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Consumer Motivation by Using Unified Theory of Acceptance and Use of Technology towards Electric Vehicles

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Abstract: The transport sector is the leading source of growing greenhouse gas (GHG) emissions globally. To consider environmental degradation aspects due to transport, electric vehicles (EVs) have the prospect to lead road transport to electric mobility from conventional petroleum vehicles. Despite various eco-friendly benefits, the EV market penetration ratio is very low, especially in developing countries. The primary reason for low penetration is consumer limited motivation and knowledge about the EVs features. This paper uses a unified theory of acceptance and technology (UTAUT) model to assess consumer motivation and environmental knowledge towards EVs. This research used convenience random sampling to collect data and analyzed the results using the Partial Least Squares (PLS) method on the example of 199 respondents from Malaysia. The study results revealed that factors identified in the motivational context significantly influence consumer intentions to purchase EVs. Perceived environmental knowledge and technophilia have been included in UTAUT from a motivational perspective. Furthermore, a significant relationship between effort expectancy, social influence, technophilia, perceived environmental knowledge, and purchase intention towards electric vehicles has been observed, without performance expectancy. The study findings serve to inform policymakers and automakers to formulate effective marketing strategies to enhance consumer motivation, knowledge, and value creation for EVs in a sustainable era. Ultimately, the policies will help to encourage consumers to buy eco-friendly vehicles that will help reduce transport carbon emissions and attain sustainable development goals (SDGs).

Keywords: consumer motivation; sustainable; electric vehicle; perceived environmental knowledge; sales; business strategy

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1. Introduction

Due to the rise of the world population and new economic power's emergence (i.e., China, Russia, India, etc.), the consumption of fossil fuels has significantly increased. However, a considerable chunk of the world energy requirement is still fulfilled from fossil fuels comprising oil, coal, and natural gas [1]. The burning of fossil fuels from the transport and industry sector leads to a rampant surge of pollutants and GHGs emissions [2]. Business strategies have been actively developed to reduce environmental pollution from a consumer perspective by using eco-friendly products to counter this carbon emission issue [3]. Due to the current adverse global ecological situation, the quest for reducing the release of GHGs into the atmosphere is a primary concern.

Asian countries' transport sector has accounted for a substantial share in transport carbon emissions. Therefore, worldwide organizations have been given significant consideration to reduce the consumer usage of internal combustion engine (ICE) vehicles and adopt sustainable vehicles to reduce the ratio of transport carbon emissions [4]. In developing countries globally, Malaysia ranks 24th in carbon emission [5], and the transport sector accounted for 36.4%, the largest energy consumer in 2020 [6]. In Malaysia, combustion engine vehicle ownership among consumers is relatively high in percentage, almost 89.7% [7], and third largest globally, with a ratio of 93% [8]. Malaysia's rising carbon emission ratio is expected to worsen if efficient and sustainable vehicle usage is not enhanced. The consumer should be encouraged to switch towards electric vehicles (EVs) [9] to curb the transport GHG emission. Electric vehicles are vital in enhancing future transport due to their efficacy in reducing carbons emissions, air pollution, and transport noise [10]. However, the EV market saturation has yet to be effective in enhancing consumer awareness in developing countries.

With the mounting pressure for the usage of eco-friendly vehicles, EVs are considered the finest possible solution in reducing transport emissions globally. As in the Paris 2015 agreement, the Secretary-General also focused on climate change and set strict goals to reduce carbon emission by 45% by 2030 and net-zero by 2050 [11]. As part of the global community, Malaysia is also combating reducing GHG emissions and setting the Green Tech Master Plan 2030 [12] and Malaysia Progressive 2050 [13] of being sustainable and reducing carbon emissions, which can be possible by promoting EV sales and consumer adoption. Different studies discussed adoption and consumer behavior towards EVs in Malaysia, but EV adoption has not been successful and is limited. Multiple dimensions of electric vehicles across countries have been identified and include business models [12–14], charging infrastructures [15,16], policies and other incentives [17–19], among others. Other review studies focused on aspects of electric vehicles' adoption, for instance, Biresselioglu, et al. [20], Hardman, et al. [21], Rezvani, et al. [22], respectively, explored the starring role of the nonfinancial and reoccurring incentives in EVs adoption, the EV adoption barriers, and drivers based on theoretical perspectives.

The automobile industry is showing great interest in adopting eco-friendly behavior, and the leading world automobile companies are striving to adopt new technologies for electric cars. The supply of EVs is already available in the Malaysian market, but consumer adoption is very low. The demand for purchasing these vehicles is down due to several reasons, such as high purchase costs, range limitations, vehicle charging time, uncertain infrastructure, etc. [23–26]. Furthermore, another reason for consumers not finding alternative models of these vehicles is also a drawback [27]. Relatively ample empirical evidence about EV adoption factors and advantages are widely known, but still, the consumer adoption of electric vehicles is very low [22,25,28,29].

In developing countries, introducing innovative technology requires consumer awareness, acceptance, and financial support [30]. The sale of EVs has not been escalating despite its ecological benefits. Government agencies' support and funding policies are required to penetrate EVs into the market successfully [31]. The government should prioritize developing effective strategies to green the transport sector and the economy. The electrification of vehicles is the key solution to cut and decarbonize transport emissions and improve air quality. However, the question remains unanswered why the demand and acceptance for electric vehicles are still limited. The existing literature unheeded the heterogeneous attributes of the low consumer adoption issue. This study argues that consumer awareness and motivation are crucial in triggering behavior towards it. When individuals are more conscious about the features of EVs, their interest to explore more will be developed. Through awareness, consumer behavior can be triggered towards new vehicle technology. Usually, automakers face challenges in enhancing consumer motivation towards new technology products [32], as individuals are usually skeptical about adopting a new product. The low consumer ratio of EV adoption has posed new challenges for the policies makers and suppliers to develop effective strategies.

For this purpose, this study explored the issue with the help of factors, such as consumer knowledge and awareness of electric vehicles features. Moreover, the EVs' supply has been pushed into the Malaysian market, and it requires knowledge and awareness among consumers to make it acceptable, as the consumer knowledge and awareness related to electric vehicles have not been explored. Driven by the desire for consumer awareness, the researcher explored the factors that motivate and influence consumer knowledge about EV features in this study. Specifically, this study is based upon the unified theory of acceptance and use of technology (UTAUT) by Venkatesh, et al. [33] as an underlying framework to explore the effects of performance expectancy, effort expectancy, and social influence, and adding two constructs, technophilia and perceived environmental knowledge on purchase intention. Perceived environmental knowledge has been rarely discussed in EVs perspectives; however, it has been neglected in the consumer motivational views.

This study employed SmartPLS to confirm the hypothesis and for analysis. Based on this study's findings, the implications and suggestions are prepared, which can be helpful for the automakers and policymakers to develop efficient strategies to promote EVs among consumers. In addition, policymakers can apply these research-identified UTAUT factors to enhance consumer motivations and knowledge towards EVs, which will be helpful to reduce transport carbon emission and attain Sustainable Development Goals (SDGs).

The motivation for this research is: Most of the work in the literature investigates the consumer adoption of EVs [28,29,31,34–36], barriers in adoption of EVs [25,34,37–39], and other issues related to EVs (carbon emission policies, fast charging infrastructure, perceived values, tax rebate policies, etc.) [23,27,40–46]. However, the literature lacks studies about consumer motivation related to electric vehicles. Consumer intentions towards EVs can be enhanced with the motivational and awareness technique, as consumers are observed with very limited knowledge about electric vehicle features in this study.

The inspiration for studying EVs and consumer motivation is that literature neglects this issue. Moreover, the other reason for studying EVs is of four aspects, environmental (energy efficient and less harmful for ecological degradation), financial (it lowers the annual fuel cost compared to ICE vehicles), operational (comfort and innovative technology vehicle), social status (linked to social class and reputation), and last but not least is related to Sustainable Development Goals, which can help reduce the transport carbon emission by maximum adoption of EVs. For the mass deployment of EVs, consumer motivation and knowledge about the environment and EVs features is necessary. The supply of EVs is already available in the market, but consumer demand is very limited. This study proposes promotional strategies to enhance consumer motivation towards the purchase of EVs.

2. Literature Review

The researchers in the previous studies used several methods for motivation, such as the agent-based model [47], cohort estimation for vehicle survival [48], time series models, and the consumer choice model [49–52]. Consumer survey-based choice modeling is often used to understand the primary factors influencing and motivating consumer choices, price, comfort, fuel consumption, safety, reliability, and brand name [53]. The key identified factors in the studies are cost and the society that affects behavior [54–61]. A study on EVs by Sang and Bekhet [29] revealed that in Malaysia, such factors as performance, financial, social, demographic, environmental, infrastructure readiness, and government intervention are effective in motivating behavior. However, the actual purchase of EVs is much lower than the stated consumer's preference in the surveys [62]. However, to evaluate consumer intention, this study used UTAUT, which is considered the most appropriate theory for consumer intention regarding technology acceptance. Where social media can actively participate in influencing consumer motivation towards the purchase of sustainable products.

UTAUT was earlier used by Yoo, et al. [63] in the context of intrinsic and extrinsic motivation in promoting e-learning and was found significant in enhancing consumer motivations towards e-learning. Other researchers, Fagan, et al. [64], Teo, et al. [65],

Amabile [66], used the theory towards motivation and found the model significant in influencing behavior towards the usage of technology. Inevitably, UTAUT has both benefits and limitations for research applications. The first advantage of UTAUT is its holistic approach in describing the underlying relationships among various psychological and social elements that may impact the adoption of information technology. The second aspect is the consistency of validity and reliability of collected data by the UTAUT model [67,68]. According to Van Raaij and Schepers [69], one of UTAUT's limitations is that it is not parsimonious enough because it requires many variables to achieve a significant level of variance; and the UTAUT constructs social influence and facilitating condition may not be properly measured due to their complexity. Finally, considering the number of variables engaged in UTAUT, it is not cost-effective for firms to address all of them to enhance employee acceptance of e-learning. According to Lee et al. [70], research on technology acceptance should be based on employees' extrinsic and intrinsic motives, which can help firms devise effective strategies to encourage e-learning among employees in the workplace. The following section examines the traditional UTAUT and its constructs used in this study.

2.1. Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh, Morris, Davis and Davis [33] reviewed and conducted an empirical study by evaluating eight different models to assess the consumer intention related to technology acceptance. The UTAUT model has a 70% variance toward the intention. The eight models studied by these researchers were the Theory of Reasoned Action (TRA) [71,72], Technology Acceptance Model (TAM) [71,73], Theory of Planned Behavior (TBP) [74], combined TAM and TPB [75], Model of PC Utilization (MPCU) [76], Motivation Model (MM) [77], Social Cognitive Theory (SCT) [78,79], and Innovation Diffusion Theory (IDT) [54]. Based on the systematic analysis of the models mentioned above, UTAUT was proposed [33], which plays a significant role in determining the acceptance and intention of the user. This model postulated four constructs as an element of behavioral intention are: (i) performance expectancy, (ii) effort expectancy, (iii) social influence, and (iv) facilitating conditions. This study expands the theory by considering variables that have not been examined earlier to examine motivation effectiveness. Variables incorporated in the study are fuel efficiency, technophilia, and perceived environmental knowledge.

The UTAUT theory has been used and extended by many researchers in the context of EVs adoption [80–90]. The adoption of EVs has been very limited, which is why the different researchers extended the UTAUT model to examine the factors which enhance the consumer behavior towards these sustainable vehicles. Karunanayake and Samarasinghe [87] analyzed the perceived risk with the extension of UTAUT towards the purchase intention of EVs. Khazaei and Tareq [83] examined the UTAUT theory with the moderating effect of personal innovativeness and driving experience towards EV adoption. Another study by Khazaei [88] extended the UTAUT model with personal innovativeness and price value to examine the consumer intention to use EVs. Sovacool [81] integrated UTAUT into a conceptual framework towards EV adoption and was found to be very effective in enhancing consumers to adopt of these vehicles. Riga [90] used the UTAUT theory to explain the consumer intention of EV purchase. Furthermore, the UTAUT theory was found pertinent in enhancing consumer adoption of sustainable vehicles. Khazaei and Khazaei [91] extended the UTUAT theory with the moderating effect of voluntariness of use and driving experience to examine consumer EV adoption factors. Kaye, et al. [92] investigated the acceptance of automated cars with the help of UTAUT and the Theory of Planned Behavior. UTAUT was also extended with trust in safety towards the EV behavioral intention and was found to be significant [80]. Several researchers used this theory to examine the consumer adoption intention towards EVs; however, UTAUT was not used in the context of motivational factors to influence consumer intention towards EVs. Consumer motivation towards EVs was very low, and to enhance consumer intentions, this study expanded UTAUT with perceived environmental knowledge to enhance consumer motivation towards EVs.

2.1.1. Performance Expectancy (PE)

PE is defined as "the extent to which users believe that using this system will help them to use innovative technologies in voluntary situations" [33,88,92]. This construct has been driven by perceived usefulness described in TRA and TAM. PE denotes the students' beliefs regarding the use of m-learning to enhance their knowledge performance. Venkatesh, Morris, Davis and Davis [33] explored that PE is a stronger determinant of users' behavioral intention in using technology. While in new technology, a vehicles' purchase intention, the degree to which it has been analyzed that the purchase of the EV will help better performance compared to conventional vehicles, needs to be analyzed [93]. In the literature, PE significantly affects purchasing innovative technology [33,82,94–96]. PE was also found significant in influencing consumer intentions in accepting cloud technology in Pakistan [94]. Tran, Zhao, Diop and Song [95] support that PE influences consumer intentions positively in electric vehicle sharing in China. Thus, the following hypothesis has been proposed.

Hypothesis 1. *The performance expectancy of consumers positively affects intentions to purchase EVs***.**

2.1.2. Effort Expectancy (EE)

EE is introduced in UTAUT and is a key predictor of technology acceptance. EE is referred to as a perceived degree of comfort and ease associated with using new technology [33]. The literature confirmed EE positive relevance in predicting consumer intentions [81,84,85,95]. Madigan, Louw, Dziennus, Graindorge, Ortega, Graindorge and Merat [85] confirmed that EE positively affects consumer acceptance of new road transport systems in European areas. EE positively influences consumer intention to use and the actual use of particular technology [97–99]. EE positively influences consumer adoption intention of cloud technology among Pakistanis [94]. In this study, EE refers to the consumer perception of ease of using innovative technology vehicles. By using innovative technology, vehicles will have no complications and will be effortless to use. Therefore, if vehicle users expect EVs to perform excellently, they will be more likely to accept and adopt them. It is expected that EE will positively impact consumer motivation to purchase EVs. Therefore, the following hypothesis is proposed.

Hypothesis 2. *The effort expectancy of consumers positively affects intentions to purchase EVs*.

2.1.3. Social Influence (SI)

SI is the extent to which individuals perceive the significance of other beliefs regarding new technology usage [33]. Previous studies demonstrated that other society members, such as friends, relatives, and parents, usually influence people's decisions [100,101]. SI is a significant factor affecting consumer intentions to purchase EVs in Malaysia [29]. Social media can be very effective in enhancing the consumers towards the specific product or brand [102], as the social media community was found to be significant in driving consumer intention towards the brands' product [103]. A large role is played by social media in creating long-term relationships between the product and its customers [102], and social media was also found to be important in increasing customer loyalty to the brand [103]. Additionally, the SI positive relationship with intentions was also supported for accepting automated transport systems in European areas [85], and social media is an active player in developing robust relationships. Ali, Mehmood, Majeed, Muhammad, Khan, Song and Malik [94] also confirmed SI's positive influence to adopt cloud technology in Pakistan. Therefore, this study assumed that SI would positively influence consumers towards the purchase of EVs. In this connection, the following hypothesis is suggested.

Hypothesis 3. *The social influence regarding the usage of EVs positively affects consumers intentions to purchase EVs.*

2.1.4. Technophilia

Technophilia has been defined as a strong fascination and attractiveness for innovative technologies [104]. It is specifically related to consumer interest and openness towards new technology. According to Rogers [54], consumers are enthusiastic about adopting technophile's innovative technology development early when the product is not commonly available on the market. Hirschman (1980) viewed new technology products as a wish to find something innovative and unique. Being tech-savvy and skeptical about innovative products inspires consumers to purchase [25]. Consumers are having EVs share their experience with others about new technology vehicles [105]. Technophilia is not only about emotions for innovations but also a motivation towards adopting innovative technology. A consumer seeking innovative technology is influenced by new products [106]. The efficient performance of the product is a core factor in the acceptance of innovative technology [33]. Consumers with a strong extent of innovativeness are very interested in adopting mobility innovations, such as EVs [107,108]. Blättel-Mink, et al. [109], Fazel [110] identified technophilia and intrinsic motivation as significantly impactful for consumer EV usage. The following hypothesis is proposed.

Hypothesis 4. *Technophilia regarding EV usage positively affects consumer purchase intention towards EVs.*

2.1.5. Perceived Environmental Knowledge (PEK)

PEK is known as an individuals' information about an ecosystem, environment, and the effects of human acts on the environment [111]. Environmental knowledge refers to the consumers and customers who have information and are aware of eco-friendly issues and their solutions [112]. Consumers nowadays are more concerned about choosing the product based on their information and knowledge [113]. Perceived environmental knowledge significantly enhances customer interest in purchasing environment-friendly products; hence, improved environmental knowledge also expands customer consumption patterns [114]. Through green marketing strategies, government agencies and companies need to develop consumer positivity towards environment-friendly products [115]. Effective marketing strategies can influence consumers' environmental awareness and knowledge and encourage them to revise their lifestyle towards eco-friendly products. Info and knowledge about a specific product verifies how the consumer will perceive this product uniqueness [116] and what type of evidence is used in the product decision-making process. Therefore, environmental knowledge can be an effective driver of consumer behavior [117]. Chan, et al. [118] examined that employees' having perceived environmental knowledge, awareness, and environmental concern positively influences consumer behavior. Mohr, et al. [119] utilized the scale of perceived environmental knowledge used widely. Having perceived environmental knowledge can be effective in encouraging consumers to purchase EVs.

Hypothesis 5. *Perceived environmental knowledge positively affects consumer purchase intention towards EVs.*

This study developed the theoretical model and the hypothesis among the independent variables (IVs) and dependent variable (DV), shown in Figure 1.

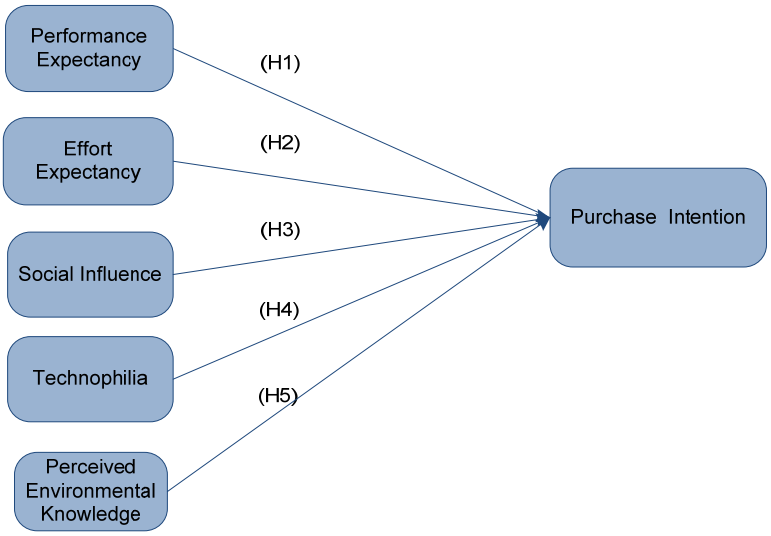

Figure 1. The study model.

The study's theoretical model, in Figure 1, shows five IVs: performance expectancy, effort expectancy, social influence, technophilia, and perceived environmental knowledge; and the one DV is purchase intention. These IVs were taken in the context of consumer motivation to enhance consumers' purchase intentions towards EVs.

3. Methods

3.1. Measurement of Constructs

The survey was conducted to evaluate the impact of the factors on purchase intention. The questionnaire measurement items selected (see Appendix A), explaining the purpose of the research, were sent through email. Among 500 contacted respondents, only 199 were valid. In this study, 8 scale items of performance expectancy, 6 items scale of effort expectancy, and 4 item scale of social influence identified by Venkatesh, Morris, Davis and Davis [33] were used. The 8 item scale of technophilia was used that was identified by Haarmann, et al. [120], Zwick and Renn [121], Hüsing, et al. [122], Franken and Luley [123]. Furthermore, perceived environmental knowledge was measured by the 5-item scale identified by Ellen, et al. [124]. Moreover, the purchase intention scale with 5 items was identified by Ajzen [74], Dodds [125]. Minor modifications in scale items were made according to the research on consumer motivation, EVs, and purchase intentions. Items were assessed on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

Initially, a pilot study was conducted on 50 respondents and was pretested numerous times. The questionnaire also consists of significant demographic info (age, gender, race, and income). Then, the instrument was modified based on the pilot study results and then validated with practitioners, experts, and academicians. The primary purpose of validation was to ensure there was no issue in understanding and answering the questions and whether to keep the suggestions. The questions were modified based on the gathered feedback, and some were eliminated.

3.2. Data Collection

The questionnaire was delivered online by targeting high-income respondents in Malaysia. High-profile income groups were targeted as a respondent because the price of the vehicles is quite high. Three major income-based groups of Malaysia are: B40 (bottom 40%), M40 (middle 40%), and T20 (top 20%). These are further classified into 4 groups M1, M2, M3, M4, while T is grouped into T1 and T2). The target respondents of the study were those with having more income than MYR 9000, which lie in the groups M4, T1, and T2. The selection of high-income groups was based on the high cost of these vehicles. The

sampling technique used in the study was convenience, which includes the respondent's judgment to achieve the research's objective [126].

The demographic attributes of respondents, identified in Table 1, are as follows: 123 (62%) males and 76 (38%) females were surveyed out of 199 respondents in the present field. All respondents were adults (18 above), where most respondents were found within the age groups of 40–49 (44.1%) and 30–39 (29.4%), respectively, followed by age groups 50–59 (16%), 18–29 (7%), and 60 years and above (3.4%). While (62.2%) 124 are Malay, (17%) 34 are Chinese, (14%) 28 are Indian, and (6.6%) 13 are from mixed races. Based on monthly income (33.4%), 67 respondents have an income of MYR 10,001–15,000, (21.07%) 42 have MYR 5001–10,000, (18%) 36 have MYR 15,001–20,000, (13.3%) 26 have MYR 5000 or below, (10.3%) 21 have MYR 20,001–25,000 and (3.6%) 7 respondents have MYR 25,001 and above. Therefore, such a sample profile indicates that respondents are mature and have a high-income profile, have a deeper understanding of under investigation topics [127], and are more likely to have sustainable behavior to purchase eco-friendly products.

Table 1. Demographic Profile of Respondents (n = 199).

Demographic	Frequency Rate	Percentage
Male	123	62%
Female	76	38%
Age Group		
18–29	14	7%
30–39	58	29.4%
40–49	88	44.1%
50–59	32	16%
60 years and over	7	3.4%
Race		
Malay	124	62.2%
Indian	28	14%
Chinese	34	17%
Others	13	6.6%
Income (MYR)		
5000 or below	26	13.3%
5001–10,000	42	21.07%
10,001–15,000	67	33.4%
15,001–20,000	36	18%
20,001–25,000	21	10.3%
25,001 above	7	3.6%

Source: Authors Estimations.

3.3. Pretesting

Pretesting has been considered an effective way to prepare for actual data collection [128,129]. The specialized researchers in the field have pretested questionnaires to guarantee their correspondence to the structure. The purpose of pretesting is to revise the ambiguous questions and thus ensure the reliability of the study. In this research, 50 respondents were selected based on convenience heterogeneous sampling for the pretesting of questionnaires. Furthermore, its results show that all dimensions have Cronbach's α in between 0.68 and 0.91, the values having greater than 0.65 means they will have good reliability [130,131]. The factor analysis has a value greater than 1 and factor loading greater than 0.6, and each factor and item correlation will be greater than 0.5; this convergent validity criterion was proposed by [132–134].

4. Results

4.1. Assessment of the Measurement Model

Partial Least Squares-based Structural Equation Modeling (PLS-SEM) was used to conduct confirmatory factor analysis. According to Leung, Shi and Chow [134], Cheung, Pires, Rosenberger, Leung and Sharipudin [103], Koay, Ong, Khoo and Yeoh [133], the SmartPLS method was used due to this research's nature of testing a hypothetical framework from a prediction perspective [133–135].

Construct reliability and validity can be assessed in three measures [136]. First, the factor loadings of all indicators, secondly Cronbach Alpha value, and finally average variance extracted (AVE), was measured [137]. The performance expectancy's Cronbach alpha lies on an average level of validity and reliability on testing of 0.75. Cronbach's alpha for effort expectancy reliability is 0.776. The construct technophilia Cronbach Alpha reliability is 0.756. The social influence scale Cronbach Alpha reliability is 0.770. The Cronbach Alpha reliability of perceived environmental knowledge is $\alpha = 0.853$. The construct purchase intention scale Cronbach alpha value is 0.845. All the constructs' values show that there is no issue in reliability as all the values are more than the recommended values.

Construct Reliability and Validity

Even though the original model included all scale elements, the model was tested, and objects with factor loading less than 0.60 were deleted [138]. The average variance extracted (AVE) for the constructs was greater than the critical value of 0.50 [136]. However, AVE values more than 0.40 would also be acceptable [139], where construct reliability and validity are listed in Table 2.

Table 2. Measurement model assessment.

	Cronbach's Alpha	rho A	Composite Reliability	Average Variance Extracted (AVE)
EE	0.776	0.783	0.848	0.528
PE	0.759	0.761	0.832	0.453
PEK	0.853	0.855	0.895	0.631
PI	0.845	0.847	0.889	0.616
SI	0.770	0.801	0.851	0.591
TEC	0.756	0.775	0.835	0.505

Cronbach Alpha (CA), rho A, and Composite Reliability (CR) values should be greater than the threshold value of 0.7. However, a Cronbach alpha greater than the recommended value of 0.6 is also acceptable [140]. All the CA, rho A, and CR values were more than 0.7, confirming that the reliability is achieved. AVE values greater than 0.40 is also an acceptable value [139], and all the values are more than 0.4, which means that the constructs fulfil the validity values. Thus, these values fulfil the condition of reliability and validity values.

Discriminant validity was evaluated using the Heterotrait–monotrait ratio (HTMT) approach [141], which is believed to be the latest approach to use in discriminant validity analysis. Henseler, Ringle and Sarstedt [141] identified the acceptable HTMT ratio as below the 0.85 threshold value, which is the criterion for discriminant validity.

There are two approaches for assessing HTMT discriminant validity: (1) as criteria (2) as a statistical test. In the criteria approach, if the value of HTMT is more significant than 0.85 [142], or a value of 0.90 [143], it signifies the discriminant validity issue. The second criterion is to test the null hypothesis (H0: HTMT ≥ 1) against the alternative hypothesis (H1: HTMT < 1), if a confidence interval surpasses the value of 1, then there is an issue in discriminant validity [141]. All the values are less than 1, which means that there is no discriminant validity issue. Values less than 1 are all acceptable and valid to go for further analysis. In these values, there is no discriminant validity issue, and it can be seen in Table 3.

Table 3. Heterotrait–Monotrait Ratio (HTMT).

	EE	PE	PEK	PI	SI	TEC
EE		—				
PE	0.945	—				
PEK	0.612	0.702				
PI	0.821	0.823	0.801			
SI	0.706	0.720	0.650	0.806		
TEC	0.900	0.887	0.615	0.781	0.583	

4.2. Assessment of Structural Model

The overall R^2 value is 0.683, which means 68.3% of the cases predict the dependent variable, and the value of Q^2 is 0.408, representing the 40.8% predictive relevance shown in Figure 2. After the satisfactory results of the measurement model, this study tested the hypothesis with the structural model assessment depicted in Figure 3. Statistical significance, T-value, and effect size of path coefficients were examined by bootstrapping 5000 samples [144].

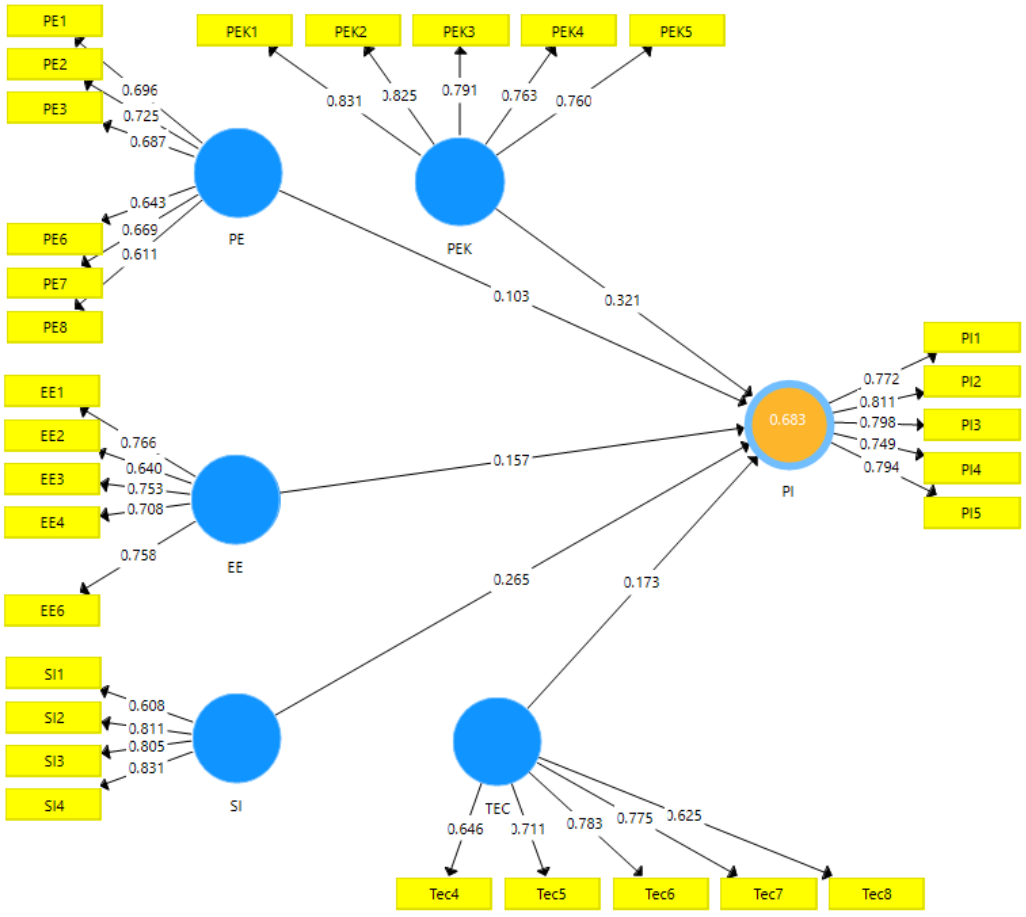

Figure 2. Structural model.

In the meantime, to test the independent variables performance expectancy, effort expectancy, social influence, technophilia, and perceived environmental knowledge impact on purchase intention, multiple regression has been used. The results demonstrated that except for performance expectancy, all independent variables substantially influence purchase intention.

The results suggested a model having 68.3% of explanatory capacity for consumer purchase intention with $R^2 = 0.683$. Moreover, it discovered that the relationship between

EE, SI, TEC, and PEK with purchase intention is substantial and positive. However, the relationship between PE and purchase intention is insignificant. A summarized overview of variables' findings and hypotheses is listed in Table 4. The *p*-values show whether the hypothesis is supported or unsupported.

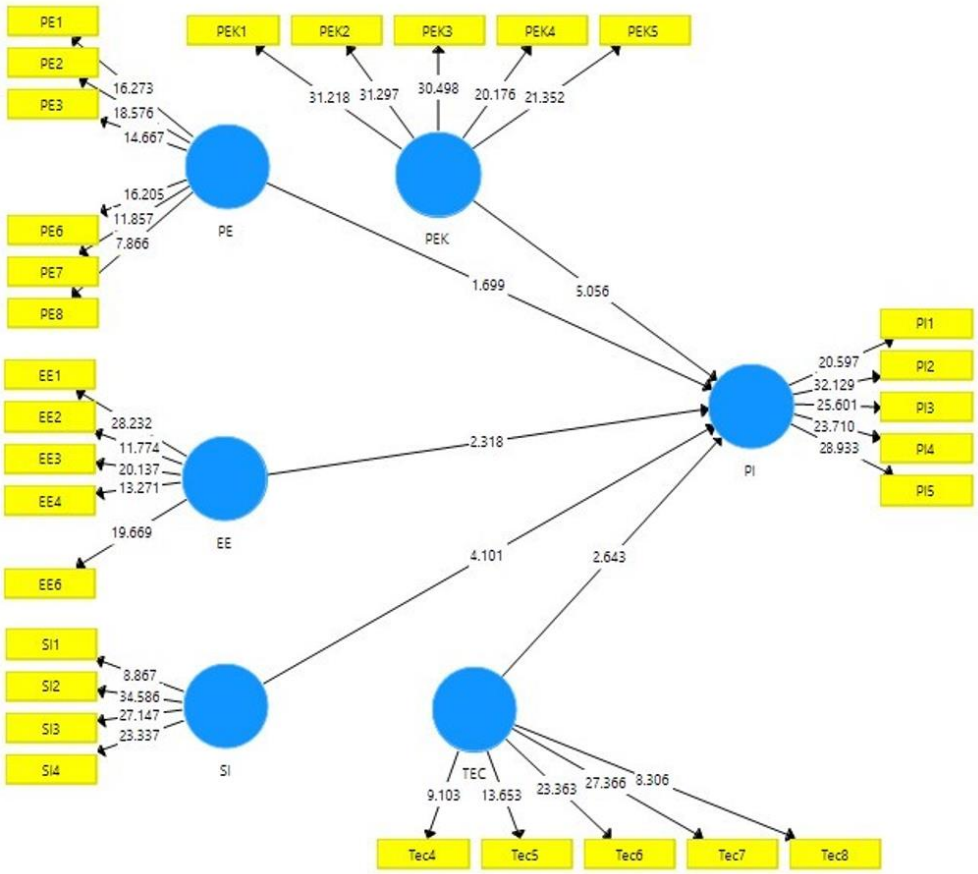

Figure 3. The assessment of the study model.

Table 4. Structural Model Assessment.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	*p*-Values	Hypothesis
EE -> PI	0.157	0.156	0.068	2.318	0.020	Supported
PE -> PI	0.103	0.105	0.061	1.699	0.089	Not Supported
PEK -> PI	0.321	0.320	0.063	5.056	0.000	Supported
SI -> PI	0.265	0.267	0.065	4.101	0.000	Supported
TEC -> PI	0.173	0.172	0.066	2.643	0.008	Supported

Based on the results, this study supports the applicability of motivational factors to enhance consumer purchase intentions towards EVs, as it has been observed that consumer knowledge is limited. Previous study findings related to Venkatesh, Morris, Davis and Davis [33] UTAUT, in the adoption of different technology, was also significant [85,145–150] and was also found to be significant in enhancing consumer behavior. However, this study has proposed these factors in a motivational context as the consumer motivation and knowledge related to EVs features were limited. The provision of the UTAUT model was found effective in enhancing consumer intentions towards EVs. Except for the PE in this study, all the other factors' values were significant.

5. Discussion

5.1. Hypothesis Relationship

The total number of developed hypotheses is five, and this section discussed the hypothesis relationship with purchase intention. The bootstrapping technique was used to assess the hypothesized relationship significance and path coefficient [141].

In the literature, performance expectancy has shown a significant relationship with purchase intention; however, in this study, the effect of performance expectancy and consumer intention has shown an insignificant relationship (T = 1.699, p = 0.089); based on the described results, H1 is not supported. Due to low factor loadings of PE, some items were also deleted, but the construct's effect remains insignificant. The PE result in this study was insignificant same as the study from Verkijika [36], where performance expectancy has no significant effect on consumer intention. This study's results failed to support the developed hypothesis, and the findings are contrary to previous studies, such as the adoption of technologies by Alalwan [151], Jaradat and Al Rababaa [152], Morosan and DeFranco [153], Oliveira, et al. [154].

The effect of effort expectancy on purchase intention has been positive and significant (T = 2.318, p = 0.020); based on the results, H2 is supported. The results of the study are consistent with the outcomes of Venkatesh, Morris, Davis and Davis [33], Tosuntaş, et al. [155], Escobar-Rodríguez and Carvajal-Trujillo [156], Casey and Wilson-Evered [157]. With the increase in consumer motivation towards EVs, their expectancy to purchase these vehicles will also be high. Consumers expect that EV usage will need less effort to handle, save time and fuel, and be environmentally friendly. Therefore, users will become quite skillful in using it.

The effect of social influence on consumer intentions was found significant and positive (T = 4.101, p = 0.000), and based on the results, H3 is supported. Consistent with Venkatesh, Morris, Davis and Davis [33], Escobar-Rodríguez and Carvajal-Trujillo [156], Yu [158], Thomas, et al. [159], a positive relationship was found. Malaysia is a collectivist country, which means peoples are committed to extended families and extended relationships. In this context, it can be said that Malaysian consumer motivations can be much more influenced by the people who are usually close to them. Consumers' awareness about sustainable environment and vehicles can influence others' intentions as well.

Technophilia has been found effective in influencing consumers towards new technology in the literature. In this study, technophilia has also been significant and positive (T = 2.643, p = 0.008), and based on the results, H4 is supported. Items that had loadings less than 0.5 were removed, and the result was found to be significant. Consistent with the results of Seebauer, et al. [160], Schlüter and Weyer [161], technophilia was significant enough to motivate and influence consumers towards the usage of new technology.

Furthermore, the effect of perceived environmental knowledge on consumer intention is found significant and positive in this study. Based on the results (T = 5.056, p = 0.000), H5 is supported. This study corroborates with Chang and Chang (2017) that environmental knowledge significantly influences consumers' innovative technology.

This study findings indicate that consumer motivation can be influenced by enhancing consumer awareness and knowledge towards the features of EVs. This research supports the applicability of UTAUT by Venkatesh, Morris, Davis and Davis [33] in enhancing and motivating the consumer to purchase EVs. The results of the study show that the model is significant in the EVs motivation context.

This study contributes to the literature by extending the UTAUT model with perceived environmental knowledge in the context of motivational factors. Earlier studies by Chen, Li, Gan, Fu and Yuan [84], Almetere, et al. [162], PARK and AHN [163], Patil, et al. [164], Saparudin, et al. [165], Wedlock and Trahan [166] discussed and extended the UTAUT model towards the acceptance of different technologies. These studies found the UTAUT model effective in the acceptance and adoption of innovative technology. However, this study differentiates and contributes in the context of consumer motivation among high-income respondents. As consumer knowledge and awareness related to sustainable vehi-

cles have been witnessed very limited and with the context of the motivational factors and awareness, this research can contribute to enhancing consumer knowledge and awareness by creating effective strategies. This research extended the UTAUT model with perceived environmental knowledge towards the acceptance of EVs. The results of this study were found to be significant, and all the other motivational factors were found effective in enhancing the consumer intentions towards EVs, except PE.

5.2. Research Contributions

Malaysia is an energy reliant country experiencing international pressure to reduce the ratio of greenhouse gases and adopt sustainable technology, which is vital to take necessary actions to mitigate hazardous gases. EVs have been introduced that emit zero carbon and can help to reduce transport emissions, but the sale of these vehicles is very low. Consumer motivation and environmental knowledge could be enhanced with effective marketing strategies from automakers and government agencies. The uplifting EVs sale among consumers is possible through supply and demand.

Investing in EV production needs high capital expenditure, which can minimize and influence the product prices to encourage consumers. To reduce the prices, the government encourages and promotes the local automaker to develop new technology products with effective subsidies to make them affordable for the consumer [167]. This study prompts automakers to introduce EVs' motivational strategies.

This research endeavors to predict consumer awareness and knowledge in Malaysia by proposing the research model integrating different prospects in UTAUT. The purchase of EVs is low and comprises altruistic and moral perspectives. With the help of UTAUT and motivating factors, it can be further clarified effectively. Integrating this UTAUT theory explained much more variance towards new technology [168].

5.3. Managerial Implications

A universal view of motivations has significant implications on consumer behavior. Policymakers and government agencies can incorporate these research outcomes to enhance consumer awareness and knowledge of environmentally-friendly electric vehicles. Automakers and government policymakers should incorporate environmental knowledge and awareness strategies to appease consumers towards the purchase of sustainable vehicles. For instance, automaker companies can design promotional strategies about EVs features and environmental prospects in societal marketing concepts, which should enhance consumer motivations. These companies should offer synchronized and accurate information about the vehicles in the promotional strategies. Meanwhile, consumers prefer to go for eco-friendly products, and environmental knowledge awareness will be effective for the companies to impress prospective consumers. Environmental awareness and knowledge programs should be introduced to enable the consumers' intentions towards EVs. Moreover, the promotional strategies for awareness should be up to standard in order to impress the consumers toward sustainable vehicles. Any unprofessional and societal harmful activity can negatively influence consumers towards these products.

These research findings revealed that consumers prefer to purchase eco-friendly products. However, their behavior towards EVs is very limited, which needs to be traversed with the help of developing efficient awareness strategies to motivate consumers. With the help of motivators, consumer purchase intentions can be developed which can lead to enhanced sales of EVs as mentioned in Figure 4.

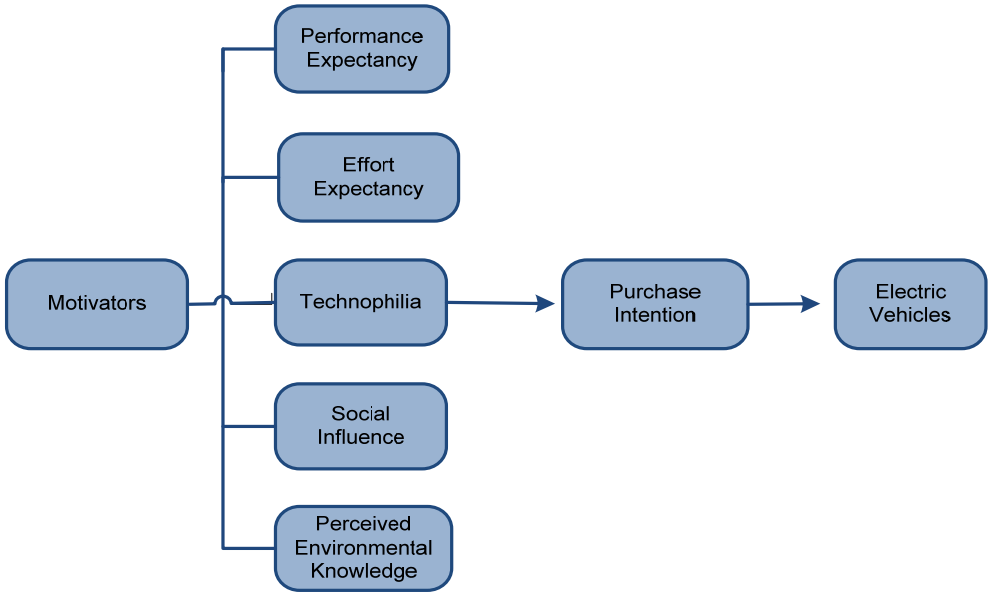

Figure 4. Conceptual model.

6. Conclusions

This research concludes that consumer motivation can be effective in enhancing their intentions towards the purchase of EVs. This research linked five significant routes related to consumer EV purchase intention, which are: performance expectancy, effort expectancy, social influence, technophilia, and perceived environmental knowledge. Perceived environmental knowledge is linked to the sustainability perspective where EVs contribute to reducing transport greenhouse gas emissions. PEK has not been widely used in the perspective of EVs, especially in motivational factors. Moreover, study results showed that these factors are effective enough to motivate the consumer to purchase EVs. Factor performance expectancy is found ineffective in this study; however, it has been influential in the literature in enhancing consumer intentions towards specific technology.

Although the EV supply is already available in the market, its demand needs to be increased. EVs, as modern technology, need global acceptance to reduce transport carbon emissions. However, consumer knowledge and awareness can be enhanced to purchase these vehicles by motivating factors. Companies and government agencies should promote and sponsor EV-related knowledge to motivate consumers to boost their purchasing behavior. Consumer motivation and acceptance of these vehicles will help the government achieve its target of reducing carbon emissions of Green Tech Master Plan 2030 and Sustainable Development Goals. The maximum diffusion of environmental knowledge among consumers will enhance consumer perception and motivation to accept these vehicles.

6.1. Future Directions

Future research is encouraged to implement this study model to diverse genres of consumer adoption of EVs to examine the role of performance expectancy, effort expectancy, social influence, technophilia, and perceived environmental knowledge in predicting consumer intentions. Further variables could be added to the EVs perspective to analyze the consumer acceptance and motivation effect.

6.2. Limitations

This study used a quantitative approach that limits the in-depth view about the adoption of EVs. Due to resources and time constraints, in-depth research about consumer intentions using a mixed-method method could not be adopted. Forthcoming studies can employ a mixed-method approach for better understanding. This research used a small

number of questionnaires, and the study results are specific to high-income respondents. Further study suggestions are not only limited to extending the total number of respondents but also to collecting the data through face-to-face questionnaires.

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Appendix A

Table A1. Survey Measurements Items.

Serial No	Variables	Items	Source
1	Performance Expectancy	1. The use of EVs would enable me to have eco-friendly behavior. 2. I can learn the EVs usage as a new technology more efficiently. 3. The use of EVs can reduce my fuel and maintenance cost as compared to gasoline vehicles. 4. Home charging availability of EVs is helpful to motivate me. 5. I think Using the electric vehicles will have no drawbacks 6. I am influenced that the use of EVs will improve my learning and technical activities 7. I believe Using EVs will enable me to follow the global trend of reducing transport carbon emission. 8. I believe Usage of EVs will be helpful to reduce the environmental degradation	(8) Venkatesh, Morris, Davis and Davis [33]
2	Effort Expectancy	1. I believe the use of EVs will be characterized without any stress. 2. The use of EVs will not require any technical expertise to handle. 3. The use of EVs can reduce my fuel and maintenance cost as compared to gasoline vehicles. 4. The use of EVs as a sustainable vehicle enhances the consumer satisfaction of being environmentally conscious. 5. I believe barriers in EVs usage like limited battery timings, cost of vehicles and charge infrastructure make it difficult to buy. 6. I think sustainable EVs adoption will not be frustrating.	(6) Venkatesh, Morris, Davis and Davis [33]
3	Social Influence	1. I believe my family, peers, and friends know about sustainable products and environmental degradation. 2. If my friends buy sustainable products i.e. EVs, then they will also insist me buy these products. 3. I will share information about sustainable products with my friends and family members. 4. I believe my family and friends prefer to buy sustainable products.	(4) Venkatesh, Morris, Davis and Davis [33]

Table A1. *Cont.*

Serial No	Variables	Items	Source
4	Technophilia	1. I believe an unpleasant thing of EVs is recharging the battery everyday. 2. EVs as the new technology may have difficulties in finding repair or service centers. 3. I believe It's better that PHEVs can run on gasoline as well after the battery is out of charge. 4. I believe having battery replacement centres around the country have no fear of battery failure and recharge bother. 5. Innovative vehicle technologies make me enthusiastic to adopt EVs. 6. EVs as an Innovative technology will have advanced features to use like no air and sound pollution. 7. I believe the new technology of EVs will have fewer issues in maintenance, that can save cost and time. 8. It's good to have recharge outlet at home or workplace, so that vehicle can recharge easily overnight. 9. I think by having recharge facilities at home or workplace, no need to worry about going to the fuel station.	(8) Haarmann, Scholz, Wasmer, Blohm and Harkness [120], Zwick and Renn [121], Franken and Luley [123]
5	Perceived Environmental Knowledge	1. I know that I buy environmentally safe products. 2. I know the selection of sustainable products that reduce the waste in the end. 3. I know the environmental symbols and phrases used on product packaging. 4. I have much knowledge about environmental issues caused by carbon emission. 5. I think using eco-friendly products is a primary source of reducing environmental pollution.	(5) Ellen, Eroglu and Webb [124]
6	Purchase Intention	1. I intent to buy sustainable products because they are environment friendly. 2. I will help the environment by purchasing sustainable products and electric vehicle. 3. I would suggest others to buy and use sustainable products to save the environment. 4. I intend to purchase the electric vehicle although it is expensive. 5. I am very likely to purchase electric vehicles in the future.	(5) Ajzen [74], Dodds [125]

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