CONSUMER PERCEPTIONS FROM LANDED PROPERTY OWNERS IN MALAYSIA TOWARDS THEIR INTENTION TO PURCHASE PHOTOVOLTAIC (PV) SYSTEM

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Abstrak

Persepsi pengguna memainkan peranan yang penting dalam penggunaan teknologi tenaga boleh diperbaharui. Kajian ini bertujuan untuk meninjau peranan penerimaan pengguna dan percubaan untuk memodelkan kesannya terhadap penggunaan photovoltaic (PV) panel. Malaysia mempunyai banyak pendedahan cahaya matahari tetapi penjanaan tenaga solar masih terhad. Oleh itu, kajian ini bertujuan untuk mengkaji keadah yang berpotensi untuk pemasangan PV sistem panel dalam pemilik harta tanah di Malaysia. Carian literatur yang luas telah dijalankan dan pembolehubah yang sesuai telah dikenal pasti untuk konsep model perniagaan. Dalam konteks ini, satu kajian besar-besaran telah dijalankan untuk memahami persepsi pengguna terhadap teknologi tenaga solar, seperti kos dilihat, pulangan ekonomi, halangan teknologi, kebimbangan alam sekitar dan pengaruh sosial terhadp pembelian PV sistem panel. Kira-kira 157 responden Malaysia mengambil bahagian dalam kaji selidik itu dan 47% daripadanya mempunyai niat untuk memiliki sistem panel PV di rumah mereka. Walau bagaimanapun, mereka yang berminat untuk memasang sistem panel PV tetapi dengan syarat kos panel adalah lebih murah, tiada halangan teknologi, beberapa skim pulangan dalam bentuk elektrik wang. Di samping itu, kebanyakan responden yang berniat untuk membeli sistem panel PV dipengaruhi sama ada daripada rakan-rakan atau saudara-mara mereka atau pun daripada kenalan rapat. Saiz bumbung hartanah tidak menghalang niat pembelian PV sistem panel. Walau bagaimanapun, interaksi dengan beberapa peramal mendapati saiz bumbung memberi kesan kepada pembelian. Kajian ini mempunyai banyak implikasi teori dan praktikal dan juga tips bagi pengeluar dan pelanggan sistem panel PV.

Abstract

Consumer perceptions play an important role in the adoption of renewable energy technologies. The current study aims to explore the role of consumer acceptance and attempts to model its effects on photovoltaic (PV) panel adoption. Malaysia has plenty of sunlight exposure still the generation of solar energy is limited. Hence, the present study aims at studying the potential determinates for the installation of PV panel system in the landed property owners in Malaysia. The extensive literature search was carried out and the appropriate latent variables were identified for conceptualization of the business model. In this context, a massive survey was conducted to understand consumer perceptions on the solar energy technology, such as perceived cost, perceived economic returns, technology barriers, environmental concerns and social influence on the purchase intention of PV panel system. About 157 Malaysian respondents participated in the survey of which 74 (47%) respondent have purchase intention to install PV panel system in their landed property houses. However, they interested to go for installation of PV panel system provided the panel cost is cheaper, no technology barrier, some returns in the form of electricity money back scheme. Further, most of the respondents who have favored intention to purchase PV panel system were influenced by their friends or relatives or also from their close associated colleagues. The size of roof of the landed property did not moderate the purchase intention of PV panel system. However, the interactions with some of the predictors with size of the roof do have impact on purchase intention. The study has lots of theoretical and practical implications and provides valid tips for manufacturers and customers of PV panel system.

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, a brief overview of the entire research will be presented. This chapter comprises the research outline of the study by highlighting the background of the intended study and the problem statement. This is then followed by research objectives and research questions. Significance of the study in terms of the theoretical and practical contributions and brief overviews of the structure of the study is also provided at the end of the chapter. This chapter is concluded with a summary of the chapter.

1.2 Background of the Study

The chapter has several sections dealing with the topic of the study namely the intention of Malaysian consumers to purchase photovoltaic (PV) panel system in their landed property. Those respondents who own landed property without PV panel roofing were considered for this research. As we all know that Malaysia has plenty of sun exposure and therefore there is high scope for generating electricity from solar energy. This idea motivated me to undertake the present study to find the determinants of Malaysian consumers not favouring PV panel system in their homes. Before proceeding further into the study, the key terms will be defined and explained.

1.3 Renewable Versus Non-Renewable Energy

Energy resources have two categories which are renewable and non-renewable. Non-renewable energy resources such as coal, nuclear, oil and natural gas are available in limited supplies throughout the globe. These resources cannot be easily replenished by the environment over relatively long periods of time. While renewable resources can be replenished by the environment over comparatively short periods of time. Example of renewable energy resources are solar, wind, water (hydro), biomass, and geothermal.

Renewable sources of energy was used by the beginning of humanity people for their daily routine such as wind and water for grinding, wood for warming and cooking, and solar for lighting enthusiasms. First born generation people have already created technology to extract energy from plants and animals. Since coal, oil, and natural gas are limited resources, solar, wind, wood and water serve as the main alternative sources of fuel.

It is well known that renewable energy resources offer substantial benefits for APEC countries ecomony. These renewable sources of energy are potentially secure, sustainable in long term and greenhouse gas (GHG) emissions is low with potentially available enormously. As APEC countries are commited to minimize the GHG emmisions and air pollution, had encourage more development of renewable energy power generation to overcome the harmful impact of fossil fuel combustion. Figure 1.1 shows that power generation mix of renewable energy including hydro and NRE is increasing from 17 percent in year 2010 to projected 22 percent in year 2035. In term of percentage, NRE having substantial growth of 490 percent, comparing to natural gas (110%) and nuclear (89%)

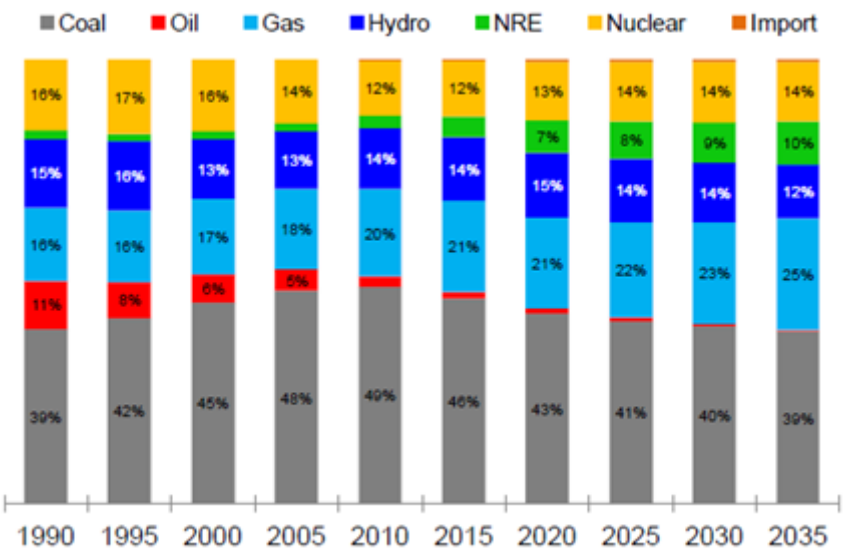

Figure1.1: APEC Region Electricity Generation Mix (1990-2035)

Source: APERC Analysis (2012)

Malaysia's energy sector is heavily dependent on non-renewable fuel such as natural gas and fossil fuels as a source of energy which is limited in nature. Due to depletion and environmental issues, non-renewable energy resources are fluctuating in price and renewable energy such as solar energy has a significant role acts as the fifth fuel source in Malaysia. Furthermore, various efforts have been taken by the government of Malaysia in order to encourage investment in solar PV projects (Johari et al., 2011). Based on World Renewable Energy (2014), one of the major source of clean, renewable energy besides wind, hydropower, bioenergy is solar power generated from sun exposure. Besides this, major focus on installation of sustainable renewable energy systems has been followed by the industries and government around the world to reduce the greenhouse emissions (Mekhilef, 2012). Researchers around the

world are taking great effort to explore the alternative source of renewable energy and one of the freely available energy is solar power.

Global environmental issues and depletion of energy resources used to generate electricity such as fossil fuel and natural gas had raised society's concern on the sustainability issue. Moreover, the increased of environmental impacts from conventional fossil fuels, most importantly those related to climate change has been the main factor driving the transition towards green energy and generation of power from renewable energy sources that are abundant and free (Mekhilef, 2012).Below Figures show the World Electricity Generation by Fuel.

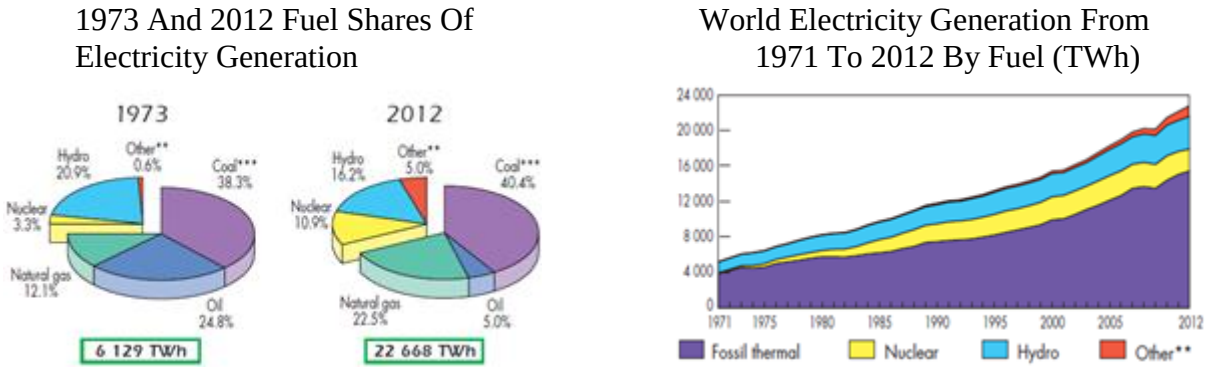

Figure 1.2: World Electricity Generation by Fuel (TWh) (IEA, 2015)

On the CO2 account, low emissions nuclear power has been replaced by "low emissions" renewable energy (burning biofuel and timber does produce CO2). The actual energy substitutions are a little more complex (Euan Mearns, 2015). Issues of climates change and environmental pollution from fossil fuels is the main factor to drive towards renewable energy.

Hence, the era of conventional electric power generation by natural gas is soon to be obsolete (Mekhilef, 2012).

Therefore, boundless amount of efforts are carried out to explore alternative sources of renewable energy by researchers around the world. Alternative source of renewable energy or green energy is the energy produced that will have less amount of waste and by-products that cause pollution or impact the environment compared to the main energy sources such as natural gas, fossil fuel which harm the natural of environment. (Mohamed Gaafar Elnugoumi, 2012) Governments and industries all around the world are looking for ways to reduce the greenhouse emissions from their operations with a major focus on installation of sustainable renewable energy systems (Mekhilef, 2012)

1.4 Electricity Capacity, Generation and Consumption in Malaysia

Euan Mearns has comprehensive research on Global Energy Statistical Review 2015 has pointed out that all types of energy sources and sign of slowing growth in fact in decreasing trend for fossil fuels (oil, gas and coal) has seen may due to a high prices of energy and China market slowing growth. Fossil fuels accounted for 86% of total global energy consumption in year 2014 and 88% in year 2004 for comparison, there is still large dependency on fossil fuels in the world showed in Figure 1.3. Meanwhile, seeing exponential growth of renewable energy in recent years where it's grown from 0.87% in 2004 to 2.98% in 2014 (Mearns, 2015).

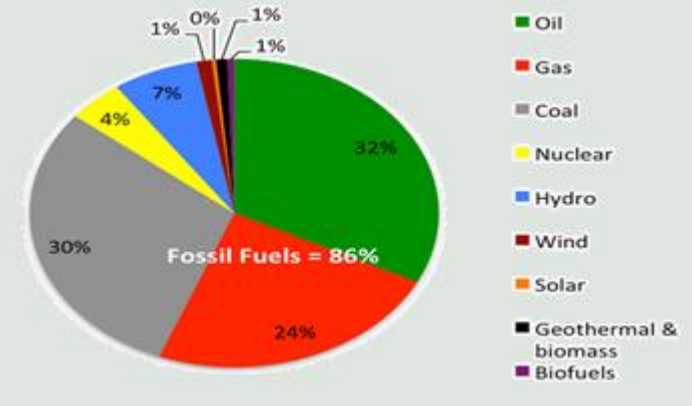

Figure 1.3: Global Energy Consumption in 2014 (Mearns, 2015)

Source: Energy matters euanmems.com BP 2015 data

Besides that, majority of Malaysia's electricity generation capacity is natural gas-fired, even though gas shortages in Peninsular Malaysia and growing electricity requirement nowadays have sparked the utilization of some other energy sources such as coal, diesel, and renewable sources. In 2012, total generation capacity was 29.1 gigawatts (GW), which located mostly in Peninsular Malaysia. As shown in Figure 1.4, Malaysia electricity Generation sector in 2014 for natural gas is highest which is 46 % follow with coal 41 %, hydroelectricity 7 %, petroleum and other liquids 5 %, and lastly is biomass and other renewables 1 %. Where else Malaysia electricity capacity sector in 2012 for natural gas is highest which is 53 % follow with coal 26 %, hydroelectricity 12 %, petroleum and other liquids 6 %, and lastly is biomass and other renewables 3 %. Natural gas is most important in both Malaysia electricity generation sector in 2012 and Malaysia electricity capacity sector in 2012. To make sure Malaysia meet the electricity demand, the government get ahead an additional 6 GW of new generation will come online between 2015 and 2020. The government's efforts are centred on meeting increasing

electricity demand through a more balanced portfolio of electric generation using coal, renewable sources, and to a lesser extent natural gas, in the next decade. Malaysia's policy to reduce power consumption also entails reforming electricity prices to be more reflective of market values and promoting demand-side conservation measures

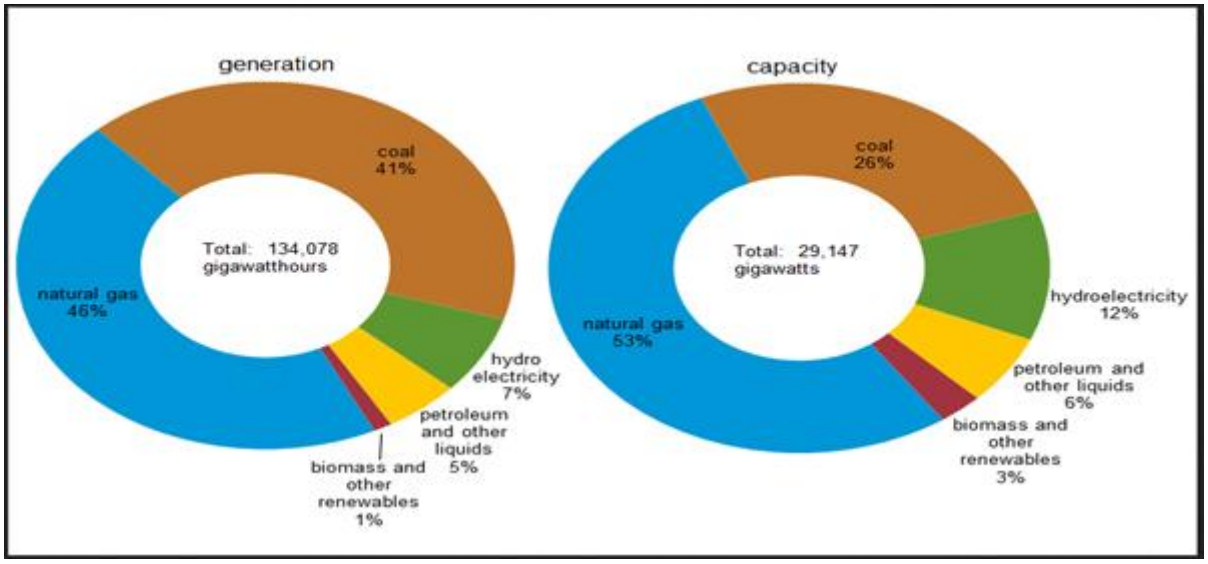

Figure 1.4: Malaysia Electricity Sector 2014

Source: Malaysia Energy Information Hub *(*MEIH*) extracted from*

http://www.eia.gov/beta/international/analysis.cfm?iso=MYS

Primary energy consumption discusses to the straight usage of the source supply to users without transformation of crude energy. Malaysia main objective is to improve manufacturing and Economic growth by acquiring energy through cost-effective and diversifying its fuel source collection. Petroleum and other liquids is the highest country's energy consumption in Malaysia which is 40%, then follow with natural gas 36%, coal 17%, Biomass and waste make up 4% and

lastly is hydropower contributes 3% to total consumption in Malaysia. Malaysia is assurances of economic growth on Petroleum, other liquids and natural gas will be sustained but government is emphasizing fuel diversification through coal imports. In other words Malaysia is encouraging investments in renewable energy.

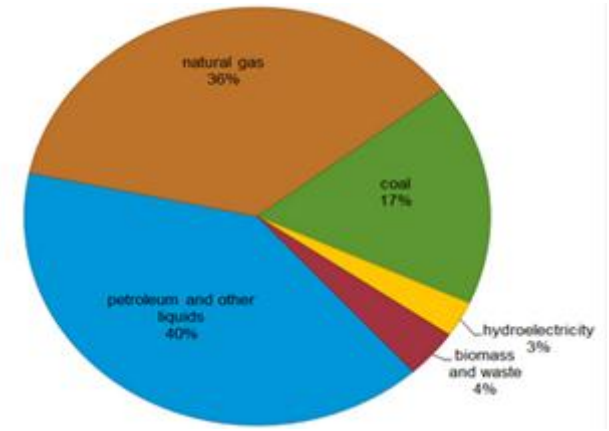

Figure 1.5: Malaysia's primary enegry consumption, 2012

Source: U.S Enegry Information Administration extracted from http://www.eia.gov/beta/international/analysis.cfm?iso=MYS

1.5 PV Panel System and Solar Energy Generation

Energy received by the earth from the sun is considered as solar energy (SE), which will be in the form of solar radiation, in order to make the production of solar electricity achievable. In order to provide a source of clean and low cost renewable energy, it depends on some devices such as solar cells or solar panels. Solar energy is an alternative energy that has potential in fulfilling the worlds growing energy demand. Based on Petrova-Koch, (2009), the first solar house was developed by the ancient Egyptians during the seventh century BC and to harness solar energy, there were many research projects and experiments conducted worldwide. Hence,

solar power generated energy is best known as one of the major source of clean, renewable energy despite wind energy, hydropower and bioenergy (World Renewable Energy, 2014).

Any form energy collections will outcome some kind of pollution, however generally solar energy creates power with less pollution. As an example, residence which is covered with solar panels for collecting energy for electricity will have surplus energy which can be sent back through the local power grid to be used at other destinations (Razykov et al., 2011). Hence, solar energy is a safe and powerful energy source and can be used as a worthy alternative to assuage the grim environmental issue. Global environmental issues and depletion of energy resources used to generate electricity such as fossil fuel and natural gas had raised society's concern on the sustainability issue. Moreover, the increased of environmental impacts from conventional fossil fuels, most importantly those related to climate change has been the main factor driving the transition towards green energy and generation of power from renewable energy sources that are abundant and free (Mekhilef, 2012).

According to (Yaqin Sun 2014) sunlight consists of photons solar energy which is converted into electricity besides that Solar energy is radiant light and heat from the Sun it actually generate light and heat. Besides that only the absorbed photons provide energy to generate electricity (Bharat Sanchar Nigam Limited, 2011).

One of the components in our efforts to diversify our electricity is solar energy and it will be important for our future energy equation. Therefore, solar's potential is nearly unlimited as its produced by harnessing the sun's radiant energy and converting it into electricity and the sun radiates more energy upon the earth in one second than people have used since the beginning of time (Solangi et al.2 2011). Producing electricity from the sun is still in its early stages and there

are still rival technologies fighting to dominate this universe. The world's first solar collector is builded by a Swiss scientist Horace de Saussure back in 1767 is an insulated box covered with three layers of glass to absorb heat energy. Since then, Saussure's box became commonly known as the first solar oven, reaching temperatures of 230 degrees Fahrenheit. It then later used by Sir John Herschel to cook food during his South Africa expedition in the 1830s (U.S. Department of Energy, 2014).

Concentrated solar power and photovoltaics are two of the leading technologies. Concentrated solar power (CSP) uses mirrors to concentrate the solar power on a receiver that converts the sunlight to thermal power which is used by a steam turbine or heat engine to power a generator. Photovoltaics (PV), uses modules to directly generate electricity and mostly located on top of buildings. In other hand a large power plant which needs lots of land and capital is required for CSP and this technology is referred to as utility scale solar. According to US Department of Energy 2011, PV is generally viewed as a smaller-scale and a decentralized option.

Solar energy produces less negative impact to the environment than other energy sources like fossil fuels, which are often produced with harmful side effects. According to Fayaza et al. (2011) the types of energies are solar, wind, hydro, geothermal energy and several more including nuclear energy which is often deliberated as solar energy source due to its lower waste output relative to energy sources such as coal or oil.

According to Philibert (2011) solar PV systems can provide most of the cooling, heating, and electricity requirements which can work under most of the climate condition. In order for light (photons) to convert into electricity (voltage), it must allow the electrons go through the

material to produce electricity. This process is called as photovoltaic (PV). Baed on Ekins-Daukes (2009); Petrova-Koch (2009) both photovoltaic and can produce solar electricity generating system.

Below is sample of Solar Panels Mounting System, which the installing only takes 3 days for 3000 Elements. Now days solar panels are use in multipurpose and anyone are affordable to own one of it on their rooftop of the house. Free energy will be generate from this solar panel system. The types of PV system available as shown in Figure 1.6 and Figure 1.7

Figure 1.6: Example of Solar Panel on the Roof
Source: http://www.solarpanelsindustry.com/2012/05/simple-mounting-system.html extracted on 17 July 2015

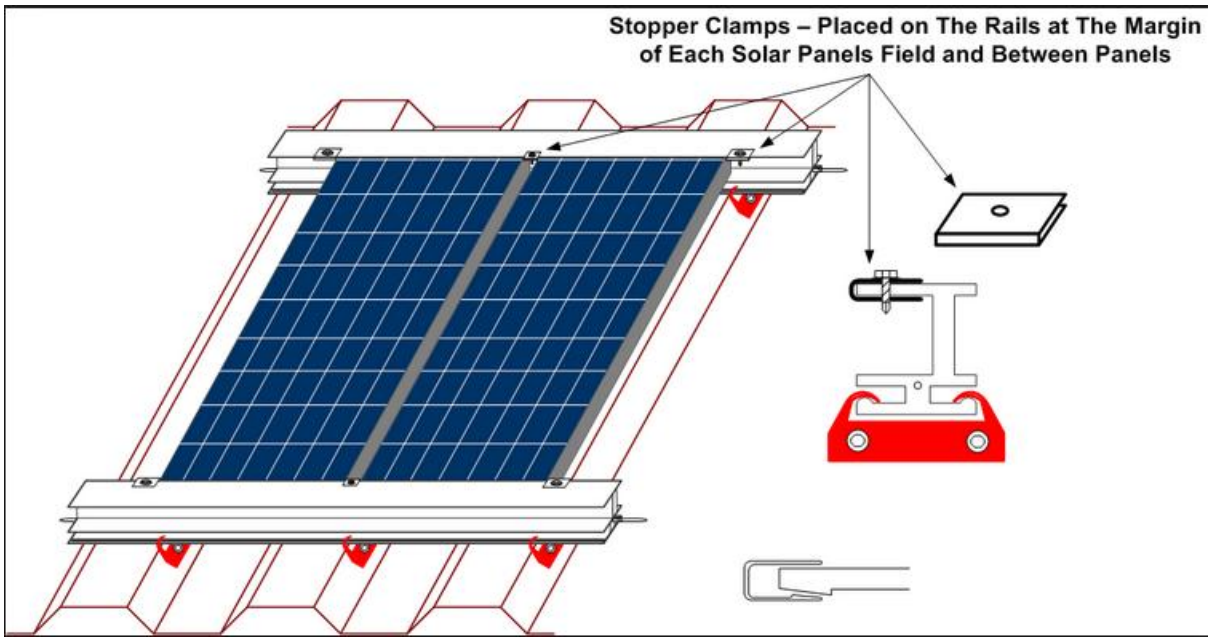

Figure 1.7: Example of Solar Panel on the Roof
Source:https://www.google.com/search?q=pv+panel+system+on+roof&biw=1366&bih=626&tbm=isch&tbo=u&source extracted on 17 July 2015

Today's the majority of typical PV device utilizes an individual junction kind of cell to generate electricity (Knier, 2002) a solar PV system consists of several photo voltaic modules, casually known to use solar panels. A solar PV system includes multiple photovoltaic modules, delicately referred to as solar panels (Muttaqin, 2013). A module consists of small solar cells. A typical single silicon cell produces 1 or 2 watts of power. Generally, one square meter PV module can generate 150 watts of power (Murmson, 2013). The number of solar modules a family needs is dependent on the area in which they are living

The growth of solar photovoltaic (PV) global capacity was rising exponentially from year 2008 to 2013 as shown in Figure 1.8. Akinyele, Rayudu , Nair (2015). In 2013 the capacity (GW) was 139 which have increased 88.49% compare from 2008 when the capacity (GW) was

only 16. This shows the development status of solar PV-based electricity generation systems at universal level. The countries which are high spot ridiculous in solar energy resources such as Germany, Spain, Japan, Italy, US, Nigeria and Malaysia should utilized the resources of solar photovoltaic (PV).

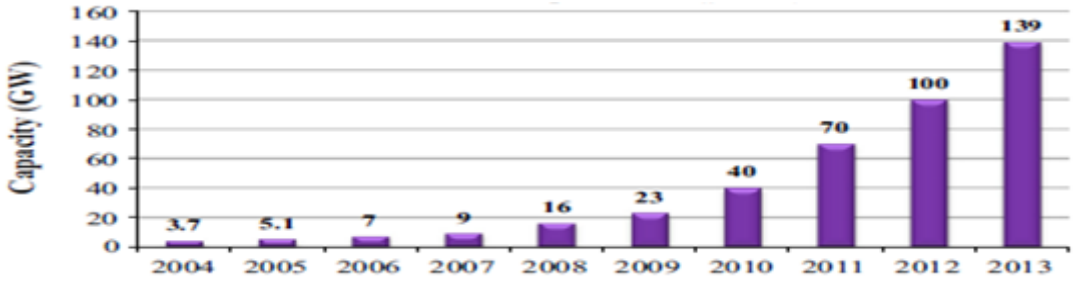

Figure 1.8: Solar PV total global capacity between 2004 and 2013

For example, according to Yaqin Sun (2014) huge economic growth in China due to the world largest population of 1.3 billion and largest developing country which led to an increasing demand for energy. According to EIA (2014), the growth of energy demand will still continue to grow. According to Sun power Corporate Papers (2011), demand is expected to increase by 75 percent by 2035.Therefore solar energy will be needed to make sure sustainably take place in future. Besides that, due to the result of a subsea explosion in the Gulf of Mexico which have proven the world experienced a huge oil leak .This have impact massive to our local vicinity on both the environment and the economy. Such event has triggered people to focus even more on renewable energy options, which have less environmental effect to the world (Choi, 2010).

Adoption of solar energy systems is slowly spreading throughout the world, but trails wind, biomass, and geothermal in total global electricity production as shown in Figure 1.9. Most of solar energy installations have taken place in the developed world, led by Germany, Spain, Japan, Italy and the US The US makes up approximately 6 percent of the world's installed solar capacity (Earth Policy Institute 2011). And while solar's share of electricity production continues to increase, the US mirrors the rest of the world in that it makes up less than 1 percent of total generation (EIA 2012).

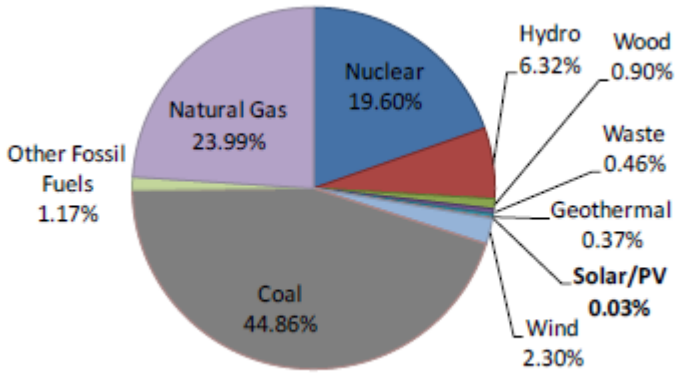

Figure 1.9: US electricity sources as of 2010.
Source: EIA 2012

Although solar technology has existed for decades, substantial levels of development have only materialized over the last few years. The market first showed signs of life in 1997 but it was not until 2003 that the technology began to make meaningful inroads in the market (Tour et al. 2011). Due to this relatively recent push, PV has become the subject of many studies including renewable technology and renewable policies. However, little has been done to look at the geographic and temporal nature of PV installations and manufacturers. Such studies can be

pursued using US installation information which is most available from states including California and New York. California substantially leads the US in policies and installations while

New York is still in the early stages of developing their solar market, however is among the top 10 states for installations. In addition to being at different stages in their installations and policies, California and New York are located at opposite ends of the country and house two varying demographics which make them suitable for comparison.

However the largest energy consuming country, China is facing environmental deterioration, which results from the overuse of non-renewable conventional energy such as coal. Solar photovoltaic (PV) energy, an unlimited and clean energy with minimal impacts on the environment, is considered to be a good alternative to alleviate this severe issue. We designed and conducted a survey among Chinese residents in some major cities. Based on the first hand data, we utilized basic statistical methods to examine Chinese resident's knowledge of, concerns, and attitudes towards PV adoption. The research aims to identify the drivers and dynamics that mostly encourage customers to install solar PV systems in their residential buildings. The significant preferences we concluded from the data included cost reduction, more government incentives, lower the percentage of fossil fuel usage, and education to increase awareness of solar PV system as well.(Yaqin Sun 2014)

Malaysia itself contributes about 208,267 thousands of metric tonnes (0.69% of the worldCO2 emission) on 2008, ranking 26th of the highest CO2 emission in the world mainly contributed by natural gas, liquid petroleum gas, kerosene and electricity (Millennium Development Goals Indicator). In fact, we ranked 30th with 93.8 billion of kilowatt hour (kWh)

electricity usage in the world (Index Mundi). Electricity are mainly generated by oil and coal which composes of complex molecules with higher carbon ratio, nitrogen and sulphur contents that emits higher ratio of carbon emissions and also releases ash particles to the environment which eventually contributes to pollution (Natural gas.org). Therefore it is important to bring out the awareness to the society to help to at least preserve the current environment if not able to reverse on the damage done on mother nature. One of the main contributions to reduce CO2 emissions is by using an alternative method to generate household energy which eventually reduces the level of greenhouse gasses generation. The best alternative available is to use the existing solar energy from the sun which is the Solar Photovoltaic Panel which converts solar energy to electricity. However, Solar PV initial installation price is very pricey with approximately RM 54K for terrace house, RM 102K for semi-detach house and RM224K for bungalow owners (Haris, 2011). With Malaysian average annual income of RM43K in 2007, not everyone would be able to afford to purchase the Solar PV for electricity generation (The Edge Malaysia, 2008).

Based on Mohamed Gaafar Elnugoumi (2012) with the implementation of the motivation packages and forceful limited time system to pull in both foreign and local investors, the government has identified solar energy as one of the growth areas to promote. As a result of such strategy, Bosch Malaysia plans to set up a new solar energy manufacturing site in Penang, Malaysia. With a planned investment of RM2.2 billion (EUR 520 million), the construction project is one of the biggest in the company's history. However, the usage of photovoltaic (PV) panel system are yet to be popular among Malaysians landed property owners as compared to other countries like China, Turkey, Brazil, European Union countries such as Germany, Spain.

Therefore, a research is carried out to understand what favors the usage of photovoltaic (PV) Panel system among Malaysian landed property owners.

1.6 Research Gap of the Study

The solar energy in Malaysia is plenty as the sun exposure on an average in Malaysia is very high. This means that the solar energy can be harnessed easily due to the large exposure and thus renewable energy can be easily produced in Malaysia but this is not the case as of now. Malaysia has favorable solar energy with other photovoltaic (PV) Panel system country users with average monthly daily solar radiation of 4000-5000 Whr/m2 and sunshine duration ranging from 4-8 hr (Sopian, Othman, Yatim, & Shamsudin, 2000). However, the usage of photovoltaic (PV) Panel system in Malaysia is not as widely used in countries like China, Turkey, Brazil and European Union countries such as Germany, Spain. Therefore, the current study is undertaken to understand the gap for not fully utilizing the natural solar energy resource by using photovoltaic (PV) Panel system. With a strategic geographic location, Malaysia has benefits from a huge amount of solar insolation, ranging from 1400 to1900kWh/m2 (Ahmad etal., 2011), averaging about 1643 kWh/m2 per year (Haris, 2008) with more than10 sun hours per day (Amin etal.,2009). Recently, Azman student et al., (2011) stated that Malaysia is gifted with sunshine throughout the year with about 4.0-4.9 kWh/m2/day of solar radiation.It was calculated theoretically that a 1 kWp of solar panels installed in an area of 431km2 in Malaysia could generate enough electricity to satisfy the electricity requirement of the country (Haris, 2008). Thus, the solar power in Malaysia is plenty but the extraction and utilization of sun light power is

less which is motivated to study the extent of consumer purchase intentions towards the installation of PV panel system.

Secondly, the utilization of the solar energy in Malaysia is very low. Thus the awareness and the importance and benefits of solar energy must be augmented in order to increase the utilization of the solar energy. Solangi, Badarudin, Lwin and Aman, (2013) have pointed out that there is a lack of awareness and knowledge on solar energy at all levels of society. Besides that, the environmental performance is another reason of resident to avoid PV usage in Malaysia (Tampakis et al., 2013, Zahi, 2010) and energy conversion affects the environment and solar energy has no exception. To some extent, solar energy (PV in particular) is connected with environmental problems such as toxic substances, but is more or less free from problems that other renewables face, for example the biomass resource limitations and the landscape change and destruction for wind power and hydropower dams. The energy pay-back times are for Si photovoltaics 2-7 years and for thin-film technologies 1-3 years - the figures varying greatly with location. This is much shorter than their lifetimes (20-30years or more), which means that PV technologies will provide energy and avoid CO2-emissions compared with any fossil-fuel alternative. The conclusion is that solar energy causes some environmental effects that need to be dealt with, but on the whole constitutes a better alternative for the environment than most of today's conventional power plants. Hence, the current study focuses on the effect of environment influence and social influence factors (Solangi, 2013) on the purchase intention of PV panel system by the landed property owners in Malaysia.

Thirdly, the cost of acquiring the solar energy technology is really exorbitant. This poses as a major setback as the technology uses solar cells in order to harness the solar energy but the cost of the solar cells are really high and barely affordable. Hence, the high acquisition cost poses to be a major setback even though the awareness might be there among the non-users of PV panel system. This study finds out that high cost of the solar panels is dragging consumers to use electricity generated by fuels instead of solar power (Solangi et al., 2013).

Fourthly, there is no government subsidy in the form of incentive for people to purchase the solar technology. If the government raised awareness and were especially concerned, they would provide subsidies in order to ensure that it was affordable and the level of consumption would be increased.

Fifthly, the technology which allows the use of solar energy as a renewable energy has hazardous effects on the health. Social acceptability is a determinant factor in failure or success of the government decisions about which electricity generation sources will satisfy the growing demand for energy. The factors influencing the social acceptance of solar energy in Peninsular Malaysia, and conceptualizes the conditions that promote investor confidence (Solangi, Badarudin, Lwin and Aman, 2013) are the need of the hour. According to Solangi et al., (2013), the costs of solar panel products, maintenance and spare parts are very costly. Malaysia is so advanced in technology and also in developmental activities but still have challenges in bringing solar technology into the market because of heavy costs. The PV panel installation cost is so high and unless or otherwise, the government provides subsidies, people are willing to invest on solar power. Also, every penny invested on business, people expect for returns in this sense, the

returns received from solar power is not immediate but it will take time since the process of generating electricity through solar energy is in gradual phase. The present costs for extracting solar power has been estimated to 180-300 €/MWh in Europe which is about 50% higher than earlier estimates, the price increase has been blamed on the raised material costs and limited competition on some key components. Hence, the present empirical study focuses on the perceived cost of the installation of PV panel system and how consumers reflect on this in their purchase intention.To make solar economically competitive, engineers must find ways to improve the efficiency of the cells and to lower their manufacturing costs (Schaller et al., 2013 & Beard et al 2006). Hence, the current study focuses on the technology barriers and its impact on the customer purchase plan intention towards the installation of PV panel system.

1.8 Research Objectives

The current study has the following primary objectives:

1) To investigate the extent of Malaysian landed property owners who wish to have purchase intention plans for the installation of PV panel system.

2) To find the potential determinants (namely Perceived cost, Environmental concerns, Perceived economic returns, Technology barriers and Social influence) which are

favorable for the purchase intention of PV panel system among the landed property owners in Malaysia.

3) To examine the moderating effect of roof size on the customer purchase intention of PV panel system.

4) To determine the interaction effect of moderating variable on the relationship with the independent variables (namely Perceived cost, Environmental concerns, Perceived economic returns, Technology barriers and Social influence) and the dependent variable namely the customer purchase intention.

1.9 Research Questions

1) Does Malaysians have purchase intention plans for the installation of PV panel system in their landed property houses?

2) Do the factors Perceived cost, Environmental concerns, Perceived economic returns, Technology barriers and Social influence have effect on the purchase intention of PV panel system among the landed property owners in Malaysia?

3) Whether roof size has the moderating effect on the customer purchase intention of PV panel system?

4) Whether there is an interaction effect of moderating variable on the relationship with the independent variables (namely Perceived cost, Environmental concerns, Perceived economic returns, Technology barriers and Social influence) and the dependent variable namely the customer purchase intention?

1.10 Significance of the Study

Theory & practical

According to this study factors influencing purchase intention of Photovoltaic (PV) Panel system will be examined in the light of support from the theory of planned behavior (TPB). TPB involves constructs like subjective norm, behavioral control and attitude and they converge to intention and consequently to behavior. The research model proposed in the present study is supported by TPB. Besides this, the moderating variable namely the size of the roof in the landed property in Malaysia was added to enhance the theory. Thus, this study will be related with the theory of TPB with the predictors (independent variables) and dependent variable in considering

the consumer purchase intention for the adoption of photovoltaic (PV) Panel system in landed property owners.

We have already seen the research objectives and the research questions. It has given us a brief idea as to what this research aims to provide. Thus, we can see that this research will provide the key factor to find out Malaysian resident about the potential customers who have interest in installing photovoltaic PV system. This research will give how much the details and which will identity is it a good idea to implement in Malaysia

The major significance of the study is to understand the factors consumer perception towards photovoltaic (PV) system. By identifying the key variables the administrators can focus on the services which need to be improved in order to increase the perception level of the Malaysian resident. Besides that, the level of adoption towards photovoltaic (PV) system by Malaysian residents will be identifying easy.

Thus this research will help in making decisions and understand the key reasons to use photovoltaic (PV) in Malaysian is a good choose or not. Special focus and special services can be provided in order to better their system and meet the standards expected by the resident. This is the significance of this study and it is important in making further decisions or future decisions.

1.11 Structure of the Thesis

The proposed thesis will consist of five chapters in addition to executive summary and abstracts. The first chapter will delve into the intention to purchase photovoltaic (PV) system by Malaysians with introduction to the topic and by explaining the background to the study. It is also relevant to introduce the purpose of the study, central concepts and explain what significance the study has. First chapter also establishes the research objective as well as problem statement supported by research questions. In addition the structure of the thesis is explained.

The second chapter will include the literature review. Essential supporting literature is critically evaluated to find central concepts relevant to the current research. The second chapter also lays down the groundwork for the following chapters as the following theoretical framework is derived from the previous literature.

Chapter three will present the theoretical framework of the research. It introduces the research model and the related variables. These variables and their measurement are then explained with detail. The research hypotheses are formulated in the respected chapter. Finally the research design, sampling and data collection methods are all explained with further detail.

Chapter four revolves around data analysis and respected findings. These findings are then further analyzed and brought into context of the research. Finally these findings are summarized and critically evaluated.

The fifth chapter will consist of conclusive arguments and discussion of research limitations. With respect to the current research, future directions are also evaluated.