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Predicting Purchase Intention of Hybrid Electric Vehicles: Evidence from an Emerging Economy

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Abstract: Dependence on energy-intensive transportation systems could escalate the chances of environmental degradation. A shift of transportation modes from conventional vehicles to energy-efficient vehicles is a viable method of mitigating the rate of carbon emissions; however, the adoption rate of environment-friendly vehicles is still low globally and vital to explore. This study aims to investigate the determinants that influence individuals' intention to purchase hybrid vehicles, through the development of a research model based on the Theory of Planned Behavior, integrated with environmental knowledge as an additional variable. Data were collected from 256 car users across Malaysia's metropolitan city. The findings augment the rich theoretical basis of the Theory of Planned Behavior by incorporating environmental knowledge as a supplementary variable in assessing individuals' behaviour in the sustainable transportation domain, which constitutes the novelty value of this study. The outcomes imply the need for governments and practitioners to execute appropriate approaches in nurturing public's motivation in adopting energy-efficient cars, so that the adoption rate of pro-environmental vehicles can be increased. Overall, this study infers that the adoption of hybrid vehicles is viable if individuals are properly provided with sufficient awareness and education, which subsequently builds trust, empowerment, and confidence in owning these vehicles.

Keywords: electric vehicles; hybrid vehicles; pro-environment behavior; green purchase intention; environmental knowledge; Malaysia

1. Introduction

"Going green" seems to be a string of journeys towards a sustainable world [1]. Yet, the dependence on energy intensity around the globe increases the chances of environmental degradation over time. As reported by the International Energy Agency (IEA), the emission of carbon dioxide is viewed as one of the largest contributors to climate change, of which two-thirds is dominated by the transportation sector [2]. Within this figure, cars accounted for the largest amount of energy consumption. Thus, the agency suggested that fuel economy could improve the efficiency of energy use for vehicles, and eventually reduce the statistics of fuel combustion emissions of the world [3]. Therefore, the need to satisfy the vision of energy-efficiency, especially in the transportation sector, should draw the concern of every country to embrace fuel-efficient vehicles.

As reported by the International Organization of Motor Vehicle Manufacturers (OICA), the production of cars is growing globally over time, which reflects that the demand for this mode of transport has never withered [4]. Consequently, car makers need to adopt cleaner powertrain systems as a viable response to the challenges of mitigating fuel combustion emissions. To this end, the deployment of hybrid cars is viewed as a promising way of addressing the aforementioned circumstances to achieve an energy-efficient transportation system [5]. Hybrid cars are different from conventional cars, mainly in terms of the degree of carbon emissions, with hybrid cars promising

lower carbon emissions [6]. Hence, hybrid cars seem to be one of the feasible alternatives for reducing dependence on energy-intensive transport and improving the efficiency of transport energy.

Though the aim of improving the efficiency of transport energy is unhesitatingly deemed to be realistic, it still remains to be achieved, as the statistic of hybrid cars' adoption is still far behind the adoption of conventional cars globally. This can be proven by the statistics produced by the IEA, which indicate the market share of environment-friendly cars is still comparatively small, compared with conventional cars [7]. Even though there are still many countries with a low level of adoption of hybrid cars, the market share of those green cars is steadily showing a positive expansion. European countries remain the world's highest in market share of hybrid cars, while China is the only country representing Asia with a sizeable market share of hybrid cars and is one of the key players in hybrid vehicle adoption globally [3]. From the perspective of Malaysia's automotive market, the adoption of energy-efficient vehicles is still at a relatively low rate, in line with the green trend in Malaysia, which is still in an early phase [8].

In Malaysia, electrified vehicles are still in the early stage of adoption, and technology acceptance is not as notable as represented in other developed countries such as the United States and Europe [3,8,9]. In reality, the infrastructures and facilities of these electrified vehicles are still not entirely developed to be easily accessible in different areas within the country [10,11]. The access towards charging infrastructures and facilities is still limited to certain metropolitan areas. Commercial-wise, battery electric vehicles (BEVs) are available in limited numbers (e.g., Nissan Leaf, Renault Zoe, BMW i3), and their prices are well beyond the reach of the mass consumers in the country. Hence, any research attempts to gauge BEVs' adoption will not produce accurate results that reflect the reality of the current situation.

While BEVs promise a greener environmental impact than hybrid electric vehicles (HEVs) and plug-in hybrid vehicles (PHEVs), the short span of BEVs' battery life can potentially cause impractical driving experience owing to the under-developed charging infrastructures and facilities in the country [12,13]. Hybrid cars are primarily introduced as vehicles that are operated with more than one means of propulsion instead of the sole means of engine propulsion [9]. In this regard, a hybrid car is designed to be powered by a fuel combustion engine along with an electric motor. In the Malaysian context, the HEV market is generally occupied by mainstream brands such as Honda and Toyota. In contrast, the PHEV market is dominated by premium brands like BMW and Mercedes, considering its higher cost structure. Thus, hybrid technology—rather than BEV technology—appears to strike the right balance between driving convenience and purchasing ability among Malaysian car buyers, given the immaturity of the existing charging infrastructure.

The dismal statistic of hybrid car adoption globally might trigger several questions and is definitely something of a compelling phenomenon. Why are the global statistics of hybrid car adoption still lagging behind as compared with conventional cars? Are hybrid cars not competitive enough to win the hearts and minds of consumers? Are hybrid cars not promising enough to convince car users to make the transition from conventional cars to ecological cars? Or, do car users have their own preferences in adopting the vehicles? The list goes on. The game is changing; it is crucial to connect the missing dots. In this respect, the authors of [14] propose that the adoption rate of hybrid cars can be increased if the appropriate understanding is strengthened in terms of both pros and cons. Thus, the driving factors influencing hybrid car adoption can be examined in order to increase the adoption rate. On the other note, the motivation for purchasing a hybrid car is not only limited to an environmental-preservation motive. The adoption of a hybrid car can be triggered by a broad motivational factor, including economic consideration [15]. In this respect, while pro-environmental behaviors are viewed as primary drivers of ecological preservation, fuel-efficiency of hybrid technology grants an exceptional economic value that may develop individuals' motivation to own hybrid vehicles [16].

Nevertheless, Malaysia imposes a relatively higher tax structure for foreign-based manufacturers, and both of its national car makers do not offer any hybrid models. For instance, Honda's hybrid models are costlier to own and maintain than its conventional petrol-powered variants, even with

some equipment downgrade. Thus, the economic value of hybrid vehicle ownership is not considered to be factored into our study's proposition.

On the basis of the above discussion, this study intends to examine the factors that drive consumers' intention to purchase hybrid cars. This study embraces the Theory of Planned Behavior (TPB) as its underpinning theory to gauge people's attitude, social pressures, and self-control towards purchase behavior. Moreover, environmental knowledge is integrated into the model to explain the ecological behavior of decarbonising the transportation system.

2. Review of Literature

2.1. The Theory of Planned Behavior

TPB is an extension of the Theory of Reasoned Action that shapes a person's behavioural intention based on internal and external factors. According to the TPB model [17], behavioural intention is influenced when consumers exhibit a positive attitude towards the behaviour, when the consumers are responsive to the support or acceptance of the behaviour from their social circles (subjective norm), and when their capability of adopting the behaviour is within the bounds of their capacity (perceived behavioural control).

To date, studies that utilize the TPB have found that environment-friendly behaviour could be assessed with the fundamentals of TPB; that is, attitude, subjective norm, and perceived behavioural control. Significant findings from previous studies validate that the implementation of TPB in accessing consumers' environment-friendly behaviour is undoubted. For instance, TPB was used in recent studies pertaining to energy-saving behaviour [18]; in studies of consumers' intention towards restaurants' organic menus [19]; and to examine the behavioural intention to reduce car travel by [20].

Despite the wide and powerful application of TPB, which has been widely tested in numerous environment-friendly behavioural studies, the authors of [21] suggested that additional variables seem to be applicable in enriching the explanatory power of TPB. According to [22], environmental knowledge plays a vital role in investigating consumers' behaviour in the perspective of ecological study. On the basis of the study, the scholars found that environmental knowledge exhibits a prominent impact on consumers' ecological behaviour.

In addition, previous work by [23] claimed that the application of one single theory alone is insufficient to explain people's behaviour. Hence, additional variables play a significant role in improving the explanation of behaviour. Therefore, apart from the three fundamentals of TPB (attitude, subjective norm, and perceived behavioural control), this study adds another variable, environmental knowledge, to investigate the environment-friendly behavioural intention of individuals.

2.2. Green Purchase Attitude and Intention to Purchase a Hybrid Car

'Attitude' refers to "the degree to which an individual has a desirable or undesirable appraisal or assessment of the behaviour" [17]. The concept of attitude encompasses two subcomponents, namely affective and instrumental [24,25]. In this respect, the subcomponent of affective is conceptualized based on individuals' evaluations, specifically their tendency or desire towards a certain behaviour. Meanwhile, the instrumental subcomponent of attitude refers to individuals' evaluations on whether a specific behaviour is considered as either beneficial or harmful [25]. Concerning the deployment of hybrid cars, the preferences that are looked at by car users are important and may determine their attitude towards the behaviour [5]. As implied by [26], the process of hybrid car adoption may involve evaluations and perspectives, both in positive and negative views of adopting the environment-friendly behaviour, whether to adopt or decline. The authors of [27] found that attitude exhibits a significant influence towards environment-friendly cars. In contrast, the authors of [28] found that the pricing factor of hybrid cars, which are categorized as expensive, leads to the withdrawal of a positive attitude towards purchasing the vehicles. Subsequently, if the price of hybrid cars can be lowered down to the affordable price, it may draw the interest of people to have a positive attitude towards hybrid cars'

adoption. Hence, the divergence of the influence of attitude towards behavioural intention to purchase hybrid cars, as mentioned previously, leads to further investigation to be carried out concerning that matter.

2.3. Subjective Norms and Intention to Purchase a Hybrid Car

The underpinning Theory of Planned Behavior suggested that subjective norm refers to “perceived social pressure from others to perform or not perform a certain behaviour” in certain circumstances [17]. The subjective norm construct is composed of injunctive and descriptive characteristics [24,25]. Injunctive subjective norm relates to individuals’ assessments or beliefs on whether their social circles want them to perform in a certain behavior or vice versa. Meanwhile, descriptive subjective norm is measured based on individuals’ evaluations on whether or not a certain behavior is being performed by their social circles [25]. Within the context of hybrid cars’ purchase intention, people tend to be encouraged to “perform that behaviour” when they perceived that their social circle or people around them are shifting towards decarbonising the transportation system by the deployment of environment-friendly cars [29]. The influence can be triggered or take place when people around them share their views and insights among each other. Social influence is not limited to family circles, but might be from anyone whom they respect, including friends, social influencers (e.g., celebrities), and others [30]. The higher the social pressure that takes place, the more likely it is that people will be influenced in performing the behaviour [26]. In another view, the authors of [31] suggest that the influences or pressures of social peers in the context of adopting environment-friendly cars are obscure and not convincing, considering the low statistical rate of environment-friendly cars’ adoption across the globe to date. Thus, this study seeks to examine the influence of social norms in driving people’s intention to purchase hybrid cars.

2.4. Perceived Behavioural Control and Intention to Purchase a Hybrid Car

Perceived behavioural control is the third determinant based on the Theory of Planned Behavior, and is widely applied in numerous studies to investigate people’s behavioural intention [32]. As defined by [17], perceived behavioural control or self-control refers to “the perception of people pertaining to the degree of either ease or difficulty in performing the behaviour of interest”. Perceived behavioral control has two elements, namely self-efficacy and controllability [24,25]. Self-efficacy relates to individuals’ appraisal of the ease or difficulty in performing a behaviour, while controllability refers to individuals’ absolute control in performing a certain behavior [25]. In the context of the intention to purchase hybrid cars, perceived behavioural control deals with whether the individuals are perceived as capable of purchasing hybrid cars, specifically their financial capacity [33], as well as the availability of other external resources (e.g., government tax exemption and purchasing rebate) [34]. Having said that, the authors of [27] clarify that the influence of perceived behavioural control towards behavioural intention may be diminished if people have negative perspectives about hybrid cars, such as certain features of hybrid cars that might fall below their expectation or preference. Thus, such conditions may limit their interest in performing the purchase behavioural intention. In this study, the influence of perceived behavioural control towards the intention to purchase hybrid cars will be explored further.

2.5. Environmental Knowledge and Intention to Purchase a Hybrid Car

Environmental knowledge refers to an individual’s knowledge of the environment and the pressing issues surrounding it, such as climate change, deforestation, and sea contamination of non-degradable waste. Environmental knowledge includes the idea of the ability or self-efficacy of individuals relating to the understanding and evaluation of societal activities and their impacts on the ecosystem, concerning both positive and negative implications [35]. The idea conveys that environmental knowledge assists individuals in the process of understanding and evaluating the good or bad outcomes in relation to environmental wellbeing, which can influence one’s behavioural action. Consumers who have high levels of environmental knowledge are expected to be adept in assessing

whether a certain behavioural action leads to environmental consequences, both positive or negative. They also tend to be mindful that adverse environmental consequences are often derived from human consumption activities and behavior [35].

In many studies, environmental knowledge is assessed as an indicator to influence people's behavioural intention in the context of pro-environmental studies [36,37]. Similar to other ecological behaviour studies, individuals' environmental knowledge is measured based on subjective knowledge instead of objective knowledge [36,37]. Scholars emphasized that subjective knowledge is more applicable to be employed in environmental behaviour research as compared with objective knowledge [38–40]. Objective knowledge relies on the accuracy perspective (i.e., how much an individual actually knows). In contrast, subjective knowledge depends on the self-assessment perspective (i.e., how much an individual thinks he/she knows) [40–43]. Furthermore, individuals' objective knowledge does not reflect the degree of individuals' actual level of knowledge, and it does not indicate the individuals' perception of how much he or she knows [38,40]. Among the hurdles that are commonly associated with subjective knowledge are individuals' direct and indirect experience concerning pro-environmental behavior [40]. Thus, the present study emphasizes individuals' ecological vehicle purchase intention, where the relevancy of individuals' direct or indirect experience of the vehicle is essential.

The authors of [44] stressed the importance of educating consumers about sustainability and wellbeing in relation to green purchase implications, in which their limited knowledge is deemed to be a barrier that may impede their intention to go green. Similarly, from the perspective of the intention to purchase hybrid cars, the authors of [37] indicated that the likelihood of people adopting hybrid cars can be multiplied as their environmental knowledge is increased. As implied by [45], people's pro-environmental decision is strongly dependent on their knowledge of environmental wellbeing. Overall, this study will investigate the influence of environmental knowledge on the intention to purchase hybrid cars.

3. Hypothesis Development

According to [46], a research hypothesis can be defined as a “logically conjectured relationship between two or more variables expressed in the form of a testable statement”. Therefore, in this study, four hypotheses were developed to be tested based on the literature of previous studies. Figure 1 illustrates the conceptual model proposed for this study, which was developed based on the underpinning of the Theory of Planned Behaviour by [17], with an additional variable. The hypotheses of this study are shown below:

Hypothesis 1 (H1). *Green purchase attitudes positively influence the intention to purchase a hybrid car.*

Hypothesis 2 (H2). *Subjective norm control positively influences the intention to purchase a hybrid car.*

Hypothesis 3 (H3). *Perceived behavioural positively influences the intention to purchase a hybrid car.*

Hypothesis 4 (H4). *Environmental knowledge positively influences the intention to purchase a hybrid car.*

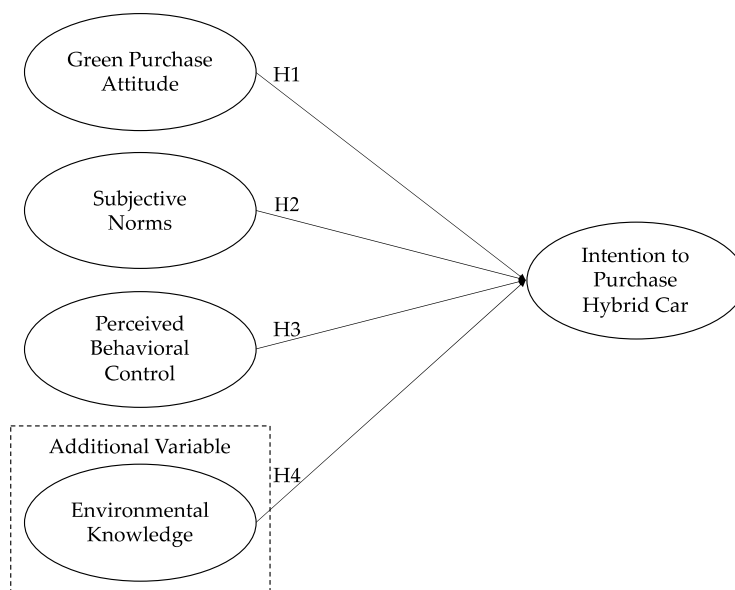


Figure 1. Research framework.

4. Methodology

4.1. Measures

In order to obtain the data for the study, an online self-administered survey was conducted. The survey was structured based on a closed-ended questionnaire, which comprises of three sections. Section A asked about the respondents' demographic background: gender, employment, income, education, and age. Section B examined the respondents' intention to purchase a hybrid car. Section C consisted of questions about factors that may influence the respondents to purchase a hybrid car. The measures were adapted from previous established questionnaires: intention to purchase hybrid cars [47,48], attitude [49], subjective norm [50,51], perceived behavioural control [52], and environmental knowledge [53]. Some modifications have been made from the original measures to fit the context of the current study. Five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree) were used to measure the items, as shown in Appendix A.

4.2. Participants and Data Collection Procedures

The questionnaire was administered through online social media platforms, specifically social groups that cater to Malaysia's car owners. There were more than 50,000 members who participated in these social groups. The data collection process took place between May 2019 to July 2019 and successfully obtained a total of 256 usable responses. As the sampling frame of the study could not be obtained owing to personal data protection (Act 709), the data were collected using a purposive sampling technique and the responses were filtered to include only those with a valid driving license, a monthly income, and aged 18-year-old and above. The respondents' participation was fully based on their voluntary consent and their personal information was kept anonymous.

In this case, an invitation was posted on Facebook; the country's prominent social media platform, to car clubs and societies across Malaysia. Those who volunteered to participate in the study were directly led to SurveyMonkey, an online survey platform. The platform allows respondents to be filtered based on the study's requirement. The study required participants to possess a valid driving license and have adequate purchasing power (individual salary of at least RM3000). Inconsistent with Cohen's (1988) rule of thumb for power analysis and the Gpower software [54], 172 samples were needed for the model to yield a medium effect size ($f = 0.15$). From the online field survey, 256 samples were acquired. Hence, the samples comfortably exceed the required sample size.

The collected sample has sufficient statistical power to test the research model and represents the study's population, although some researchers have suggested lower figures [55–57]. G*Power software was used to evaluate the reasonable number of samples required for multiple regression analysis [58]. Table 1 below summarizes the sampling details of past environmental behaviour studies.

Table 1. The summary of studies related to the adoption of pro-environmental/new energy vehicles. EVs, electric vehicles.

Source	Data Collection	Sample Size
[59]	Offline questionnaire survey	167 respondents in Germany
[55]	Online questionnaire survey	124 respondents in Germany
[60]	Web-survey	205 conventional car drivers in Norway
[61]	Offline questionnaire survey	213 residents in Hefei and Shanghai, China
[62]	Online stated-preference survey	221 online users in Munich, Germany
[63]	Online questionnaire survey	229 car-pool managers including adopters and non-adopters of EVs in Germany
[64]	Mixed-method: in-depth interviews (n = 7) and online questionnaire survey	245 car owners in Denmark
[65]	Questionnaire survey	240 urban households in China
[66]	Self-reported questionnaire survey	254 respondents in China
[67]	Online questionnaire survey	256 car drivers in Germany

4.3. Tools for Data Analysis

A number of empirical analyses were performed using the computer software, Statistical Package for Social Sciences (SPSS) version 26. Among the tests conducted were principal component analysis (PCA), reliability test, correlation analysis, and multiple regression analysis.

5. Results

5.1. Demographic Profile of Respondents

Table 2 represents the participants' demographic profile. As shown in the table, the majority of the respondents were male, comprising 55.1 percent of the 256 respondents. Of the total of 256 respondents, most (71.1 percent) were categorized as in paid employment. Respondents who were self-employed, students, retired, and unemployed comprised 22.3 percent, 5.9 percent, 0.9 percent, and 0 percent, respectively. Most of the respondents' monthly income ranged from RM3001 to RM6000, with 57.4 percent in this range; 32.4 percent earned in the range of RM6001 to RM9000; and 10.2 percent had a monthly income of RM9000 or more. More than 60 percent of respondents had an undergraduate education level, while about 37 percent were at postgraduate level and 2 percent were at high school level or below. Lastly, most of the 256 respondents were aged between 25 and 34 years old.

Table 2. Demographic profile of respondents.

Demographics	Frequency	Percentage (%)
Gender		
1. Male	141	55.1
2. Female	115	44.9
Employment		
1. Paid employment	182	71.1
2. Self-employed	57	22.3
3. Student	15	5.9
4. Retired	2	0.9
5. Unemployed	0	0
Monthly income		
1. <RM3000	0	0
2. RM3001 to RM6000	147	57.4
3. RM6001 to RM9000	83	32.4
4. >RM9000	26	10.2
Education level		
1. High school or below	6	2.3
2. Undergraduate (bachelor's degree/diploma/equivalent)	155	60.6
3. Postgraduate (master/PhD/equivalent)	95	37.1
Age		
1. Under 18	0	0
2. 18–24	57	22.3
3. 25–34	96	37.5
4. 35–44	75	29.3
5. 45–54	26	10.2
6. 55–64	2	0.8
7. 65+	0	0
Total	256	100

5.2. Results of the Principal Component Analysis

Principal component analysis is carried out by the dimension reduction technique to assess any removable items, to ensure that the factors are really measuring and explaining the variables [68]. For further details, the most popular rotation technique is used, which is the orthogonal varimax rotation technique. As there is no specific rule of thumb to be followed in selecting the rotation technique, the aforementioned rotation method selected is considered to be superior to other rotation methods in achieving a simplified factor structure [69]. As represented in Table 3, one item is deleted from the structure of environmental knowledge, as the factor loading exhibited is lower than the significant loading value. The sufficient factor loading value for interpretative purposes should be greater than 0.5 [69]. All other items are retained as there are no issues with eigenvalue, commonalities value, cross factor loadings, and factor loading values.

Table 3. Results of the principal component analysis and reliability.

Construct	Items	Loadings	Cronbach's Alpha Value
Green purchase attitude (GPA)	GPA1	0.763	0.930
	GPA2	0.822	
	GPA3	0.807	
	GPA4	0.802	
	GPA5	0.800	
Subjective norms (SN)	SN1	0.695	0.903
	SN2	0.760	
	SN3	0.706	
	SN4	0.718	
	SN5	0.685	
Perceived behavioural control (PBC)	PBC1	0.763	0.918
	PBC2	0.720	
	PBC3	0.783	
	PBC4	0.592	
	PBC5	0.727	
Environmental knowledge (EK)	PBC6	0.619	0.808
	EK1	0.615	
	EK2	0.727	
	EK3	0.660	
	EK4	0.604	
Intention to purchase hybrid car (INT)	INT1	0.865	0.878
	INT2	0.824	
	INT3	0.696	
	INT4	0.651	
	INT5	0.539	

5.3. Common Method Variance—Harman's Single Factor Test

This study was based on a self-administered questionnaire, so it is vulnerable to the possibility of common method bias or variance (CMV). According to [70], common method bias is a potential problem in behavioural research. The authors of [71] underlined that the presence of common method bias in a study can be assessed through Harman's single factor test. On the basis of the results, it can be inferred that the data set of this study does not support any CMV as the variance explained by the single factor is less than 50%. Therefore, the potential problem of CMV in this research is absent.

5.4. Analysis of Reliability

In addition to the foregoing analyses, another analysis carried out was the test of the instrument's reliability. In order to measure the scales' internal consistency, the test of reliability, assessed by the value of Cronbach alpha, is vital in a research study. As shown in Table 3, the reading of Cronbach's alpha values for all the variables of the study reach an acceptable value, as recommended by [72]: all the Cronbach's alpha values are above the threshold value of 0.70. The results indicated that the instrument of the survey is deemed to be reliable in measuring all the constructs consistently. Therefore, as all of the instruments indicated a satisfactory inter-item reliability and consistency level, all of the items are retained without deletion as the items are fit to measure the variables of interest.

5.5. Correlation Analysis and Normality

Table 4 represents the correlation matrix consisting of the Pearson correlations, which indicate the inter-correlation among the variables studied. As shown in the table, all of the study variables are significantly correlated between one another. These results indicate the discriminant validity of the constructs, whereby each of them is associated with each other, but they do not overlap each other. Perceived behavioural control has the strongest correlations with the intention to purchase hybrid cars ($r = 0.633$, $p < 0.01$), followed by environmental knowledge ($r = 0.575$, $p < 0.01$). Furthermore,

the skewness and kurtosis values are within the acceptable range of -3 to $+3$ each, indicating that the data of the study are normally distributed, and the normality assumptions of the study are sufficiently met. The means, as shown in the table, show that most of the respondents show a positive tendency towards the intention to purchase a hybrid car.

Table 4. Inter-construct correlations.

	GPA	SN	PBC	EK	INT
Green purchase attitude (GPA)	1				
Subjective norms (SN)	0.635 **	1			
Perceived behavioural control (PBC)	0.594 **	0.685 **	1		
Environmental knowledge (EK)	0.504 **	0.640 **	0.659 **	1	
Intention to purchase hybrid cars (INT)	0.491 **	0.538 **	0.633 **	0.575 **	1
Mean	4.270	4.006	4.018	3.961	3.827
Standard deviation	0.614	0.600	0.676	0.656	0.712
Skewness	−0.174	0.118	−0.167	0.189	0.081
Kurtosis	−0.967	−0.197	−0.304	−0.800	−0.613

Note: ** Correlation is significant at the $p < 0.01$ level (two-tailed).

5.6. Regression Analysis

Multiple regression analysis was used in order to test the proposed hypotheses of the study, as it allows the examination of the influence of the predictors on the dependent variable. The variance inflation factor (VIF) values of all of the variables are below the value of 10 (from 1.91 to 2.50), and the tolerance values of each variable are more than 0.10, indicating that there is no problem of multicollinearity for the study [69]. Figure 2 reported the normal P–P and residuals' scatter plots, indicating that the normality, linearity, and homoscedasticity assumptions are met [69].

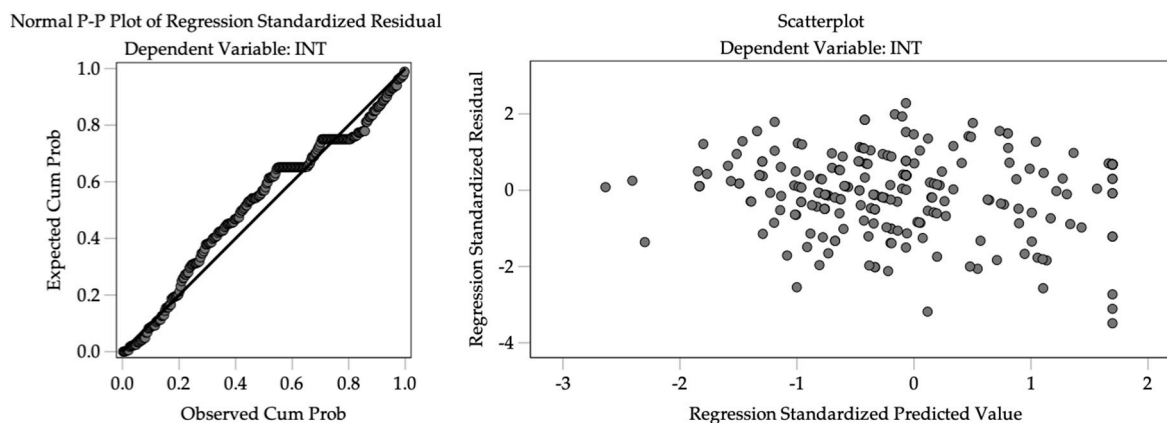


Figure 2. Normal P–P plot and scatter plot.

From the regression analysis in Table 5, the results reported that 47.8 percent of the variance of the intention to purchase hybrid cars is explained by green purchase attitude, subjective norms, perceived behavioural control, and environmental knowledge. After controlling for the demographics, the analysis shows that perceived behavioural control ($\beta = 0.387$) and environmental knowledge ($\beta = 0.224$) significantly influenced the intention to purchase hybrid cars. Hence, H3 and H4 are supported. Meanwhile, green purchase attitude ($\beta = 0.082$) and subjective norms ($\beta = 0.088$) have an insignificant influence on the intention to purchase hybrid cars. Therefore, H1 and H2 are rejected. On the basis of the regression analysis, perceived behavioural control is the most salient influence towards the intention to purchase hybrid cars. The overall results of the hypotheses testing are reported in Table 6.

Table 5. Regression analysis.

	Model 1		Model 2		Model 3	
	β	t	β	t	β	t
<i>Control Variables</i>						
Gender	0.140 *	2.250	0.009	0.189	−0.016	−0.325
Income	−0.014	−0.180	−0.093	−1.522	−0.072	−1.200
Education	0.211 **	3.240	0.060	1.162	0.051	0.998
Age	−0.155 **	−2.041	−0.094	−1.596	−0.096	−1.661
<i>Independent Variables</i>						
Green purchase attitude			0.093	1.439	0.082	1.282
Subjective norms			0.155 *	2.169	0.088	1.204
Perceived behavioural control			0.479 ***	6.966	0.387 ***	5.330
Environmental knowledge					0.224 **	3.377
R ²	0.066		0.454		0.478	
R ² change	0.066 **		0.388 ***		0.024 **	
F	4.467 **		29.491 ***		28.313 ***	
F change	4.467 **		58.746 ***		11.404 **	

* Note: Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 6. Summary of hypotheses testing

Hypothesis	Path	Decision
H1	Green purchase attitude → Intention to purchase hybrid cars	Rejected
H2	Subjective norms → Intention to purchase hybrid cars	Rejected
H3	Perceived behavioural control → Intention to purchase hybrid cars	Accepted
H4	Environmental knowledge → Intention to purchase hybrid cars	Accepted

6. Discussions

To recapitulate, this study examines the factors influencing the intention of car users to purchase a hybrid car. The factors examined in assessing their influence on the intention to purchase a hybrid car were developed based on the Theory of Planned Behavior (green purchase attitude, subjective norms, and perceived behavioural control) as well as one additional variable (environmental knowledge). The regression analysis undertaken across a sample of 256 respondents confirmed that perceived behavioural control and environmental knowledge significantly influence people's intention to purchase hybrid cars. On the basis of the regression analysis report, the most salient predictor influencing the intention to purchase a hybrid car is perceived behavioural control. Thus, the result indicates that the intention to purchase a hybrid car can be highly dependent on an individual's perceived behavioural control. This result is consistent with previous studies by [73] and [60], which found that individuals' perceived behavioural control effectively influences their willingness to pay for purchasing hybrid cars, notably when they are capable of buying these innovative environment-friendly cars.

As articulated by [74], the new technology of hybrid vehicles involves several constraints pertaining to the adoption decision, such as the adoption's ease or difficulty, and the affordability and availability of the vehicles. Thus, the researchers stated that the actual behavioural control of the individuals can be increased when they have better control over their resources, including the financial perspective. On top of that, the authors of [75] justified that the higher the individuals' financial capacity, the higher the individuals' actual behavioural control; hence, they may have higher potential for adopting hybrid vehicles.

The regression analysis also reported that the additional variable added into the study model, which is environmental knowledge, exhibits a significant influence on the intention to purchase a hybrid car. The result indicates that environmental knowledge plays a vital role in influencing individuals' intention to purchase a hybrid car. Similarly, previous studies conducted by [76] and [37] found that in nurturing the adoption of energy-efficient cars, environmental knowledge plays a remarkable role in fostering the purchase decision. The authors of [77] stated that individuals with significant

knowledge about the impacts of unsustainable behaviours on environmental wellbeing would be more open to adapting to energy-efficient technology, even though it is something new to them. Exposure to the benefits of mitigating carbon emissions from transportation can enhance individuals' environmental knowledge, and lead to the development of ecological awareness, which ultimately fosters enthusiasm towards green transportation adoption [78]. Not only that, but environmental knowledge is significantly able to drive individuals' willingness to pay for sustainable transportation to mitigate carbon emissions from private vehicles [79]. The result clearly demonstrates the significance of environmental knowledge in influencing individuals' intention to adopt green vehicles. Thus, having said that, limited knowledge regarding the environmental wellbeing would constitute a barrier among individuals to environment-friendly behaviour [80].

In spite of that, green purchase attitude is incapable of exerting any significant influence towards hybrid cars' purchase intention, implying that the attitude towards ecological buying behaviour does not determine individuals' intention to purchase hybrid cars. Accordingly, as hybrid technology is regarded as innovative technology as compared with conventional vehicles, it is considered new to be adopted, which may lead to doubtful perceptions in terms of the vehicles' performance and attributes [81]. As Malaysians are unfamiliar with hybrid cars and their knowledge is limited, most of them are naïve and clueless on its potential benefits and long-term running costs. This leads to negative attitudes among individuals on the evaluation of whether to purchase green technology vehicles. Moreover, the higher price of hybrid cars as compared with conventional cars also leads to the negative attitude of individuals towards the adoption decision, which overrides the green attributes offered by hybrid vehicles [82]. Hence, saliently, a positive attitude towards individuals' intention to purchase a hybrid car depends upon the value that they perceive in the ecological vehicles [83].

Subjective norms also reported an insignificant influence on the intention to purchase a hybrid car. This is in accordance with a research finding by [37], which implied that individuals' decision to adopt hybrid cars is not determined by other people's influences; instead, the adoption decision is more vulnerable to influence by other factors, such as environmental awareness, financial ability, or the vehicles' performance. In contradiction to this, a research finding by [84] found that subjective norms play a significant role in influencing individuals' intention to purchase hybrid cars, as positive opinions shared among them increase their likelihood to be influenced. However, though adopting energy-efficient vehicles to reduce carbon emissions is an altruistic societal symbol and influence, it is insufficient to convince people to develop their intention in terms of monetary sacrifice and their willingness to pay [29]. Besides, the integration of environmental knowledge into the model nullifies the significance of subjective norms in predicting the purchase intention of hybrid cars, as shown in Table 5. This result indicates that people are putting more trust in their self-acquired environmental knowledge that carries more authenticity than the opinions of their reference groups. To summarize, this study confirmed that the pressure or influence of social circles is not an important determinant that influences individuals' intention to purchase a hybrid car.

7. Conclusions, Implications, and Future Research Directions

Our dependence on the transportation system is high, especially on private vehicles, which jeopardizes environmental wellbeing as time passes. Therefore, the adoption of hybrid vehicles is considered to be one of the best alternatives for reducing the emissions of cars equipped with internal combustion engines. In this paper, a research model based on the Theory of Planned Behavior (green purchase attitude, subjective norms, and perceived behavioural control), which is integrated with environmental knowledge, was applied to examine the factors influencing individuals' intention to purchase a hybrid car. The main findings, based on the regression analysis, confirmed that green purchase attitude and subjective norms have an insignificant influence on individuals' intention to adopt hybrid cars. Instead, individuals' intention to buy environment-friendly vehicles is more susceptible to being influenced by perceived behavioural control and their environmental knowledge.

The study found that the most influential determinant of the intention to purchase hybrid cars is when individuals perceive themselves as having better control over their resources and believe they are capable of adopting hybrid cars. Environmental knowledge was found to be the second salient factor influencing individuals' intention to purchase hybrid cars. This finding confirms that the knowledge individuals possess regarding the impacts of carbon emissions from transportation on environmental wellbeing will reinforce their intention to purchase a hybrid car.

The integration of the Theory of Planned Behavior and environmental knowledge constitutes the theoretical novelty of this study. The integration of environmental knowledge into the Theory of Planned Behavior enriches the value of the extant literature by augmenting the explanatory power of predictors that influence pro-environmental vehicles' purchase intention [13]. Studies have indicated that the value of environmental knowledge in affecting individuals' environmental actions is significant and meaningful [35,85]. Environmental knowledge plays a vital role in guiding individuals in their pro-environment decision-making process. Correspondingly, in the state of insufficient knowledge, the practice of ecological behavior might not be preferred [35].

Practically, in respect of promoting the adoption of energy-efficient cars, it is vital to study what may shape individuals' motivation in adopting the vehicles. Therefore, approaches can be executed accordingly by various parties, including governments, manufacturers, and marketers. On the basis of the results of this study, we derive several key implications for governments and practitioners to escalate the uptake of hybrid cars among consumers. Firstly, considering the negative role of green purchase attitude on the intention to purchase hybrid cars, several specific approaches should be implemented to minimize the individuals' negative perception of buying pro-environmental vehicles. Promoting and highlighting the values of hybrid cars are regarded as effective ways of cultivating individuals' acceptance of hybrid cars' adoption. For example, the attributes, performance, and other values of hybrid cars can be introduced by hybrid cars' manufacturers and relevant government agencies through multiple mediums that can reach the consumers (e.g., billboards, television shows, newspapers, and the Internet). These approaches will attract the public's attention and understanding of pro-environmental vehicles' adoption.

Next, given the non-significant effect of subjective norms towards the intention to purchase hybrid cars, practitioners and government bodies may work together to increase the effectiveness of social influence towards hybrid cars' adoption. The endorsement of public figures (e.g., celebrities) on hybrid cars' adoption can be executed to create a meaningful social pressure on the public in adopting pro-environmental vehicles. Lastly, as perceived behavioral control and environmental knowledge exhibit a positive influence on hybrid cars' purchase intention, some measures can be implemented by governments and automotive marketers. The government should enact policies that promote the provision of financial incentives (e.g., tax reduction and rebate program) to benefit the hybrid cars' purchasers. Therefore, individuals' motivation to own the vehicles can be shaped accordingly. On top of that, concerning the significant influence of environmental knowledge, educating the public concerning the ecological impacts of green vehicles' adoption is essential. In this instance, the related government bodies and automotive firms may create environmental awareness programs to expose the public on environmental knowledge. For example, specific environmental courses can be integrated into the formal education system (e.g., schools and universities). Hence, individuals will be exposed to environmental knowledge from a young age, which eventually guides them towards sustainable consumption actions.

Overall, despite the research findings, some improvements can be made concerning the limitations of this research. Hence, we propose several key points in regard to future research directions. First, the sample size could be expanded in future research so that generalizability can be enhanced. Researchers may also expand research across different national and regional contexts to have a better grasp of the overall phenomenon. Second, the current study examines the extent of individuals' intention to purchase hybrid cars. Therefore, future research can expand the study model to the extent of actual buying behaviour of individuals in purchasing hybrid cars. This type of investigation can be

performed through a longitudinal two-wave survey procedure. Third, as the method of collecting the data of this research is fully based on an online, self-administered survey, the respondents' honesty and level of understanding in answering the questionnaire could not be guaranteed. Hence, considering another data collection technique for future research could enhance the quality of the data. Fourth, the moderate level of R2 value of the current study indicates that there are predictors that are not covered in examining individuals' intention to purchase hybrid cars. Therefore, future research could explore different variables to enhance the model, which ultimately will better explain the variance of the study. For instance, brand equity [86] and consumption values [87] could be proposed as potential predictors of individuals' intention to adopt hybrid cars.

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Appendix A. Measurement of Instruments

(1) Green purchase attitude

- GPA1–Purchasing hybrid cars is good.
- GPA2–Purchasing hybrid cars is beneficial.
- GPA3–Purchasing hybrid cars is worthwhile.
- GPA4–Purchasing hybrid cars is satisfactory.
- GPA5–Purchasing hybrid cars is valuable.

(2) Subjective norms

- SN1–If I bought a hybrid car, most people who are important to me would agree with my decision.
- SN2–If I bought a hybrid car, most people who are important to me would appreciate my green purchase.
- SN3–If I bought a hybrid car, most people who are important to me would find it as a desirable purchase.
- SN4–If I bought a hybrid car, most people who are important to me would support my purchase decision.
- SN5–If I bought a hybrid car, it would be consistent with the trend of social development.

(3) Perceived behavioral control

- PBC1–I believe I have the ability to purchase a hybrid car.
- PBC2–If it were entirely up to me, I am confident that I will purchase a hybrid car.
- PBC3–I see myself as capable of purchasing a hybrid car in the future.
- PBC4–I have the willingness to purchase a hybrid car.
- PBC5–There are likely to be plenty of opportunities for me to purchase a hybrid car.
- PBC6–I feel that purchasing a hybrid car is totally within my control.

(4) Environmental knowledge

- EK1–I am very knowledgeable about environmental issues.

EK2–Compared to the average person, I am more familiar with issues related to the environment.
 EK3–I know how to select vehicles that produce the least carbon emissions.
 EK4–I understand the environmental effect of vehicle consumption.
 EK5–I know that the adoption of a hybrid car is more sustainable as compared to the adoption of a conventional car.

(5) Intention to purchase hybrid cars

INT1–In the near future, I will consider buying a hybrid car.
 INT2–In the near future, I will consider switching to a hybrid car.
 INT3–I prefer a hybrid car over a conventional car.
 INT4–I prefer a hybrid car even if it is more expensive as compared to a conventional car.
 INT5–I think purchasing a hybrid car is a valuable green purchase.

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