2014)

1.6.3 Perceived Trust (PT)

Perceived Trust defined as cognitive state affecting the users' intent for the acceptance of vulnerability that is based on positive attitude or expectations of intention of another (Kim et al., 2014).

1.6.4 Environmental value (EV)

Environmental value is an enduring prescriptive or proscriptive belief that directly reflects individual's environmental concern (Chen, 2014).

1.6.5 Perceived Cost (PC)

Perceived Cost relates to the cost of development and technological improvements, initial establishment costs, and the maintenance costs of the technologies (Park and Ohm, 2014).

1.6.6 Awareness (AW)

Awareness is the degree to which users are cognizant of the existing new technology. Awareness towards technology include benefits and drawbacks and can keep track of updates on new technologies. (Alam, Nik Hashim, Rashid, Omar, Ahsan and Ismail., 2014).

1.6.7 Attitude (ATT)

Attitude (ATT) is the perceived level of positive and negative impressions toward acting on the particular behavior and indicate a public's belief in the capacity of technological growth to be a great help to the drawbacks and limitations of our society in the future (Kim et al., 2014).

1.6.8 Install Intention (ITT)

Install intention is a combination of residents' interest in install a solar power system and the possibility of install (Chen, 2014).

1.7 Significance of the Study

Environment pollution issues have come to a critical stage which raised an alert to the public. One of the main reasons is due to the usage of natural gas, coal, nuclear and oil as the energy supply source which will produce carbon gas and bring harm to the environment. Furthermore, electric tariff is rising nowadays and believe that is time for the society to adopt renewable energy which is more clean and green. Besides that, the Malaysia government is trying to reduce the dependence on oil and gas as the main energy supply source. Therefore, it has become essential to study and analyze the factors which will influence residents' install intention towards solar power system in order to minimize harm and bad consequences to environment.

This study would help solar power developer such as top management and marketer around the world to narrow the scope and focus on potential customers and untapped markets. Moreover, with such strategies, solar power organizations are able to effectively expand their business to not only domestic market but also international market. The sales and revenue of solar power company can be increased dramatically by identifying the factors which influence residents' install intention towards solar power system.

Besides that, there are numerous of similar research in international country which relate to solar power system install intention. For instance, study from country like Taiwan (Chen, 2014), UK (Islam and Meade, 2013; Balcombe, Rigby and Azapagic, 2013), Korea (Kim et al., 2014; Park and Ohm, 2014), Greece (Tsantopoulos, Arabatzis and Tampakis, 2014). However there are limited study in Malaysia especially Penang because Penang is one of the best spot to get maximum solar radiation in Malaysia. There

is many more knowledge and understanding about Malaysia residents' that need to be explored. This is because there are different behavior and intention between international consumers and Malaysia consumer. Hence, this study can contribute to the field of research by improving the knowledge gap.

Furthermore, the contribution of this study would help Malaysia policy makers to develop more effective policy and strategies to encourage and promote the usage of solar energy. In addition, this study can educate Malaysia residents' about solar energy as the green renewable energy which can enhance the quality of life and create awareness among Malaysia residents'. Malaysia residents' are more willing to accept new technology when more solar power system information and campaign are given by the government to the public. Hence, this research will help government of Malaysia and other NGOs to encourage renewable sources of energy as solar power system can be the major source of electricity power in future.

1.8 Organization of Remaining Chapters

This research is arranged in five chapters. Introduction as well as an overview of this study is organized in chapter one. The second chapter consists of the review of literature that outlines previous studies had been conducted on factors influencing the attitudes that drive the residents' install intention toward solar power system, theoretical framework and the development of hypotheses. Moreover, chapter three will interpret the data and variable in term of research design, collection of sample, variables measurement and the method of data analysis. Then chapter four include of finding result analysis using both SPSS and Smart PLS software. Furthermore, the study analyses are focusing on

statistical analysis, validation analysis, descriptive statistic, reliability analysis and structural equation modeling analysis. Lastly, chapter five will demonstrate the overall findings and implications of the study will be discussed, limitation of the research together with future research suggestion and conclusions.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the previous study, there are quite a number of international researches already published in residents' install intention toward solar power system. It is considered that the review is well enough to present an entire picture of what has been examined in the study of residents' install intention toward solar power system. In this study, six independent variables are taken, named as, perceived benefit (PB), perceived trust (PT), attitudes (ATT), environment value (EV), perceived cost (PC), awareness (AW) and one dependent variable namely solar power system install intention (ITT). Moreover, the hypotheses are developed to test the relationship between two variables. Overall, six hypothesis has been developed in this study, the results of which will be discussed in Chapter 4.

2.2 Overview of solar power system

According to International Energy Agency report (2009) defined three generations of renewable energy, the first generation is referred to as the renewable energy technologies are mature. Technologies for hydropower, biomass combustion, and

geothermal energy are included in this first generation. The second generation is defined as the renewable energy technologies that are going through fast growth and it includes solar, wind, and bio-energy. The third generation embraces a wide range of renewable energies in the various stages of development, like concentration of solar power, ocean energy, modern geothermal energy, and integrated bio-energy.

As fossil fuels are depleted, harnessing of renewable energies, especially solar energy, is very important to people who are concerned about environment and ecological hazards (Hasnain, Alawaji & Elani, 1998). The reason is solar energy is a "renewable energy" or "alternative energy" that can replace conventional energies such as coal and oil. Thus, it is one of the most eco-friendly energy resources that does not cause climate change (Solangi et al. 2011). Due to greenhouse gases not being emitted, solar energy is considered to be one of the most environmentally friendly energy sources if compare to other energy sources. In addition, solar energy also allows countries to set up green islands that are independently maintained from the national power systems, thus helping to diversify the energy supply chain (Wang, Bell, Desilvestro, Bertoz and Evans, 2007).

Previous studies defined solar energy technologies as "the technologies which directly use energy from the sun to produce electricity and to replace fossil fuel generation at the point of endue employing active means" (Taylor, 2008). Solar energy is primarily categorized into three groups: solar thermal electric, heating/cooling. Solar photovoltaic (PV), which is generated by panels and has some similarity to semiconductor, converts photons into electricity (Kazek, 2012). When sunlight beats down and hits the panels, photons that have a specific wave length trigger electrons to

flow through the semi conducting materials in order to generate electricity (Fthenakis and Kim, 2011).

An overview of solar power systems that convert sunlight directly into electricity is given by Green (2000). During their process, solar energy generates no CO2 emissions; the impact on environment is caused by emissions which are generated during the production and disposal of the solar power. Solar power system can be connected to home for additional, full and backup supply power (off-grid), or a power system that generates revenue.

2.3 Perceived benefit (PB)

Perceived Benefits defined as benefits relates from the extensive use of renewable energy sources and the processing technologies in producing usable energy (Kim et al., 2014). Several cognitive studies have shown that potential expectations regarding an individual's perceived benefits are significantly associated with the individual's attitude towards newly introduced technology (Chen, Lin and Cheng, 2013). Prior research on user's behavior such as the Technology Acceptance Model has verified that the perceived benefits of newly introduced technologies are directly associated and positive relationship with the users' intention to employ the technologies (Gamal, 2010; Mathieson, 1991). In particular, the public perceived that technical improvements of particular technologies are able to increase the quality of life, if the public can expect more perceived benefits from the technologies (Starr, 1969).

People that are using renewable energies can consider the potential perceived benefits that include adverse effects and financial effects (Chen et al., 2013), this is because technology and sources of renewable energy is well- known. Extensive usages of solar power system are enhancing by the perceived benefits towards renewable energy attitude (Park and Ohm, 2014).

According to Sriram and Forman (1993), products that have environmentally attributes are consumed because consumers believe and have perception that these products have additional benefits as compared to the conventional ones. Number of consumers perceives green energy products to be more environmental friendly by increasing climate change and decreasing global warming, increasing quality of air and decreasing energy dependency (Roe, Teisl, Levy and Russelll, 2001). Clark et al. (2003) explored that green energy brand adopters perceived green electricity have many benefits such as to be more environmentally friendly, reducing future solar energy costs and minimizing reliance on imported oil. The study participants also believes that renewable electricity production reduces the air pollution by decreasing emission of carbon dioxide and slowing down the process of global warming as well as enhancing natural ecosystem.

Wüstenhagen and Bilharz (2006) proposed that green power customers should contribute to the renewable energy growth and ensure that their decision of purchasing should not support unsustainable energy source. A framework for analyzing the effect of perceptions of environmental benefits on renewable energy install intentions was provided by the Theory of Reasoned Action (Fishbein & Ajzen, 1977).

Bang, Ellinger, Hadjimarcou and Traichal (2000) supported the perceived benefits of renewable energy is positively related to attitude towards green energy products. In addition, past studies such as Park and Ohm (2014) and Kim et al (2014) who found that was perceived benefits is positively and significantly influence residents' attitude towards solar power system. However the recent study from Hassan et al (2014) showing that the rural residents' expressed negative perception and unfavorable attitude towards solar power energy. Therefore, numerous of renewable energy suppliers are trying to improve consumers' perceived benefits towards solar power energy's services and system quality (Senia, 2002).

2.4 Perceived trust (PT)

The public's trust is formed by the knowledge of the society as a heuristic or systematic decisions of public's opinion which in turn used to alter public's perceived trust towards particular technology (Midden and Huijts,2009; Siegrist, 2010).

When the public do not have any experience in using a specific service or technology, their perceptions towards the service or technology can be generated by (social) trust. In other words, residents' attitudes toward newly introduced services and technologies such as solar power system are primarily motivated by the residents' perceived trust (Kim et al. 2014). In this study, the researcher adopted the definition of perceived trust proposed by a study of Kim et al (2014). According to Kim et al (2014),

perceived trust defined as "a cognitive state affecting the users' intention to accept vulnerability based upon positive anticipations of the intention or behavior of another"

There are also obstacles in adoption related to perceived trust on technological performance of solar power system (Caird and Roy, 2010; Zahedi, 2011) and the suitability of their home (UK HM Government, 2011). Fuelling this uncertainty has been the perceived lack of reliable or trustworthy information (Mahapatra, Gustavsson, Haavik, Aabrekk, Svendsen and Vanhoutteghem et al., 2013). According to UK HM Government (2011) consumers are not aware of the solar power system advice and information show the lack of trust between suppliers and installers about poor installation experiences (Taylor, 2013) or aggressive product-selling (Yamaguchi, Akai, Shen, Fujimura, Shimoda and Saijo., 2013).

There is a lack of visible micro generation systems in public's eye which contributes to the unawareness in the renewable technology and low perceived trust, caused relatively small number of installation in UK with exception of solar power system (William, 2010). Caird and Roy (2010) confirmed it by finding that potential adopters want to see examples of solar power systems on local residences and public buildings in order to increase their perceived trust towards solar power system. Willingness to install solar energy is enhanced by the residents' perceived trust towards solar power system and positive advices from the friends and experts (Scarpa & Willis, 2010).

Past studies mentioned that the society formed the perceived trust, or affected by other individuals in the society, significantly impact the public's attitude towards solar

power system (Siegrist, 2010). Nano-technology, nuclear energy generating technology and carbon-hydrogen technology has also confirmed this relationship (Chen et al., 2013). Furthermore, previous research found that perceived trust is positively and significantly influence attitude towards solar power system (Kim et al., 2014; Park and Ohm, 2014). However, the finding from Balcombe et al., (2013) and Balcombe, Rigby and Azapagic (2014) studies identified that lack of trust towards solar power system's reliability level and performance will caused unfavorable attitude towards solar power system.

2.5 Attitudes toward solar power system

Attitude is a "learned predisposition to behave in a consistently favourable or unfavourable manner with respect to a give object" (Huang, Lee and Ho, 2004). In studies of TRA and related fields, an individual's attitude is defined as "the perceived level of positive and negative impressions toward acting on the particular behavior" (Ajzen and Fishbein, 1977; Ajzen, 1991). According to Ajzen (1991) which indicated that attitude is referred to as "the perceived level of positive feelings about thinking about or using solar energy technology."

Energy-related activities of individuals are best predicted by individual's attitude (Fox, C., Hinkle and Hogue, 2000). Molin (2005) also pointed that residents' willingness to employ the related technologies is leaded by residents' attitude toward particular energy sources. In addition, Ajzen and Gilbert Cote (2008) pointed that the best predictor of residents' intention of using technology is residents' attitude toward a particular