FACTORS INFLUENCING CONSUMER'S PURCHASE INTENTION OF SOLAR PANEL IN MALAYSIA

BY:

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ABSTRAK

Tenaga solar mempunyai potensi cerah untuk menjadi sumber tenaga bersih untuk masa depan dan yang boleh digunakan pengguna individu di Malaysia. Disertasi ini mengkaji pelbagai faktor yang diandai sebagai mempengaruhi niat pengguna Malaysia untuk membeli panel solar. Faktor-faktor ini adalah polisi kerajaan, kos dan penyelenggaraan, pengetahuan produk dan pengalaman, estetika panel solar, pengaruh sosial, kebimbangan terhadap alam sekitar, manfaat produk dan faktor-faktor demografik (diwakili oleh tahap pendidikan dan pendapatan). Kajian ini juga menyiasat sama ada sikap alam sekitar memainkan kesan perantara di antara faktor-faktor ini dengan niat pembelian panel solar. Kajian soal selidik yang ditadbir sendiri digunakan untuk mengumpul data daripada pengguna Malaysia yang tidak menggunakan panel solar, khususnya yang tinggal di Selangor, Pulau Pinang dan Johor. Kaji selidik ini berjaya mengumpul sejumlah 211 maklumbalas berguna bagi tujuan analisis lanjut. Analisis regresi berganda yang dijalankan ke atas data mendapati daripada lapan pemboleh ubah bebas, hanya kos dan penyelenggaraan, pengetahuan produk dan pengalaman, pengaruh sosial dan manfaat produk mempunyai kesan langsung ke atas niat pembelian pengguna panel solar. Polisi kerajaan, estetika panel solar, kebimbangan terhadap alam sekitar dan faktor-faktor demografik (tahap pendidikan dan pendapatan) didapati tidak mempunyai hubungan yang signifikan dengan niat pembelian. Kajian ini juga mendapati bahawa sikap terhadap alam sekitar telah menunjukkan kesan positif yang besar ke atas niat pembelian. Di samping itu, sikap alam sekitar didapati menjadi pengantara antara hubungan pembolehubah bebas (pengetahuan produk dan pengalaman, manfaat produk) dengan niat pembelian. Dapatan-dapatan kajian ini bermanfaat dengan menyumbang kepada perkembangan ilmu pemasaran hijau kerana kedua-dua kerajaan dan pemasar kini lebih memahami tingkah laku niat pembelian pengguna panel solar di Malaysia dan boleh bergerak

ke hadapan untuk mewujudkan polisi kerajaan dan insentif yang sesuai bagi menggalakkan lagi penggunaan produk tersebut di kalangan rakyat Malaysia.

ABSTRACT

Solar energy has a bright potential to be the clean source of energy for the future and to be applied by individual consumers in Malaysia. This dissertation investigates various identified factors that are assumed to be influencing Malaysian consumers' intention to purchase for solar panel. These factors are perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits and demographic factors (represented by education level and income). The study also investigates whether environmental attitude plays the mediating effect between these factors and purchase intention of solar panel. Self-administered questionnaire survey is utilized to collect data from Malaysian consumers who are non-solar panel users, especially those residing in Selangor, Penang and Johor. The survey managed to collect a total of 211 usable responses for further analysis. Multiple regression analysis carried out on the data revealed that from eight independent variables, only perceived cost and maintenance, product knowledge and experience, social influence and product benefits have direct impact on consumer's solar panel purchase intention. Perceived government policy, solar panel aesthetics, environmental concern and demographic factors (education and income level) were found to have insignificant relationships with purchase intention. In addition, environmental attitude was found to be mediator between the relationship of independent variables (product knowledge and experience, product benefits) and purchase intention. The findings have contributed towards the advancement of knowledge on green marketing as both government and marketers now understand better purchase intention behaviour of Malaysian consumers of solar panels and can move forward to create suitable government policy and incentives to further promote the adoption of the product among Malaysians.

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter gives an overview of solar panel industry in Malaysia which is the background of this research, the problem statement, research questions, objectives and significance of the study.

1.2 Background of study

As a developing country, Malaysia is heavily dependent on energy to meet the energy requirements for both the industries' and her citizens' needs as these provide economic growth and public's quality of life. Table 1.1 shows the rising demand in electricity usage as reported in the Eighth and Ninth Malaysia Plan from 2000 until 2010. Within a decade, the demand for electricity has increased approximately 78%. The transport and industrial sector are the key users that take up almost 80% of total consumption in 2010, followed by commercial and domestic usage. It is predicted that the demand from the industrial sector will increase significantly by the year 2020 as Malaysia becomes a high income developed country (Muhammad Sukki *et al.*, 2012).

Source	Petajoules (PJ)						Average annual growth rate (%)	
	2000		2005		2010		Eighth Malaysia Plan	Ninth Malaysia Plan
Industrial[a]	477.6	(38.4%)	630.7	(38.6%)	859.9	(38.8%)	5.7	6.4
Transport	505.5	(40.6%)	661.3	(40.5%)	911.7	(41.1%)	5.5	6.6
Residential and commercial	162.0	(13.0%)	213.0	(13.1%)	284.9	(12.8%)	5.6	6.0
Non-energy[b]	94.2	(7.6%)	118.7	(7.3%)	144.7	(6.5%)	4.7	4.0
Agricultural and forestry	4.4	(0.4%)	8.0	(0.5%)	16.7	(0.8%)	12.9	15.9
Total	1243.7	(100.0%)	1613.7	(100.0%)	2217.9	(100.0%)	5.6	6.3

[a] Includes manufacturing, construction and mining.
[b] Includes natural gas, bitumen, asphalt, lubricants, industrial feedstock and grease.

Table 1.1: Commercial energy demand by sector in Malaysia from 2000-2010 (Muhammad-Sukki *et al.*, 2012).

The primary energy sources of Malaysia's electricity generation are oil, gas, coal (fossil-fuel) and hydroelectric. Tenaga Nasional Berhad (TNB), Sabah Electricity Sdn. Bhd. (SESB) and Sarawak Electricity Supply Corp. (SESCO) are the key players for fossil-fuel electricity generation in Malaysia (Mekhilef *et al.*, 2012). Figure 1.1 depicts Malaysia's electricity generation that is highly dependent on fossil-fuel. Since fossil-fuel resource is non-renewable and the fossil-fuel power plants have affected the environment by releasing harmful greenhouse gases such as carbon dioxide (CO2), nitrous oxide (N2O) and methane (CH4) (US Environmental Protection Agency, 2014), the use of fossil-fuel for power generation cannot be sustained indefinitely as this type of resource is depleting very fast. To fix Malaysia's fossil-fuel dependency problem, the country has switched and diversify its energy mix with greener energy sources like hydroelectric and renewable energy in line with Malaysia's intention and effort to shift towards a greener energy policy. This indeed causes hydroelectric and renewable energy sources to gain more popularity in the country (Ali, Daut & Taib, 2012).

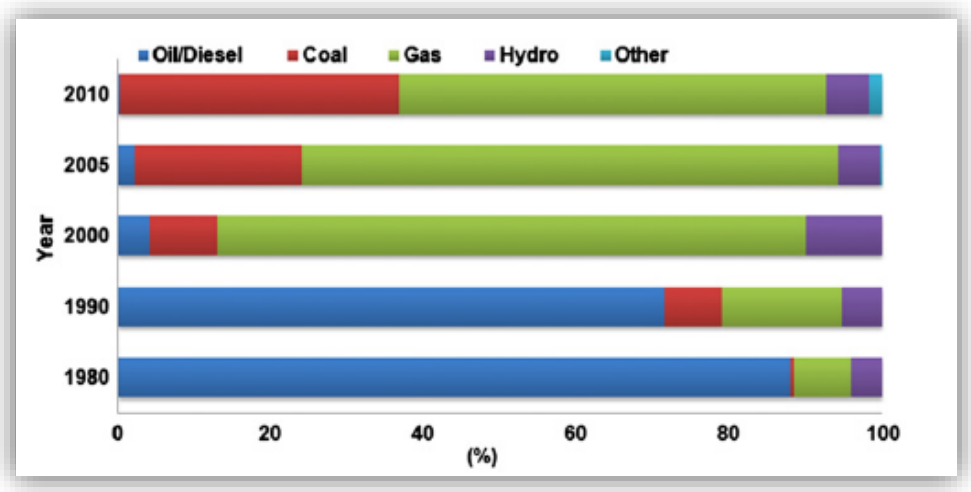

Figure 1.1: Malaysia primary energy supply by source from 1980-2010 (Muhammad-Sukki *et al.*, 2012).

As its name implies, renewable energy originates from resources that are inexhaustible. Examples of renewable energy are sunlight, wind, rain, waves and geothermal

heat (Ellabban, Abu-Rub & Blaabjerg, 2014). The benefit of using renewable energy is that it enables the generation of power without polluting the environment like the conventional fossil fuel power does. Some of the main sources of renewable energy currently promoted and used globally are wind power, hydro power, solar energy, biomass, biofuel and geothermal energy. For instance, the use of conventional fossil fuel power has been linked to carbon footprint which is associated with the phenomenon of global warming, a serious issue that the world is facing.

Several incidents that have adversely impacted the environment in relations to the use of fossil fuel have further accelerated the acceptance of renewable energy as an alternative resource for energy generation. One such event was the Gulf of Mexico oil spill in April 2010 (Smithsonian Institution, 2013). The oil leak has badly affected the ocean life and its ecosystem (Figure 1.2 and Figure 1.3). In fact, it was the worst oil spill in the US history that killed 11 people and leaked 3.19 million barrels of oil into the Gulf (Smithsonian Institution, 2013). Another incident that has further affirmed the need to venture into renewable energy was the Fukushima radioactive leakage in March, 2011. The disaster has impacted hundreds of thousands of people's health and national economies due to radioactive contamination (Greenpeace, 2014). These tragedies have significantly influenced our energy policy to focus on sources that are more eco-friendly and sustainable (Muhammad-Sukki *et al.*, 2012).

Figure 1.2 (left) & Figure 1.3 (right) show oil spill in the Gulf of Mexico and dolphins swimming through oil slicks. Images are adapted from http://ocean.si.edu/gulf-oil-spill

All of these environmental issues have acted as the catalyst for governments all over the world including Malaysia to expedite their move towards greener energy alternatives that is sustainable in the long term and therefore, reduces dependency on fossil fuel for energy. In Malaysia's case, the country is targeting to achieve 40% reduction in carbon emission by 2020 (Khor & Lalchand, 2014). To support this intention, the government has formed several ministries and agencies to help implement the renewable energy policies. The Ministry of Energy, Green Technology and Water (KeTTHA) for example has been established to promote and develop renewable energy technologies, the Malaysia Energy Centre (PTM) is tasked with performing relevant research and analysis while the Sustainable Energy Development Authority (SEDA) has been created to administer feed in tariff system (FiT) (Mekhilef *et al.*, 2012).

In Malaysia, renewable energy is still in an infancy stage; thus not all renewable energy technologies are available to the public. Wind power for example is still under research, while biomass, biofuel and small hydro power are used by the industrial sector, not for individual use (Ong *et. al.*, 2011). Solar energy is the only one that is available to all parties including the public which means that this alternative energy is the one that is suitable for further investigation.

There are many technological applications of solar energy; amongst them are solar photovoltaics (PV) that is also known as solar panel, solar hot water and concentrated solar power (International Energy Agency, 2011). The applications of these solar related products have been observed happening in many industries and individual consumers. In the case of solar PV, this product was created by Charles Fritts in 1889 (Richards, 2004). It contains PV modules which are connected electronically and placed on a supporting structure. The modules transform light energy (photons) from the sun into electricity through the photovoltaic effect. Solar PV system consists of two types which are on-grid and off-grid

system. On-grid system is the most commonly used where electricity generated from the system is connected to the national grid. On the contrary, the off-grid system is used primarily to store electricity and is more commonly used in remote areas (Adam, 2013).

Solar panel is argued to be ideal to be utilized in Malaysia. Its tropical climate allows the country to harness the sun's radiation via solar panel utilization with help of the country's strategic geographical location which enables it to receive an average solar radiation of 400-600 MJ/m2 per month (Mekhilef *et al.*, 2012). Figure 1.4 exhibits the yearly average solar radiation (MJ/m2/day) for Malaysia and identifies few states with highest solar radiation and thus, showing their biggest potential for solar panel adoption. These states are Sabah, Penang, Kedah, Perak, Perlis and Kelantan. Sarawak, however has the lowest potential for solar panel usage since it has the smallest annual solar radiation.

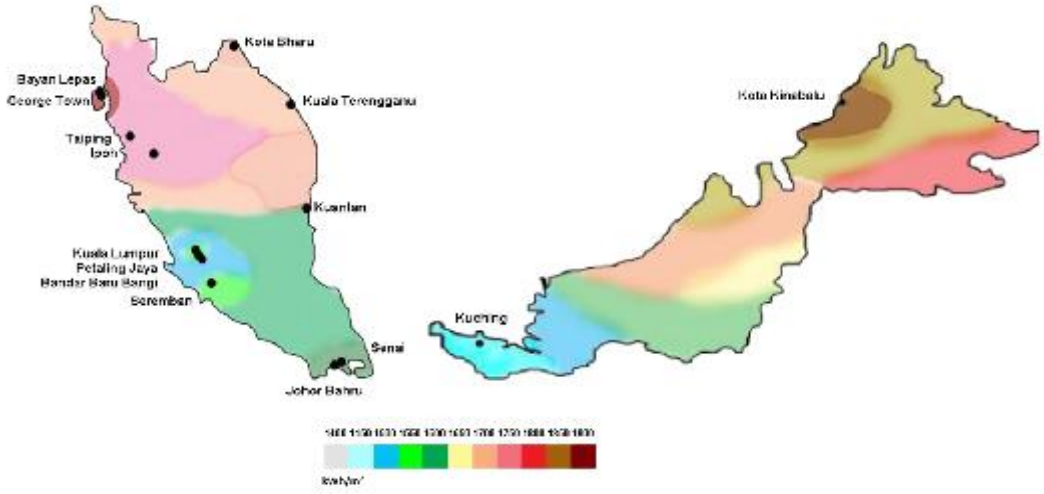

Figure 1.4: Yearly average solar radiation (MJ/m2/day) (Mekhilef *et al.*, 2012)

Historically, the implementation of solar power in Malaysia started with the 5-year Malaysia Building Integrated Photovoltaic Technology Application Project (MBIPV) in July, 2005 (Muhammad-Sukki *et al.*, 2012). The MBIPV project was carried out to demonstrate not only the viability of solar panel for electricity generation in Malaysia but also to act as a catalyst for market development of a solar panel industry. In this project, 1000 solar systems

were installed on the public premises' roofs to encourage the adoption of solar panel. This project managed to show a significant reduction in the installation cost of solar panel by 40% from RM31,410 per kW in December 2005 to RM19,120 per kWp in March 2010. Figure 1.5 depicts the current price of solar panel which is about RM2,000 to RM3,000 per kWp (Muhammad-Sukki *et al.*, 2012).

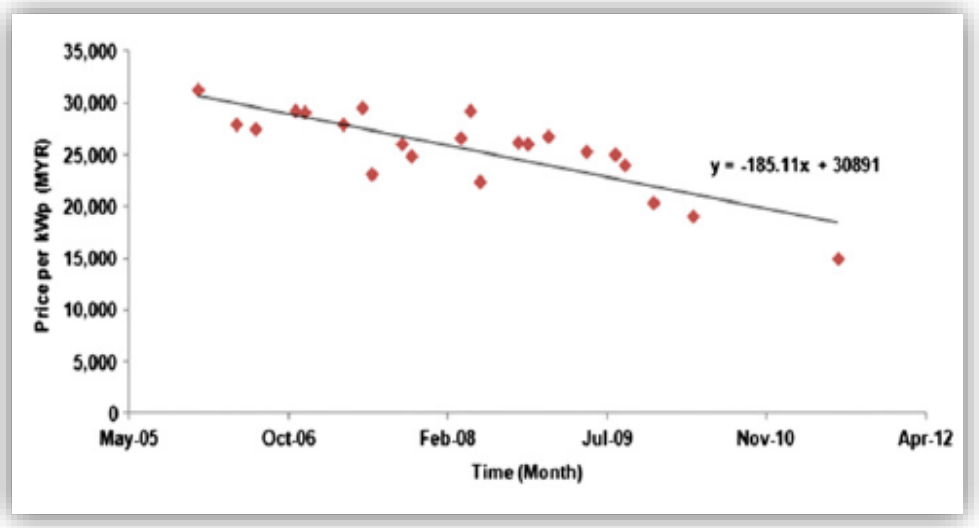

Figure 1.5: Average Building Integrated Photovoltaic Technology Application Project (BIPV) price per k p in Malaysia adapted from www.mpipv.net.my.

The Solar PV industry in Malaysia is highly regulated. The activities of the industry are regulated and governed specifically by the Renewable Energy Act 2011. The Act is enforced by the Sustainable Energy Development Authority of Malaysia (SEDA), a statutory body formed by the Malaysian Federal Government under the Sustainable Energy Development Authority Act 2011 [Act 726]; SEDA is an agency of the Ministry of Energy, Green Technology and Water.

According to SEDA (2014), solar energy has generated 36,135 MWh of electricity with carbon avoidance of 346,524.07 tonne in 2013 and thus, illustrating its potential growth in the Malaysian market. Figure 1.6 illustrates the cumulative value of renewable energy in

Malaysia where solar power is predicted to become the main source of renewable energy in the future. It is forecasted that by 2050, renewable energy will contribute about 11.5 GW of capacity and 9 GW is generated by solar PV.

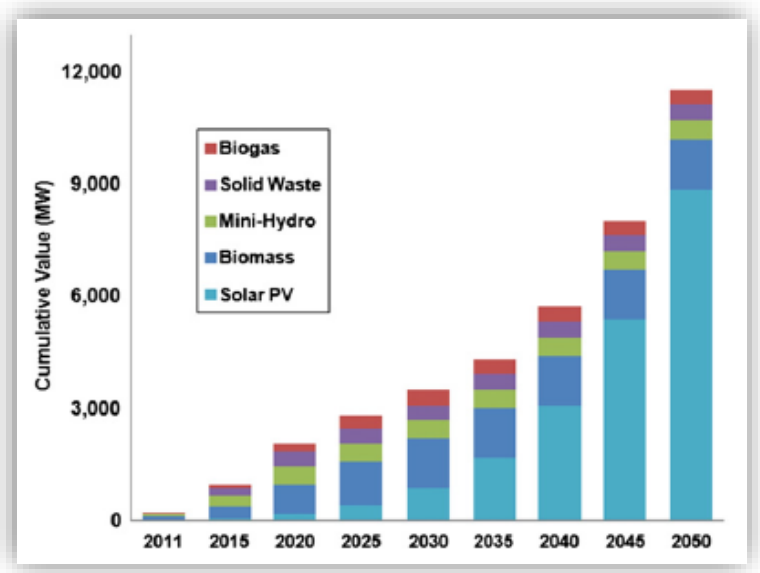

Figure 1.6: Cumulative value of renewable energy in Malaysia from 2011-2050 (Abdul Malek, 2010)

The Tenth Malaysia Plan introduced "several new initiatives anchored upon the Renewable Energy Policy and Action Plan to achieve a renewable energy target of 985 MW by 2015, contributing 5.5% to Malaysia's total electricity generation mix" (Yusof, 2012). To achieve this target, SEDA has published and revised the degression rate (gradual decrease in the tariff) in March, 2014 in order to increase and spur the development of the renewable energy sector. For solar PV, the degression rate for installed capacities greater than 24kWp will be improved from 8% to 24% (Yee, 2014).

To further promote the growth of and investments in the renewable energy industry, the government has also introduced various tax incentives such as income tax exemption on business profits and import duty exemptions for materials procurements. These incentives will significantly reduce the cost of doing business for companies in this sector. So far, these

policies have been proven successful in developing and spurring the growth of the renewable energy sector in Malaysia on a global scale.

Despite the success in the global arena, the development of the local renewable energy sector in Malaysia has been slow and lukewarm. The main reason for this is the limited fit quota that continues to plague the industry (Sumo, 2013). "Industry players in Malaysia are of the opinion that both the miniscule quotas combined with the first-come first-serve 'lottery' system are choking the solar PV industry and making the PV business unsustainable" (Sumo, 2013). Another main reason is that the limited number of available projects within the domestic market as the government projects made up the main bulk of the local market (The Star, Aug 2011). In line with this information, therefore, this paper will focus on investigating all other possible factors that affect consumer's purchase intention of solar panel in Malaysia. Reasons why will be further explained in the following section.

1.3 Problem statement

Malaysia is aiming to become a developed country in 2020. To achieve a sustainable development and a better quality of life, Malaysia has launched its latest plan, i.e. the 10th Malaysia Plan, to support, enhance and further grow the renewable energy market and industry in 2020. Some of the plans include the implementation of Feed in Tariff (FiT) system (a system that enables power provider to buy electricity produced from renewable energy resources at a fixed price for a specific period) as well as to encourage more Foreign and Domestic Direct Investment (FDI and DDI) by the MNCs and local players in renewable energy.

Despite the government's effort to encourage solar panel usage and to develop the industry, several issues may have affected on solar photovoltaic (PV) market and industry in Malaysia in one way or another. The issues pertaining to perceived government policy,

perceived high initial costs and maintenance, lack of product knowledge and experience, solar panel aesthetics, social influence, demographic factors such education level and income as well as lack of environmental attitude and concern may be part of the barriers to the adoption of domestic solar panel in Malaysia (Faiers & Neame, 2006; Farhar & Coburn, 2000; Zhang *et al.*, 2012; Tsoutsos & Staltiboulis, 2005; Sovacool, 2009). These issues may have become the bottleneck that affect the sustainability of businesses in this industry, particularly the Malaysian based industry players. While the use of solar panel for companies may directly support the solar panel industry's growth in Malaysia, it is important to note the limitation the industry faces if the product's usage is not expanded to include the individual consumers. It is believed that individual consumers' segment is vital to ensure the industry's survival, hence an understanding on how the various factors identified in this study may impact on the consumers' purchase intention of the product will provide the industry and government with relevant insight needed to help them achieve just that. The findings may lead towards the creation and/or refinement on relevant policies, incentives, and strategies alike to spur the growth of the industry.

1.4 Research objectives

This study is generally intended to investigate the factors that influence consumer's purchase intention of solar panel. It is aimed to achieve the main objectives as below:

1. To investigate whether perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits and demographic factors (income and education level) have any influence on Malaysian consumer's intention to purchase solar panel.

2. To investigate whether perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits and demographic factors (income and education level) have any influence on consumer's environmental attitude.
3. To examine whether Malaysian consumer's environmental attitude affects their intention to purchase solar panel.
4. To investigate whether environmental attitude mediates the relationship between all independent variables (perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits and demographic factors (income and education level) and purchase intention of solar panel.

1.5 Research questions

The objective of this research is to evaluate the various reasons that influence consumer purchase intention of solar panel. In line with the objectives, this research has developed the following research questions:

1. Do perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits and demographic factors (income and education level) have any influence on Malaysian consumer's intention to purchase solar panel?
2. Do perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits and demographic factors (income and education level) have any influence on consumer's environmental attitude?

3. Does Malaysian consumer's environmental attitude affects their intention to purchase solar panel?
4. Does environmental attitude mediates the relationship between all independent variables (perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits and demographic factors such as income and education level) and purchase intention of solar panel?

1.6 Significance of study

While considerable amount of literature has been published on consumer's purchase intention of solar panel in the West and Asia regions (Zhai, 2010; Beckstead, 2008; Faiers et al., 2006; Xueliang, 2011), there is a lack of similar studies being conducted in Malaysia. Among the few studies published are by Gomesh, et al. (2013) who investigated on Malaysian's perspective towards renewable energy specifically on solar energy; and another one by Muhammad-Sukki *et al.* (2011) who made an analysis on the installation of solar panel in residential houses in Malaysia. In both of these studies, high installation cost has been identified as the main factor affecting consumer's intention to invest in solar panel installation. However, neither Gomesh *et al.* nor Muhammad-Sukki *et al.* have investigated the possibility of other variables such as perceived government policy, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefits, demographic factors (education level and income) as well as environmental attitude. Furthermore, many other researchers in Malaysia have focused on solar energy in general i.e. its development in Malaysia, as well as its potential and prospects (Muhammad-Suki *et al*., 2011; Chua & Oh, 2011; Mekhilef *et al*., 2012) and not much attention is being given to consumer's purchase intention of solar panel. Hence, it is hoped that this research will close

the gap in literature by providing meaningful data on the factors that affect consumer purchase intention of solar panel in Malaysia, using consumer's environmental attitude and concern as the mediator to predict the relationship between the independent variables and purchase intention.

This research is significant as the findings are believed to contribute towards advancement of knowledge, in particular within the practical aspects. Identifying the factors that affect consumer purchase intention of solar panel will help solar panel firms and other renewable energy marketers to gain insights as well as understand their target market's intention and consumer behaviour. With the identification of the influencing factors, marketers can use this information for strategic planning to determine an effective marketing activities to persuade these customers to change this intention into actual purchase behaviour instead and thus, ensure sustainable business growth in renewable energy industry. Therefore, it's very crucial for solar panel marketers and manufacturers to understand the consumers' needs, create the wants and eventually convert this into profits for the company. Business that can connect and predict consumer behaviour will indeed gain competitive advantage in the industry. Clearly, understanding consumer behaviour is a prerequisite to a successful marketing strategy in solar panel industry.

Looking from consumers' perspective, this study is important because it can improve their knowledge on green energy especially on solar panel. Blackwell *et al.* (2006) proposed that it's crucial to study consumer behaviour since it will help to educate, create social awareness and protect the consumers. With the growing concern on environmental issues nowadays, this study will indeed enlighten consumers about the advantage of going green and the need to support environmental friendly technology. Last but not least, findings of the study will contribute towards government policy and incentives to further promote the adoption of solar panel among Malaysians.

1.7 Definition of key terms and variables used in the study

This section provides definition for some of the key terms and variables that are used in this study:

Term	Definition
Solar panel	Solar panel, also known as solar photovoltaic (PV) modules involves the conversion of sun light into electrical energy through the photovoltaic element (Solarpower-mart.com, 2007).
Perceived cost and maintenance	The degree to which an individual consider the cost and maintenance relative to his or her disposable income (Moore & Benbasat, 1991, p. 194)
Product knowledge and experience	The degree to which a person know about the product.
Solar panel aesthetic	The appearance (size and color) of solar panel which doesn't always blend into the surroundings.
Social influence	An individual's emotions, opinions or behaviours which are influenced by others (Ooi *et al*., 2012).
Environmental concern	The degree to which an individual is aware of environmental issues and help to alleviate them (Dunlap and Jones, 2002).
Product benefits	Satisfaction assured by a product based on the needs of the target consumer (Business Dictionary, 2015).
Demographic factors (income and education level)	A study on a population based on socioeconomic characteristics such income and education level (Business Dictionary, 2015)
Environmental attitude	A compilation of beliefs, influence and behavioural plan an individual has concerning environmental problems (Qader, 2008).
Purchase intention	The plan to buy specific goods or service in the near future.

Table 1.2: Definition of key terms and variables used in the study

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter starts by discussing the basic theories followed by relevant literature related to factors influencing consumer purchase intention of solar panel. The theoretical framework and hypothesis are presented in the last section of this chapter.

2.2 The underpinning theory

Many theories are deployed in consumer behaviour studies such as Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB). However, within the innovation literature, the popular one is Diffusion of Innovation Theory (DIT). Since solar panel is a new product, this research integrates TRA and DIT to better explain the theoretical framework.

2.2.1 Theory of Reasoned Action (TRA)

TRA is introduced by Fishbein and Ajzen (1975) to forecast and gain insight into individual's behavioural intention while TPB which is introduced in 1991 by Ajzen is an extension of TRA that is utilized to predict individual's behavioural intention and actual behaviour. For this research, TRA is more suitable because behavioural intention is the main focus of this research and actual behaviour is not the interest of this study. Furthermore, this is a cross sectional study where data is collected at one point of a time. Since intention is the proxy of the actual behaviour, gaining insight into consumers' behavioural intention is considered adequate rather than measuring the actual behaviour.

TRA is applied in many field such as psychology, health, education and management. For example, Gotschi *et al.* (2010) and Ng *et al.* (2009) both agreed that TRA is a great

theory to predict green purchase behaviour. This is supported by other researches where they have applied TRA in their research. For example, Abdul Wahid *et al.* (2011) used TRA to explain factors influencing the green purchase behaviour of Penang environmental volunteers. In addition, Ooi *et al.* (2012) also utilized TRA to explain the antecedents of green purchase intention among Malaysian consumers as well as Aman *et al.* (2012) which applied TRA to describe the influence of environmental knowledge and concern on green purchase intention and examine the effect of attitude as mediator. On the other hand, to apply this theory in any studies, there are three assumptions which should be met. First, purchase intention is totally under consumer's control. Second, consumers are realistic and make efficient use of information accessible to them. Third, consumers evaluate the impact of their actions before they make decision to perform or not of a specific behaviour (Fishbein & Ajzen, 1975).

According to TRA, beliefs are the antecedent of attitude and subjective norms. Consequently, both attitude and subjective norms determine behavioural intention. Therefore, TRA certainly justifies some of the variables in the theoretical framework of this study which are attitude, environmental knowledge and concern (beliefs), social influence (subjective norms) and behavioural intention (Aman *et al.*, 2012).

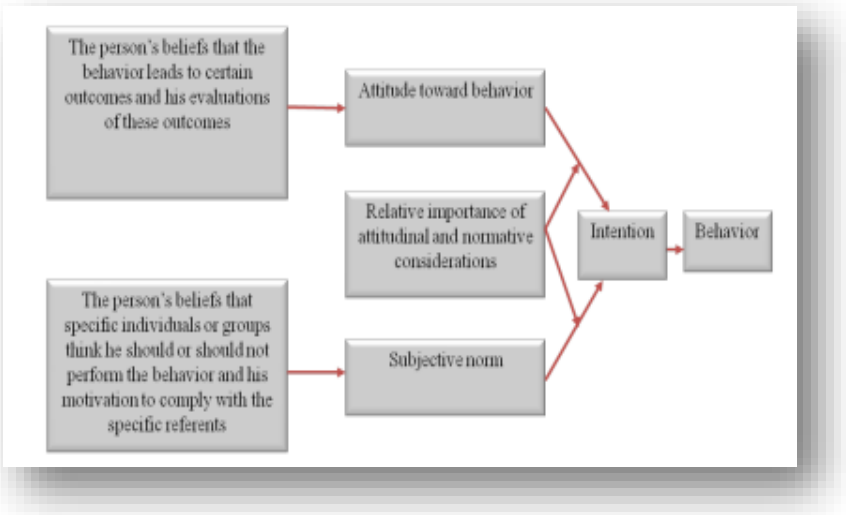

Figure 2.1: Theory of Reasoned Action (Fishbein and Ajzen, 1975).

2.2.2 Diffusion of Innovations Theory (DIT)

Diffusion of Innovations Theory (DIT) is defined as a theory that describes the spread of new ideas, products or technology among members of a given culture (Rogers, 2010). Typically, when new products or ideas are introduced, they are more likely to be embraced by small number of people and only later that the innovation will spread to others. DIT was introduced by Everett Rogers, a professor in communication studies in 1962. He identified four essential aspects of DIT which are innovation, communication channels, social system and time. He further proposed that to ensure the new idea is sustainable, it must be extensively embraced (Rogers, 2010). During the adoption curve, innovation will reach the critical mass at some point. When this happens, social system such as government policy plays an important role in influencing consumers green innovation adoption. Thus, this study will investigate whether perceived government policy is an important antecedent of consumers' purchase intention.

According to Figure 2.2, there are five types of adopters which are innovators, early adopters, early majority, late majority and laggards. Each types of adopters are characterized by different demographic profiles based on age, education level and income (Beal & Bohlen, 1957). Hence, this study is intended to analyse whether demographic factors (such as education level and income) are important predictors of consumers purchase intention.

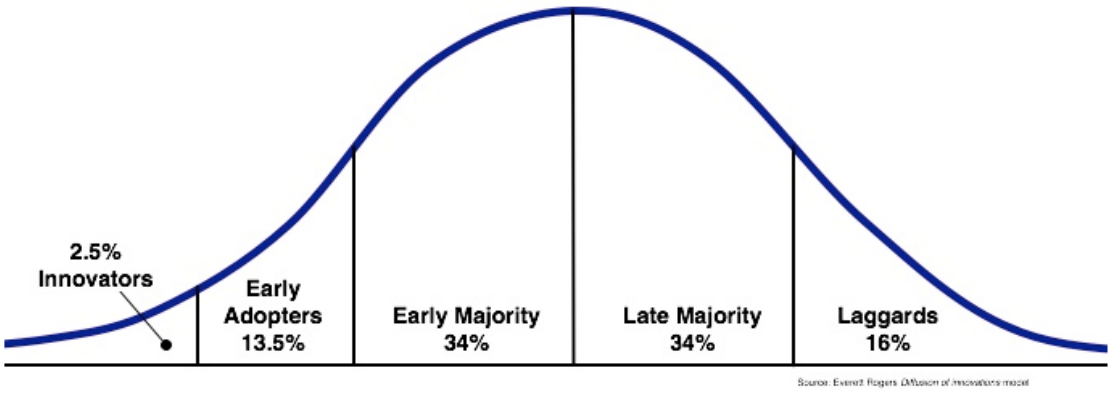

Figure 2.2: Adopters categorization based on innovativeness (Rogers, 2010)

Since solar panel is a new product, DIT is a good theory that can explain consumers' adoption of this technology. There are five stages of innovation adoption process which are knowledge, persuasion, decision, implementation and confirmation (Rogers, 2010). Looking at the consequences of innovation adoption, both positive and negative effects are expected when a person make a decision to adopt a certain product. Product benefit is certainly the positive outcomes while the cost and maintenance are the negatives. It is important to gain insight into the diffusion process to make sure proper management of new product evolution. Thus, this study will explore whether product benefit, solar panel aesthetics as well as perceived cost and maintenance influence consumers' purchase intention.

DIT is widely applied in many disciplines which involve technological innovations such as communication, political science, sociology, public health, history, economics, technology, geography, management, marketing and many more. Some of researchers who utilized DIT in their studies are Medlin (2001) and Jacobsen (1998). They suggested that Roger's DIT is the most suitable theory to examine the acceptance of technology in higher education environment. Besides that, DIT is also applied in consumer behaviour studies, for example, Goslar (1991) explored the acceptance of microcomputers in marketing community, Brancheau and Wetherbe (1990) examined the adoption of spreadsheet software in context of end user computing, López-Nicolás, Molina-Castillo and Bouwman (2008) assessed the acceptance of advanced mobile service among the Dutch in the Netherlands while Faiers and Neame (2007) conducted their research to understand consumer behaviour in domestic energy usage.

In conclusion, since this study is based on relationship basis, variables such as perceived government policy, perceived cost and maintenance, solar panel aesthetics, product benefit and demographic factors (education level and income) are added into the framework (besides those variables mentioned in TRA section) to examine whether they fit into this

research framework and thus, contribute to the advancement of knowledge in green energy consumerism.

2.3 Consumer purchase intention

Green purchase intention can be described as the probability and individual inclination to choose environmental friendly energy products over the conventional products in their purchase decision (Rashid, 2009). Mostafa (2006) conceptualized green consumerism as consumption of products which will minimize pollution, preserve the non-renewable resources and environment as well as can be recycled. Meanwhile, Chan (2001) suggested that green purchase is an environmental friendly behaviour which consumers carry out to show their concern to the Mother Nature. However, Ramayah *et al.* (2010) explained that green purchase is a motivation to behave in a specific way.

Many studies have been done on green consumer behaviour in the past. In her study to explore influencing factors on Malaysian landed property owners' preference of solar water heating usage, Lee (2011) investigated six variables i.e. environmental concern, perceived cost, perceived maintenance, government subsidies, solar panel aesthetics as well as exposure and experience on solar panel that she thought may have impacts on. Qader (2008) on the other hand, focused on five variables when she investigated the intention to purchase electronic green product among lecturers. These are perceived government legislation, self-efficacy, media exposure, health and safety concern as well as environmental attitude. Meanwhile, Alodini (2008) in his study to determine factors that affect customers to pay more for environmental friendly products in USM has adopted four main variables which are attitude, behaviour, value and knowledge. In addition, Abdul Wahid *et al.* (2010) has used eight variables such as social influence, environmental effect, environmental label, environmental knowledge, environmental attitude, environmental concern and demographic

variables (educational level and income) in her research to identify the green purchase behaviour of environmental related volunteers in Penang.

Many determinants such as environmental concern, product knowledge and experience, attitudes, social influence, product cost and maintenance, government legislation and demographics are proven to influence consumers' choice in making purchase decisions (Qader, 2008; Tan, 2011; Lee, 2011). Lee (2008) highlighted that there are less studies related to green marketing in the East compared to the West. Therefore, this research is crucial to understand the green energy purchase behaviour especially the purchase intention of Malaysian consumers.

2.4 Perceived government policy

Diekmeyer (2008) explained that government initiative is defined by the actions or supports taken by the national government. To facilitate the adoption of green consumerism, the government of Malaysia has initiated many strategies and development of sustainable consumption as well as continuous effort in promoting environmental awareness (Chen & Chai, 2011) and social advertising to the public (Haron *et al.*, 2005). Ooi *et al.* (2012) explained that government policies include encouraging car-pooling and providing incentives to manufacturers of green products.

Lee (2011) explored the aspects and benefits of government subsidies in promoting the adoption of green energy in Malaysia. A government initiative of subsidizing the consumer via feed-in tariffs has been introduced in 2011 to facilitate the effort. The major energy providers such as Tenaga Nasional Berhad, Sabah Electricity Sdn. Bhd (SESB) and Sarawak Electricity Supply Corp. (SESCO) are required to purchase the energy via the residential feed in tariffs. Western countries such as the US and Europe had seen greater adoption of solar panels due to more aggressive government policies, such as minimum of

30% tax credits in the US (US Department Of Energy). In Taiwan, some of the green products sales have increased significantly due to hybrid subsidy program from the government (Chang *et al*., 2011). Qader (2008) argued that the government initiative not only accelerated green purchase behaviour but also designed to protect the consumers. However, Zhai and Williams (2012) reported there are still social obstacles in adopting solar energy despite the government policies.

Results from studies conducted by Ooi *et al*. (2012), Sinnapan and Rahman (2011) as well as Tsen *et al.* (2006) reported that perceived government legislation strongly influence green purchase intention among Malaysian consumers. Their findings further suggested that consumers think government should take their responsibilities to encourage and nurture environmental behaviours. However, findings from Qader and Zainuddin (2011) proved that perceived government legislation did not have any impact on environmental attitude or purchase intention. Thus, this research will analyze if perceived government policy affects purchase intention of solar panel.

H_1 :Perceived government policy is significantly related to consumer purchase intention of solar panel.

2.5 Perceived cost and maintenance

The consumer perception on product costs differs based on financial and education background, social exposure and other factors. Zhai and Williams (2012) claimed from a regression analysis of data that cost benefit of adopting the technology is the strongest predictor for its adoption. The value of cost does not only depend on money, but also on individual perception of how much benefit it offers. It is reported that 66% of the people of Scotland are interested in purchasing green energy using solar PV but were holding back due

to the perceived high cost. This translates to the perception that the high cost of solar PV adoption outweighs its long term benefit (STV News, 2011).

It is clear that one of the important obstacles in supressing a high rate or early adopters for solar energy perception is the very long return of investment for a solar PV system as opposed to its lifetime. Zhai and Williams (2012) stated that a study on solar panel adopters in China shows the perceived drawback of a solar panel is the cost benefit which is gained after 21 years as opposed to its lifespan of 25 years. Faiers and Neame (2006) supported this argument via a concluded study that showed individuals with positive perception on solar PV technology were pulling back from adopting the technology by the financial cost. Yuan *et al*. (2011) concurred with this view that 23% of the respondents who did not adopt the green energy are due to the perceived high installation cost.

Apart from the perceived high cost, there is a perceived high maintenance of the product which may prolong the return of investment pay back. According to Zhai and Williams (2012), their green energy survey in Phoenix Metropolitan Area, Arizona has placed the perceived high maintenance of solar PV among the top contributor in influencing the decision for adoption. Beckstead (2008) concluded based on his study in Canada that schools have resisted the installation of solar PV projects due to more maintenance responsibility. A similar view is taken by Lee (2011) that Malaysian consumers' adoption of solar water heater system is influenced by the perception of high maintenance of the system. Lee's view is supported by Rezai and Shamsudin (2011) in their research that Malaysian consumers' attitude towards organically produces vegetable is influenced by perceived cost or price. The higher the price, the lower the purchase intention will be.

However, study conducted by Smith and Paladino (2010) discovered that price (perceived cost) does not predict consumers' purchasing behaviour. Due to contradictory findings, it is quite interesting to study the relationship between these variables. Therefore,

perceived cost and maintenance of solar panel will be investigated in detail to understand how it affects consumer purchase intention.

H_2 :Perceived cost and maintenance are significantly related to consumer purchase intention of solar panel.

2.6 Product knowledge and experience

Knowledge is defined as the characteristic that affects all the steps in consumer decision making process. Generally, knowledge also refers to how consumers collect, manage and analyse products (Alba & Hutchinson, 1987). Consumer's product knowledge can be categorized into three parts; namely, the subjective knowledge of the product, objective product knowledge and the product knowledge experience; and that consumer's product judgement is impacted by product related experience (Brucks, 1985). As Pillai and Hofacker (2007) explained, consumer's information search and processing behaviour are affected by prior knowledge or exposure of the product.

Consistent with past literature, product knowledge and experience have been identified as significant predictors of green purchase behaviour by a considerable amount of research (Diaz-Rainey & Ashton, 2008; Arkesteijin & Oerlemans, 2005; Chan & Lau, 2000; Abdul Wahid *et al*., 2011; Ooi *et al*., 2012; Aman *et al*., 2012; Mostafa, 2007).

Diaz-Rainey and Ashton's (2008) study to profile potential adopters for green electricity tariffs in UK as well as Arkesteijin and Oerlemans' (2005) study on Dutch residential users found that prior knowledge on green energy and environment strongly influence green power adoption. On the other hand, Abdul Wahid *et al*. (2011) in their quantitative study explained that product knowledge significantly correlates with green purchase behaviour among Penang environmental volunteers. Ooi *et al*. (2012) concurred

with Abdul Wahid's *et al*. (2011) view. Result of their study to explore the antecedents of environmental purchase behaviour among members of Non-governmental Organization (NGO) in Malaysia, Ooi *et al*. (2012) concluded that environmental/product knowledge positively correlates with green purchase behaviour. This view is also shared by Mostafa (2007) in his study on Egyptian consumers, Aman *et al*. (2012) on their study on Sabahan consumers using hierarchical multiple regression as well as Chan and Lau (2000) on China consumers using structural equation modelling.

Solomon (2007) concluded from his study on consumers in Canada that there are still positive attitude towards the adoption of solar PV in electric generation despite the lack of prior knowledge. This is supported by Diamantopoulos *et al.* (2003) which stated that positive attitude towards green product doesn't require much knowledge of the technology.

Meanwhile, Lee (2011) concluded from her study that part of the reason for the low adoption of solar water heating system in Malaysia is due to the lack of product knowledge. Her view is supported by Farhar and Coburn's (2000) study which described that one of the obstacle for a society to adopt green energy is the residents are not willing to install PV system until they receive more information. Most customers unwilling to choose a product that they have less knowledge even it will help them save money. The authors further argued that the acceptance to renewable energy is dependent on the society's knowledge and familiarity.

Although there are many literature that associate product knowledge and experience with green buying behaviour, there are few studies that yield contradictory results. For example, Paco and Raposo (2009), Rahbar (2008), Laroche *et al*. (2001) and Tadajewski and Tsukamoto (2006) in their research argued that environmental knowledge doesn't predict green purchase behaviours. Since past literature has contradictory results, this research will examine if product knowledge and experience affect purchase intention of solar panel.

H_3 :Product knowledge and experience are significantly related to consumer purchase intention of solar panel.

2.7 Solar panel aesthetics

Lee (2011) emphasized that physical appearance and aesthetics of solar panel are indeed very important to consumers. Most consumers don't prefer the visible and bulky unit of solar panel on their rooftop. It is even worse when birds discharge their droppings as this can create undesirable, ugly stain and consequently, affect the efficiency of solar panels. This is in line with the view of Faiers and Neame (2006). In their study of consumer attitudes towards the domestic solar panel, they find out that the placement of solar panel affects the visual landscape. This further leads to negative consumers' attitude towards solar power adoption in UK (Faiers & Neame, 2006).

However, other researches carried out in Arizona and Germany highlight that the physical characteristic of solar panel has less significant impact on purchase intention of consumers compared to other factors (Zhai & Williams, 2012; Zoellner, Schweizer-Ries & Wemheuer, 2008). Therefore, this study is intended to analyse whether the physical appearance of solar panel is an important predictor of consumers purchase intention.

H_4 :Solar panel aesthetics are significantly related to consumer purchase intention of solar panel.

2.8 Social influence

Consumer consumption behaviour has long been influenced by peers, co-workers, family and opinion leaders, and the interactions have caused consumer to perceive that the products have high social value (Zia-ur-Rahman *et al*., 2013). Ewing (2001) explained that