



A Review on Consumer Purchase Intention of Solar Panel in Malaysia

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ABSTRACT

Solar energy has a bright potential to be the clean source of energy for the future. This paper presents a review on the literature found of the solar panel industry in Malaysia followed by identification of possible factors that may influence consumer's purchase intention of the green product. The review exercise found perceived government policy, perceived costs and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, environmental attitude, product benefits as well as demographic factors (such as education level and income) as possible influencing factors for solar panel. The review outcomes are beneficial particularly for solar panel marketers and businesses who can develop proper planning and strategies to market this product from the consumer's behaviour insights gained to help the renewable energy industry to grow.

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Introduction

As a developing country, Malaysia heavily depends on energy to cater for both the industries' and her citizens' needs as these contribute towards the country's economic growth and public's quality of life. The demand for electricity for example has increased approximately 78% for year 2000 to 2010 as reported in the Eighth and Ninth Malaysia Plan with transport and industrial sectors identified as key users with almost 80% of total consumption for 2010 (Figure 1). The reports predicted that the demand from the industrial sector will increase significantly by year 2020 when 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

Figure 1. Commercial energy demand by sector in Malaysia (2000-2010). Adapted from "Solar photovoltaic in Malaysia: The way forward. Renewable and Sustainable Energy Reviews" by Muhammad-Sukki *et al.* (2012)

Oil, gas, coal (fossil-fuel) and hydroelectric have been Malaysia's primary energy sources for electricity generation; and that Tenaga Nasional Berhad (TNB), Sabah Electricity Sdn. Bhd. (SESB) and Sarawak Electricity Supply Corp. (SESCO) are the key players for fossil-fuel power generation in the country (Mekhilef *et al.*, 2012). As fossil-fuel power plants release harmful greenhouse gases like carbon dioxide (CO₂), nitrous Oxide (N₂O) and methane (CH₄) which can affect the environment (US Environmental Protection Agency, 2014); and that fossil-fuel resource is non-renewable; using such resources for power generation is not a sustainable option particularly as the resource is depleting very fast. To solve this problem, Malaysia has gradually shifted its energy mix to include natural gas and coal. Unfortunately, these resources are also non-

renewable; and are expected to be exhausted in 2035 (Muhammad-Sukki *et al.*, 2012). Noting this, Malaysia has since shifted its interest to diversify its energy mix further with greener energy sources like hydroelectric and renewable energy; and has been proactive in developing its own greener energy policy. This has led to the gained popularity of hydroelectric in the country (Ali, Daut & Taib, 2012).

Renewable energy originates from inexhaustible resources. As it generates power without polluting the environment unlike the conventional fossil fuel, renewable energy usage significantly reduces the overall carbon footprint associated with global warming. Some of the main sources of renewable energy are wind power, hydro power, solar energy, biomass, biofuel and geothermal energy.

Several incidents that have adversely affected the environment in relations to the use of fossil fuel have further expedited the adoption of renewable energy as an alternative resource for energy generation in Malaysia as well as other countries in the world. The Gulf of Mexico oil spill in April 2010 that has disastrous effect on the ocean life and its ecosystem (Smithsonian Institution, 2013) and the calamity of the Fukushima radioactive leakage in March, 2011 which caught the global attention have further affirmed the need to venture into renewable energy. The Fukushima catastrophe for instance has significantly influenced our energy policy to focus on sources that are more environmental friendly (Muhammad-Sukki *et al.*, 2012).

Malaysia for example is aiming to achieve 40% reduction of carbon footprint from 2005 level by 2020 (Khor & Lalchand 2014). In line with this, the government has formed several ministries and agencies to support renewable energy implementation in Malaysia. For instance, the Ministry of Energy, Green Technology and Water (KeTTHA) is tasked with promoting and developing renewable energy technologies, the Malaysia Energy Centre (PTM) is responsible for performing research and analysis while the Sustainable Energy Development Authority's (SEDA) function is to administer feed in tariff system (FiT) (Mekhilef *et al.*, 2012).

In Malaysia, solar energy is the only technology that is made available to all parties including the public. Wind power is still under study, while biomass, biofuel and hydro power are

utilized by the industrial sector (Ong *et al.*, 2011). There are many technological applications of solar energy. Some of them are solar photovoltaics (PV) which is also known as solar panel, solar hot water and concentrated solar power (International Energy Agency, 2011). Solar PV which was created by Charles Fritts in 1889 (Richards, 2004) consists of PV modules which are connected electronically and placed on a supporting structure. The modules convert light energy (photons) from the sun into electricity through the photovoltaic effect. There are two types of Solar PV systems, i.e. on-grid and off-grid system. Electricity generated from the on-grid system is connected to the national grid and is the most commonly used. On the other hand, the off-grid system is used primarily to store electricity and is more commonly used in rural areas.

With a strategic geographical location and an average solar radiation of 37kWh/m² per month, Malaysia's tropical climate is suitable and ideal for harnessing the sun's radiation via solar panel utilization (Haris, 2008). Figure 2 illustrates the yearly average solar radiation (kW/m²/day) on which Sabah, Penang, Kedah, Perak, Perlis and Kelantan are states in the country with the highest solar radiation and one that pose the biggest potential for solar panel adoption. Sarawak is the state with the lowest potential for solar panel usage since it has the lowest annual solar radiation.

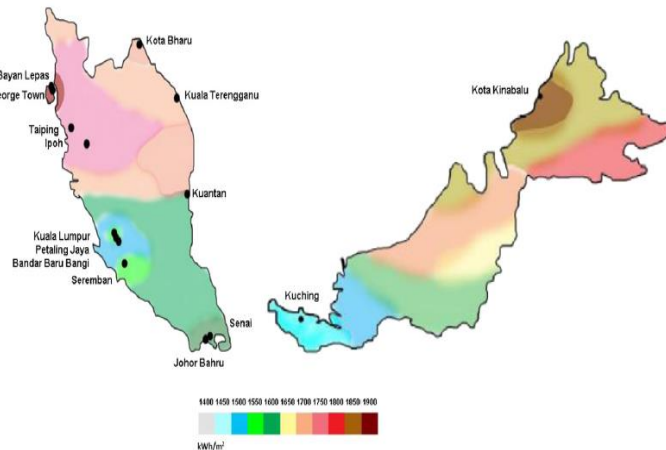


Figure 2. Yearly average solar radiation. Adapted from "Malaysia's Latest Solar PV Market Development" by Haris (2010)

Solar power deployment in Malaysia started with the five-year Malaysia Building Integrated Photovoltaic Technology Application Project (MBIPV) in July, 2005. This project demonstrated and showcased the viability of solar panel for electricity generation the purpose of which was to act as a catalyst for market development of solar panel industry. In addition, 1000 solar systems were installed on the public premises' roof to encourage and spread the applications of solar panel. Another achievement of this project was the 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 (Muhammad-Sukki *et al.*, 2012).

According to SEDA (2014), solar energy has generated 36,135 MWh of electricity with carbon avoidance of 346,524.07 tonne in 2013 alone and thus, illustrating its potential growth in the Malaysian market. Figure 3 illustrates the cumulative value of renewable energy in Malaysia on which solar power is predicted to become the main source of renewable energy in the future. The forecast shows that by 2050, renewable energy will contribute to about 11.5GW capacity and 9GW from this will be contributed by solar PV.

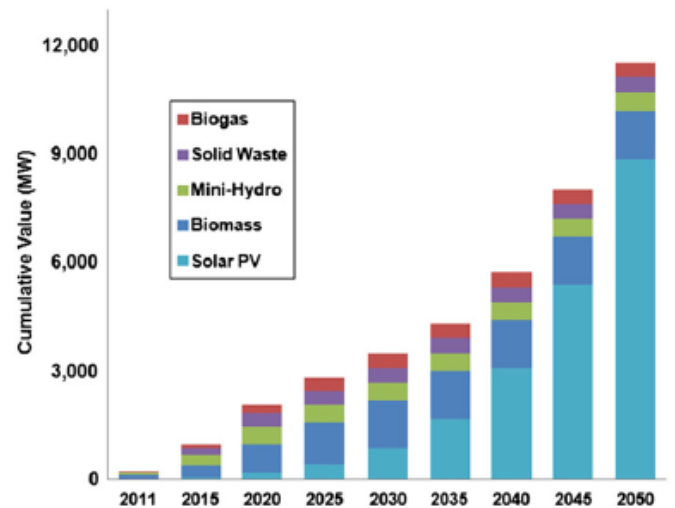


Figure 3. Cumulative value of renewable energy in Malaysia (2011-2050) adapted from "Renewable energy development in Malaysia" by Abdul Malek (2010)

Even though the worldwide market for solar panel is growing rapidly, the utilization of solar panel in Malaysia is still at an early stage and very limited as compared to other countries (Mekhilef *et al.*, 2012). Noting this, the authors intend to review the literature to identify possible factors that affect consumer's purchase intention of solar panel in Malaysia.

Literature Review

Consumer's purchase intention

Numerous studies have been conducted on green consumer behavior in the past. Lee's (2011) study for example identified environmental concern, perceived cost, perceived maintenance, government subsidies, solar panel aesthetics, exposure to and experience on solar panel as the six influencing factors for why Malaysian landed property owners favor solar water heating usage. In Qader's (2008) investigation on lecturer's intention to purchase electronic green product however, five factors; i.e. perceived government legislation, self-efficacy, media exposure, health and safety concern, and environmental attitude were used. Meanwhile, Alodini's (2008) study used four variables i.e. attitude, behavior, value and knowledge to determine factors that affect customers to pay more for environmental friendly products in USM. In Tan's (2010) research to identify the green purchase behavior of environmental related volunteers in Penang, eight variables i.e. social influence, environmental effect, environmental label, environmental knowledge, environmental attitude, environmental concern and demographic variables (educational level and income) were used.

From these studies, many factors that determine consumer's choice and/or purchase decisions have been identified. These include environmental concern, product knowledge and experience, attitudes, social influence, product cost and maintenance, government legislation and demographics (Qader, 2008; Tan, 2010; Lee, 2011). While the identification of these determinants are acknowledged, the fact that there are less studies related to green marketing in the East compared to the West must also be noted (Lee, 2008). In this instance, what the current research attempts to do is crucial as a way to develop an understanding on the green energy purchase behavior like purchase intention of the Malaysian consumers.

Green purchase intention and behavior

Green purchase intention is defined as the probability and individual inclination to choose environmental friendly energy products over the conventional products in their purchase decision (Rashid, 2009). The literature has several definitions on

green purchase behavior. These include Chan *et al.* (2000) who suggested that green purchase is an environmental friendly behavior that consumers carry out to show their concern to the Mother Nature; whereas Ramayah *et al.* (2010) explained that green purchase is a motivation to behave in a specific way.

Fishbein & Ajzen (1975) asserted that green purchase intention is a crucial determinant of consumer buying behaviour. When intention to purchase the product increases, it is highly possible that a consumer will make that purchase eventually. In the evaluation phase of purchasing process, consumers choose brands and forms as their top preference. Nevertheless, there are two factors that can affect both purchase intention and purchase decision; namely, attitude and unexpected situational aspect. Price, income and product value may influence consumer purchase too (Qader, 2008; Ramayah *et al.*, 2010).

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 Malaysian government has initiated many strategies for developing sustainable consumption in addition to continuing efforts to promote public's awareness (Chen & Chai, 2010) and social advertising (Haron *et al.*, 2005). Mei *et al.* (2012) reported that government policies include encouraging car-pooling and provide 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. In 2011 for instance, the government has initiated consumer's subsidies via feed-in tariffs to facilitate the effort. This is where major energy providers like TNB, SESB and SESCO are required to purchase the energy produced via the residential feed in tariffs. This initiative is important; aggressive government policies in the western countries like the minimum of 30% tax credits in the US has led to increased adoption of solar panels (US Department of Energy). In Taiwan, some of the green products sales have increased significantly due to hybrid subsidy program from the government (Chang, 2011). Qader (2008) argued that the government initiative not only accelerated green purchase behaviour but also designed to protect the consumers. It is important to note however that despite the government policies, there will still be social obstacles that affect the adoption of solar energy (Zhai & Williams, 2012).

Perceived cost and maintenance

The consumer perception on product costs differs based on financial and education background, social exposure and other factors. From a regression analysis of data, Zhai and Williams (2012) claimed that cost benefit in 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). The very long return of investment for a solar PV system as opposed to its lifetime becomes one of the important perceived obstacles that suppress adopter's (innovators and early adopters) intention to purchase solar energy. According to Zhai and Williams (2012), a study on solar panel adopters in China identified cost benefit of a solar panel as the drawback factor as consumers perceive that the cost benefit is gained only after 21 years as opposed to its lifespan of 25 years. Other studies concurred with this finding. Faiers and Neame's (2006) study for example concluded that individuals with positive perception on solar PV

technology were pulling back from adopting the technology due to the financial cost. In another study, Xueliang (2011) found 23% of his respondents who did not adopt the green energy were due to the perceived high installation cost.

Apart from the perceived high cost, perceived high maintenance of the product may also prolong the return of investment pay back. As noted by Zhai and Williams (2012), a green energy survey in Arizona has placed the perceived high maintenance of solar PV among the top factors that influence people's decision for adoption. Based on a study in Canada, Beckstead (2008) concluded that schools have resisted the installation of solar PV projects due to more maintenance responsibility. Similarly, Lee (2011) found that the Malaysian consumers' adoption of solar water heater system was influenced by the perception of high maintenance of the system.

Product knowledge and experience

Unsurprisingly, consumers with prior knowledge and experience on green technology are the ones who are more likely to adopt them. These variables have been identified as significant factors by three studies (Diaz-Rainey & Ashton, 2008; Arkesteijin & Oerlemans 2005, Ozaki 2011). As Pillai and Hofacker (2007) explained, consumer's information search and processing behavior are affected by prior knowledge or exposure of the product.

Consumer 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). Solomon (2007) however argued that consumer's purchase decision is based on memory and choices upon learning on the product. He concluded from a study in Canada that there are still positive attitude toward the adoption of solar PV in electric generation despite the lack of prior knowledge. This is supported by another study by Diamantopoulos *et al.* (2003) which found that positive attitude towards green product does not require sufficient knowledge of the technology.

One of the obstacles for a society to adopt green energy is when residents are not willing to install PV system until they receive more information (Zhai & Williams, 2012). Most customers are not willing to choose a product that they have less knowledge on although when they know that it will help them save money. Lee (2011) concluded that one of the reasons for the low adoption of solar water heating system in Malaysia is due to the lack of understanding of the product and its benefit to the consumer.

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 Faiers and Neame's (2006) view. In their study on consumer attitudes towards domestic solar panel, they found that the placement of solar panel affected the visual landscape which leads to negative consumers' attitude towards solar power adoption in UK (Faiers & Neame, 2006). Other studies carried out in Arizona and Germany however found 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).

Social influence

Consumer consumption behaviour has long been influenced by peers, co-workers, family and opinion leaders, and the interactions have caused consumers to perceive that the products have high social value (Zia-ur-Rahman et al., 2013). Ewing (2001) explained that environmental friendly behavior is significantly motivated by social norms. In addition to social influence being a major factor in green purchase behaviour, interpersonal communication is also identified as the most important aspect of social influence affecting consumer green purchases (Lee, 2008). This is because social groups that consist of people with similar habits, desire and thinking will cultivate environmental friendly culture. Lee (2008) also discovered social influence as the top predictor of Hong Kong consumer's green purchasing behaviour.

Mei et al. (2012) emphasized the effect of peer pressure in changing a person's mind set. A large behavioural shift often occurs when a person is not doing what is asked when others are complying. Daido (2004) stated that a person's mind set can be influenced by changing the surrounding. Meanwhile, Zhai and Williams (2012) argued that cultural acceptance to renewable energy is dependent on the society knowledge and familiarity. The inherit behaviour of a society in preferring the status quo requires them to slowly adjust and familiarize with a particular energy product before it attains a higher social value. Schelly (2014) found that the chances of a society in embracing an innovative technology relied upon the combination of its demographic compositions, perceptions among the individuals and social leader as well as the social networks to accelerate the information flow. Further, in their study of Penang-state volunteers who participate in environmental related activities, Abdul Wahid et al. (2011) discovered the significance of social influence over the segment's green purchase behaviour.

Environmental concern

Public environmental awareness has been steadily increased since the 1980s and continues to rise (Qader, 2008). But even if the environmental concern had reached inimitable level in 1990, it has not transformed into a preferable environmental action. Recent studies in the past two decades show very small correlations between environmental concern and environmental behaviour even with the higher rate of natural resource depletion globally (Wall, 1995).

Hartmann et al. (2012) argued that the recent growth in consumers buying of environmental friendly, premium-price electronic products is contributed by the overall favourable attitudes toward green energy globally. The effects of environmental concerns on purchasing intention are mediated by the attitude towards renewable energy, indicating that green energy consumers have higher environmental awareness than the general population. The effect of environmental concern on purchase intention is however only partially mediated by the attitude towards the brand.

The high rise of public environmental concern is due to the influence of media, greater consumer awareness and depletion of natural resources which currently causes the current power crisis. The importance of environment in consumer buying decision has caused some western countries like the US and Europe to adopt green marketing. Green marketing includes the planning, promotion and supply of products that have minimum impact to the environment (Zia-ur-Rehman, 2013).

According to Mohai et al. (2010), environmental concern can currently be seen as a phenomenal approach that comes in higher order. It has taken personal factors such as age and

income. The next development will take environmental concern to be part of the universal human moral values.

Bandura (1986) described the social cognitive theory in which the individuals with greater environmental awareness believe their contribution could make a positive impact to the environment. This has been found in a local study on which environmental concern was significantly related to Penang's environmental-related volunteers green purchase behaviour (Abdul Wahid et al., 2011). Lee (2011) further found that the involvement in collective public environmental attitude are motivated by the self-efficacy in social beliefs, in which influences plan to purchase a green product with the altruistic value for the better well-being of humankind.

Product benefit

Consumers believe that environmental friendly products provide advantage compared to conventional products. Consumers perceive that green energy help to alleviate global warming, reduce air pollution and energy depletion issues (Roe et al., 2001; Clark et al., 2003). In addition, consumers also think that by adopting green electricity, they help to reduce air pollution and consequently help to preserve natural ecosystem.

Product benefit has been found and acknowledged in the literature as one of the factors that could influence consumer's purchase intention and willingness to pay for green products as long as the product benefits them (Qader, 2008; Diamantopoulos et al., 2003, Ali et al., 2010; Roe et al., 2001). Mendonca et al. (2009) study also found that the adoption of green energy's success depends on the environmental and economic benefits to consumers in Denmark. In Germany, Zoellner et al. (2008) identified economic costs and benefits as the main reasons that influence consumers in Germany to adopt solar PV. Farhar and Coburn (2000) who conducted a study in Colorado found that the main advantage of solar panel installation is the cost efficiency for prolonged energy supply. As for Faiers's (2005) study, respondents were reported to gain long term benefit in terms of reduction in future expenses and increment of their property value.

Interestingly, Korcaj et al. (2014) argued that consumer's purchase decision of solar panel does not solely depend on the product benefit. There are many other significant factors that affect consumers' adoption of solar panel such as price, government policy, product knowledge and social influence. This argument is supported by Zhang et al.'s (2012) study when he found that high installation price of green energy to be the barrier for consumer to purchase the product despite its benefit.

Demographic (income and education level)

A number of studies in green marketing have attempted to examine the profile of green electricity potential consumers. For instance, some authors proved that higher income increases intention to pay for green electricity (Diaz-Rainey et al., 2011, Ek et al., 2008; Rowlands et al., 2003; Zamikau, 2003). Several authors concurred that higher level of education has strong correlation with willingness to purchase green electricity (Ek et al., 2008; Rowlands et al., 2003; Wiser, 2007; Zamikau, 2003). However, other researchers concluded that income is not an important predictor in the Dutch market (Arkesteijn et al., 2005). Kotchen et al. (2007) highlighted that there's an absence of significant proof that link income to green electricity purchasing in the US market. Further studies on demographics by Diaz-Rainey et al. (2008) and Kotchen et al. (2007) suggested that age, gender and education as not significant in predicting consumers' green buying behaviour.

Environmental attitude

Some authors (Blackwell *et al.*, 2006; Schultz & Zeleny, 2000) described attitude as actions which form consumers preferences and "attitude of environmental concern are rooted in a person's concept of self and the degree to which an individual perceives himself or herself to be an integral part of the natural environment" (p.443-457). Rashid (2009) described environmental attitude as "a learned predisposition to respond consistently favourable or unfavourable manner with respect to the environment". Chen and Kyle (2014) defined attitudes toward energy conservation as "a person's subjective judgements about the positive and negative evaluation of the act of energy use" (p.24). Laroche *et al.* (2001) on the other hand, emphasized that attitude is the top determinant of consumer purchase intention for green products. Kaiser *et al.* (2003) reported that attitude is strongly associated with recycling, fuel saving and environmental association involvement. Clearly, evidence shows that individual who has positive attitudes towards green electricity will be more inclined to purchase green electricity (Chen & Kyle, 2014).

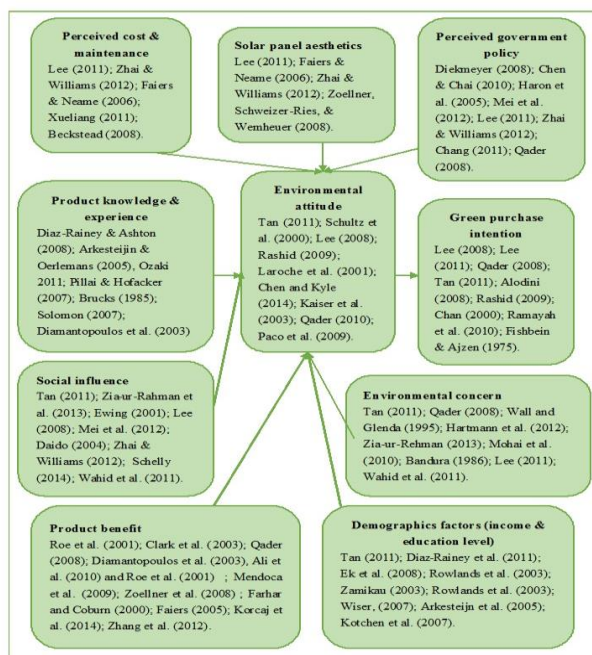


Figure 4. Proposed conceptual framework of factors influencing consumer purchase intention of solar panel

However, Qader (2008) argued that environmental attitudes show less consistency and has incompatible relationships to consumer purchasing behaviour. Finally, Paco *et al.* (2009) added that even though attitude may not be the basis of consumers purchase decision, it is still a significant factor that determines green purchases.

Conclusion

Based on what has been reviewed and found in the literature, a conceptual framework has been developed (Figure 4). In the proposed model, independent variables for Malaysian consumer's green purchase intention of solar panel have been identified to be made up of perceived government policy, perceived cost and maintenance, product knowledge and experience, solar panel aesthetics, social influence, environmental concern, product benefit, demographic factors (such as income and education level) as well as environmental attitude. Environmental attitude is proposed as a mediator between all the independent variables and the green purchase intention of solar panel.

These review outcomes are beneficial not only for the development of model framework on the subject of interest, but its significance is more particularly appreciated by the industry i.e. solar panel marketers and businesses who can use these factors to construct proper planning and strategies for marketing this product to targeted consumers. In sum, the consumer's behavior insights gained will be able to help the renewable energy industry to grow.

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