

**FACTORS IMPACTING CONSUMER INTENTION TO  
PURCHASE ELECTRIC VEHICLES IN THE BANGKOK**

**MOHAMMADREZA KHALEGHIYARAZIZ**

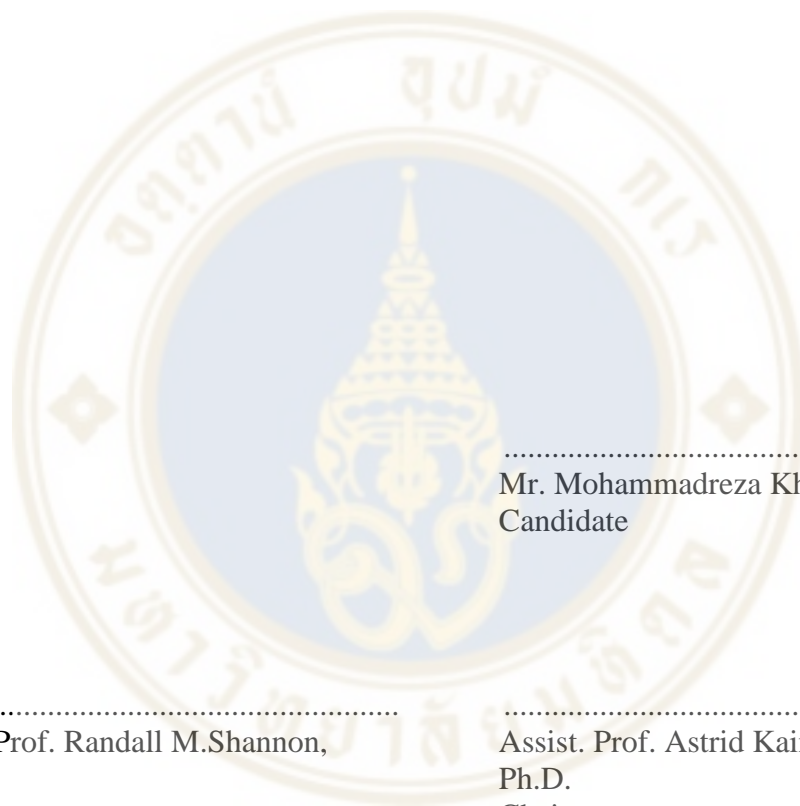


**A THEMATIC PAPER SUBMITTED IN PARTIAL  
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Mohammadreza Khaleghiyaraziz

## **FACTORS IMPACTING CONSUMER INTENTION TO PURCHASE ELECTRIC VEHICLES IN THE BANGKOK**

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### **ABSTRACT**

This study aims to investigate the determinants that influence individuals' intention to purchase electric vehicles (EVs), through the development of a research model based on the Theory of Planned Behavior, integrated with performance factors, environmental factors, financial factors, infrastructure factors and intention to buy electric vehicles (EVs) in Bangkok. Data were collected from 125 car users across Bangkok metropolitan city. The findings in this research reveal that only performance factors (e.g., battery life, driving range, charging time, new technology) and financial cost fear (resale market, operating and maintenance cost) have significant relation to Bangkokian intention to purchase electric vehicles. Whilst not being concerned much with the environmental factors and the financial factors (incentive policies) of electrical vehicles.

**KEY WORDS:** intentions to purchase/ electric vehicles/ financial cost fear/ performance factors/ Bangkok.

34 pages

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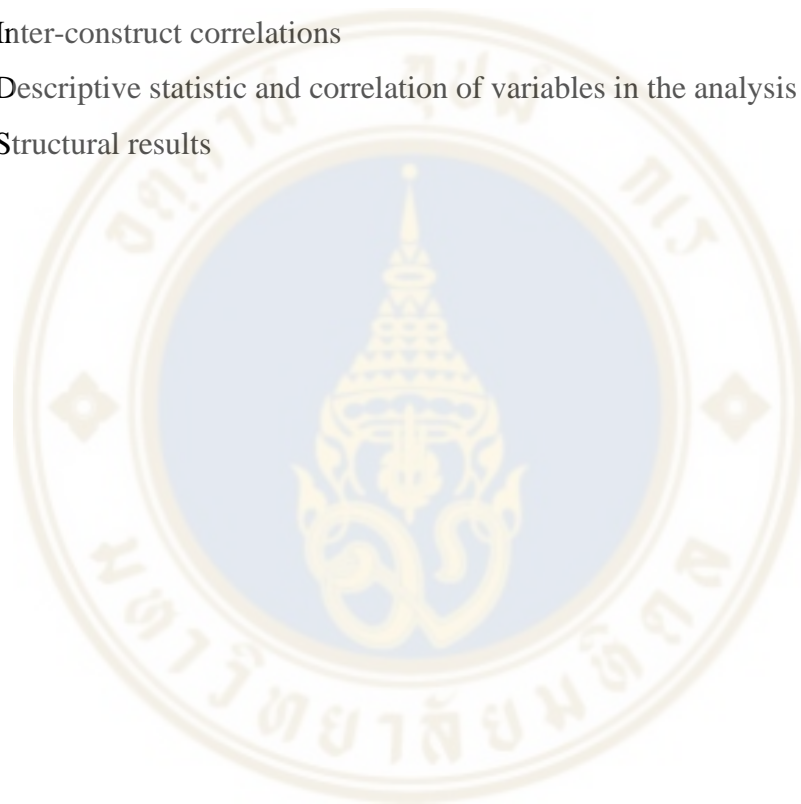
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## **CHAPTER I**

### **INTRODUCTION**

The issue of environmental degradation has gained much importance in recent years, because of ongoing and out of control emissions of dangerous atmosphere pollutants through a variety of human activities. Fossil fuel consumption by the industries as well as the transport system is considered the main reason. Different studies have paid considerable attention to the pollution caused by the vehicles, while it has been widely analysed because of its serious environmental outcomes. The global increase in the ownership of individual vehicles has been accompanied with considerable energy consumption, contributing to the production of more greenhouse gases (Ma, Fan et al. 2019) and leading to serious problems regarding energy security and environmental conservation (Huang and Ge 2019). Statistics of the International Energy Agency indicates, an estimated number of one million vehicles are recently used worldwide, with a daily consumption of around 60 million barrels a day (about 70 % of the total oil production); next to 36 million barrels of daily oil consumption is associated with private vehicles, guiding to emission of 14 million tons of carbon dioxide (Sang and Bekhet 2015). Consequently, the replacement of conventional vehicles with renewable energy vehicles may be considered as a promising solution (Tu and Yang 2019). In this regard, electric vehicles (EVs) are expected to reduce the negative effects on the environment and help to conserve the rare non-renewable fuel reserves across the whole cycle of life (Liu, Ouyang et al. 2019). EVs are considered as effective alternatives to maintain urban transportation through the reduction of oil dependence and subsequent air pollution, leading to significant health as well as environmental advantages (Wu, Liao et al. 2019). Past studies have indicated that EVs can lead to a 30e50 % reduction of carbon dioxide emission and 40e60 % increase in fuel efficiency in comparison with conventional vehicles which are dependent on fuels (Liu, Ouyang et al. 2019).

Deployment of EVs has been the centre of attention by setting targets and applying policies, making it attainable for the EVs to become a vital component of the



future vehicles (Buekers, Van Holderbeke et al. 2014). Currently, there has been an increase in the registration of EVs around the world from 6000 in 2010 to 750,000 in 2016, and the plug-in passenger vehicles stock are estimated to reach 150 million by 2030 (Cazzola, Gorner et al. 2016).

Promoting EVs will help achieve the carbon reduction targets of the Paris Agreement while effectively reducing urban air and noise pollution (IEA, 2017). Several countries are strongly promoting the production and adoption of EVs. As the world's largest consumer market for EVs, China's results in promoting EVs are particularly outstanding. By the end of June 2018, China's EV ownership ranked first in the world reaching 1.99 million units (MOPS, 2018) (Ma, Fan et al. 2019).

Thailand is the eleventh largest car manufacturing country in the world and is a centre for pick-up truck and small car production for both domestic and global markets (Organisation Internationale des Constructeurs automobiles, 2019). However, the steady increase in car usage in Thailand has resulted in problems such as traffic jam in major cities (e.g., the Bangkok, Chiang Mai, and Phuket). The rapid growth of cars not only increases Thailand's reliance on imported oil, but also poses a serious problem from air pollution caused by car fumes and carbon emissions (Thananusak, Rakthin et al. 2017).

The interest in EVs in Thailand has greatly increased following the modification in policy direction of the Thai government. In 2015, the Thai government regulate a new national economic strategy, Thailand 4.0, which aimed to develop a new economic growth engine for Thailand via innovative industries. One of the targeted industries was the EVs industry. The government created a 20-year EV roadmap and national energy policy (2016–2036) and set the target that Thailand should have 1.2 million EVs by 2036. The goal was to foster the EV industry and become the hub of EV production in the ASEAN region as well as reducing energy intensity by 30% by 2036. Moreover, in 2017, the Thailand Board of Investment issued new incentives to attract investment in EVs and boost EV demand in the country. For instance, there will be 0% tariff on both EV machinery and completely-built-unit imported EVs in order that car companies can test the market demand before setting up a large-scale manufacturing facility. The companies investing in EVs will receive corporate tax exemptions of up to

10 years. The excise tax for EVs is also reduced to lower the purchase price for car buyers (Thananusak, Rakthin et al. 2017).

Despite the establishment of these EV policies and incentives, the Thai EV adoption target seems overly ambitious. At the end of 2016, the number of EVs in Thailand reached only 0.19% of the total number of vehicles (70,000 EVs out of 37.3 million cars that were registered with the Department of Land Transportation (Thailand Development Research Institute, 2016). This EV number reflects the global trend where EV represents around 1% of the current number of used vehicles (International Energy Agency, 2017). Although past research has shown that many factors (e.g., performance, costs of ownership, infrastructure of EVs) could affect customers' intentions to adopt EVs, different settings and various customers' perceptions on EVs in each country are found to differentially affect their adoption (Chanaron and Teske 2007, Egbue and Long 2012). Thus, the study of the factors affecting EV adoption in Thailand could potentially shed light on another angle of EV adoption (Thananusak, Rakthin et al. 2017).

A research results in Bangkok state the factors that will affect the consumer to purchasing electric vehicle such as product appearance, the quality of material, notable of brand, price, worthiness, service centre, marketing promotion, after sale service, research and development, quality of battery, complexity, charger station, and risk of battery, consumer behaviour, and government support policy. Additionally, demographic and lifestyle factors that affecting the decision to purchasing electric vehicle (Dolcharumanee 2019).

Results of another study in Spain state that, most of the papers are focussed on the operations or the impact on the grid, while only a few papers address the design of EV charging stations (Domínguez-Navarro, Dufo-López et al. 2019).

one of the most important problems in EV development is the shortage of charging infrastructure. Drivers can charge their EVs at home, but the charge time is quite long. To promote the EV development, it is necessary to install fast-charging station in which the EV battery can be charged in about 15 minutes. By contrast, the disadvantage of fast charging is the high-power demand and its impact on the grid. In order to address this, renewable sources and storage systems can be installed in these stations (Domínguez-Navarro, Dufo-López et al. 2019).

Results of a study in Malaysia state that, electrified vehicles are still in the early stage of adoption, and technology acceptance is not as notable as represented in other developed countries such as the United States and Europe. The infrastructures and facilities of these electrified vehicles are still not entirely developed to be easily accessible in different areas within the country. The access towards charging infrastructures and facilities is still limited to certain metropolitan areas. Commercial-wise, battery electric vehicles (BEVs) are available in limited numbers, and their prices are well beyond the reach of the mass consumers in the country.

How to make consumers pay attention to, accept, purchase, and use EVs is an important topic for governments and manufacturers. To address this topic, it is necessary to study consumer preferences for EVs, which includes identifying the various factors that influence consumers' choices of EVs. The research discusses the background of the principal subject of the research: factors impacting consumer intention to purchase electric vehicle (EV) in the Bangkok's population, Thailand. Most of existing studies have found the factors such as environmental factors, incentives policies from government, performance factors, infrastructure, financial performance, and lifestyle factors.

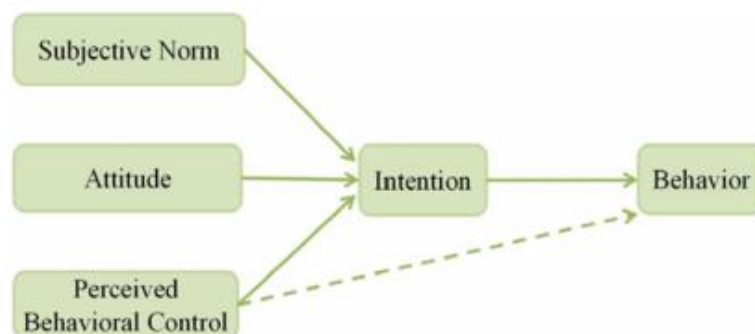
In this paper, a research model based on the Theory of Planned Behaviour (Subjective norms, attitude, and perceived behavioural control), which is integrated with performance, environmental, financial and infrastructure factors was applied to examine the factors impacting consumer intention to purchase electric vehicles in the Bangkok. this research needs to be developed further in future due to limitations of time, budget, and scope of sampling of Bangkokian, eventually need to state that this information is useful for academic usage however may it be useful for the government to formulate corresponding public policies to promote EV promotion, and manufactures can determine the direction of their production and investment to promote EV sales.

## CHAPTER II

### 2. LITERATURE REVIEW & FRAMEWORK DEVELOPMENT

#### 2.1 Theoretical study

Social psychology studies have shown that intention is a good indicator for predicting individual behaviour because it includes all the relevant factors that may affect an individual's actual behaviour (Ajzen 1991). The TPB has strong explanatory power for individual intention and behaviour. The TPB is the successor to the theory of reasoned action (TRA). The TRA suggests that attitude and subjective norms are the driving factors affecting behavioural intention (Fishbein and Ajzen, 1975). Behavioural intention is a direct psychological determinant of actual behaviour. Attitude is an individual's overall evaluation of participating in a specific behaviour, and the subjective norm is the perception of social pressure from significant referents. However behavioural intention and behaviour do not depend entirely on attitude and subjective norms. For example, when a consumer wants to buy an EV, the actual purchase behaviour depends not only on the consumer's attitude towards the purchasing behaviour of EVs and the influence of important people around him but also on the degree of ease or difficulty perceived by the consumer regarding the behaviours of purchasing EVs. Therefore, to improve the interpretive power of the TRA, Ajzen (1985) introduced the perceived behavioural control variable. In the TPB, attitude, subjective norms, and perceived behavioural control can directly influence behavioural intentions and indirectly affect behaviours through behavioural intentions (Fig. 1). Because of its strong explanatory power, the TPB has been widely adopted to investigate environmentally friendly intention and behaviour, such as pollution reduction intentions, household energy-saving intention and behaviour, green product purchase intentions; and environmental protection intention and behaviour (Huang and Ge 2019).



**Fig.1** The framework of TBP.

The process of EVs adoption may involve evaluations and perspectives, both in positive and negative views of adopting the environment-friendly behaviour, whether to adopt or decline. Result of a study indicated that attitude exhibits a significant influence towards environment-friendly cars (Schmalfuß, Mühl et al. 2017). In contrast, the authors of other studies found that the pricing factor of vehicles, which are categorized as expensive or affordable price, leads to the withdrawal or positive attitude towards purchasing the vehicles (Schmalfuß, Mühl et al. 2017, Thananusak, Rakthin et al. 2017). Hence, the divergence of the influence of attitude towards behavioural intention to purchase hybrid cars, as mentioned previously, leads to further investigation to be carried out concerning that matter.

In the context of the intention to purchase EVs, perceived behavioural control deals with whether the individuals are perceived as capable of purchasing EVs, specifically their financial capacity, as well as the availability of other external resources (e.g., government tax exemption and purchasing rebate). The authors of (Schmalfuß, Mühl et al. 2017) clarify that the influence of perceived behavioural control towards behavioural intention may be less significant if people have negative perspectives about EVs, such as certain features of EVs that may fall below their expectation or preference.

## **2.2 Performance factors**

Result of study indicated that for deployment of EVs, the preferences that are looked at by car users are important and may determine their attitude towards the behaviour (Tanwir and Hamzah 2020). One of the key performance factors of EVs is the driving range (She, Sun et al. 2017). Technology enthusiasts tend to adopt new technology when they see a higher performance of EVs compared with conventional vehicles. From various surveys, customers tend to be most concerned with the longest range that EVs can drive on one charge EV car buyers are also concerned with charging time (Thananusak, Rakthin et al. 2017, Dolcharumanee 2019, Huang and Ge 2019, Ma, Fan et al. 2019, Tu and Yang 2019). To fully charge an EV battery at home, car owners normally need an overnight charge. Research has suggested that customers are willing to pay more for extra features, increased functionality of EVs and convenience. Thus, the long charging time presents another performance factor to EV purchase. Related to the issue of range, EV customers may experience range anxiety and may not feel safe when they need to drive EVs for a long distance away from the charging facilities (Thananusak, Rakthin et al. 2017, Dolcharumanee 2019, Huang and Ge 2019). In summary, performance factors related to the EV purchase lie in the driving range, charging time, and safety and reliability concerns. Without direct experience of EVs, car buyers may be uncertain about the performance, stability, and safety of EVs (Jensen, Cherchi et al. 2013, Heyvaert, Coosemans et al. 2015).

## **2.3 Environmental factors**

Past studies have shown that the environmental concerns of car buyers have a positive effect on the intention to buy EVs (Jensen, Cherchi et al. 2013, Heyvaert, Coosemans et al. 2015). Literature in past study in Thailand found that the environmental concern is significantly correlated with the intention to buy EVs (Thananusak, Rakthin et al. 2017). Another study result in Malaysia indicates that environmental knowledge plays a vital role in influencing individuals' intention to purchase a hybrid car (Tanwir and Hamzah 2020). In many studies, environmental concerns are assessed as an indicator to influence people's behavioural intention in the context of pro-environmental studies (Suki 2016, Mohiuddin, Al Mamun et al. 2018).

## 2.4 Financial factors

One of the major obstacles contributing to the consumers' withdrawal from purchasing EVs is their high prices (Lin and Wu 2018). Other literature indicate that the purchase price has a significant association with EVs adoption (Barth, Jugert et al. 2016). However, at another literature result finds that Thai consumers are willing to pay a price-premium for EVs (Thananusak, Rakthin et al. 2017).

The cost of EV ownership also is another financial factor that car buyers consider. Since EVs are not widely adopted and not many people have experienced them, people may not be able to correctly calculate the cost of ownership (e.g., operating and maintenance costs). Apart from the purchase price, cost of ownership, and resale price, the perceived trend of oil prices as well as the relatively cheap and improved fuel efficiency of conventional vehicles also affect the financial factors of EVs. Past research suggests that the expectation is that oil prices would rise and the future fuel savings from buying EVs could motivate customers to adopt EVs. Moreover, companies have made their cars more energy efficient (e.g., Ford Ecoboost engine; Mazda Sky Active Technology; Honda Earth Dream Technology). Thus, the difference from the expected fuel savings between EVs and conventional vehicles has become lower and, in turn, makes EV adoption a lesser priority for car buyers (Rezvani, Jansson et al. 2015).

Another related issue financial factor is incentive policy. Incentive policy measures are important factors that influence consumers' purchase intention. To promote the development of EVs, many countries have introduced incentive policy measures for EVs. Studies have shown that the main policies that have a positive impact on consumers' EV purchase intention include purchase subsidies, parking fee reductions, related tax incentives and driving privileges (Hackbarth and Madlener 2013, Helveston, Liu et al. 2015, Sang and Bekhet 2015). Study result in china show that Monetary and Non-monetary incentive policy measures have a significant positive effect on EV purchase intention (Huang and Ge 2019).

Another conducted research on the influence of incentives on the adoption and sale of EVs, indicating the positive influence of them on the consumers' decision toward EVs adoption (Lin and Wu 2018).

## 2.5 Infrastructure factors

The infrastructure factor of EV adoption includes the number of charging infrastructure points and charging conditions. At present, there are still limited public charging facilities and charging stations compared with gas stations for conventional vehicles. Several studies have confirmed that the unavailability of enough charging infrastructure is a major constraint for EV diffusion (Sierzchula, Bakker et al. 2014, Chen, Liu et al. 2017, Berkeley, Jarvis et al. 2018). Result of literature in Taiwan indicate that consumers believe that the number of charging piles for electric vehicles will affect their purchase intention (Tu and Yang 2019). Unlike EV enthusiasts, conventional car users tend to focus more on the convenience factor (i.e., the availability of EV charging stations within their living or working areas and on the highways) (Lane and Potter 2007, Nayum, Klöckner et al. 2016). Thus, governments are recommended to provide and support the charging infrastructure to promote private adoption of EVs (Delang and Cheng 2013, Lim, Mak et al. 2015). In other research confirmed about the stronger consumers' purchase intention because of availability of Product attribute like charging infrastructure, the stronger consumers' purchase intention (Huang and Ge 2019).

Unlike other research, result of a study show that the infrastructure is not significantly related to the intention to buy EVs in Thailand (Thananusak, Rakthin et al. 2017).

## 2.6 Research model and hypotheses

According to (Rejikumar 2016), a research hypothesis can be defined as a “logically conjectured relationship between two or more variables expressed in the form of a testable statement”. Therefore, in this study, seven variables were developed to be tested based on the literature of previous studies. Figure 1 illustrates the conceptual model proposed for this study, which was developed based on the underpinning of the Theory of Planned Behaviour by, with an additional variable. The hypotheses of this study are shown below:

In this paper, a research model based on the Theory of Planned Behaviour (Subjective norms, attitude, and perceived behavioural control), which is integrated with



performance, environmental, financial and infrastructure factors was applied to examine the factors impacting consumer intention to purchase electric vehicles in the Bangkok. Fig 2 illustrates the conceptual model proposed for this study, which was developed based on the underpinning of the Theory of Planned Behaviour by (Ajzen 1991), with an additional variable from past studies (Thananusak, Rakthin et al. 2017, He, Zhan et al. 2018, Huang and Ge 2019, Tu and Yang 2019, Tanwir and Hamzah 2020, Asadi, Nilashi et al. 2021).

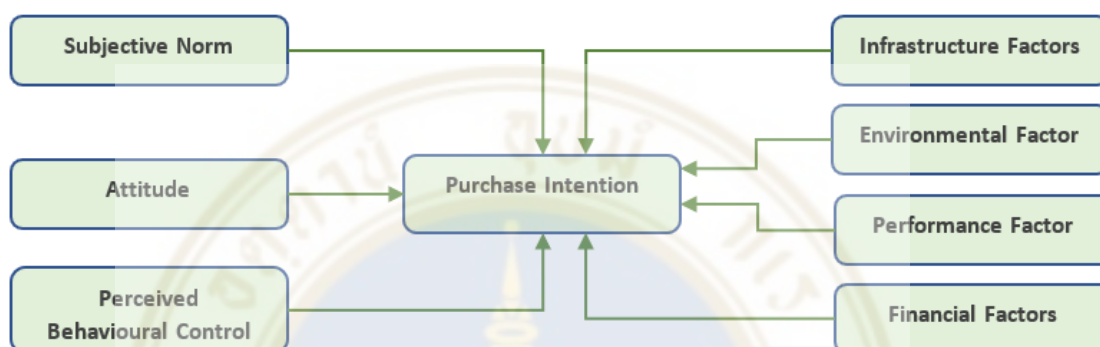


Fig 2. Research framework.

## **CHAPTER III**

### **3. METHODOLOGY**

#### **3.1 Sample and data collection**

Consistent with the previous studies examining consumers' intention to buy EVs, an online survey provides the data for this study. To test a proposed model framework, the questionnaire was developed and distributed randomly via a web-based survey.

The respondents are Thai and foreigners' adults who live in Bangkok. The respondents own a conventional vehicle or owned in past, or who are currently own an EV or considering purchasing an EV in future.

The screening conditions are in two level and examine people who living in Bangkok and have been owned or own a car. Totally collected 125 valid responses out of the 190 received.

#### **3.2 Respondent profiles**

The demographics of the respondents were as follows: 50.4% male and 49.6% female. Respondents were within the following age groups: 20–30 (34.4%), 31–40 (40%), 41–50 (18.4%) and over 50 years old (7.2%). Of the respondents, 26.4% identified as public company employees, 47.2% private company employees, 21.6% business owners and 4.8% students. 54.4% of the respondents held master's degrees or higher, 37.6% Bachelor's degree and 8% college graduated. The respondent's monthly income ranged as follows: less than 10,000-20,000 Baht, 8%, 20,001–40,000 Baht, 24%, 40,001–60,000 Baht, 30.4%, 60,001–80,000 Baht, 13.6%, 80,001–100,000 Baht, 8%, and more than 100,000 Baht, 16%. Details of demographic characteristics of respondents are presented in Table 1.

### 3.3 Measures

In general, most of the key variables in this study are using linear scales (5 scales). The item rating of measures was 5 = ‘Strongly Agree’ and 1 = ‘Strongly Disagree’.

**Table 1** Demographic distribution of participant (N=125)

<i>Variables</i>	<i>Percentage (%)</i>
<b>Gender</b>	
Male	50.4
Female	49.6
<b>Age range</b>	
20-30 years old	34.4
31-40 years old	40.0
41-50 years old	18.8
Over 50 years old	7.2
<b>Highest education level</b>	
College	8.0
Bachelor’s degree	37.6
Master’s degree or higher	54.4
<b>Present Occupation</b>	
Employee of public company	26.4
Employee of private company	47.2
Business owner	21.6
Student	4.8
<b>Personal income per month</b>	
10,000-20,000 Baht	8.0
20,001-40,000 Baht	24
40,001-60,000 Baht	30.4
60,001-80,000 Baht	13.6
80,001-100,000 Baht	8.0
More than 100,000 Baht	16.0

## CHAPTER IV

### 4. FINDING / RESULTS

#### 4.1 Results of the Principal Component Analysis

Principal component analysis is carried out by the dimension reduction technique to assess any removable items, to ensure that the factors are really measuring and explaining the variables. For further details, the popular rotation technique is used, which is the varimax rotation technique. The rotation method selected is superior to other rotation methods in achieving a simplified factor structure. The sufficient factor loading value for interpretative purposes must be greater than 0.4. All items are retained as there are no issues with eigenvalue, commonalities value, cross factor loadings, and factor loading values. Ultimately 4 constructs recognised successfully and named based on relevant items at each group. Details of components are presented at table 2.

**Table 2 Rotated component matrix.**

Rotated Component Matrix <sup>a</sup>					
Constructs	Items	Component			
		1	2	3	4
Incentive policies	I will purchase electric vehicle due its Preferential insurance policy.	.881			
	I will purchase electric vehicle due its Parking fee reduction policy in city.	.840			
	I will purchase electric vehicle due its Tax exemption policy.	.732			
	I will purchase Electric Vehicle due to its Purchase Subsidy.	.665			
Performance	I find the Battery life is important to me.		.838		
	I find the Driving range is important to me.		.778		
	I find the Charging time is important to me.		.750		
	I find the New technology adoption in Electric vehicles caused higher performance to compare with conventional vehicles.		.536		

Financial cost fear	I do not want to buy Electric vehicles because of its high operating cost.			.924	
	I do not want to buy Electric vehicles because of its high maintenance cost.			.913	
	I do not want to buy Electric vehicles because its resale market in future in unpredictable.			.695	
Environment	I will buy electric cars if it helps to preserve the environment.				.875
	I would buy Electric vehicle when I aware its positively impact on our ecosystems.				.862

#### 4.2 Common Method Variance—Harman’s Single Factor Test

This study was based on a self-administered questionnaire, so it is vulnerable to the possibility of common method bias or variance (CMV). Common method bias is a potential problem in behavioural research. The authors of underlined that the presence of common method bias in a study can be assessed through Harman’s single factor test (Podsakoff, MacKenzie et al. 2012). Based on the results, it can be inferred that the data set of this study although does support CMV as the variance explained by the single factor is less than 50%.

**Table 3** Total variance explained

Component	Initial Eigenvalue			Extraction Sums of Squared Loading		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.874	46.847	46.847	1.874	46.847	46.874
2	1.004	25.088	71.935			
3	.633	15.822	87.757			
4	.490	12.243	100.000			

Extraction method: Principal Component Analysis

### 4.3 Correlation analysis and normality

Table 4 represents the correlation matrix consisting of the Pearson correlations, which indicate the inter-correlation among the variables studied. We have no missing data in this data set, all correlations were based on all 125 cases in the data set. As shown in the table 4, all the study variables are significantly correlated with intention to purchase. These results additionally indicate that environment has correlation with performance. Performance has the strongest correlations with the intention to purchase EVs ( $r = 0.411$ ,  $p < 0.01$ ), followed by environment ( $r = 0.391$ ,  $p < 0.01$ ). Furthermore, the skewness and kurtosis values are within the acceptable range of  $-3$  to  $+3$  each, indicating that the data of the study are normally distributed, and the normality assumptions of the study are sufficiently met conversely performance Kurtosis values is over acceptable range which characterizes a non-normally distributed data. The means, as shown in the table, show that the respondents show a positive tendency towards the intention to purchase EVs.

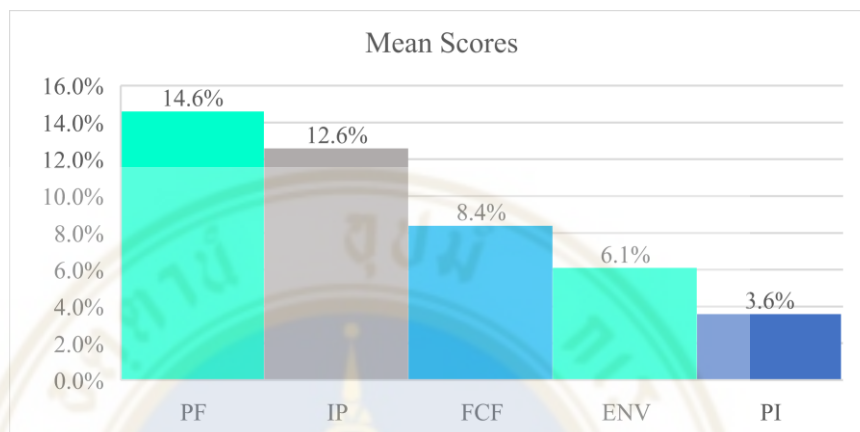
**Table 4** Inter-construct correlations

		<b>IP</b>	<b>PF</b>	<b>FCF</b>	<b>EN</b>
<b>IP</b>	Pearson correlation	1			
	Sig.(2Tailed)				
	N	125			
<b>PF</b>	Pearson correlation	.411**	1		
	Sig.(2Tailed)	.000			
	N	125	125		
<b>FCF</b>	Pearson correlation	.332**	.153	1	
	Sig.(2Tailed)	.000	.089		
	N	125	125	125	
<b>EN</b>	Pearson correlation	.391**	.352**	.019	1
	Sig.(2Tailed)	.000	.000	.836	
	N	125	125	125	125
<b>Mean</b>		12.5660	14.5660	8.3520	6.1040
<b>Standard deviation</b>		2.98318	2.07232	2.65397	1.39743
<b>Skewness</b>		-.990	-2.211	-.677	-1.143
<b>Kurtosis</b>		.977	6.963	-.359	1.308

**Note:** \*\*. Correlation is significant at the 0.01 level (2-tailed)

#### 4.4 Compare means analysis

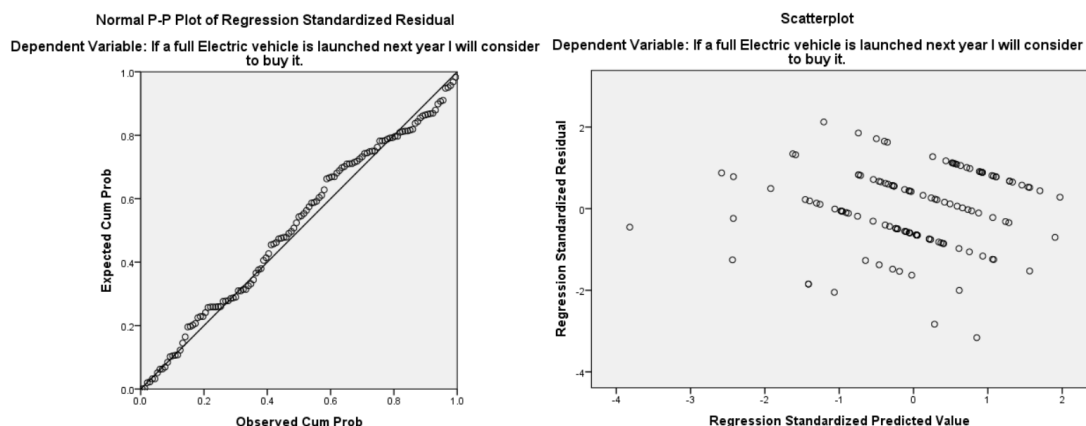
The mean score analysis of variables are as follows, 14.6 % performance (PF), 12.6 % incentive policies (IP), 8.4 % financial cost fear (FCF), 6.1 % environment (ENV) and 3.6 % purchase intention (PI) presented at Fig. 3.



**Fig 3.** Mean score analysis.

#### 4.5 Regression analysis

Multiple regression analysis was used in order to test the proposed hypotheses of the study, as it allows the examination of the influence of the predictors on the dependent variable. The variance inflation factor (VIF) values of all of the variables are below the value of 10 (from 1.142 to 1.348), and the tolerance values of each variable are more than 0.10, indicating that there is no problem of multicollinearity for this study. Fig 4 reported the normal P–P and residuals' scatter plots, indicating that the normality, linearity, and homoscedasticity assumptions are met (Hair, Black et al. 2013).



**Fig 4.** Normal P–P plot and scatter plot.

From the regression analysis in Table 5 and 6, the results reported that 22.2 percent of the variance of the intention to purchase EV is explained by Environment, Financial cost fear, performance, and incentive policies. The analysis shows that financial cost fear ( $\beta = -0.025$ ,  $p < 0.05$ ) and performance ( $\beta = 0.064$ ,  $p < 0.05$ ) significantly influenced the intention to purchase EVs. Hence, H4 and H8 are supported. Meanwhile, incentive policies ( $\beta = 0.203$ ) and Environment ( $\beta = 0.322$ ) have an insignificant influence on the intention to purchase EVs. Therefore, H5 and H7 are rejected. Based on the regression analysis, financial cost fear is the most notable influence towards the intention to purchase EVs for Bangkokians. The overall results of the hypotheses testing are reported in Table 6.

**Table 5** Descriptive statistic and correlation of variables in the analysis (N=125)

	<i>Mean</i>	<i>SD</i>	<i>PI</i>	<i>IP</i>	<i>PF</i>	<i>FCF</i>	<i>ENV</i>
PI	3.61	1.099	1.000				
IP	12.566	2.983	.347	1.000			
PF	14.566	2.073	.257	.411	1.000		
FCF	8.3520	2.654	.058	.322	.153	1.000	
ENV	6.1040	1.397	.423	.391	.352	.019	1.000



**Table 6 Structural results**

Hypothesis	Path	INTEN	Result
H1	PF → INT	0.484*	Supported
H5	ENV → INT	0.001*	Not supported
H7	IP → INT	0.039*	Not supported
H8	FCF → INT	0.770*	Supported
	Construct R <sup>2</sup>	0.222	

\*Note: Significant levels: \*p < 0.05.



## CHAPTER V

### 5. CONCLUSION AND SCOPE FOR FUTURE RESEARCH

This research goal was to examine the factors that affect the intention to purchase electrical vehicles in Bangkok. Past research stated that subjective norms, attitude, perceived behavioural control, financial factors, infrastructure, performance of electric vehicles, environmental concerns influenced intention to adopt electric vehicles. However, findings in this research reveal that only performance factors and financial cost fear have significant relation to Bangkokian intention to purchase electric vehicles. In terms of performance factor interestingly results of past study in Thailand indicate that performance factors determine the intention to buy electric vehicle (Thananusak, Rakthin et al. 2017). Thus, to promote EVs to the Bangkok market, car manufacturers and government agencies supporting EV adoption should utilize of performance factors as a key factor. It is necessary to highlight in which performance areas EVs outperform conventional cars to educate car buyers and, in turn, stimulate EV demand. Therefore, implementing right strategies in this case would be highly effective to most people in Bangkok for understanding of the performance difference between EVs and conventional vehicles. Audience may not be sure about EVs reliability of battery life, driving range for a single charge. The public may not be sure about how safely EVs could be used in their driving journey. Ultimately higher attention regards research and development would be another key aspect which required stronger corporation and support within both government and car manufacturer.

Providing this information by government and enterprises would assure the audience and its consequence could increase the rate of EV adoption in Bangkok.

Moreover, finding in this study reveal that financial cost fear is the most significant factor that positively related to Bangkokian intention to buy EVs. This finding is in line with past studies indicates relationship between financial cost fear (risk of high operating cost, high maintenance cost and unpredictable resale market in future among public) with the intention to buy EVs in many countries as well as Thailand (Thananusak, Rakthin et al. 2017, He, Zhan et al. 2018, Kumar and Alok 2020). EV

implementations and technologies are still in the initial stages, especially battery technology which public still not assure regards quality of batteries in long run operation or its maintenance cost. Moreover, the limited battery technology of EVs may lead to higher traffic risk for consumers compared with conventional vehicles. Consumer may uncertainty regard unpredictable resale market that they may face in future.

Thus, to promote EVs to the Bangkok market, car manufacturers and government agencies supporting EV adoption should have higher attention regards quality and period extension of services such as warranties and guarantee of main components in EVs to eliminate public negative preference regards mentioned risk.

Therefore, given a deep examination by government and car manufactures in suggested topic and moreover educating public to how government and manufacturer will be supportive in terms of reduction of risk and uncertainty in future. This would be incredibly useful to increase the rate of EV adoption in Bangkok.

Notably, although in the many studies indicate that availabilities of infrastructure facilities and incentive financial policies have positive relationship with consumers' intention regarding adoption of electric vehicles (He, Zhan et al. 2018, Ma, Fan et al. 2019, Kumar and Alok 2020, Asadi, Nilashi et al. 2021). In this study in line with another study in Thailand we found that the infrastructure and financial performances are not significantly related to the intention to buy EVs in Bangkok (Thananusak, Rakthin et al. 2017). These results regard infrastructure factors indicate that the Thai respondents are not concerned with the availability and number of the charging stations in highways or shopping malls due to availability of adequate charging facilities in cities. Availability of these significant level of infrastructure may be because of providing policies by government for setting up charging facilities in shopping malls and vicinities of cities.

The environmental factor was another factor that many study findings support the positive relationship of environmental concern with the intention to buy EVs (Thananusak, Rakthin et al. 2017, He, Zhan et al. 2018, Tanwir and Hamzah 2020, Asadi, Nilashi et al. 2021). However, result of this study does not support previous result. This may be because many Thai people specially who living in Bangkok still do not consider the environmental problem as an urgent issue and due the majority trend they focus more on the conventional vehicles.

Finally based on Theory of Planned Behaviour; subjective norms, attitudes, and perceived behavioural control were other factors that many studied in region in countries such as China, Malaysia, Taiwan indicated their positive relationship with the intention to buy EVs (Huang and Ge 2019, Tu and Yang 2019, Tanwir and Hamzah 2020, Asadi, Nilashi et al. 2021). However, in the results of this research could not find any significant relationship with intention to purchase EVs in Bangkokians.

## **5.1 Future research directions**

In this paper, a research model based on the Theory of Planned Behaviour (Subjective norms, attitude, and perceived behavioural control), which is integrated with performance, environmental, financial and infrastructure factors was applied to examine the factors impacting consumer intention to purchase electric vehicles in the Bangkok. The main findings, based on the regression analysis, confirmed that environment and incentive policies have an insignificant influence on individuals' intention to adopt electric vehicles.

The empirical result of this study found that the most influential factors were financial cost fear and performance respectively which has a relation with consumer purchase intention. Financial cost fear and performance play a vital role in guiding individuals in their decision-making process.

Essentially, in respect of promoting the adoption of electric vehicles, it is vital to study what may shape individuals' motivation in adopting the vehicles. Therefore, approaches can be executed accordingly by both parties, including governments and manufacturers. Based on the results of this study, I derive several key implications for governments and practitioners to escalate the uptake of electric vehicles among consumers. Firstly, considering the negative role of financial fear cost on the intention to purchase electric vehicles, several specific approaches should be implemented to minimize the individuals' negative perception of buying electric vehicles. Promoting and highlighting the security of ongoing operating cost of electric vehicles are regarded as effective ways of raise individuals' acceptance of electric vehicles adoption. For example, the effect of providing longer warranties and guarantee services, providing attractive resale channel, providing incentive policies for consumer

to return their old electric vehicles and get a new model with some special offers or other concern of electric vehicles can be introduced by manufacturers and relevant government agencies through multiple channels that can reach the consumers (e.g., car exhibitions, billboards, television shows, newspapers, radio, and the Internet). These approaches will attract and educated the public's attention and understanding of electric vehicles' adoption. Next, higher attention to research and development regards batteries life, charging time and new technologies that adoptions which cause higher performance on electric vehicles. Some actions can be implemented by governments and automotive marketers. The government should enact policies that promote the provision of financial incentives (e.g., tax reduction and subsidies) to benefit consumers. Therefore, individuals' motivation to own the vehicles can be shaped accordingly. On top of that, educating the public concerning the ecological impacts of green vehicles' adoption is essential.

In Overall, despite the research findings, some improvements can be made concerning the limitations of this research. Hence, essential points regarding future research directions. First, the sample size could be expanded in future research the roles of these variables may vary in different geographies, and future research may be aligned to make it more collaborative. Researchers may also expand research across different cities in Thailand to have a wider out outcome. Second, the current study examines the extent of individuals' intention to purchase hybrid cars. Therefore, future research can expand the study model to the extent of actual purchasing behaviour of individuals in purchasing electric cars. Third, as the method of collecting the data of this research is fully online based, self-administered survey, the respondents' honesty, and level of understanding in answering the questionnaire could not be guaranteed. Hence, considering another data collection technique for future research could enhance the quality of the data. Fourth, there are predictors that are not covered in examining individuals' intention to purchase electric cars. Therefore, future research could study more on behavioural aspects such as subjective norms, attitude, perceived behavioural control, perceived value, and personal norms to enhance the model, which ultimately will better explain the variance of the study. these could be proposed as potential predictors of individuals' intention to buy use EVs.

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## APPENDICES

### QUESTIONNAIRES

#### Screening questions

- 1) Where is your current living?
  - \* Bangkok or its suburbs
  - \* Other cities (Teminate)
- 2) Have you ever Buy/Owen a Car?
  - \* Yes
  - \* No (Teminate)

#### Rating questions

	Strongly Agree	Agree	Disagree	Strongly Disagree
<p><b>Attitude</b></p> <p>1) I think it is very necessary to use electric vehicles due to their positive environmentally friendly impact.</p> <p>2) I think the affordable price will highly encourage us to purchase an electric vehicle.</p> <p>3) I support the country in introducing more policies to encourage individuals to purchase an electric vehicle.</p>				

<p>4) I think buying an electric vehicle will highly help us to have a much greener environment.</p>				
<p><b>Subjective norm</b></p> <p>1) If people around me use electric vehicles, this will prompt me to purchase it too.</p> <p>2) People who have an influence on me (such as family and friends) think that I should buy an electric vehicle.</p> <p>3) Most people, important to me, would approve me to purchase an electric vehicle.</p> <p>4) News media propaganda will prompt me to buy an electric vehicle.</p>				
<p><b>Perceived Behavioral Control</b></p> <p>1) I can largely decide whether to purchase or not purchase an electric vehicle at home.</p> <p>2) I will have the ability to purchase an electric vehicle in the future.</p> <p>3) I am confident that if I am able, I will definitely choose an electric</p>				

<p>vehicle for my next purchase.</p> <p>4) I am confident that the government tax exemption will decrease the operating cost of an electric vehicle.</p>				
<p><b>Environmental Factors</b></p> <p>1) I will buy electric cars if it helps to preserve the environment.</p> <p>2) By purchasing electric vehicle, I will feel that I have played a part in reducing carbon emissions and conserving the environment.</p> <p>3) I would buy electric vehicle when I aware its positively impact on our ecosystems.</p> <p>4) I find replacement of conventional vehicles with electric vehicles will help to conserve the rare non-renewable fuel reserves across the whole cycle of life.</p>				
<p><b>Financial Factors</b></p> <p>1) I would buy electric vehicle without attention to oil market price.</p> <p>2) I don't want to buy electric</p>				

<p>vehicles because of its high maintenance cost.</p> <p>3) I don't want to buy electric vehicles because of its high operating cost.</p> <p>4) I don't want to buy electric vehicles because its price is higher than conventional vehicles.</p> <p>5) I don't want to buy electric vehicles because its resale market in future is unpredictable.</p> <p>6) I find that I am willing to pay more price for electric vehicles if charging process is faster.</p> <p>7) I would buy electric cars if the maintenance cost were lower than conventional vehicles.</p>				
<p><b>Infrastructure Factors</b></p> <p>1) I find the availability of charging infrastructure in highways for electric vehicles is important to me.</p> <p>2) I find the availability of indispensable support facilities for electric vehicle is important to me.</p>				

<p>3) I find the availability of the charging facilities in shopping malls and working area is important to me.</p> <p>4) I find the number of charging infrastructure in cities is important to me.</p> <p>5) I find the availability of after sales service infrastructure is important to me.</p>				
<p><b>Performance factor</b></p> <p>1) I find the new technology adoption in Electric vehicles caused higher performance to compare with conventional vehicles.</p> <p>2) I find the safety and reliability of battery is important to me.</p> <p>3) I find the electric vehicles performance is less compare with conventional vehicles.</p> <p>4) I find the driving range is important to me.</p> <p>5) I find the battery life is important to me.</p>				

<p>6) I find the charging time is important to me.</p> <p>7) I find uncertainty regards performance of electric vehicles in the long run operation.</p>				
<p><b>Incentive policy</b></p> <p>1) I will purchase electric vehicle if purchase loan amount had increased.</p> <p>2) I will purchase electric vehicle due to its purchase subsidy.</p> <p>3) I will purchase electric vehicle due its Tax exemption policy.</p> <p>4) I will purchase electric vehicle due its parking fee reduction policy in city.</p> <p>5) I would purchase electric vehicle if its maintenance cost were low.</p> <p>6) I will purchase electric vehicle due its preferential insurance policy.</p> <p>7) I would purchase electric vehicle to support local manufacture in Thailand.</p>				

<p><b>Purchase Intention</b></p> <p>1) If a full Electric vehicle is launched next year, I will consider to buy it.</p>				
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### **Personal Information**

1) Could you please specify what is your gender?

- Male
- Female

2) Could you please specify what is your age range?

- 20-30 years old
- 31-40 years old
- 41-50 years old
- Over 50 years old

3) Could you please specify what is your highest level of education?

- College
- Bachelor's degree
- Master's degree or higher

4) Could you please specify what is your present occupation?

- Employee of public company
- Employee of private company
- Business owner
- Student

5) Could you please specify what is your personal income per month?

- 10,000 - 20,000 THB
- 20,001 - 40,000 THB
- 40,001 - 60,000 THB
- 60,001 - 100,000 THB
- More than 100,000 THB