Transportation Research Part A 113 (2018) 259–278

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

What make consumer sign up to PHEVs? Predicting Malaysian consumer behavior in adoption of PHEVs

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ARTICLE INFO

Keywords:
Consumer behaviour
Adoption
Environmental concern
Hyperbolic discounting
PHEV
Empirical study

ABSTRACT

Malaysia is amongst the major energy intense countries and is under an excessive burden to advance its energy efficiency and to also work towards the reduction of its carbon emission. Plug-in Hybrid Electric Vehicles (PHEVs) have the potential to lessen the carbon emission and gasoline consumption in order to alleviate environmental problems. Consequently, attempts are being initiated to popularise the use of PHEVs as the main mode of transportation. The diffusion of PHEV adoption is a positive initiative. A sample of 403 respondents has been collected from Malaysia in order to forecast the customer's intention to adopt PHEVs by using the extended theory of planned behaviour. The empirical outcome using the PLS investigation exposed that all four constructs, subjective norm, personal moral norm, perceived behavioural control, and attitude ominously shows an indirect effect which has inclined towards the Malaysian consumers' intention to adopt PHEVs. All these four major constructs were significantly predetermined by their respective environmental concern. Whereas, hyperbolic discounting moderated the relationship between intention and adoption. The fostering result verifies that the relevance of the extended TPB had a good explanatory power in the line of predicting the Malaysian consumers' intention to adopt PHEVs. For future study, grounded by the observed outcome, authors explain the implication aimed at promoting the PHEV adoption.

1. Introduction

The world is going through crucial issues like energy scarcity, air pollution, and the emission of greenhouse gas (GHG) (Sang and Bekhet, 2015). Vehicles which use both electrical and internal combustion engines for propulsion purposes, appear to be a very promising prospect (Millo et al., 2014). There are 3 types of road transports powered by electricity such as electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in-electric vehicles (PHEVs). These vehicles offset foreign petroleum usage and cost less to refuel per mile than conventional vehicles. EVs are propelled by a battery-powered motor, and the battery is charged by plugging the vehicle into the electric grid either at home or at a public charging station (Ahmadi et al., 2015). EVs do not have an internal combustion engine and therefore do not use petroleum. HEVs are powered by conventional or alternative fuels as well as electric power stored in a battery. The charging of a battery is performed through the internal combustion engine and regenerative braking. Alternatively, the captured battery energy generally lost during braking by the use of electric motor acted as a generator. Contrasting

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https://doi.org/10.1016/j.tra.2018.04.007
Received 5 March 2018; Received in revised form 27 March 2018; Accepted 18 April 2018
0965-8564/ © 2018 Published by Elsevier Ltd.

Nomenclature

GHG	greenhouse gas
EVs	electric vehicles
HEVs	hybrid electric vehicles
PHEVs	plug-in hybrid electric vehicles
BEVs	battery electric vehicles
AFVs	alternative fuel vehicles
ICEVs	internal combustion engine vehicles
AEVs	all-electric vehicles
HEVs	hybrid electric vehicles
TRA	theory of reasoned action
TPB	theory of planned behaviour
PN	personal norm
PBC	perceived behavioural control
EC	environment concern
SN	subjective norm

EVs and PHEVs, HEVs are not plugged into charge (Adnan et al., 2017a). However, HEVs use both petroleum and electricity and a good mean for long distance driving. PHEVs are powered by alternative or conventional fuels as well as electric power stored in a battery. The battery can be charged by plugging it into an outside power source, by the internal combustion engine, or by re-generative breaking (Adnan et al., 2017a). Unlike HEVs, which still depend on petroleum, it is possible for PHEVs to run on only electricity when fully charged. Because PHEVs can run off petroleum or electricity, they are a good option for driving long distance if you are uncertain about charging station availability.

Moreover, PHEVs are extensively recognised as an answer that will reduce the harmful effect on the climate and lessen the carbon emission (Adnan et al., 2016). Hence, this sort of vehicle offers an advantage in the quest to reduce carbon emissions by as much as 30 percent to 50 percent and be able to attain 40 percent to 60 percent improvement in fuel efficiency. Though, Bonges and Lusk (2016) stated that in actual fact, they are going to be somewhat on the lower side. Several researchers have proved that a great amount of reduction in greenhouse gas emissions and in the increasing dependence on oil could be accomplished by the electrification of the transport sector, which further needs proper understanding and adoption from the consumer's point of view (Barbarossa et al., 2015; Bateman et al., 2013). Certainly, the emergence of Hybrid Electric Vehicles (HEVs) has received substantial industrial accomplish-ment starting from the last decade. However, all the vehicles are categorised into 3 major groups, such as Internal Combustion Engine Vehicles (ICEVs), Hybrid Electric Vehicles (HEVs), and All-Electric Vehicles (AEVs) (Adnan et al., 2016a; Boroojeni et al., 2017). Nonetheless et al. (2016) specified that a PHEV has less CO2 emission and it helps towards environmental sustainability. Schuitema et al. (2013) argued that the disadvantage of PHEV batteries is that they cannot offer the same mileage that a pure EV would offer as batteries are easily drained off for PHEVs. Furthermore, Hosseini et al. (2012) claimed that there are very few plug-in facilities that such vehicles may require. Rezvani et al. (2015) highlighted that the PHEV is the combination of a gasoline or diesel engine with an electric motor and it also carries a large rechargeable battery. Khooban et al. (2016) emphasised that since they use less gas, they also cost less to fuel: driving a PHEV can save hundreds of dollars a year in gasoline and diesel costs and help to save the environmental sustainability. In order to gain the main goal of this study, there is a need to resolve the shortcomings, i.e., limited mileage offered by the batteries as well as the inability to charge the batteries with the frequency required, that have hindered the acceptability of PHEVs (Chang et al., 2015). However, Johansson and Mattsson (2012) suggested that the adoption of plug-in hybrid electric vehicles is gaining popularity and increasing acceptability. Because of PHEVs being more practicable, they are becoming more popular in the developed nations, such as the U.S., Japan, and Europe (Fotouhi et al., 2016). However, in the context of the developing countries likewise, such as in Malaysia where the government has noted the advantages offered by PHEVs and has taken measures to promote their use (Luo et al., 2012).

The Malaysian higher authority had fixed the goal of 500,000 PHEVs being driven on Malaysian roads at the end of 2015 and around five million by the year 2020 (The National Council of Malaysia, 2012). In order to promote the usage of PHEVs, the government has initiated a number of policies, including subsidising the sale of PHEVs. The government has also paid special consideration to the advancement and manufacture of PHEVs in the eleventh 5 year-long Plan. The government has also planned to invest RM 100 billion ($ 16 billion) for the improvement of technologies in the 25 year-long planning (Sang and Bekhet, 2015; Zhang, Tolbert, and Ozpineci, 2011). The government did indicate in 2009 a 10 cities-thousand Vehicles initiative to give a boost to the growth of PHEVs and to popularise their use. However, the consumer reaction fell short of expectations (Richardson, 2013; Sang and Bekhet, 2015). According to the Malaysian Automobile Manufacturers Associations, the cumulative sales were 27,400 EVs in 2012. Of these, 23,000 were acquired by the governing agency and the community service sector whilst 4400 were bought by individuals. It was seen that the ordinary Malaysian considered the performance of the conventional vehicle to be superior to the PHEV (He and Zhan, 2017; Zhang et al., 2013). The consumer did, however, show his/her preference to have a PHEV as a second vehicle (Sang and Bekhet, 2015). Currently, it is estimated that 13% of households have a second PHEV type vehicles. Likewise, the PHEV technology may also improve and consumers may prefer the new innovations (Li and Loo, 2014). In any case, there are bright prospects for PHEVs gaining popularity in Malaysia.

The penetration of electric vehicles into the market of Malaysia has directed the vehicular industry to an entirely new dimension which is based on less dependency on fuel, and an improved fuel efficiency (Rezvani et al., 2015). Though Falvo et al. (2013) declared that electric vehicles may decrease the overall tailpipe emission, the benefits in the context of entire emissions are slightly marginal if the traditional power generation still uses coal as a primary source. So, the governing agency has substantially sponsored the vast usage of alternative energy like solar and biomass in order to lessen the dependency on coal (Adnan et al., 2016a). Although the use of PHEVs as a cleaner alternative is well sponsored by the government through many programs and policies, less information is provided from the social perspective regarding the PHEV's public acceptance (Danial et al., 2013). As the exposure to PHEVs is comparatively new in Malaysia, there has been no former research study or analysis carried out on Malaysian drivers to measure the

public acceptance as well as user intentions of this innovative and recent technology (Adnan et al., 2016a; Sang and Bekhet, 2015). Actually, communal acceptance appears to be one of the powerful impediments for successful market diffusion and can hinder the improvement of the Malaysian PHEV adoption. Researchers propose that the consequences offer a noteworthy influence in offering the visions to benefit the policy makers and consumers to better comprehend the significance of fortifying the environmental sustainability ingenuities to recover the achievement of such initiatives (Schechter, 2007; Schneidereit et al., 2015). PHEVs require funding from different governmental agencies for successful market penetration (Bühler et al., 2014; Chua and Oh, 2011). Although, Sang and Bekhet (2015) suggested that it is important that customers also target buying PHEVs. Many researchers have studied the intention of customers considering their purchase of environment-friendly cars (Adnan et al., 2016a; Egbue and Long, 2012; Graham-Rowe et al., 2012). For example, Ahmad and Tahar (2014) discovered the affecting factors for the adoption behaviour amongst the PHEV consumer community. Schuitema et al. (2013) explored the effect of the PHEV's adoption intention due to private vehicle owners' perception of the PHEVs' qualities. Ahn et al. (2010) presented an analysis to examine the intention of consumers to accept the PHEV; as well, they noticed some vital factors influencing the adoption intention of consumers, such as performance features, economic benefits, environmental consciousness, and the psychological requirements. PHEV characteristics are that they are rechargeable by plugging in, have a higher electric drive during the charge depletion period and need reduced refueling. Whilst the characteristics of the BEV is only plug-in recharge, purely electric mode, and no refueling. This study is focused exclusively on introducing the experience of Malaysians on the adoption of PHEVs. This study has motivated the researchers in a rigorous behavioural framework on the basis of the TPB literature by signifying the presence of a reasoning prejudice and hyperbolic discounting to possibly increase the overall TPB predictability. Thus, producing deeper knowledge about the internal and external motivations of environmental concerns amongst Malaysian consumers towards the adoption of the PHEV. To date, this study comprises 5 main segments. The "Literature review" section gives the detailed literature studies directly linked to the extended TPB model. Grounded in this specific analysis study, firstly, a detailed discussion on the conceptual framework has been provided followed by the suggestion of the hypotheses in the "Conceptual framework and research hypotheses" segment.

1.1. 1Motivation

This study is inspired by the rapid evolution of technology in the electric vehicle subsector over the past few years. PHEV/EV are not entirely new in fact the technology has been around for quite some time. The progress made was slow in the past, due to the lack of proper facilities to support the car usage (e.g. charging facility) and also given the electric car's relative performance compared to current car with internal combustion engine. Nevertheless, the technology strives and as of today, electric car can perform comparably similar to the conventional car, with the added benefits of reduced environmental impact. Studies have shown PHEV/EV technology can reduce carbon emissions by about 30–50%, and be able to achieve 40–60% improvement in fuel efficiency (Church, 2016; Parshall et al., 2010; Shuai et al., 2014). Thanks to national governments' commitment to reduce carbon footprint, as well as intense competition among major car manufacturers in capturing major share within the PHEV/EV market, the technology is penetrating fast into the car market in the developed countries. The same story cannot be said for developing countries like Malaysia. In the country, the sales of PHEV/EV car is very modest and remains relatively small within the commercial car segment. This is despite the government's efforts by promoting awareness, offering financial incentives to potential buyers, increasing charging facilities, among many others (Sang and Bekhet, 2015).

The future outlook of the country shows that Malaysia will continue to grow rapidly in the coming years in its bid of becoming a developed nation. Demographically, there is no signs of the population growth to slow down. Malaysia, hence, will remain consuming a lot of energy in the process. In fact, Malaysians rely a lot on cars to move around which is translated into a robust car market [4], and the potential for PHEV/EV to gain more market share is there, provided that effective strategies are adopted to further promote the PHEV/EV technology.

The government remains committed to the efforts of fighting climate change as laid out by the Sustainable Development Goals plan by the United Nations. And one of the major culprits contributing to the climate change is carbon emission from vehicles. One thing PHEV/EV technology is important in reducing the dependence on fossil fuels which in turn helps to mitigate the environmental

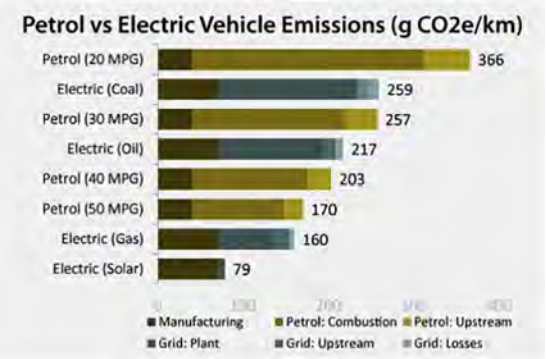

Fig.1. Petrol versus Electric vehicle emission (Source: DEFRA (emission factors), EPA (ratings), IPCC. Year: 2014).

impacts associated to it at the same time does not impact the productivity needed for the country to grow further. All in all, it is thus crucial for researcher to look at the causes to the lack of intensity among consumers in Malaysia in adopting PHEV/EV technology. This is even more needed given there has been no previous study on measuring public perception and user intentions on PHEV/EV technology in Malaysia (Adnan et al., 2017b).

2. Literature review

2.1. Adoption of PHEVs

A Plug-in Hybrid Electric Vehicle (PHEV) is a car that utilises 2 unlike sources of power, which are a battery and petrol/ diesel. In modern days, electric vehicles are regarded as one of the most state-of-the-art innovations in the automotive business. As the first PHEV in the world, Toyota Prius was produced worldwide early in the year 2000. Here, Fig. 1 shows petrol versus electric vehicle emission in a graph. The results are certainly clear, in that the better the fuel economy of a traditional car (running on petrol), the lower its emissions will be. Regarding electric vehicles, the major difference is the source of electricity. The lowest emissions by a distance are electric vehicles that use solar energy.

Various governmental efforts worldwide have already been initiated in order to reduce CO2 emissions. Whereas, there is increasing literature concentrating on CO2 emissions which influence financial incentives on the sales of electric vehicles. Nevertheless, author Zhang et al. (2011) concluded that there is no indication of lawful agencies' encouragements as an influential factor in the electric vehicle purchase by a statistical investigation carried out in Nanjing, China. In contrast, Sierzchula et al. (2014) found financial incentives as a slightly positive as well as statistical influence. They carried out a multi-national research (statistical point of view) study of the elements influencing the rates of adoption towards Electric Vehicles for thirty countries in the year 2012. According to Graham-Rowe et al. (2012), incentives less than two thousand dollars had a very little influence towards the adoption of the PHEV. Here, the overall sales of PHEVs in Malaysia are projected to increase in the upcoming years primarily due to the increasing hybrid vehicles' popularity, increasing awareness amongst consumers towards the PHEV's extended incentives of tax by the government of Malaysia, and the latest model promoted by vehicle manufacturing companies. Moreover, PHEVs are designed to deliver better in terms of fuel efficiency and cost savings (The Star Newspaper, 2008). Moreover, in 2012, the overall trades of PHEVs in Malaysia were about 15,355 units as related to 8334 units in the year 2011 (The Star Newspaper, 2013). The topmost 3 PHEV suppliers were Lexus (266 units), Toyota (2456 units), and Honda (4595 units) (Yang et al., 2016). PHEVs in Malaysia are still considered very new in the automotive industry unlike Japan, the USA or Europe (Hong et al., 2013). In emerging countries like Malaysia, the shift from traditional vehicles to PHEVs requires taking an extended time as there are vast challenges and obstacles that must be tackled by the government officials (Rahman et al., 2015; Sang and Bekhet, 2015). For the establishment of an appropriate as well as a sustainable commercial model for the PHEV trade, the automobile industry and the government should harmonise closely to deal with those technical glitches. In addition, regulations, policies, and inducements are some of the main drivers for the development of PHEVs amongst consumers. Although there is an increasing demand for green products in Malaysia (DiPietro et al., 2013; Yong, Ramachandaramurthy, Tan, and Mithulananthan, 2015), the actual purchase level is low in Malaysia. Again, in spite of the increase in the hybrid car sales year by year, the hybrid car has only taken up 3% (approximately 50,000 units sold since 2008) of the market share in the automotive industry (Wen et al., 2015). Besides that, as a comparison with an ASEAN partner country, Thailand, the ASEAN automotive market leader, there were 37,530 units of hybrid cars registered in Thailand (Laoonual, 2013). However, only 18,967 units of hybrid cars were sold in Malaysia in 2013 (Segawa et al., 2014). On the other hand, the sale of hybrid cars in the US (which had been available for more than fifteen years) hit around 88,000 units in the year of 2014 (Segawa et al., 2014). So, in recent years, the PHEV has shown greater market success in Western countries. One of the main reasons for this success is linked with the consumption behaviour of the consumers (Adnan et al., 2016). Thus, this study is carried out with the aim to use the Theory of Planned Behaviour (TPB) which explains the prediction, description, and explanation in affecting consumers' consumption behaviour. Apart from that, attitudes have been included as a mediator in this study which will contribute as a new dimension for the theory of consumption value.

2.2. Theory based on the adoption of the electric vehicle

The behavioural intention and behaviour are widely defined in the Theory of Planned Behaviour (TPB) (Ajzen, 2011) which is an extension of the Theory of Reasoned Action (TRA) model (Ajzen, 2011, 2015; Fishbein and Ajzen, 1975). Actual behaviour is found from this model by defining the behavioural intention. After that, 3 elements control the behavioural intention: subjective norm (SN), attitude towards the behaviour, and perceived behavioural control (PBC) (Ajzen, 1991). Now, researchers also utilise the TPB structure in order to discover eco-friendly and green consumer behaviours. For instance, the TPB model proposed by Chen et al. (2010) extracts consumers' behavioural intentions towards waste recycling and defines consumer recycling intention. Macintosh and Lockshin (1997) and Sigurdardottir et al. (2013) utilised the TPB for the prediction purposes amongst the teenagers towards car or bicycle adoption. Chen and Tung (2014) worked on the TPB model by means of psychological factors, for example, attitudes and norms, having a major influence on green cars acceptance. All these researchers concluded that the TPB model is an appropriate concept to predict eco-friendly communication and increase the overall explanatory power by adding some variables like moral beliefs (Kautonen, Gelderen, and Fink, 2015). For example, Beck and Ajzen (1991) and Ajzen, 1991; Chen et al., 2010; and Chen and Tung, 2014 specified that the TBP's explanatory power has been increased by personal approaches of moral accountability or individual moral ethics when inspecting the intention of individuals to behave in an eco-friendly manner and noted that one's moral

norms are a possible way to find the behavioural intention. Kroshus et al. (2014) stated that buyers from Germany were conscious about the change of climate and hence showed interest towards green vehicle adoption by paying a significant amount and fulfilling their moral norms and responsibilities. By these researches, we can come to a conclusion that personal moral norms, as a variable, plays an important role where the behavioural intention is concerned. The TPB, which previously had 3 main elements, namely, subjective norms, attitude, and perceived behaviour control, may be converted into an extended TPB model by adding personal norms in the TPB model (Jansson, 2011; Chen and Tung, 2014). Jalilvand and Samiei (2012) mentioned that consumers are now more concerned about the environment from the last decades due to the dreadful condition of the environment. Many researchers have defined the link between green concerns and definite eco-friendly behaviour, and have worried about the environmental concerns in predicting that particular behaviour. As an example, Afroz et al. (2015) observed that the environmentalists usually buy more PHEVs than the non-environmentalists. Fedor et al. (2015) observed that the concern regarding the environment is the most significant and dominant factor towards the purchase of PHEVs. The consumers, who are highly concerned with the environment, will be more willing to buy PHEVs. Ziegler (2012) showed in his research that, a buyer who shows concern towards the environment, bears greater preference for environment-friendly (or green) vehicles. Moreover, Bateman et al. (2013) utilised the defined data structure and statistics on both the decision for buying a vehicle and consumer concerns towards the environment to study consumer preferences towards green technologies and concluded that the consumer will pay more for low emission vehicles as they are highly concerned with the environment. Bamberg (2003) defined the role of environmental concern and mentioned it as an important component of the model named the extended TPB. The research study of Bamberg et al. (2011) showed that by performing an all-inclusive study and to comprehend the consumers' intention towards the adoption of PHEVs, individual environmental concern and ethical norm were included into the model of the TPB in order to change it into a model named the 'extended TPB'. Hence, our research study recognises the suitability of this model as well as confirms the explanatory power of the extended TPB model in better-predicting consumers' intention towards the adoption of PHEVs.

3. Main theoretical contribution

3.1. Conceptual framework and hypothetical relationship

The The behavioural intention and behaviour are widely defined in the Theory of Planned Behaviour (TPB) (Ajzen, 2011) which is an extension of the Theory of Reasoned Action (TRA) model (Ajzen, 2011, 2015; Fishbein and Ajzen, 1975). Actual behaviour is found from this model by defining the behavioural intention. After that, 3 elements control the behavioural intention: subjective norm (SN), attitude towards the behaviour, and perceived behavioural control (PBC) (Ajzen, 1991). According to Davis (1989), observation in the model of the TPB, actual behaviour as well as behavioural intention (BI) have similar factors, although BI is usually more powerfully forecasted compared to the actual behaviour. Moreover, in the year 1991, Ajzen observed BI as a direct determining factor of actual behaviour, and when a suitable portion of intention is attained, this generally results in the maximum accurate behaviour prediction. As a result, adoption intention may be more powerfully connected to the factors rather than the actual type of adoption. Schuitema et al. (2013) also defined that the actual adoption measurement level is slightly tough to attain. In the meanwhile, PHEVs are in the beginning mode in Malaysia and many consumers are making the decision on PHEV adoption. Therefore, this particular paper has concluded that the adoption intention measurement is more applicable compared to the actual adoption. Han and Kim (2010) noted that in regards to the elements present in the extended theory of TPB, the complete evaluation of the specific behaviour is directed by the attitude in the perspective of consumer intention towards the adoption of PHEVs; and, attitude is the term that is defined as the positive or negative assessment of the adoption behaviour. Heath et al. (2013) observed that in many studies, attitude is an important variable (anterior) of behavioural intention. For example, Klöckner et al. (2013) surveyed on a national basis to find out the consumer intention towards the purchase of environment-friendly cars, and he concluded that the consumers having a positive mindset regarding the environment are more eager towards green vehicle adoption. Ajzen (1991) stated that the consumers who have a more positive attitude, their intention will be stronger to perform a certain behaviour. He further defined that the subjective norms of an individual are received from the social pressure from groups of people or other people that are important in his/her life and wish him/her to act in a specific manner. Additionally, Bockarjova and Steg (2014), and Chen and Tung (2014) observed that it has been proved in past researches that subjective norms affect behavioural intention in a positive manner. However, they further elaborate that for people considering that they would achieve a specific behaviour, they will have more intention to perform it due to a higher degree of social pressure (Wang et al., 2016; Bockarjova and Steg, 2014; and Chen and Tung, 2014). In the TPB, the Perceived behavioural control is the last predictor of intention (Ajzen, 1991). Whereas, Ajzen (1991) also defined the perceived behavioural control (PBC) as the grade of comfort and difficulty perceived by an individual with respect to conducting a certain behaviour. In the recent scenario, the perceived behavioural control consists of the perception of technology, price, availability or knowledge to use the PHEV, and the capability to perform the adoption behaviour. López-Mosquera and Sánchez (2012) stated that the more a consumer has the ability to control these elements, the more behavioural intention will be developed. However, Ajzen (1991) defined that the personal moral norm, i.e., a protracted part defined in the Theory of planned behaviour, indicates that people sense a need for performing a specific moral behaviour and make their findings depend on their responsibilities or principles. There is quite a bit of alteration between the subjective norm and personal moral norm. Whereas, subjective norms cover external social pressure whilst personal moral norms can be differentiated by the internalised ethical rules or standards (Kautonen et al., 2015). In the line of this study, the researchers explain the personal moral norm through which a consumer will decide either to adopt the PHEV or not grounded by his/her individual accountability or moral attitude rather than societal compression or his/her social norms. Rezvani et al. (2015) stated that if the customer has a higher degree of the individual ethical norm,

then he/she will have extra willingness to adopt PHEVs. By the above mentioned thorough literature survey, the proposed hypotheses are as follow:

H1 Consumer's attitude will have a significant effect on consumer's intention to adopt PHEV.
H2 Consumer's subjective norm will have a significant effect on consumer's intention to adopt PHEV.
H3 Consumer's perceived behavioural control will have a significant effect on consumer's intention to adopt PHEV.
H4 Consumer personal moral norm will have a significant effect on consumer's intention to adopt PHEV.

3.2. Extended theory of the planned behaviour model based on environmental concern

According to Schuitema et al. (2013), environmental concern is a term that defines the consideration and awareness of environmental issues. Therefore, Richardson (2013) defined that an important factor related to environmental concern is the help for an individual to deviate from their present behaviour to a more environmental-friendly behaviour. Moreover, Ajzen et al. (1991) mentioned in their research that environmental concerns do not impact directly on specific environmental behaviour; rather, it is by some different variables, indirectly. Klöckner, (2013) has performed a meta-analysis and found the association amongst environmental concerns and environmentally approachable behaviours, and noted that the reading between 0.23 and 0.35 is called the mean of the correlation coefficient of behaviour and environmental concern. This result shows that environmental concern does not depend on behaviour, which confirmed a result of the work by Ajzen (2011, 2015) and Taylor and Todd (1995). Bamberg (2003) proposed that environmental issues put forth an impact on a person's behavioural intention by his/her attitudes, beliefs, and norms. So, authors can conclude that behavioural intention is an indirect environmental concern factor and frontal influence of the foundations of the extended theory of planned behaviour model.

Finally, a number of studies have also investigated the interaction between habit and behavioural intention (Chen, Xu, and Frey, 2016; De Bruijn and Rhodes, 2011; Norman and Cooper, 2011; and Adnan et al., 2017). The main argument is that: when behaviour is repeated, a habit is developed. Accordingly, the behaviour is less likely to be determined by intention and is instead measured by habit strength. This argument is supported by the TPB research as the inclusion of habit proved to enhance the amount of variance explained by an average of 3–5% (De Bruijn and Rhodes, 2011; Adnan et al., 2017). However, unlike an outcome such as mode choice, which is highly influenced by habit strength, there is no evidence to support the idea that purchasing a new vehicle should be treated similarly. Instead, it is argued that the long time period between most purchases means that such decisions are not habitual in nature and, therefore, are mainly influenced by the behavioural intentions of each consumer (Adnan et al., 2016a; Kunasekaran et al. (2011); and Lane and Potter, 2007). The TPB, when it is hypothetically grounded, can be scrutinised for a relationship; the theoretically divergent exercise took place from the existing TPB variable and has been established applicability to a large number of behaviours. The current TPB variable is reasoning based on the prediction; it is suitable to scrutinise the possible effect of the perceptive prejudices. Whereas, it gives an extra variable, named hyperbolic discounting, which is additionally added to regulate its probable effect as a moderating construct. Though this particular variable was chosen on a contribution from experts, from an assessment of the literature, and in response to calls for additional research to investigate the effects of the organisational behaviour on decision-making (Al-Alawi and Bradley, 2013; Carter and Jacobs, 2014). This construct of hyperbolic discounting was founded by Herrnstein (1961) based on a matching principle and represents a practice of quick satisfaction. It exemplifies the distinct inclination for an instant, less-beneficial payment over choices that might deliver better upcoming assistances (Ellabban, Abu-Rub, and Blaabjerg, 2014; Herrnstein, 1961; Otal, 2014). Hyperbolic discounting is defined as a retreat from the economic fundamental theory as decision-makers do not maximise utility, instead of succumbing to methodical prejudices, and show an overall absence of self-control (Otal, 2014; Swaim et al., 2016). The application introduced by Sheeran (2002), which was grounded by the cognitive bias, likewise added hyperbolic discounting in the TPB by recognising a common gap between actual behaviour and behavioural intention. Elstrodt et al. (2013) detailed this particular loophole by opposing how traditional behaviour and habit efficiently restrain the intention– behaviour gap. Precise to the environmental concern, such as those which are related to the availability of energy and reduction of pollution, customers are frequently of an enduring plan that requires an equilibrium amongst current, as well as upcoming positioning even whereas the short term, is based on the return on investment. In this study, it is assumed that the consumers' attitudes, subjective norms and personal moral norms, and perceived behaviours, which will be used to control the adoption of the PHEV, are affected positively. However, environmental factors indirectly affect the behavioural intention to adopt. Whereas, the collective outcome of hyperbolic discounting has a direct effect on the consumer's EC-based intention and the actual adoption of the PHEV's conceptual framework which is illustrated in Fig. 1. This is based on the fundamental literature based on TPB. Subsequently, the fundamental literature is given below:

H5 Attitude have a significant effect to mediate the relationship between Consumer's environment concern and consumer's intention towards adopting PHEV.
H6 Subjective Norm have a significant effect to mediate the relationship between Consumer's environment concern and consumer's intention towards adopting PHEV.
H7 Perceived behavioural control have a significant effect to mediate the relationship between Consumer's environment concern and consumer's intention towards adopting PHEV.
H8 Personal Norm have a significant effect to mediate the relationship between Consumer's environment concern and consumer's intention towards adopting PHEV.

3.2.1. Moderating role of hyperbolic discounting

Strotz (1956) defined hyperbolic discounting as "a concept of the usefulness of function activated as a revival of the discussion of time conflict in the tradition". Though, hyperbolic discounting is also described by many authors, such as Doyle et al. (2013); Greene et al. (2004); and Laibson (1997), hyperbolic discounting is the propensity of people to discount plunders as their method for a time-based prospect in the past or future. It also addresses the instance of the partiality problem that prompts vigorously unpredictable favourites, suggesting an inspiration for consumers to oblige their own future adoptions (Mitchell et al., 2015). As per the literature assumed by Laibson (1997), the hyperbolic discounting utility function has been used in the context of a wide range of issues: growth, self-regulation, information acquisition, job search, choice of retirement age, procrastination, addiction, investment in human capital, etc. These instances of hyperbolic discounting cannot be explained properly amongst PHEV ownership. As balance results, once the PHEV ownership decision maker is assumed to use hyperbolic discounting. Little empirical research has investigated the influence of hyperbolic discounting amongst PHEV owners and satisfaction in the transport sectors. An insufficient number of studies have reported the importance of hyperbolic discounting amongst PHEV owners. This paper's research paradigm is based on the appropriate theme in the context of increasing the concern over global warming. Whereas, adopting PHEVs is one of the efficient ways of commerce with the outstanding challenge. Furthermore, this paper argues that the main problem related to the adoption of EVs is the gap recognised by the past literature on consumers' attitudes. Theoretic representations in this research framework of hyperbolic discounting have been projected as a moderating variable review founded on psychological experimentations which have led to systematically examining the problem and providing the empirical pieces of evidence. Consequently, drawing on these urgings, authors suggest the subsequent theories that follow:

H9 Hyperbolic discounting will have a positive moderating the relationship between the intention and adoption

In addition, authors have included several control variables in the model to test their impacts on the intention to adopt the PHEV. The variables included: age, gender, income, employment status, household size, education level, annual travel distance, and household fleet characteristics (fleet size, garage, and additional or replacement vehicle). In addition, their inclusion has been based on the findings of previous studies (Adnan et al., 2016, 2016a; Kaplan, Gruber, Reinthaler, and Klauenberg, 2016; Lane and Potter,

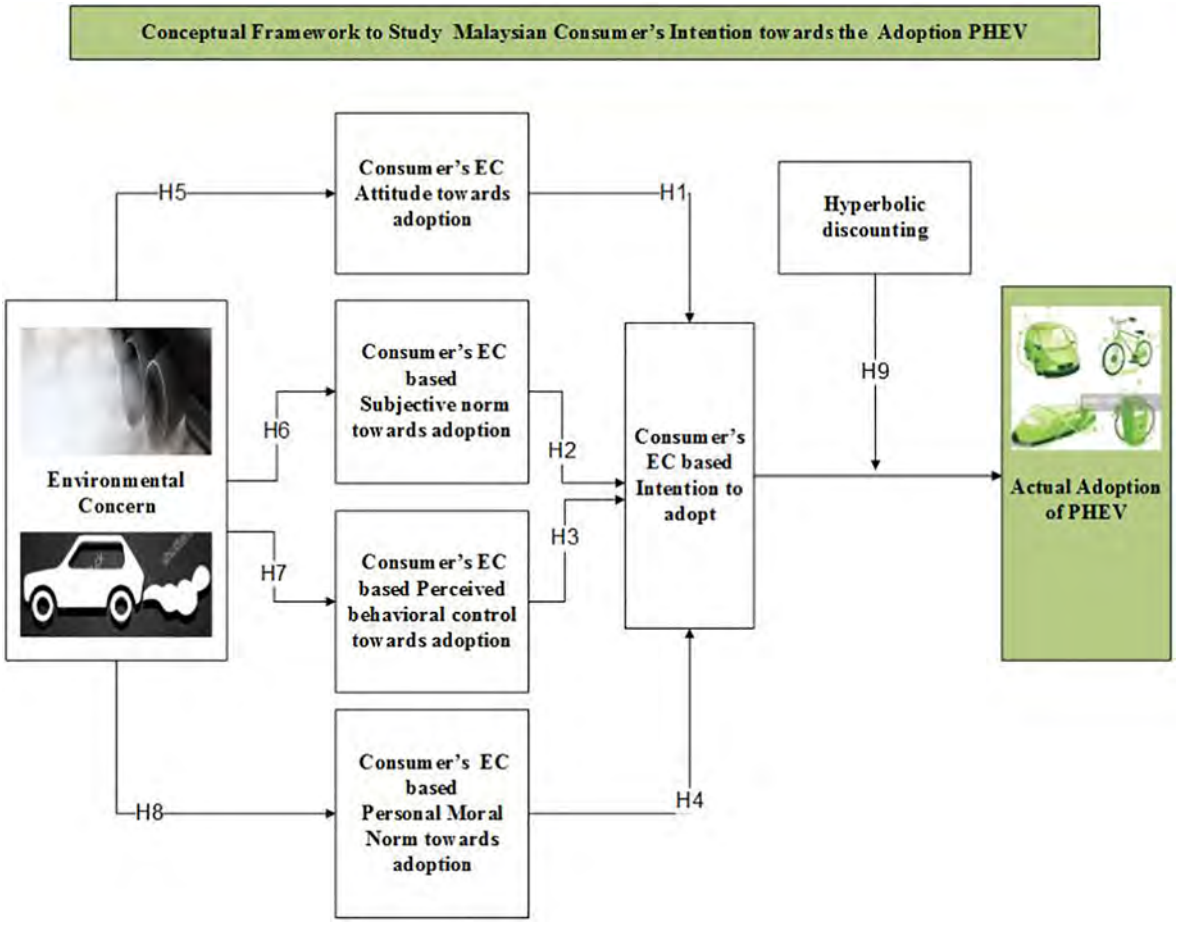

Fig. 2. Conceptual framework.

2007; and Ozaki and Sevastyanova, 2011). It should be noted that, by examining behavioural intention, our model can offer information on the factors influencing the stated preferences towards PHEVs. However, this approach does not analyse the revealed behaviour. The degree to which the PHEV translates into the actually purchasing of a PHEV in the future can be affected by factors that may intervene in the time between a stated intention and a revealed behaviour and, as such, this research can only offer a snapshot of the Malaysian market at one point in time. In order to test the theoretical construct, an investigation was carried out in Malaysia. A survey was based on the extended theory of planned behaviour item from literature (refer to Appendix A).

4. Methods and data

4.1. Data collection methods and operationalization

The sample is that part of the population from which information is collected. Weiss et al. (2012) stated that sample size that is appropriate to achieve a reasonable estimate depends on either the total population or the type of statistical tools to be used in the study. This study's is about the adoption of PHEVs, the sample consisted of Malaysian consumers. In particular, authors targeted the respondents who owned cars, and those who were keen to adopt new technology. The sample size was calculated based on power analysis using G∗Power which is the most useful power analysis program for many statistical test in behavioural and social sciences (Faul et al., 2007). The relationship among alpha, sample size, effect size and power is difficult to measure but also suggested by many researchers (Faul et al., 2009; Cohen, 1977). Using predictor correlations to determine the effect size, this research applied Linear Multiple Regression: Increase of R2 test. Having the effect size of 0.12, error probability $\alpha = 0.01$ and Power $(1 - \beta)$ 0.99 with number of predictor 4, the sample size for this study was estimated as 2 as displayed in Fig. 2. Hair et al. (2010) also suggested that the power can be increased at alpha level, 0.10 rather than 0.05 as increase in power level increase the sample size. Whereas, the minimum sample size was 272. Henceforth, the researchers set out to gather the data which was somewhat greater than the minimum number of sample size (seeFig. 3.).

4.2. Methods to analyse data

The data was coded in SPSS 22.0. An exclusive code was allocated to each questionnaire with the intention that if it was obligatory at any phase of the data analysis, it could be recovered. After coding, the data was censoriously separated for response bias and missing values. Answer bias is a condition that takes place during the surveys which affects the participants in regards to their answers (Villar, 2008). These circumstances may lead to non-random deviation of the replies from their real value. A questionnaire is affirmed as a biased reply if any respondent chooses only one selection for all the items. To classify the response bias, the standard deviation of each participant was intended, and the response with a zero standard deviation was erased. This resulted in the deletion of 44 replies having zero standard deviations, which specified that these replies were not correctly filled out.

Lastly, the researchers found that 450 replies were separated for missing values. According to Rubin (1976), there are 3 cataloging

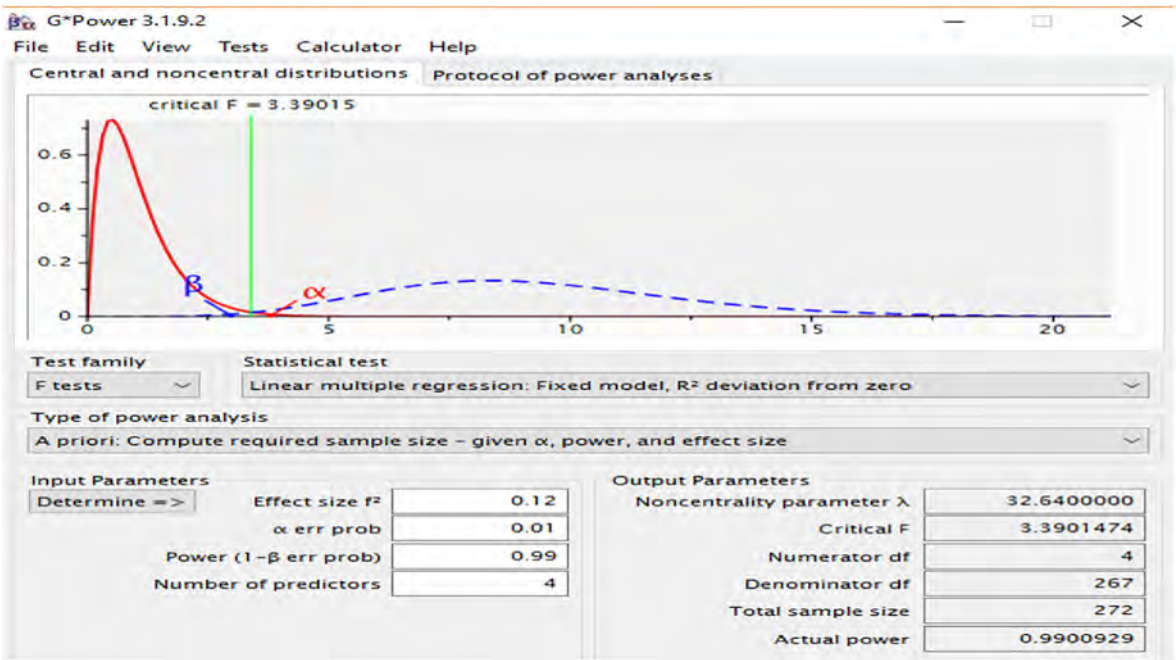

Fig. 3. Sample Size Calculation.

schemes through which the missing values can be recognised explicitly, missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). In order to deliberate any of the cases, the treatment of the missing values was essential before moving towards the data analysis. In line with this research, the missing values could be conducted through case wise erasure (Baraldi and Enders, 2010). Case wise deletion (also known as complete-case analysis or list wise deletion) is a simple method in which cases with missing values are discarded, and the analysis is performed only on the cases with complete data (Baraldi andand Enders, 2010). This approach is useful for the studies with large sample sizes. The study applied the convenient sampling method to collect the data because the population is too large with an unknown population size and it is impossible to include every individual. Since this study already had a big enough sample size, the missing values were treated through the case wise deletion approach. In total, 47 responses were discarded due to missing values, resulting in 403 cases with complete data.

4.3. Description of the data sample

The respondents of this survey were based in Malaysia; authors collected the data from internet sources such as social media, Malaysian Yahoo group, which was based on sale and purchase of vehicles in Malaysia. To assure Malaysian consumers perceptions which are based on understanding and the experience of driving vehicles, the questionnaire was only included those respondents who had prior vehicle driving experience and carried a valid private vehicle driving license. Furthermore, authors sent email, which authors found from Jabatan Pengangkutan Jalan official so the researchers sent 789 emails in August 2016. An online survey was included which was based on a hyperlink sent through an email. In the first round, 202 valid responses were received. The major problem for the questionnaire surveys is non-responding respondents (Bryman, 2015; De Vaus, 2013). A follow-up email was directed to those respondents who were unable to respond after 2 weeks; from which, authors received 105 responses for a total of 350 respondents, which was a valid response for the data analysis and the rest (53) authors got after another few weeks. 49.6% of the subjects were female and 50.3% were male. Generally, the number of the sample is a symbolic segment, which is helpful to test the instrument because the Malaysian consumers have a high potential to adopt PHEVs. Furthermore, Malaysian consumers were the participants for this research study. To test for non-response bias, the sample distribution for the sample dissemination of the second

Table 1
Respondent demographic profile.

Demographic Profile	Frequency	Percentage %
Gender		
0 Women	200	49.6
1 Men	203	50.3
Age		
Under20	100	24.81
20–30	120	29.77
31–40	90	22.33
41–50	50	12.4
51 and above	43	10.66
Marital Status		
Single	98	24.31
Married	289	71.77
Other	16	3.97
Education level		
Primary School	13	3.22
Secondary School	50	12.40
Diploma	30	7.44
Bachelor's Degree	120	29.77
Master's Degree	150	37.22
Doctorate Degree/ PhD	40	9.925
Occupation		
Government Sector	98	24.31
Private Sector	105	26.05
Self-employment	68	16.87
Other	132	32.75
Household Income		
< 2000 Ringgit	106	26.30
2001–4000 Ringgit	141	34.98
4001–6000 Ringgit	94	23.32
> 6000 Ringgit	62	15.38
Current locality		
Selangor	112	27.79
Kuala Lumpur	87	21.58
Johor	94	23.32
Penang	50	12.40
Others	60	14.88

Notes: Malaysia total population ¼ 30.267 millions; male ¼ 50.7%; female ¼ 49.3%.

set of respondents was compared by using Kolmogorov Smirnov (KeS), which is performed by Ryans (1974). He further explained that the distribution of the two groups do not differ statistically whilst indicating that the non-bias reply was not contemporary. Whereas, Harman's test was examined to check for the common method bias (Podsakoff et al., 2003). In the particular data of this research, the researchers did not find a significant common method of biases.

In order to measure the proposed hypotheses, authors carried out a study on Malaysian consumers towards the adoption of PHEVs. The researchers have taken the measurement scale based on the extended Theory of planned behaviour in the Malaysian perspective (Han et al., 2010; Kim and Han, 2010; Jakovcevic and Steg, 2013). Whereas, the researchers have changed the wording in the context of Malaysian consumers towards the adoption of PHEVs. The adoption behaviour of Malaysian consumers was measured by using a 7 point Likert scale which was based on strongly agree 7 and strongly disagree 1. The consumer's attitude in the direction of adopting PHEVs was measured by using the 7-point Likert scale items with the branch. Moreover, the researchers used four measurement indicators for the environmental concern which were adapted from Fujii (Gadenne, Sharma, Kerr, and Smith, 2011) and (Bamberg, Fujii, Friman, and Gärling, 2011; Ramayah, Lee, and Lim, 2012). Furthermore, the previous studies mention that the intention to purchase a PHEV may be pretentious by using a demographic variable, such as age, gender, educational level, and household income (Achtnicht, 2012; Gadenne et al., 2011).

4.3.1. Respondent profile

In line with this research, authors have added five control variables which may affect the adoption of PHEVs; they were age, gender, educational level, household income, and occupation. In the primary stage, authors cast-off a mock construct for the different sexes, which was 1 for men and 0 for women. In the next step, a separate construct variable was used for the age, such as under 20 years old, between 20 and 30, between 31 and 40, between 41 and 50, and between 50 and above, separately. In the third stage, authors separated the variable of the educational level. In order to get the educational level, authors created the level Doctorate Degree / Ph.D., Master's Degree, Bachelor's Degree, Diploma, Secondary school, and Primary School. Lastly, as the adoption decision is influenced by the household financial control, the other control variable was revenue. The researchers measured it by the household income per month; where, authors used a separate variable for the household income per month as per month = 1, 2, 3, and 4 for less than 2000 Ringgit, 2001–4000 Ringgit, 4001–6000 Ringgit, and 6001 Ringgit and above, respectively. Table 1 illustrates the respondent's demographic profile. After authors developed the questionnaire, the pilot study took place. Whereas, the respondents answered the questionnaires and gave valuable responses towards our information. A large number of the respondents were well educated with 81% of them being university graduates and postgraduates. 77% of the total participants were married. In terms of household income, 35% of the respondents were earning above RM4000 per month.

4.3.2. Statistical methodology

The statistical methodology practice for the purpose of the empirical investigation used was the second generation multivariate model which is known as (SEM) structural equation modelling (Fornell, 1982). However, this SEM examination has the benefit of analysing the explanation of the latent variable in the setting of a cluster of instrumental possessions in order to employ SEM concurrently, inside a single, comprehensive, and methodical process, combined together with the structural model and measurement model. Furthermore, this method has been formerly adopted by a number of researchers, such as Gallardo-Vázquez and Sanchez-Hernandez (2014) and Hair et al. (2011), because of its probable description, which is a more reasonably novel instance from the theoretical model, and the measures deprived of a systematic theoretic contextual (Chin, 1998).

Precisely, to test the projected hypotheses, the PLS approach was adopted. The PLS approach is one of SEM techniques which is based on the variance-based SEM (Reinartz, Haenlein, and Henseler, 2009). Dissimilar with the covariance-based SEM, the PLS variance- based technique is more appropriate for the application of predictive research studies which discover compound glitches and where the preceding theoretical background is unusual (Hulland et al., 2010).

Meanwhile, all the constructs of the projected model were considered as factor methods and so the consistent PLS method was used. The estimation procedure for PLS-SEM is the ordinary least square (OLS) method whereas the estimation procedure for CB-SEM is the maximum likelihood (ML) estimation procedure. In light of this, the main objective of the PLS-SEM analysis is to calculate the estimates' coefficient (path coefficient) that maximises the R2 values of the PLS-SEM analysis. Hence, Hair's PLS analysis technique was used because the research objective is theory development and the explanation of variance (Prediction of construct).

5. Results

In PLS, structural models are estimated using an iterative procedure that maximizes the strength of the relationship between independent and dependent variables. PLS path models are defined in terms of two sets of linear relations: inner and the outer models (Lohmöller, 1989). The variance-based approach was suitable for this research study as using the partial least square (PLS) was appropriate because not all the data sets were alienated normally However, this research model was not tested in the earlier literature because it is considered as a too complex a model to be analyse by any statistical tool in the previous research. To analyse the data of this data set, the researchers used the Smart PLS3.2.4 software to estimate the research model (Hair et al., 2011; Hair et al., 2016). By using this software, authors first analysed the measurement model to assess the reliability and validity, and then the structural model was tested. Finally, in order to test the significance of the path coefficients and the loadings, a bootstrapping method was used (Hair et al., 2014).

5.1. Analyze the measurement model (MM)

In the measurement model, the researchers evaluated the variable reliability indicator, discriminant validity, and then the convergent validity. The researchers checked the variables' reliability which was tested by using composite reliability and Cronbach's alpha (Straub, 1989). The value of Cronbach's alpha must be above 0.7 in all the cases, which suggested the constructs reliability; where, if the loading was less than 0.4, authors needed to delete that loading (Henseler, Ringle, and Sinkovics, 2009). A few items were dropped due to a low factor loading; whereas, the remaining loading was (>) greater than 0.7. Whilst, all of the items were statistically significant at the level of 0.01. The overall outcome of the instrument presented good indicator reliability. The test of convergent validity was performed to get the values of the average variance extracted (AVE). According to several authors (Fornell and Larcker, 1981; Henseler et al., 2009), the values of the AVE must be higher than 0.5 so the latent variable explains more than half of its indicators. Whereas, it is shown that the constructs had an AVE higher than 0.5 in order to meet the criteria. The discriminant validity of each of the constructs was estimated by using two different criteria: (a) Fornell-Lacker criteria and (b) Cross loading. Accordingly, Chin stated that with the Fornell-Lacker approach, the square root of AVE should be higher than all the correlations between each pair of the variables. Table 2 shows that all the diagonal values of the AVE square root were greater than the off-diagonal value which was an indication of the correlation between the constructs. Fornell and Larcker (1981) stated that the cross loadings' principle recommended that the loading of each indicator should be higher than all the cross-loadings.

In line with this study, the loadings were bigger than the correspondent cross-loading; however, the criteria were satisfied by providing the evidence of the discriminant validity of the scale. Whereas, the measurement model results specified that the indicator reliability, construct reliability, discriminant validity, and convergent validity of all the variables that had been used in this research were acceptable. All those variable researches were used to test the structural model. However, Table 3 illustrates the discriminant validity result based on Fornell-Lacker.

5.2. Analyze the structural model (SM)

Hair et al. (2016) stated that in the structural model approach, model researchers should evaluate the R^2 by using the corresponding t-value and beta. In order to the get t-values, the procedure of the bootstrapping with 5000 resamples approach was applied. Hair et al. (2016), furthermore, highlighted that scholars should also report the (Q^2) predictive relevance and (f^2) effect size.

Table 2
Convergent validity Quality criterion (AVE, composite reliability, alpha) and factor loadings.

Item	AVE	Composite Reliability	Cronbach's alpha	Loading
AD1	0.926	0.98	0.973	0.962
AD2				0.97
AD3				0.965
AD4				0.952
ATT3	0.86	0.878	0.81	0.861
ATT4				0.622
ATT5				0.849
ATT6				0.861
EC1	0.82	0.867	0.795	0.708
EC2				0.793
EC3				0.833
EC4				0.81
HD1	0.879	0.956	0.93	0.968
HD3				0.882
HD4				0.96
INT1	0.856	0.892	0.836	0.684
INT2				0.861
INT3				0.864
INT4				0.863
PBC1	0.852	0.867	0.795	0.704
PBC2				0.801
PBC3				0.832
PN2	0.825	0.934	0.894	0.909
PN3				0.908
PN4				0.908
SN1	0.926	0.98	0.973	0.963
SN2				0.97
SN3				0.964
SN4				0.952

Note: HD2, HD5, ATT1, ATT2, ATT7 and PN1 are deleted due to low factor loading .whereas, p value < 0.01. $AVE = \sum_{\lambda} 2/\{(\sum_{\lambda} 2)(\sum_{\sigma} 2)\}$(Greene et al., 2004) {(summation of squared factor loadings)/(summation of squared factor loadings) (summation of error variances)}ss. $CR = \sum_{\lambda} 2/\{(\sum_{\lambda} 2) + \sum_{\sigma} 2)\}$ {(square of the summation of the factor loadings)/[(square of the summation of the factor loadings) + (square of the summation of the error variance.

Table 3
Fornell-Lacker Criterion: Matrix of correlation constructs and the square root of AVE.

	ADP	ATT	EC	HD	INT	PBC	PN	SN
Adoption	**0.962**							
Attitude	0.646	**0.804**						
Environmental Concern	0.399	0.571	**0.787**					
Hyperbolic Discounting	0.368	0.507	0.514	**0.938**				
Intention	0.694	0.736	0.44	0.571	**0.822**			
Perceived Behavioral Control	0.397	0.568	0.54	0.511	0.437	**0.788**		
Personal Moral Norm	0.446	0.648	0.38	0.57	0.95	0.384	**0.908**	
Subjective Norm	0.667	0.647	0.40	0.368	0.693	0.398	0.446	**0.962**

Note: Bolded crosswise diagonals signify the four-sided derivation of the average variance extracted though the off-diagonals are associations among constructs. Crosswise origins should be larger than non-crosswise origins in the line to establish the discriminant validity.

According to the reasonable satisfactory MM, a model was acquired, and the path analysis performed with the employed software of Smart-PLS 3.4.2 was used in the model. Whilst Table 4 shows the structural model results. In the first stage, authors observed that the Attitude, SN, PBC, and PMN to the adoption INT were all statistically substantial.

However, these results exposed that the Malaysian consumer's intention towards the PHEV adoption was influenced by previously explained points. The theory of planned behaviour's (TPB) original model clarified 33.6% of the variance in the consumer adoption intention. Though the new extended model of the theory of planned behaviour (TPB) gave 34.3% of the variance amongst Malaysian consumers towards the adoption of PHEVs. The variable of PMN, as a pointer, amplified the variance by 0.7%. The Theory of planned behaviour (TPB) model amplified the explained variance by 5% (Rivis and Sheeran, 2003). Bamberg et al. (2011) stated that the personal moral norm was an additional forecaster that elevated the quantity of clarified variance of the intention by 1–10 % in the area of pro-environmental performance behaviour. This study increased the explained variance by less than the expected amount if compared it with the past research of the personal moral norm research paradigm. This should not be a shocking result in the Malaysian consumer perspective because collectivism is relatively leading in many aspects of daily life ((Moons and De Pelsmacker, 2012; Furnham, 2012), and social pressure shows a significant role in affecting the Malaysian consumers' behaviour. Therefore, SN explained variances relatively in a limited way. By dissimilarity, individualism was mostly supported by western countries; for instance, in Europe and the USA (Realo and Beilmann, 2012) the role of the personal norm governs the role of the subjective norm. Later the role of SN, PBC, Personal moral norm, and Attitude were statistically significant as they all affected environmental concern. The result shows that all the hypotheses are supported in the model. Table 4 demonstrates the PLS approximation results. The model explains 71.8% of the behavioural intention to adopt mobile payments. The hypotheses related to behavioural intention, H1, H2, H3, H4, H5, and H6, were established and statistically significant. Amongst the variables that were significant in explaining the Malaysian consumer behavioural intention to adopt PHEVs, attitude was one of the important constructs ($\beta = 0.26$; $p < 0.01$), followed by subjective norm ($\beta = 0.437$; $p < 0.01$), Perceived behavioural control ($\beta = 0.365$; $p < 0.01$), personal moral norm ($\beta = 0.184$; $p < 0.01$), and Intention ($\beta = 0.35$; $p < 0.01$). The structural model confirmed the hypotheses formulated for this research study. The results of this model were analysed without one of the moderator factors, and then tested by including them. These analysis results are consequently comprehensive (the comprehensive investigation consequences are obtainable from the scholar and by request). Subsequently, the endorsement variables have merely 1 straight influence; whilst, the overall influence developed a supportive vision into the indirect effects of the other constructs.

5.3. Mediating effect test

The recent analysis suggested the need for the application of the bootstrapping method of Preacher and Hayes (2008) to perform a

Table 4
Path Coefficient of the Structural Model.

Hypothesis	Relationship	Std Beta	Std Error	t-value	Decision	R2	f2	Q2
H1	ATT → INT	0.256	0.039	8.60**	Supported	0.569	0.232	0.615
H2	SN → INT	0.437	0.044	7.08**	Supported		0.333	
H3	PBC → INT	0.365	0.049	9.86**	Supported		0.095	
H4	PN → INT	0.184	0.041	2.42**	Supported		0.089	
H5	EC → ATT	0.298	0.037	8.42**	Supported	0.692	0.351	0.627
H6	EC → SN	0.571	0.039	2.99**	Supported		0.145	
H7	EC → PBC	0.321	0.033	6.62**	Supported		0.098	
H8	EC → PN	0.421	0.042	7.89**	Supported		0.069	
H9	INT → ADP	0.350	0.049	8.11**	Supported	0.693	0.054	0.577

Note:
** $p < 0.01$ (ATT) Attitude, (SN) Subjective Norm, (PBC) Perceived behavioural Control (PMN) Personal Moral Norm, (EC) Environmental concern, (ADP) Adoption.

mediation investigation which was based on a non-parametric investigation and did not disturb the supposition of the normality. The researchers adopted the process of Preacher and Hayes (2008) to test the multiple mediating effects. As per this approach, there were three indirect effects that had to be estimated through M1 (attitude), M2 (SN), M3 (PBC), and M4 (Personal moral norm). Consequently, the researchers presented the PROCESS advanced by Hayes (2012) and calculated three hypothesis equations: three for each work as a mediators. Whereas, Aiken, West, and Reno (1991) suggested all the constant constructs be centred before the investigation. Fig. 2 shows the estimations after the controlling variables of age, sex, level of education, household, who had used a PHEV, and experience. Table 5 shows the results of the mediation effect analysis. Whereas, the effect of the mediation effect analysis specified that all four elements of the extended theory of planned behaviour (TPB) model mediated the indirect effect of environmental concern on the adoption of PHEVs. As per the suggested result, the Malaysian consumer environmental concern has a significant indirect effect on the Malaysian consumer's behavioural intention through all the four variables of attitude, SN, PBC, and personal moral norm of the extended TPB model. As for the transportation adoption intention increasing with the increase of environmental concern, it may not be sufficiently granted. In fact, the Malaysian consumer's adoption intention may depend on the joint effects of environmental concern along with the 4 major constructs of the extended Theory of planned behaviour (TPB).

The outcome of the finding supports the level of the Influence amongst the EC as the independent variable, the ATT, SN, PBC, and PMN as the Mediators, and the INT as the dependent variable. Consequently, the findings of the mediation analysis support the indirect effect. Afterwards, the researchers had to evaluate the significance of the paths by using the percentile bootstrap (Preacher and Hayes, 2008; Hair et al., 2014). In line with this, the bootstrapping process is classically in certain types of software, such as SMART PLS (Ringle et al., 2005). Using these applications and following the guidelines and recommendations of some previous authors (Ringle et al., 2005; Preacher and Hayes, 2008) the model valuations were accomplished and the mediating effects were investigated.

However, this bootstrap process produced a 95 percent confidence interval for the indirect relationship. When an interval for the mediating effect does not contain zero, the indirect effect is significantly different from zero with a 95% confidence level. As, Table 5, in the confidence intervals obtained, the value zero was not contained in the paths EC → ATT → INT, EC → PBC → INT and EC → PMN→INT, so authors can endorse that the indirect effect was statistically substantial and that ATT, PBC, and PMN mediated the influence of INT.

5.4. Moderation effect test

In order to test the moderation and moderated mediation hypotheses, authors used the approach developed by Preacher et al. (2007). In Fig. 1, the 9th hypothesis, that hypothesised the effect of the level of uncertainty on the adoption of PHEVs was moderated by the hyperbolic discounting that the researchers had obtained about the Malaysian consumers. The researchers assumed that the strength of the mediating effect in this particular study was linearly contingent on the adoption of PHEVs. The concurrent incidence of both the terms of moderation and mediation in one model is frequently discussed by Preacher et al. (2007). Generally, it is difficult to examine the moderation and mediation under one statistical analysis. Nevertheless, Preacher et al. (2007) had established a macro-based bootstrap method to examine and properly test moderation-mediation. The researchers used their macro effect to examine the mediated effects and found that the interactive Malaysian consumers behavioural intention on the adoption of PHEVs was further moderated by the hyperbolic discounting. Authors performed bootstrap analyses to generate a bias-corrected and accelerated 95% confidence interval for the moderation mediation effect of Malaysian consumer behavioural intention on the adoption of PHEVs. In this particular analysis, the authors controlled both the independent variable and the controlled variable. However, hyperbolic discounting acted as a significant moderator between the behavioural intention and the adoption of PHEVs ($\beta = 0.122$; SE = 0.035, $p < 0.01$). Authors calculated the indirect effect that was estimated for a range of the moderator hyperbolic discounting (one standard deviation above, one standard deviation below), which meant that none of the bias-corrected and accelerated 95% confidence intervals included zero. However, that meant that authors could securely assume that the hyperbolic moderated the mediation effects of the level of the behavioural intention on the adoption of PHEVs. Post-hoc searching exposed that when the estimation of the obtained hyperbolic discounting phenomenon was more positive, it could build the significant relationship between the Malaysian consumer intention and the adoption of PHEVs. Whereas, the more negative the impact on hyperbolic discounting was, the stronger the positive relationship between the Malaysian consumer's intention and the adoption of PHEVs. Table 6 shows the outcomes of the moderation effect analysis.

Table 5
Results of the (Indirect effect) mediation effect analysis.

IV	MV	DV	Path coefficient	t- value	Percentile (Bootstrapping 95% confidence intervals) UL LL		Decision
EC	ATT	INT	0.544	8.754**	0.252	0.474	Supported
EC	SN	INT	0.016	1.530	−0.063	0.079	Not Supported
EC	PBC	INT	0.176	3.042*	0.162	0.391	Supported
EC	PMN	INT	0.583	9.160**	0.17	0.26	Supported

Notes: Independent variable (IV), Mediating Variable (MV) and Dependent Variable (DV).
** $p < 0.01$.
* $p < 0.001$.

Table 6
Results of the Moderation effect analysis.

IV	Mod	DV	Path coefficient	t- value	Decision
INT	HD	ADP	0.122	3.464**	Supported

Notes: Independent variable (IV), Moderator Variable (MV) and Dependent Variable (DV).
** $p < 0.01$.

5.5. Key findings

This study has motivated the researchers in a rigorous behavioural framework on the basis of the TPB literature by signifying the presence of a reasoning prejudice and hyperbolic discounting to possibly increase the overall TPB predictability. Thus, producing deeper knowledge about the internal and external motivations of environmental concerns amongst Malaysian consumers towards the adoption of the PHEV. The outcomes in this research on the factors influencing the adoption of PHEVs originated to upkeep the preceding past works. Though not all of the previous researches have led with similar investigation settings, the empirical investigation has revealed that the mentioned predictors are also appropriate and noteworthy in the domain of PHEV adoption.

The motivation of this empirical study is to determine the key predictors that influences the consumer adoption of PHEVs in the context of Malaysia. This research contributes to the consumers' understanding regarding the PHEVs as a green technology in the transport sector by scrutinizing the motivation for this new technological acceptance. Moreover, this study was carried out under a theoretical framework that was established based on the former findings from the discussed literatures. The multiple regression analysis demonstrattes that the environmental concerns, performance attributes, hyperbolic discounting, social pressures, demographics are very important elements of PHEVs usage intentions. In terms of the initiative of Malaysian government towards the use of PHEVs, it is certainly invaluable to understand the predictors that influence the consumer behaviour.

6. Discussion

This study aims at scrutinising the substantial factors that influence a consumer's decision in the context of the PHEV adoption. There are many aspects that depend upon the adoption of the PHEV. However, social as well as psychological factors belong to the core decision of the adoption (Rahim et al., 2012). In this study, authors have dealt with the domain encompassing the extended theory of planned behaviour. Above all, the consumer awareness of the environmental concern was recommended as a vital factor in the consumers' PHEV adoption decision by the studied literature. Nevertheless, socio-psychological benefactions are the key features that upkeep or limit the societal behaviour of the consumers on the adoption decision (Schuitema et al., 2013). Franceschini (2013) highlighted the challenges with self-reported environmental behaviours that might be prejudiced by the specific environmental concern, which leads towards the sustainable environment. This comprises sponsorships and enticements as main obstacles towards the PHEV adoption. According to the view of Al-Alawi and Bradley (2013) and Kempton and Tomić (2005), some variables like consumer educational qualification, behaviour, age, experience, income, etc. are the key factors towards the PHEV adoption decision of consumers. Consumers alone or collectively can either be inspired or de-motivated by the PHEV adoption decision. The PHEV adoption enhances the information and awareness amongst more consumers about sustainability, and the issues and challenges that are tackled by the lawful agencies (Ahmadi et al., 2015; Ozaki and Sevastyanova, 2011). Hence, the next subsection deals with the implications of consumer adoption in terms of the managerial perspective.

Finally, this study also provides a methodological contribution to the body of knowledge by using the partial least squares-based structural equation modelling (PLS-SEM) to analyse the proposed model. As Ali and Kim (2015) noted, 94% of the papers published in top hospitality journals used the co-variance-based structural equation modelling (CB-SEM) whilst only 6% have used PLS-SEM. It is noteworthy that CB-SEM is so widely used that many researchers simply refer to CB-SEM as SEM, ignoring the fact that PLS-SEM is an equally important approach (Hair et al., 2013). Hence, our results support the arguments by many scholars that the PLS approach should be used more because it can model latent constructs under conditions of non-normality in small to medium sample sizes (Hair et al., 2013), maximising the explained variance of the endogenous variables, and the prediction of values for latent variables using multiple regressions (Chin et al., 2008).

6.1. Managerial implications

Various governmental efforts worldwide have already been initiated in order to reduce CO2 emissions. Whereas, there is increasing literature concentrating on CO2 emissions which influence financial incentives on the sales of PHEVs. Nevertheless, author Zhang et al. (2011) concluded that there is no indication of lawful agencies' encouragements as an influential factor in the electric vehicle purchase by a statistical investigation carried out in Nanjing, China. In contrast, Sierzchula, Bakker, Maat, and van Wee (2014) found financial incentives as a slightly positive as well as statistical influence. They carried out a multi-national research (statistical point of view) study of the elements influencing the rates of adoption towards PHEVs for thirty countries in the year 2012. According to Graham-Rowe et al. (2012), incentives less than two thousand dollars had a very little influence towards the adoption of the PHEV. Here, the overall sales of PHEVs in Malaysia are projected to increase in the upcoming years primarily due to the increasing hybrid vehicles' popularity, increasing awareness amongst consumers towards the PHEV's extended incentives of tax by

the government of Malaysia, and the latest model promoted by vehicle manufacturing companies (Yang, Arshad-Ali, Roeleveld, and Emadi, 2016). Moreover, PHEVs are designed to deliver better in terms of fuel efficiency and cost savings (The Star Newspaper, 2008).

In spite of the increase in the hybrid car sales year by year, the hybrid car has only taken up 3% (approximately 50,000 units sold since 2008) of the market share in the automotive industry (Wen, Siong, and Noor, 2015). Besides that, as a comparison with an ASEAN partner country, Thailand, the ASEAN automotive market leader, there were 37,530 units of hybrid cars registered in Thailand (Laoonual, 2013). However, only 18,967 units of hybrid cars were sold in Malaysia in 2013 (Segawa, Natsuda, and Thoburn, 2014). On the other hand, the sale of hybrid cars in the US (which had been available for more than fifteen years) hit around 88,000 units in the year of 2014 (Segawa et al., 2014).

A pro-environmental attitude plays a vital impact towards the adoption of PHEVs in Malaysia (Adnan et al., 2016). Moreover, PHEVs have noteworthy visions owing to their low emissions and extended mileage. Hence, vendors can utilise the fuel economy as well as eco-friendly vehicles as one of the advertising tools in their marketing in order to inspire the local consumers towards the adoption of PHEVs (Ahmadi et al., 2015). In the product strategy context, more PHEVs must be introduced by the manufacturers with a view to attracting the consumers. The PHEVs must have the features like easy operation, fuel efficiency, and high quality in the context of reliability and durability. The overall cost of a hybrid PHEV is about 30% higher than a non-hybrid PHEV in Malaysia. For the purpose of avoiding excess-pricing, the car manufacturers must propose more reasonable EVs. Incentives from the government are also one of the factors that affect the hybrid PHEV adoption in Malaysia. As per the outcome, the lawful agencies should ensure giving incentives for the buyers of PHEVs. In addition, the local government can provide distinctive incentives, such as low corporate tax as well as low manufacturing plant tax for a 5–10 year duration, to those vehicle manufacturers who assemble PHEVs in Malaysia.

6.2. Limitations and forecasting of PHEV trades in Malaysia

The research study has a few limitations. Whereas, this study contains a small sample size and the convenience sampling technique did not allow for a generalisation. The research findings should consequently be understood with careful attention being given. Additionally, the knowledge idea should be scrutinised in more detail in further research. The marketing literature demonstrates dissimilar clarifications and conceptualisations of the knowledge idea obtainable by numerous authors, its limits, and lack of in the systematic literature (Gentile et al., 2007).

Interpreting the diffusion rate of the PHEV situations for the estimation of upcoming sales of PHEVs needs the projection of new car sales over a certain period of time. This can only be possible by applying an estimation for the actual growth of Malaysia's Gross State Product (GSP) over the passage of time. Sivak (2013) conducted a study of 48 nations starting from the year 2005 till 2011, and found a strong predictor of the logarithm of vehicle sales which is called the 'logarithm of gross domestic'. Firstly, the sample size for this research study for Malaysia was too small and covered only the targeted Malaysian car users. The upcoming researchers should focus on a larger sample size in order to make the results valid and more precise. Secondly, most of the vehicle manufacturers showed an unwillingness to disclose their buyers' designations and detail addresses. Therefore, this research study did not exactly consider the early Malaysian adopters of the PHEVs. It would be very valuable to study this buyers' group, exclusively. In upcoming years, the study may compare the factors influencing PHEVs' adoption between non-adopters and adopters. Moreover, a research study may also consider consumers' attitudes towards the electric vehicle in Malaysia.

7. Conclusions

This research study has given a comprehensive idea of the literature concerning the factors influencing the adoption of PHEVs. Grounded on the delivered literature, authors found that this study bridges the gap and forecasts the studies based on the PHEV penetration rates of the consumer behaviour towards PHEV adoption. Especially in the Malaysian transportation sector, the reduction of carbon dioxide emissions being kept in view, the PHEV has been considered as the best alternative. For this, a set of scenarios that suit most of the today's market conditions were assumed in order to develop the major modelling techniques used in the literature on PHEV marketplace forecasting. Ours is the first study to examine and confirm the moderating role of Hyperbolic discounting amongst Malaysian consumers in adopting PHEVs.

The research for the extended TPB model based on Kang et al.'s study (2006) was used to find consumers' intentions towards the adoption of PHEVs. Authors have also observed from the past literature about the consumers' moral norms and progressive signs towards the intention towards adoption. However, based on the comparison carried out by past researchers (Arts, Frambach, and Bijmolt, 2011; Kaiser, Doka, Hofstetter, and Ranney, 2003; Kaiser, Oerke, and Bogner, 2007; Long, Grow, Majoris, and Hines, 2011), it is quite clear that the addition of the personal moral norms has upgraded the explained variance, which was less than the expected one. In this research, the impact of personal moral norms was the minimum compared to the measured values in the international studies. In Malaysia, the main reason was that communalism is leading on numerous sides of day-to-day life, which is not really very effective (Furnham and Gunter, 2015; Furnham and Telford, 2012) and arguments lead to societal stress amongst consumers and this expresses a vital role towards changing consumer behaviour. The influence of SN leads to individual moral norms. Moreover, the effect of eco-friendly concerns on the components of the extended TPB structure as well as the intention towards the PHEV adoption is further explained by the researchers mentioned above. As an associated impact, the investigation shows a bright understanding on the specific theme of the adoption of the PHEV where hyperbolic discounting plays an important role in our research of environmental sustainability.

The intention towards adoption is effected by environmental concern, indirectly, and its effect is positively related to attitude, SN,

PBC, and personal moral norms. However, the collective outcome of hyperbolic discounting plays as a moderator which has a direct effect on the consumer's intention and the actual adoption of PHEVs. Moreover, it is also important to highlight that the environmental concern and adoption intention are not directly proportional. In fact, the intention of adoption depends on the impacts of eco-friendly concern and the 4 parts of the extended TPB model. The finding of the relevant information is useful for governments and vehicle dealers. This research has concluded that consumer attitude towards adopting PHEVs is positive when impacted by environmental concerns. In other words, if the consumers have more concern towards the environment, they will have more attraction towards adopting PHEVs. In general, with respect to the marketing angle, a vehicle seller shows and launches PHEVs; by this, they enhance the popularity of the brand as well as the consumer's environmental concern and emphasise the awareness of eco-friendly environmental benefits towards the adoption of PHEVs. Consumers giving importance to societal pressure or other pressures inserted by people or primary adopters are one of the most significant factors of their intention towards adoption. By supporting the research, authors will stand a chance of developing this further with the theoretical frameworks of emotions in psychology, consumer behaviour, and ethics. Whereas, there is a need for a proper communication memorandum. Instruction and strategies can generate explicit intellectual and emotive replies in consumers and, therefore, affect their choices and behaviours. Accepting the reasoning and emotional reactions can assist marketing authorities and lawful agencies to collaborate in their communication, instruction, and strategies to be able to overcome more obstacles towards the adoption of the PHEV. The assessment of the PHEV of these participants and initial adopters bear a vital impact on the customer's adoption intention. So, the Government sector and sellers should come forward in order to enhance the early adopters' evaluation of their PHEV. Though, there was a major initiative that had been carried out by policy makers, such as PHEV Clubs and the (WOM) Word-of-Mouth marketing policy that might be the 2 vital and dominant methods for the increment of SN that consumers observe. Hence, this paper tries to fill the gap by proposing a conceptual framework by tailoring the sustainability of the environmental concern. The proposed conceptual framework has theorised the significant relationship amongst the variables towards the proper adoption of PHEVs as well as environmental sustainability and opens a new path for future research to empirically prove the hypothetical relationship amongst the variables. It is needless to say that, there are a few limitations in this analysis study. The domain of preference as well as attitude studies is a huge one, and the authors here only studied the findings that explicitly related to the PHEV. However, our dedicated study regarding consumers' preferences and attitudes towards PHEVs has sorted out numerous prevailing gaps in information whilst recognising a number of encouraging procedural avenues and approaches for the upcoming research thrust. The prevailing doubts regarding the improvement of the attitudes towards Fuel cells as well as hydrogen-powered vehicles in the upcoming years seem to permit a more substantial research work in this domain.

Conflict of interest

The author declares that there is no conflict of interest regarding the publication of this paper.

Acknowledgements

The authors would like to thank all the Professors, Senior Lecturer and Lecturer from the Department of Management and Humanities of Universiti Teknologi PETRONAS (UTP) to facilitate this research study. Furthermore, authors would CGS for providing GRA scheme [YUTP]. The authors would also like to thank the reviewers for their valuable suggestion in order enhance the manuscript.

Appendix A

Constructs	Notation	Source	Items
Attitude	ATT_1	Bagozzi et al. 2003; Nordlund and Garvill 2003; Han et al. 2010; Kim and Han 2010; Jakovcevic and Steg 2013	I like PHEV because it is wise idea to use it.
	ATT_2		I like PHEV because it is pleasant experience to ride
	ATT_3		I like PHEV because it is necessary to the society
	ATT_4		I like PHEV because it gives positive message to the society
	ATT_5		I like PHEV because it is favorable to environment
	ATT_6		I like PHEV because it reduce carbon emission
	ATT_7		It is essential to use PHEV in Malaysia to reduce the fuel consumption.
Environmental Concern	EC_1	Ramayah et al. 2012; Gadenne et al. 2011; Kim and Choi 2005; Fujii 2006	I think environmental problems are becoming more and more serious in recent years
	EC_2		I think human beings should live in harmony with nature in order to achieve sustainable development
	EC_3		I think we are not doing enough to save scarce natural resource from being used up

	EC_4		I think individuals have the responsibility to protect the environment
Subjective Norm	SN_1	Bagozzi et al. 2003; Nordlund and Garvill 2003; Han et al. 2010; Kim and Han 2010; Jakovcevic and Steg 2013	I think people around me thought that I should adopt PHEV near future.
	SN_2		I think people who are important to me they want to buy PHEVs
	SN_3		I think if I purchase PHEV, then the most people who is important to me would also buy PHEV.
	SN_4		I think peoples opinion I value the most when I make my decision to adopt PHEV near future
Perceived Behavior control	PBC_1	Bagozzi et al. 2003; Nordlund and Garvill 2003; Han et al. 2010; Kim and Han 2010; Jakovcevic and Steg 2013	I think the price of PHEV is important to me and I can afford it when I decide to adopt
	PBC_2		I think the maintenance and repair of PHEV is important to me when I decide to adopt
	PBC_3		I think I can find where to buy PHEV if I wanted to buy
Personal Norm	PN_1	Bagozzi et al. 2003; Nordlund and Garvill 2003; Han et al. 2010; Kim and Han 2010; Jakovcevic and Steg 2013	I think because of my own principles I feel an obligation to use PHEV to reduce carbon emission and improve air quality
	PN_2		I think if I buying PHEV is an obligation for me, to reduce carbon emission regardless what other people does
	PN_3		I think I feel obliged to take the environmental consequences of vehicle use into account when making adoption choice
Purchase Intention	INT_1	Bagozzi et al. 2003; Nordlund and Garvill 2003; Han et al. 2010; Kim and Han 2010; Jakovcevic and Steg 2013	I intent to purchase PHEV because it is environmental friendly.
	INT_2		I intent to purchase PHEV car even though it is more expensive than conventional car.
	INT_3		I intent to purchase PHEV over conventional car when their product qualities are similar.
	INT_4		I feel that I will played a great part in helping the environment when I drive PHEV.
	INT_5		I feel more comfortable if I drive hybrid car rather than conventional Vehicle.
	INT_6		I intent to buy PHEV in near future.
Adoption of PHEV	ADP_1	Bagozzi et al. 2003; Nordlund and Garvill 2003; Han et al. 2010; Kim and Han 2010; Jakovcevic and Steg 2013	I believe that innovation gives more control over my daily life
	ADP_2		I believe that adoption of PHEV makes my life easier
	ADP_3		I am enjoying to figured out how to use PHEV
	ADP_4		I feel like I am overly dependent on PHEV
Hyperbolic discounting	HD_1	Tian Wu et al., 2016	I think installment plan while purchasing PHEVs innovation should be given
	HD $_2$		I think I prefer to take discount today rather later, while purchasing PHEVS
	HD $_3$		I think I am enjoying to take more profit later rather sooner little discount while purchasing PHEVs
	HD_4		I think to get rewards faster while the purchase of PHEV gives me more satisfaction
	HD_5		I think the delay of discount rewards appear to be less attractive while the purchase of PHEV

Appendix B. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.tra.2018.04.007.

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