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Consumers Purchase Intentions of Green Electric Vehicles: The Influence of Consumers Technological and Environmental Considerations

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Abstract: The purpose of the current study is to explore barriers influencing consumers' intention to adopt sustainable electric vehicles (EV) based on the modified theory of planned behavior (TPB) model. Structural equation modeling (SEM) and confirmatory factor analysis (CFA) were employed to analyze the research model, using 262 valid responses. The findings of the current study explored how attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC) significantly influenced users' sustainable consumption intentions. The finding also explored ways in which environmental concern significantly influenced ATT, SN, PBC, and sustainable consumption intention of the users. Not only measurements of vehicle performance, namely safety, reliability, and range, but other factors, such as purchasing price, charging facility, and maintenance and battery cost also influenced consumers' sustainable consumption intentions. The predictive power of the proposed model (R2 = 63.5) was better than the original TPB (R2 = 53.6). Results also indicated that Taiwanese are primarily concerned about the greenhouse effects on the environment, which reflected their sustainable consumption intentions. The conclusions of the current study could assist government and policymakers in designing sustainable programs, which could improve consumers' sustainable consumption intentions to prevent further air pollution and reduce CO_2 emissions from the transportation sector.

Keywords: electric vehicle (EV); environmental concern; pro-environmental consumption; green consumption; sustainable EV adoption; green consumption

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1. Introduction

Carbon dioxide (CO_2) is one of the critical components of greenhouse gases (GHGs) that contribute to global warming. Thus, reducing carbon emissions universally is a considerable challenge, specifically in the transportation sector, as the transportation sector is the largest end-use source of CO_2 emissions. According to the International Energy Agency's [1] report, the transportation sector contributes around one-fourth of the total universal greenhouse gas, projected to increase from 23% to 50% by 2030. Therefore, switching to better and more effective vehicles is considered an efficient method for reducing CO_2 emissions by several countries.

Alternative fuel vehicles (AFVs) are usually classified as all sorts of cars that can be fueled entirely or partially by alternative fuels, biofuels (ethanol, biogas), and electricity [2]. Inline, EVs incorporate diverse technologically advanced vehicles, hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), extended-range battery electric vehicles (E-REVs), and battery electric vehicles (BEVs). In the present study context, EV is considered electrified transport with onboard batteries that can be recharged from an electric outlet. It can also diminish CO_2 emissions substantially, as electricity is generated from

green energy sources [2,3]. However, biofuels and electric cars are sustainable solutions as long as land use, land-use changes, and forestry are also considered (LULUCF Regulation in EU, for example), and forestry is not compromised for biofuel production.

Nevertheless, the benefits mentioned above offered by EV have not fully materialized, due to the lack of user adoption [2,4]. Currently, EV shares a niche market share of the transportation sector. The literature stated that individuals might not be interested in using a pro-environmental vehicle that intervenes in their conventional driving behavior [2,4,5]. Thus, understanding the factors influencing individuals' intention to adopt a sustainable EV is one of the key elements in ensuring optimal integration. In addition, it ultimately measures benefits for both policymakers and the automobile industry regarding green consumption.

Since the consumers' behavior is a critical factor in participation, consumption, and adoption, the theory of planned behavior (TPB) is considered an appropriate underpinning theory for the current study purpose. However, literature indicating the predictive power of the original TPB regarding consumers' pro-environmental behavior could be improved using antecedent variables [2–4]. Thus, the primary objective of the current research is: (1) To explore the significant antecedent factors influencing consumers' attitudes, subjective norms, and perceived behavioral control to adopt a sustainable EV; (2) To explore the influence of attitude, subjective norm, and perceived behavioral control on consumers' intention to adopt a sustainable EV; (3) To explore the direct effect of environmental concern on consumers' attitudes, subjective norms, perceived behavior control, and intention to adopt a sustainable EV; (4) To explore how the findings of the current study from the Taiwanese perspective might compare with a global perspective. We are confident the current study's findings can enhance our present interpretation concerning consumers' consumption of pro-environmental EV. Both the automobile industry and policymakers will be supported to ascertain the determinants that improve consumers' intention to adopt pro-environmental EV.

The Motivation of the Study

There are mainly two key motivations for conducting the current research. Firstly, EV is a comparatively new innovation in Taiwan; additionally, EV is a worthwhile topic to explore from the perspective of problems related to the environment. Thus, exploring the determinants, which directly and indirectly influence consumers' intention to adopt this new environmentally sustainable innovation, can be a game-changer for the Taiwan government and companies from the perspective of fighting against the escalation of CO_2 in the environment. Secondly, the adoption of environmentally sustainable EV has been widely studied in developed countries, but very few studies have been performed to investigate these factors in the Taiwanese context. The literature shows that different countries encounter different problems in terms of new product adoption, as each country is different in its own culture, demographic, and social ways. Thus, exploring factors from a specific country is recommended. There is a lack of experience within consumers and organizations, and most potential users are unqualified.

2. Theoretical Model

2.1. The Electric Vehicle in Taiwan

To clean up the environment and improve the consumption of green energy, the Taiwan government has been intensely promoting the adoption of battery-powered EV, which emits no tailpipe emissions, since the last decade [6]. In 2014, the Taiwan government launched the Smart EV Development Strategy and Action Plan to promote a smart EV development strategy and an action plan covering electric cars, scooters, and buses [7]. This action plan proposes a number of subsidization and incentive plans for EV users; for example, any purchase of an EV (including small passenger cars, motorcycles, public buses, and cabs) will be exempted from the commodities tax, subject to the completion of the relevant registration requirement, for the next five years, until 2021 [6].

The Taiwan government planned to phase out the most polluting gasoline scooters within the next five years. The government offered substantial subsidies, covering up to 40% of an e-scooter cost, to expedite the process. With a government subsidy of roughly NT$30,000 (1 US$ = 31 NT$), now, the e-scooter has become affordable for most Taiwanese individuals [6]. The Ministry of Economic Affairs has been expecting to boost the sales of electric cars by 5939 units and 150,000 electric motorcycles with the help of the latest action plan. Despite the loss of commodity tax revenue on such sales, the government is hopeful that improved business-tax reimbursements, among others, will more than pay for any deficit. At the same time, the industrial output value of all EV sales is also expected to be around NT$94.399 billion (US$3 billion) [6]. Thus, it is likely that these policies, together with the other existing incentive policies, will expand the market, maximize energy conservation, and help to reduce carbon emissions in Taiwan.

2.2. The Development of Electric Vehicle Worldwide

Based on the statistical data of IEA [7] in 2018, around 3.29 million battery electric vehicles (BEV) were sold in 2018, which showed a 41% increase from 2017. Additionally, after the global sales volume of electric vehicles exceeded 1.95 million in 2017 and 1.20 million in 2016, the global stock of electric vehicles in 2018 exceeded 3 million, a 46% increase from 2016 [7].

The EV30@30 campaign was launched at the Eighth Clean Energy Ministerial in 2017 to increase the market share of electric vehicles in all the member countries of EVI (Electric Vehicles Initiative) to 30% by 2030 [8]. The challenge involves improving the global ownership of electric vehicles, developing related battery production technology and material requirements, deploying charging facilities for electric vehicles, energy and fuel conservation, reducing greenhouse gas emissions, and other measures beneficial for sustainability.

With this context, several governments are developing goals associated with electric vehicles, carrying out more precise signals to vehicle manufacturers and other stakeholders to improve their confidence in the future policy framework. In addition, some countries, such as Norway in 2025, Ireland, Netherland, and Slovenia in 2030, Scotland in 2032, United Kingdom, Sri Lanka, and France in 2040, have announced plans to ban internal combustion engine vehicles, which marks an essential step in the development of electric vehicles [9].

Because of the flourishing development of the electric vehicle industry, researchers from all over the world have given more attention to consumers' purchase behaviors and intentions in recent years. Literature explored that consumers' willingness to buy EVs is increasing. However, the findings of these studies are inconclusive and inconsistent, and most studies focus on the national or regional level. Thus, it would be interesting to examine the underlying drivers for EV adoption by consumers who usually have different characteristics and values. Understanding the diversity of the adopters and values they express in the context of EV would give invaluable knowledge for policymakers, automobile companies, and marketing agencies trying to increase EV sales, which still struggle to take off in most countries.

Moreover, by examining the existing studies regarding EV adoption and including the individual perspective, we could represent the diffusion process. It is, therefore, our rationale to find novel patterns in the EV purchase decision process. It would be fascinating to understand how consumers value different aspects of EV and how their traits influence their perception of this innovation. Thus, we investigate the factors that influence Taiwanese consumers' EV purchase intentions and how these are different from the previous findings.

2.3. Theory of Planned Behavior (TPB)

TPB is the improvement to the Theory of Reasoned Action (TRA) proposed by Ajzen [10]. The primary hypothetical contribution of TPB to its previous model, TRA, is the incorporation of perceived behavioral control, i.e., how easy or challenging it is to

perform the behavior. TRA exclusively depends on individuals' volitional progression, which consists of attitude towards the behavioral and subjective norm. TPB considers a non-volitional process along with a volitional dimension. Specifically, in TPB, the development of individuals' intentions can be more efficiently and comprehensively explained by its range, covering the volitional and non-volitional processes [11,12].

According to Ajzen and Fishbein [13], attitude (ATT) toward the behavior implies individuals' positive or negative tendency to answer back in a constant way to a specific activity. Subjective norm (SN) indicates individuals' perception of social pressure involved with significant referents' authorizations and shared beliefs concerning the particular action [10,12]. Perceived behavioral control (PBC) refers to individuals' perception of easiness or difficulty attached to employing a specific activity [12,13].

Because of its strong pre-emptive capability, TPB has become one of the most sustained theories in social psychology, and has been applied in an extensive range of study perspectives for the prediction of an individual's behaviors (such as travel mode choice, healthcare, drinking and driving, environmental behavior, and pro-environmental behavior) [14–17]. Additionally, TPB can expand the standard construct to better explain the factors influencing consumers' self-interest as the most critical motivation for pro-environmental behavior [17–19]. Thus, the current study aims to determine the belief that drives consumers to adopt EV, and aims to give recommendations towards improving consumer behavior. Therefore, this study adopts TPB to explore consumers' consumption of pro-environmental EV in the context of Taiwan.

2.4. Environmental Concern

Environmental concern has been linked to individual–specific beliefs or general environmental beliefs and world views [19]. Aguilar-Luzón et al. [20] further state that environmental concern is one of the unique beliefs. An individual's environmental concern is an essential type of personal belief. Thus, consumers' environmental protection or belief is a potential factor to shape their decision to use pro-environmental green products. Various studies on consumer consumption of pro-environmental EVs have indicated that EVs are eco-innovations that can reduce the environmental problems of the transportation sector [14,21,22]. The role of these environmental-related variables has also been found in exploratory studies where adopters articulated protecting the environment as a motivation for their choice of adopting EV [14,21,23].

Afroz et al. [24] found that environmentally concerned individuals are more prone to select fuel-efficient vehicles. Consumers who are environmentally sensitive and perceive themselves as environmentally responsive would be more likely to adopt EVs [25]. Thus, previous studies recommended that, similar to carrying out self-sacrificing activities (such as giving to a charity), EVs users could sense a "warm-glow" and "intrinsic emotional reward in pro-environmental behavior" [26], as they perceived that they played their role in curtailing carbon emissions and preserving the environment. This pleasing sense of honor encourages consumers to adopt EVs.

The environmental concern has been growing dramatically in recent years due to severe environmental issues and the government's appeal to protect the environment. According to the Global Burden of Diseases project report, air pollution was responsible for 4.2 million deaths worldwide in 2015 [27]. It seems that governments of different countries are trying to solve pollution in different ways. In this sense, EV offers an opportunity for Taiwan to improve air quality by reducing emissions [25]. Hence, individual environmental protection concerns can improve Taiwanese individuals' motivation to adopt EV.

3. Model and Hypothesis Development

3.1. Theory of Planned Behavior

Subjective norm (SN) is the perceived social pressure exerted by salient referents in performing the behavior. The higher the perceived stress, the more likely the behavioral intention [10]. Ajzen and Fishbein [13] defined attitude as the degree to which an individual

assesses a behavior as being favorable or not. As per Ajzen [10], the magnitude of the relationship between perceived behavioral control (PBC) and intention is dependent on the type of behavior and situation.

Yang and Sun-Choung [18] explored that subjective norms that positively affect behavioral intention. However, they further elaborate that people considering that they would achieve a specific behavior will have more intention to perform it due to a higher degree of social pressure [14,16].

In terms of eco-innovation adoption attitude, this reflects an individual's view about whether an eco-innovation actually has less harmful impacts on the environment and is thus more or less beneficial, according to the individual's green values [27]. A significant number of studies have shown a positive relationship between consumers' attitudes and their intentions to adopt new technologies, especially EV [28–31].

Shi et al. [29] explored that the more a consumer can control these elements, the more behavioral intention will be developed. Wang and Yan [30] also found a positive relationship between perceived behavioral control and purchase intention regarding the consumption of green electric cars. Thus, the following hypotheses are proposed:

Hypothesis 1 (H1). *Subjective norm is positively related to intention to adopt a sustainable EV.*

Hypothesis 2 (H2). *Attitude is positively associated with adopting a sustainable EV.*

Hypothesis 3 (H3). *Perceived behavioral control has a positive relationship with consumers' intention to adopt a sustainable EV.*

3.2. Norm Factors

3.2.1. Peer Pressure

Peer pressure is the ability of a friend or subordinate to convince an individual to act. Taylor and Todd [32] split referent groups into two: peers and superiors. The expectations of each group often differ. In the context of adopting a new system, the critical referent groups are peers, friends, subordinates, and colleagues. For this study, we focused on peer influence. In the context of purchasing EV, peer influence is the degree to which a person perceives that a peer or colleague shares information regarding the benefits of adopting EV [33] with him/her. Because they experience regular opportunities to exchange information, peers, specifically those closest to a user, such as friends, colleagues, or family members, often influence others [29]. With the emergence of social media, this exchange of information has become much easier and quicker, making this characteristic even more evident. Literature exploring peer influence has given rise to product consciousness amongst people from all age groups and classes [28,29], which directly or indirectly impact users' adoption intention. It is usually noticed that consumers tend to purchase a product along the same lines as their peer groups [28–30]. Masur et al. [34] explored that peer influence positively affected users' subjective norm of information sharing. Thus, we can also consider that peer influence towards using an environmentally-friendly car positively relates to consumers' subjective norm of pro-environmental consumption. Therefore, the following hypothesis is proposed:

Hypothesis 4 (H4). *Peer influence has a positive effect on a consumer's subjective norm of adopting a sustainable EV.*

3.2.2. Mass Media Influence

Liu et al. [35] defined mass media as the influence or pressure from the mass media to perform the behavior. In other words, mass media is defined as the perception of how the mass media will affect any individual's use of a particular system. According to Ajzen's [10] findings, mass media is considered the antecedent of subjective norms. Mass media influences the IT usage of the end-users. According to Pedrosa et al. [36], mass media

plays a vital role in determining individuals' behavior positively and negatively. Numerous studies have concluded that mass media influence has a positive and significant effect on subjective norms [33–35]. Mass media channels are more effective in disseminating information related to innovations, which are more effective in forming and changing norms toward a new idea and influencing the decision to adopt or reject a new concept [37]. In any society, the individual influences other members to use services and augment acceptance [38]. Thus, the following hypothesis is proposed:

Hypothesis 5 (H5). *Mass media influence positively affects a consumer's subjective norm of adopting a sustainable EV*.

3.3. Attitudinal Factors

3.3.1. Maintenance and Battery Replacement Cost

A key barrier to the high uptake of an electric car is uncertainty about the cost of the battery [19]. Additionally, Egbue and Long [21] also indicated that, even though electric vehicles' environmental benefits and sustainability factors have a key influence on electric vehicle adoption, they are still ranked low in factors such as battery replacement costs.

Tu and Yang [34] indicated that battery price influences consumers' attitude and behavioral intention when choosing an EV. A study by Zeng et al. [39] stated that battery replacement price is a conclusive factor determining vehicle acceptance. This is also verified by Dasharathraj et al. [40], who found that battery price is one of the main concerns leading to attitude and behavioral control of EVs. Zeng et al. [39] also indicated the higher price of electric vehicles is mainly due to the expensive battery pack, which is always a key factor for consumers. When planning to adopt a new vehicle, battery replacement costs directly influence consumers' adoption attitude and behavioral control and are still a significant issue in terms of EV adoption [35–37]. According to the study by Taljegard et al. [41], battery costs have been reduced by four times since 2008, and the battery range of EVs has increased tremendously. However, battery cost still exceptionally influences consumers' attitude, which leads to their positive intention to consume green EV. As a result, the following hypotheses are proposed:

Hypothesis 6 (H6). *Maintenance and battery replacement costs negatively influence consumers' attitude toward adopting a sustainable EV*.

Hypothesis 7 (H7). *Maintenance and battery replacement costs negatively influence consumers' perceived behavioral control of adopting a sustainable EV*.

3.3.2. Availability of Charging Facility

Charging difficulty, including long charging time and insufficient charging infrastructures, potentially negatively influenced adopting intention [42,43]. Jiang et al. [44] suggested that swappable batteries might be used to improve the consumer's intention, considering the drastic decline in overall charging time that would result. Asensio et al. [45] explored the effect of charging at the workplace; the number of charging stations and the location of charging stations was very significant. Adhikari et al. [42] and Amin et al. [43] found that consumer demands for charging stations in the public domain, such as supermarkets, parks, and restaurants, are trivial, and they are keener to charge EVs at home. Charging facilities in both public and domestic areas intensify consumers' adoption intention.

Additionally, they found that charging mode also influences consumers' charging habits. Asensio et al. [45] found that charging facilities impact consumers' adoption intention and impact consumers' attitude and perceived behavioral control. Adhikari et al. [42] explored charging facilities as the basis for promoting the development of electric vehicles, as it directly influences consumers' attitude. Thus, we also consider that the charging infrastructure of green vehicles positively relates to consumers' attitudinal consumption. As a result of this, the following hypotheses are proposed:

Hypothesis 8 (H8). *Charging infrastructure has a positive relationship with the attitude of the consumer's intention to adopt a sustainable EV*.

Hypothesis 9 (H9). *Charging infrastructure positively correlates with perceived behavioral control of the consumer's intention to adopt a sustainable EV*.

3.3.3. Purchasing EV Price

Previous studies found the high up-front purchasing cost, as compared with conventional fuel vehicles (CFVs) of a comparable configuration, as an obstacle to adopting EV [46,47]. In contrast, the lower operative costs reinforce EV adoption [39]. Barth et al. [47] asserted that consumers that lack basic knowledge are prone to evaluate the tangible prices of CFVs along with the reimbursement time of EV. Adepetu and Keshav [46] explored that the information concerning traditional CFV ownership, cost, and driving compared to EV prices was projected to be a critical feature influencing consumers' intention and attitude.

Dumortier et al. [48] pointed out that consumers assess the current expenditure more than the long-term savings of EVs. Danielis et al. [49] found that even though the energy preservation of EV can save substantial money, only consumers with long driving ranges can extensively profit from it. Though the benefits of EVs regarding price may appeal to some consumers, these advantages are not evident in the short term. Thus, we also consider that price perception towards using eco-innovations negatively relates to consumers' consumption attitudes. Therefore, the following hypotheses are proposed:

Hypothesis 10 (H10). *Purchasing price has a negative relationship with the attitude of the consumer's intention to adopt a sustainable EV*.

Hypothesis 11 (H11). *Purchasing price negatively correlates with perceived behavioral control of the consumer's intention to adopt a sustainable EV*.

3.4. Behavioral Factors

3.4.1. Vehicle Performance

Technological advancements will continue to improve performance, safety, and range for EVs, however, consumer considerations of these characteristics remain important for researchers and practitioners to comprehend. Several empirical studies have found that vehicle performance is significant, in addition to environmental and social factors [19,43]. Ozaki and Sevastyanova [50] studied 1263 Toyota Prius owners and discovered that the influence of environmental factors was smaller than that of performance. Egbue and Long [21] found that EVs' performance, such as safety, reliability, and range, has been reported as a barrier to adoption in studies of potential buyers' intentions to adopt EVs. Egbue and Long [21] also pointed out that even though the environmental benefits and sustainability factors of electric vehicles have a crucial effect on electric vehicle adoption, these are still ranked behind factors such as vehicle performance. According to the study of Jiang et al. [44], performance criteria of BEV, such as acceleration, safety, and less noise were evaluated as positive factors and influenced consumers' attitude, based on consumers from the UK who tried BEVs for a trial period. Carley et al. [51] examined the factors inducing the behavior of 2302 early EV purchasers in the 21 largest urban areas in the USA. Their findings indicated that the early adopters were sensitive to environmental factors, but safety, reliability, purchase cost, and driving range were the foremost influential factors. Tu and Yang [38] found that key factors influencing consumers' intention to purchase EVs were vehicle performance and convenience. Zeng et al. [39] found that performance attributes are vital factors influencing consumers' intention to adopt EV. Taljegard et al. [41] suggested vehicle performance influenced individuals' behavioral intention through attitude and belief. Based on the above discussion, we propose the following hypotheses:

Hypothesis 12 (H12). *Vehicle performance has a positive relationship with the attitude of the consumer's intention to adopt a sustainable EV.*

Hypothesis 13 (H13). *Vehicle performance positively correlates with perceived behavioral control of the consumer's intention to adopt a sustainable EV.*

3.4.2. Government Incentives Policy

Governments worldwide emphasize financial incentives to persuade consumers that EVs are environmentally friendly and cost-effective to increase EV adoption. The principal financial incentive used by governments is tax incentives on the buying of an EV. Xue et al. [52] explored that financial incentives are positive and statistically significant in influencing 30 countries' 2012 EV adoption rates. Previous studies indicated that, although financial incentives provided by governments or manufacturers certainly affect consumers' behavioral intention, that influences their intention to adopt EV [53,54]. Government incentives are the antecedent variables of perceived behavioral control, as the government plays a crucial role in promoting the automobile market. In the context of 'the same rights of purchase,' the automobile market will inevitably experience issues, such as rising product rates and disruptions to the status quo of enrolment in a prestigious market, which may result in additional incremental costs [52]. Profit-driven makers often transfer other costs to consumers [53]. Consumers' enthusiasm for buying a new EV will diminish in the absence of financial compensation. Therefore, government incentives such as economic subsidies, tax incentives, preferential loan policies, and increased EV facilities supply are principally significant in developing consumers' perceived behavioral control and encouraging young and millennial consumers to buy an EV through effective subsidies [52,54]. Whitehead et al. [55] found a significant relationship between government incentives and the PBC regarding the purchase of HEVs. Thus, we can also consider that government incentives towards using a green car positively relates to consumers' perceived behavioral control. As a result of this, the following hypothesis is proposed:

Hypothesis 14 (H14). *Government incentive positively correlates with perceived behavioral control of the consumer's intention to adopt a sustainable EV.*

3.5. Environmental Concern

Environmental concern is an overall consideration and consciousness toward environmental problems [20]. Environmental concern is a key determinant and helps change individuals' current behavior to a more environmentally friendly one [15,17]. However, environmental concern does not directly impact specific environmentally-friendly behavior, but rather indirectly affects it [12,16,17]. Hartmann et al. [26] studied a meta-analysis to test the association between environmental concern and environmentally-friendly behavior. They found that the average correlation coefficient of environmental concern and environmentally-friendly behavior was between 0.23 and 0.35. Findings recommended that environmental concern did not impact consumers' behavior and confirmed the supposition of Landrigan [27]. Lai et al. [25] suggested environmental concern influenced an individual's behavioral intention through norms, attitudes, and beliefs. To be specific, environmental concern is a direct and indirect determinant of behavioral intention and a frontal factor of the features of the extended TPB model. We consider consumers' attitude, subjective norm, and perceived behavioral control to adopt EVs positively affected by their environmental concern. Based on the above discussion, we propose the following hypotheses:

Hypothesis 15 (H15). *Environmental concern is positively related to the subjective norm toward adopting a sustainable EV.*

Hypothesis 16 (H16). *Environmental concern is positively related to the attitude toward adopting a sustainable EV.*

Hypothesis 17 (H17). *Environmental concern is positively related to the perceived behavioral control toward adopting a sustainable EV.*

Hypothesis 18 (H18). *Environmental concern is positively related to the intention toward adopting a sustainable EV. Figure 1 presents the research model used in the current study.*

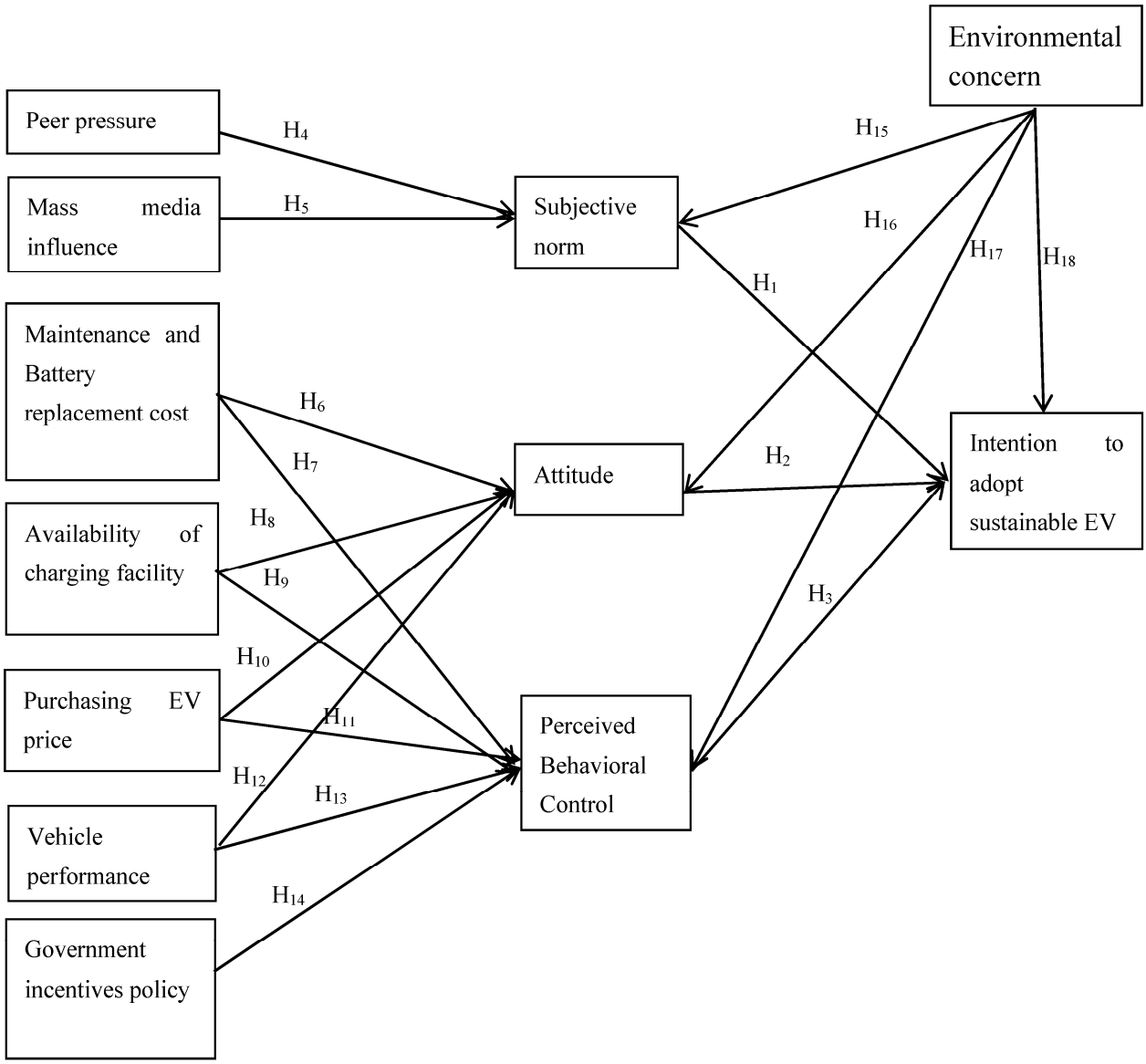


Figure 1. Conceptual Research Model for the current study.

4. Materials and Methods

4.1. Questionnaire Design and Data Collection

An initial list of measurement items was predominantly fostered after going through the literature concerning EVs, TPB, environmental concerns, government incentives, and charging facilities. The instrument castoffs for the current study consist of three segments. The intention of the study was provided in the initial section called the cover page. Respondents' demographic information (age, gender, experience, and education level) were included in the second section. The final segment contained indicators concerning TPB,

antecedent variables, and environmental concern (38 items). The items were also reformed to enrich the reliability and validity. All the items were verified on a five-point Likert scale, ranging from 1 for strongly disagree to 5 for strongly agree.

Both a pretest and a pilot study were performed to validate the instrument. The pre-test incorporated four experts, one professor of information management (IM), and three IM and business studies researchers. Respondents were urged to look at the suitability of items, the format, and the phrasing of the scales. The pilot study incorporated twenty-five respondents self-drafted from the study respondents. Depending on the respondents' answers to the pre-test and pilot study, certain items were revised to present the study's intention more clearly and shown in Appendix A (Table A1). The reliability of each item was suitable (Cronbach's alpha is higher than 0.80), and the loading of items in the confirmatory factor analysis (CFA) is more than 0.70. Thus, the study instrument has advocated reliability and content validity. Appendix B (Table A2) exhibits the outcome of the pilot study.

4.2. Research Setting

The objective population of the present study was Taiwanese. We applied convenience sampling methodology as the survey tool because it is economical and it is likely to attain an assorted sample that would meticulously keep on demonstrating demographic classifications of individuals [56]. All participants were provided the consensus form and information piece, evidently defining the present study's intention. Respondents were also informed about their privileges to withdraw commitment at any time during the research. Furthermore, we offered a concise narrative of how the EV works to our participants for two reasons. First, to overcome any lack of consideration about EV because of its continuous technological transformation, and second, to shape a coherent opinion about the prospective exercises of EV.

4.3. Data Analysis

Data analysis was performed on the two-step method advocated by Anderson and Gerbing [57]. First, analyze the measurement model's convergent and discriminant validity, and then explore study hypotheses and structural model. Structural equation modeling (SEM) was employed for statistical investigation for two reasons. First, SEM is a multivariate method that permits the concurrent assessment of multiple equations [58]. Second, SEM performs factor and regression analysis in a solitary step. All constructs were exhibited as reflective for the model test. The current study employed Smart-PLS 2.0 for statistical determinations.

5. Results

5.1. Demographic Data

The current study collected 274 responses, however, 12 responses were considered ineffective due to missing values. Thus, 262 valid responses were used for the final analysis. Respondents' demographic values are shown in Table 1, indicating that respondents differ in age, gender, and educational level.

5.2. Instrument Reliability Test

Reliability analysis was verified to quantify the model's internal consistency using Cronbach's alpha and composite reliability (CR). Cronbach's alpha was calculated using the formula:

$$\alpha = \frac{N\bar{c}}{\bar{v} + (N-1).\bar{c}} \quad (1)$$

where, N = the number of items; $\bar{c}$ = average covariance between item-pairs; $\bar{v}$ = average variance.

Table 1. Demographics of survey respondents.

Item	Option	Frequency	Percentage (%)
Gender	Male	138	52.81
	Female	124	47.19
Age	20–25	22	8.32
	26–30	53	20.07
	31–35	62	23.73
	36–40	67	25.42
	41–45	22	8.47
	46–50	11	4.24
	51–55	8	3.24
	56–60	13	4.81
	61 or above	4	1.70
Educational Qualification	Less than High School	1	0.49
	High School degree	10	3.88
	Bachelor	137	52.43
	Associate degree	13	4.85
	Master	52	19.90
	Doctoral degree	31	11.65
	Other	18	6.80

Composite reliability was calculated using the formula:

$$\frac{\left(\sum_{i=1}^{p} \lambda i\right)^2}{\left(\sum_{i=1}^{p} \lambda i\right)^2 + \sum_{i}^{p} V\left(\delta\right)} \quad (2)$$

where, λi = completely standardized loading for the ith indicator; $V(\delta i)$ = variance of the error term for the ith indicator; and p = number of indicators.

According to Hair et al. [58], Cronbach's alpha and composite reliability value of the latent factor 0.7 or above 0.7 indicates good reliability. Table 2 shows that Cronbach's alpha of each construct ranged from 0.905 to 0.986, above the value of 0.7 recommended by Hair et al. [58]. The composite reliability of each construct ranged from 0.936 to 0.991, above the value of each construct 0.7, also recommended by Hair et al. [58]. Thus, this indicates complete reliability.

Table 2. The measurement quality evaluation.

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
ATT	0.967	0.976	0.911
BAC	0.905	0.936	0.829
CH	0.920	0.950	0.865
EC	0.959	0.970	0.891
GI	0.972	0.981	0.947
INT	0.969	0.977	0.915
MM	0.986	0.991	0.974
PBC	0.978	0.985	0.958
PR	0.947	0.974	0.950
Peer pressure (PPR)	0.923	0.951	0.867
SN	0.922	0.951	0.866
VEP	0.950	0.968	0.911

5.3. Convergent Validity

Convergent validity of the instrument is explored by measuring two standards proposed by Bagozzi and Yi [59]: (1) Composite reliability should be more than 0.7; and (2) Average variance extracted (AVE) of each construct should exceed the variance due to

the measurement error of that construct (i.e., AVE should exceed 0.50). From Table 2, the composite reliability of each construct ranged from 0.936 to 0.991, which is beyond the suggested value of 0.7, and AVE values ranged from 0.866 to 0.974, therefore meeting both conditions for convergent validity. Thus, it indicates comprehensive convergent validity.

5.4. Discriminant Validity

Discriminant validity provides evidence of whether the constructs in the model are highly correlated among them or not. Fornell and Larcker [60] suggested the square root of the AVE of each construct should be greater than the assessed correlation shared between the construct and other constructs in the model to validate discriminant validity. (Table 3) shows that the square root of AVE for each construct was above the correlation values of the construct, thus sustaining the specification of discriminant validity.

Table 3. Correlation of measurement items.

	ATT	BAC	FI	EC	INT	IT	PBC	PI	PP	RA	SE	SN
ATT	0.954											
BAC	−0.01	0.910										
CH	0.446	−0.10	0.930									
EC	0.479	−0.08	0.667	0.943								
GI	0.902	−0.08	0.530	0.461	0.973							
INT	0.502	−0.07	0.484	0.741	0.473	0.956						
MM	0.468	−0.08	0.815	0.600	0.543	0.563	0.986					
PBC	0.463	−0.13	0.827	0.598	0.541	0.583	0.927	0.978				
PR	0.451	−0.11	0.860	0.797	0.532	0.538	0.819	0.806	0.974			
PPR	0.002	0.886	−0.12	−0.10	−0.08	−0.06	−0.07	−0.13	−0.13	0.931		
SN	0.477	−0.15	0.811	0.679	0.559	0.692	0.862	0.894	0.878	−0.15	0.930	
VEP	0.442	0.188	0.819	0.705	0.521	0.609	0.846	0.906	0.876	−0.17	0.918	0.954

5.5. Tests of the Structural Model

The summary of the hypotheses' tests is presented in Table 4. The results provide support for the thirteen proposed relationships (i.e., H1, H2, H3, H4, H5, H8, H9, H13, H14, H15, H16, H17, and H18) while the remaining five relationships (i.e., H6, H7, H10, H11, and H12) are not significant at the 0.05 level of significance. Tests of significance for all the paths are performed employing the bootstrap resampling procedure.

Table 4. Result of hypotheses testing.

Hypothesis	Proposed Hypothesis Relationship	Path Coefficients	t-Statistics	Hypothesis Test Results
H1	SN → INT	0.475	4.172	Supported
H2	ATT → INT	0.139	2.462	Supported
H3	PBC → INT	−0.182	2.332	Supported
H4	PPR → SN	−0.077	2.727	Supported
H5	MM → SN	0.709	18.488	Supported
H6	BAC → ATT	0.048	0.823	Rejected
H7	BAC → PBC	0.034	1.360	Rejected
H8	CH → ATT	0.209	2.263	Supported
H9	CH → PBC	0.290	5.933	Supported
H10	PR → ATT	−0.122	0.697	Rejected
H11	PR → PBC	−0.058	0.724	Rejected
H12	VEP → ATT	0.151	1.097	Rejected
H13	VEP → PBC	0.779	14.159	Supported
H14	GI → PBC	0.075	2.008	Supported
H15	EC → SN	0.246	6.143	Supported
H16	EC → ATT	0.334	2.598	Supported
H17	EC → PBC	−0.131	5.821	Supported
H18	EC → INT	0.461	5.427	Supported

Figure 2 displays each path's standardized path coefficients, path significances, and variance explained (R^2). R-squared is determined, as it indicates a goodness-of-fit measure for linear regression models and measures the strength of the relationship between the model and the dependent variable. The variance (R-square scores) from the PLS output is as follows: attitude 0.264; subjective norm 0.792; perceived behavioral control 0.858; intention to adopt a sustainable EV 0.635 Figure 2.

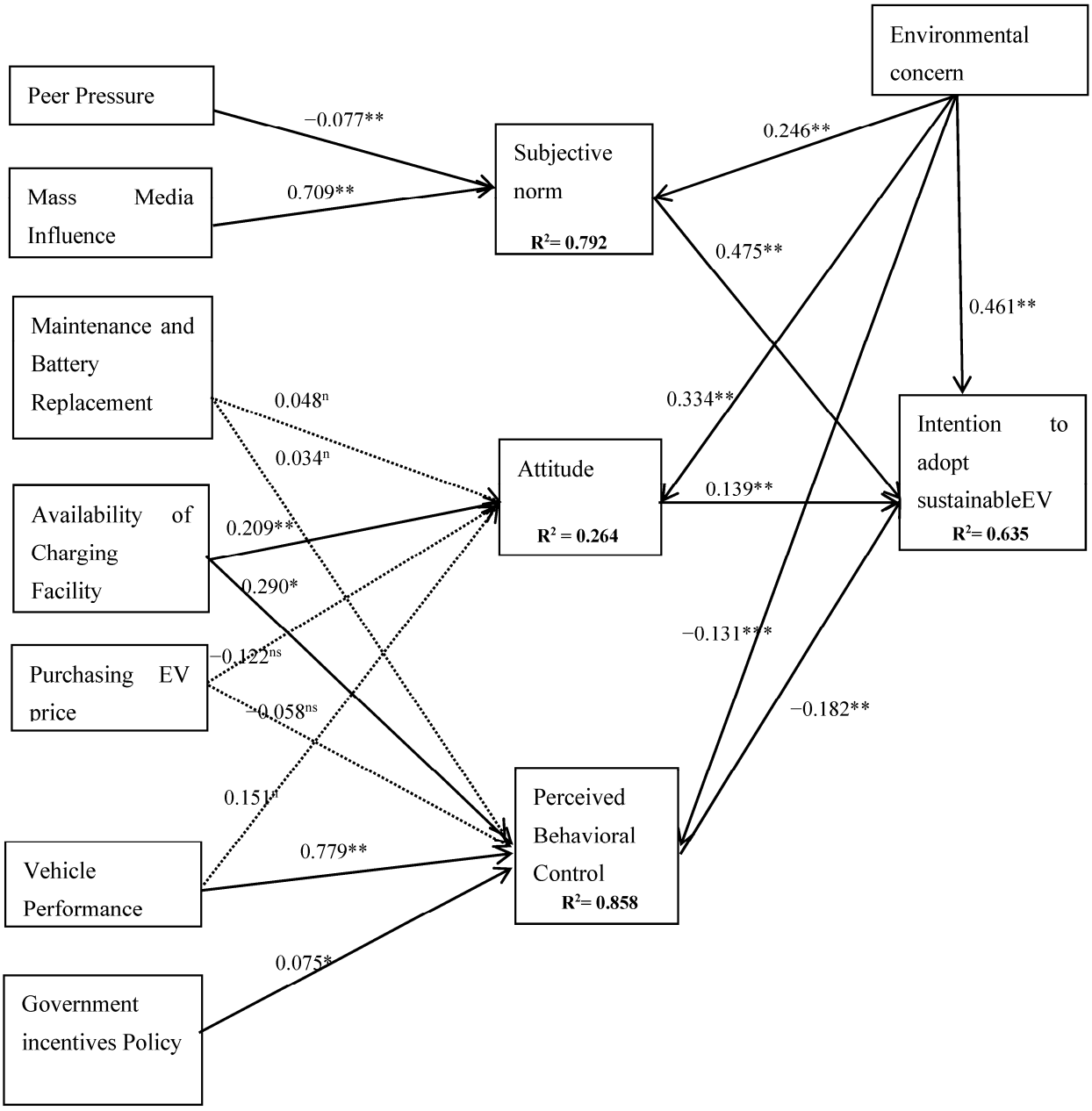


Figure 2. Path analysis result. * Significant at $p < 0.05$ * level, $p < 0.01$ **, $p < 0.001$ ***, ns not significant at $p < 0.05$ level.

5.6. Model Comparison

To provide validation of the inclusion of antecedent variables, we compare the variance (R-square scores) of the dependent variable of the proposed model with the original TPB (Theory of planned behavior). Figure 3 displays each path's standardized path coefficients, path significances, and variance explained (R^2). The variance (R-square scores) from the PLS output are as follows: intention to adopt a sustainable EV 0.536. Thus, we can conclude the proposed model comprehensively explores the aim of the present study. Additionally,

the inclusion of antecedent variables supports achieving the study's purpose better than the original TPB, as the variance (R-square scores) from the PLS output of the planned model (R^2 = 0.635) is higher than TPB (R^2 = 0.536) Figure 3.

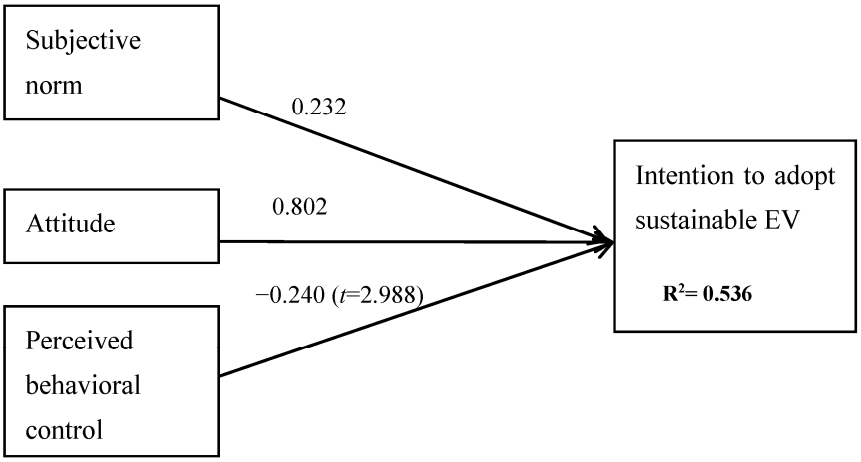


Figure 3. Path analysis results of Theory of Planned Behavior.

To test the credibility of the results, data investigation was executed on the two-step methodologies proposed by Anderson and Gerbing [57]. Afterward, we conducted the reliability investigation to evaluate the model's internal consistency by Cronbach's alpha and composite reliability (CR). Values of Cronbach's alpha and composite reliability of each variable are within the range proposed by Hair et al. [58], specifying suitable reliability as well as the credibility of the study results.

Next, we used convergent validity to explore the degree to which the study constructs are theoretically related, using composite reliability and average variance extracted (AVE). Values of composite reliability and AVE of each variable are within the range proposed by Bagozzi and Yi [59], which states appropriate convergent validity and credibility of the study findings. Next, discriminant validity was conducted to determine whether the constructs in the proposed model are interrelated among them or not using the square root of AVE for each construct, which denotes apposite discriminant validity. Finally, structural equation modeling (SEM) was conducted to test the proposed hypotheses at the 0.05 significance level and compare them.

6. Discussion

Summary of Findings

The current study's findings explored how subjective norm, attitude, and perceived behavioral control positively influence consumers' intentions to adopt EV. These findings are consistent with previous findings [13,15]. Subjective norm is essential to the growth and development of positive intention that encourages consumers to self-regulate EV adoption. Consumers attempt to conform to the expectations of others under social pressure. If consumers perceive a positive attitude toward adopting EV, their intentions of adopting EV also improve. Thus, a positive attitude should be considered an active contributing factor where EV adoption is concerned. Promotion of consumer adoption of sustainable EV requires skills, opportunities, and resources related to finding and collecting precise information and preferential policies such as providing a certain degree of subsidies and tax benefits to consumers. Thus, easily available resources could boost consumers' perception of control by improving their skill levels. The subjective norm is the most dominant factor of behavioral intention, followed by attitude and perceived behavioral control from the effect sizes. Perceived behavioral control accounted for the least variance among three factors, possibly because information about the benefits of electric vehicles, such as low or no gasoline consumption, reducing environmental pollution, etc., is still not directly influencing consumers' intentions to adopt EV.

Respondents of the current study perceive that mass media provides valuable information regarding the new product. The effect of mass media on EV adoption could be eclipsed by the more goal-oriented effects of public administration information and interpersonal influences. The internet and mass media help policymakers improve consumers' usage intention, as younger generations are the most tech savvy users and consider mass media as one of the most important sources of information. Thus, policymakers must create the right kind of advertisements and publicity policies to reach the tech-savvy generation. Similarly, previous literature shows the significant effect of mass media on adopting new services [36].

Individuals also give importance to other opinions that are near and dear to them. Generally, the peer is important to teach individuals essential rational aspects of consumption, in which several dimensions are employed to compare and evaluate brands, with a predominance of perceived over functional characteristics. Previous studies provided evidence that peer influence has a positive and significant effect on the subjective norm in new product adoption [34,35]. Potential consumers seem greatly motivated by the opinions of earlier adopters or people they are accustomed to; this inspiration combines informative and normative characteristics. Thus, policymakers and vendors should take affirmative actions by encouraging celebrities and other popular faces to share their experiences of using EV that improve individuals' norm towards EV adoption, which can directly or indirectly influence consumers' behavioral intention.

We hypothesized that maintenance and battery replacement costs negatively influenced consumers' attitude and perceived behavioral control. While both the relationships were positive in the regression model, they did not significantly predict EV adoption's likelihood. These findings contradict previous results that indicated battery replacement costs were the significant key restriction in EV adoption [38]. The EV consumers in the current study agreed that environmentally-friendly vehicles such as EV are more expensive than traditional ICE vehicles. At the same time, the lower operative costs reinforced their intention to adopt EV [37]. Ullah et al. [61] found that the battery life of an EV is generally 4 to 12 years. Thus, EV owners would be charged fees for replacing the battery at a minimum of every four years. The current finding indicates that a satisfactorily significant percentage of consumers were comfortable with the battery replacement cost of environmental-friendly vehicles. Nevertheless, regular sales promotion pricing does influence consumers to determine whether the appropriate value is attained from purchasing an environmentally friendly vehicle.

The availability of a charging facility is a significant factor in eliminating consumers' concerns regarding the range of EVs. During the last few years, the Taiwanese government had different plans to encourage people to adopt EVs. With the support of positive government planning, several charging stations were successfully installed in prime locations, which indicates that the government addressed consumers' key concerns and range of use anxiety. Additionally, the Taiwan government has clearly defined its planning regarding installing additional charging stations with the increasing demand for EV. By 2023, more than 3300 charging and replacement stations will be installed to meet the demand for charging nationwide [62]. Additionally, EV manufacturers came out with positive plans to install charging stations in public areas and private locations such as household charging facilities. It is believed that these steps improve consumers' attitude and behavioral control.

We hypothesized that EVs' generally higher purchasing price influences consumers' attitude and perceived behavioral control negatively. These findings are in line with the literature, as Barth et al. [47] found that upfront purchase price is a deciding factor that influences consumers' attitude. Currently, EV prices still lay well above the price levels of similar internal combustion engine ICE cars. However, the price of EV is dropping every year. If EV's price moves closer to price levels of comparable ICE cars, then it is expected to improve both consumers' attitude and behavioral control. A purchasing price which impacts consumers' decisions towards purchasing a vehicle must also be considered within a comprehensive valuation of ownership costs, comprising gasoline, preservation,

devaluation costs, and resale value. Thus, we can consider that EV still shares a small niche of the market and is still in the early stages of adoption.

The current study's finding shows that vehicle performance, such as safety, reliability, and range, influence Taiwanese consumers' perceived behavioral control. It suggests that vehicle performance is a crucial concern influencing Taiwanese consumers' behavioral management regarding purchasing consideration. Taiwan consumers generally are more concerned about safety, reliability, and driving range when making a purchase decision of an environmentally-friendly EV. The current study concludes that vehicle performance, especially driving range and safety, are key determining factors, which coincides with previous studies [18,44].

The current study's finding in terms of the relationship between vehicle performance and attitude is not consistent with previous research findings, due to several reasons. With the development and regeneration of electric vehicles' technology, EV performance such as safety, reliability, and range has increased and is not more similar to that of internal combustion engine vehicles (ICEV). Thus, Taiwanese consumers are not overly concerned about EV performance, such as driving range. Secondly, when consumers purchase EV, the essential purpose is to use them for daily life. The current driving range is generally more than 300 miles, which is acceptable for short-distance driving. Most of the time, consumers who live or drive in a city are not too much worried about the present driving range and charging facilities for the daily drive. Generally, better public transportation methods, such as high-speed railways, help individuals to go far, quickly. Thus, the concerns of driving range and charging facilities are not significant concern for consumers. However, additional investigation is required to develop a comprehensive conclusion regarding the insignificant relationship, as characteristics such as driving range, charging time, safety, and reliability concerns are limited to validate vehicle performance. Additionally, this indicates that the product's effectiveness is not very significant in inspiring consumers' attitude to adopt EV, but certainly influences their behavioral control.

Government incentives policies have a positive influence on perceived behavioral control. The findings state that the government's policy plays a crucial role in directing consumers' intention towards adopting EV. This finding coincides with the conclusion of previous studies [52,53] that show that the government's incentive policies considerably influenced EV purchasing intention. However, current incentives policies mainly focus on lowering the cost of EV, which is undoubtedly essential, but the government should develop a variety of financial policies that promote sustainable development in the automobile market. Through the government's incentive policies, consumers can receive additional financial benefits, significantly inspire their behavioral control, and indirectly influence their willingness to adopt EV. Thus, the government should develop a variety of financial policies to encourage consumers to adopt EVs. These incentives should aim to develop sustainable development in the automobile market.

The current study's findings demonstrate that Taiwanese consumers' environmental concern positively affects their attitude, subjective norm, perceived behavioral control, and willingness to buy an environmentally-friendly product, such as EV consumption.

The current study's findings showed that environmental concern has a positive and considerable influence on consumers' attitude. If consumers have further ecological concerns, they are more eager to buy the product, which is good for the environment. In other words, green product consumers have an environmental concern that positively affects their attitude. The consumer's environmental concern shapes the consumer's thinking process to express their attitude toward the environment.

Findings of the current study reveal that social and reference groups, especially peers and other individuals with proximity to consumers, influence consumers' green purchase decision-making process. If consumers feel more pressure from significant others to purchase green apparel, they may become more engaged in purchasing green apparel products [34]. Therefore, the pressure from reference groups such as families or close

friends could have altered consumers' purchase intention in favor of environmentally-friendly EV.

An individual with better behavioral control is more interested in buying an environmentally-friendly product such as EV than those with lower behavioral control. Ajzen [9] stated that PBC only provides a precise prediction of behavior while individuals have accurate perceptions of control over a given behavior. Therefore, consumers who have better behavioral control are better at assessing their true control over behavior. Subsequently, their control expression is likely better associated with true control, either because they meet a smaller number of barriers or can overwhelm such barriers. For this reason, environmental concern is a critical determinant that cannot be overlooked. Even if consumers have less environmental concern, there are few leftovers to conduct green consumption.

The findings of the current study contribute to theory and practice in several aspects. First, an individual's pro-environmental behavior is primarily believed to be driven by self-interest or pro-social motives. Based on the assessment related to pro-social intentions for theorizing pro-environmental behavior, a conceptual framework was tested in the eco-friendly EV usage context in the current study. The proposed framework effectively employs the perspective of environmentally-friendly EV use and provides empirical evidence of the usefulness of the extended model in explaining pro-environmental decisions or behavior. Second, information circulated through mass media communication sources (e.g., internet, social media, TV) directly impacts consumers' norms to purchase new environmentally-friendly EV. Since mass media has become a part of daily life and millennial individuals spent more time on social media, their attitude is more favorable toward information acquisition. This suggests that mass media communication has plenty of potential in forming the positive attitude of Taiwanese consumers concerning novel, environmentally-friendly EVs. Mass media can transmit information rapidly and help maximize the penetration and effectiveness of new environmentally friendly messages. Thus, the government can consider it a tool to educate individuals about environmental problems and possible environmentally-friendly actions that could further save the environment. Furthermore, automobile companies should pay more attention to developing their brands on mass media and instituting their relationships with individual users and potential consumers. They can remain in contact with their consumers to meet their expectations and impact their purchase decisions. Third, peers tend to influence the intention to purchase specific goods to fit into particular peer groups. Since potential consumers generally follow a trend, it is not surprising that they are more likely to get reviews about EV from their family members, friends, colleagues, etc. Thus, automobile companies should include a referral to peers to gain a discount or enter a contest through mass media to increase purchase intention. This will improve communication between peer networks and possibly improve possible consumers' environmentally-friendly behavior. Fourth, the government's financial incentives policy plays a crucial role in the diffusion of EVs at the market development phase. Financial support such as tax exemptions and subsidies has significantly reduced the liability of buying EVs and nurtured EV market growth in many countries. With government support for the public, it is also essential to consider positioning strategies that target main groups and customize financial support to improve government support's efficiency. Fifth, Taiwanese consumers cope comparatively well with the limiting factors during EV purchasing, since PBC is one of the most important predictors of an automotive purchase's behavioral intention among TPB constructs. This finding emphasizes that availability improves consumers' decisions toward purchasing EV. If EV is easily accessible to consumers, then he/she would have more intention to choose it. Consequently, choosing from among EV options becomes a key issue when more than one automobile company offers products for consumers. Thus, the government's communication and incentive programs might be indispensable to encourage companies to invest more in EV research.

7. Limitations and Future Research

Notwithstanding its perceptive conclusions, the current study suffers some limitations that must be addressed. First, we employed a convenient sampling method to accumulate data from Taiwan. Therefore, the simplification of the current study outcomes is significantly restricted. To endorse the recent study outcomes, a forthcoming study must incorporate a comprehensive sampling range and possibly compare the current study's findings with the findings from different geographic locations. Second, even though the competency of the proposed model in assuming intent was found acceptable, its inclusiveness can be further developed by incorporating additional predictors (such as the anticipated feeling of guilt and anticipated sense of pride) that are crucial in pro-social or pro-environmental intentions. Thus, future research might incorporate such positive and negative forms expected of effect in the current theoretical model to improve the model's inclusiveness.

8. Conclusions

The current study examines critical factors influencing consumers' intention to buy EV through an integrated model derived from classical theory TPB with attitudinal–norm–behavioral factors, maintenance and battery replacement cost, availability of charging facility, purchasing EV price, mass media influence, peer pressure, and government incentive. Additionally, we explore the direct effect of environmental concern's contributions, both academically and in practice. SEM analysis validated that the model provided significant insights for perception, interpretation, and anticipation and offered adequate explanatory power to predict consumers' intentions to buy EV and provide a new direction for researchers to consider in subsequent research. Mainly, the constructs rooted in the expanded planned behavior theory accounted for around 63.5% of the variance in intention to buy environmentally responsible EV. This value is more significant than TPB (53.6%). The current study primarily identifies all three factors, attitude, subjective norm, and perceived behavioral control, as positively influencing consumers' intention to purchase EV. Results show both peer pressure and mass media influence have a positive relationship with consumers' subjective norm. Vehicle performance and government incentives policy positively influence consumers' perceived behavioral control, but vehicle performance negatively influences consumers' attitude. Availability of a charging facility positively influences consumers' attitude and perceived behavioral control, but both purchasing price and maintenance and battery replacement cost negatively influence consumers' attitude and perceived behavioral control. Additionally, environmental concern directly influences consumers' attitude, subjective norm, perceived behavioral control, and intention to adopt EV.

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Appendix A

Table A1. Measurement items used for the current study.

Dimension	Coding	Item	Source
Attitude	ATT1	I think electric vehicle would be beneficial to the environment in the long term (Kaplan et al., 2016)	Afroz et al., 2015a; Barbarossa et al., 2015; Kaplan et al., 2016
	ATT2	Electric vehicle can decrease the use of petroleum (Afroz et al., 2015a)	
	ATT3	I would feel satisfied about myself if I buy an environmental-friendly electric vehicle (Afroz et al., 2015).	
	ATT4	I like the idea to own an environmentally-friendly electric vehicle (Barbarossa et al., 2015)	
Subjective norm	SN1	Most people who are important to me think I should adopt an electric vehicle when adopting a vehicle in the near future (Wang et al., 2016).	Wang et al., 2016; Han, 2015; Afroz et al., 2015a
	SN2	If I buy an electric vehicle, then most people who are important to me would also buy an electric vehicle (Wang et al., 2016).	
	SN3	Most people who are important to me would want that I use an environmentally-friendly electric vehicle instead of an internal combustion engine vehicle (Han, 2015).	
Perceived behavioral control	PBC2	The price of an electric vehicle is important to me and I can afford it when I decide to adopt it (Wang et al., 2016)	Han, 2015; Wang et al., 2016; Eneizan 2019
	PBC3	The maintenance and repair of an electric vehicle is important to me when I decide to adopt it (Wang et al., 2016)	
	PBC4	I can find where to buy an electric vehicle if I wanted to (Eneizan 2019)	
Intention to adopt a sustainable EV	INT1	I have the intention to drive an electric vehicle in the near future (Moons et al., 2015).	Afroz et al., 2015a; Moons et al., 2015; Barbarossa et al., 2015
	INT2	Next time I buy a vehicle, I will consider buying an environmentally-friendly electric vehicle (Barbarossa et al., 2015)	
	INT3	I will recommend the use of the electric vehicle to other people (Moons et al., 2015).	
	INT4	I would buy an electric vehicle if the quality is lower than a conventional vehicle (Afroz et al., 2015a).	
Peer pressure	PR1	My friend's experience influences me that I should buy an electric vehicle (Zahid and Din 2019).	Jorgensen 2015; Zahid and Din 2019
	PR2	Before I buy an electric vehicle, I gather information from my friends (Zahid and Din 2019).	
	PR3	I spend a lot of time talking with my friends and parents about products and brands regarding electric vehicle (Jorgensen 2015).	
Mass media influence	MM1	The mass media suggest that I should use electric vehicle.	Zahid and Din 2019
	MM2	The mass media urge me to use an electric vehicle.	
	MM3	Mass media is full of reports, articles, TV, radio, newspapers and internet suggest that I should use an electric vehicle.	
Maintenance and Battery replacement cost	BAC1	The maintenance cost of an electric vehicle is lesser than conventional internal combustion engine vehicle (Kim et al., 2018)	Hagman et al., 2016; Kim et al., 2018; Junquera et al., 2016
	BAC2	The cost of battery pack of an electric vehicle is higher than the drivetrain of internal combustion engine vehicles (Hagman et al., 2016).	
	BAC3	Electric vehicles have high costs to replace a battery (Kim et al., 2018).	

Table A1. *Cont.*

Dimension	Coding	Item	Source
Availability of charging facility	CF1	I prefer charging facility at my working place (Jensen et al., 2013).	Jensen et al., 2013; She et al., 2017
	CF2	I prefer charging facility at home (She et al., 2017).	
	CF3	I prefer charging facility on highway (She et al., 2017).	
Purchasing EV price	PR1	The purchasing price of an electric vehicle is higher than conventional internal combustion engine vehicle (Hagman et al., 2016)	Kim et al., 2018; Hagman et al., 2016
	PR2	I compare the purchasing price of electric vehicle and internal combustion engine vehicle to make sure that I get the best value for the money I spend (Kim et al., 2018)	
Vehicle performance	VEP1	The range of electric vehicle is reliable (Kim et al., 2018).	Kim et al., 2018; Egbue and Long (2012)
	VEP2	Electric vehicle satisfies the individual's expectation of driving range (Kim et al., 2018).	
	VEP3	Electric vehicle satisfies the individual's expectation of top speed (Kim et al., 2018).	
Government incentives policy	GIP1	I believe that government's incentive policy such as tax incentives on buying electric vehicle increases my intention.	Taylor and Todd 1995
	GIP2	I believe that government's incentive policy such as direct grants to consumers on buying electric vehicle increases my intention.	
	GIP3	I believe that government's financial incentive policy of buying electric vehicle increases my intention.	
Environmental concern	EC2	I am concerned about environmental problems (Lai et al., 2015).	Lai et al., 2015; Kim et al., 2018; Wang et al., 2016
	EC3	I think people should change their behavior to reduce climate change and protect the environment (Kim et al., 2018)	
	EC4	I think climate change is a threat to me and my family (Kim et al., 2018).	
	EC5	I think environmental problems are becoming more and more serious in recent years (Wang et al., 2016)	

Appendix B

Table A2. Results of confirmatory factor analysis and reliability analysis.

Constructs	Items	Standardized Cronbach's α
Attitude	ATT1	0.913
	ATT2	
	ATT3	
	ATT4	
Subjective norm	SN1	0.881
	SN2	
	SN3	
Perceived behavioral control	PBC2	0.874
	PBC3	
	PBC4	
Intention to adopt a sustainable EV	INT1	0.865
	INT2	
	INT3	
	INT4	

Table A2. *Cont.*

Constructs	Items	Standardized Cronbach's α
Peer pressure	PPR1	0.852
	PPR2	
	PPR3	
Mass media influence	MM1	0.841
	MM2	
	MM3	
Maintenance and Battery replacement cost	BAC1	0.871
	BAC2	
	BAC3	
Availability of charging facility	CH1	0.891
	CH2	
	CH3	
Purchasing EV price	PR1	0.881
	PR2	
Vehicle performance	VEP1	0.861
	VEP2	
	VEP3	
Government incentives policy	GI1	0.851
	GI2	
	GI3	
Environmental concern	EC2	0.812
	EC3	
	EC4	
	EC5	

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