Research Article

Factors Affecting the Willingness to Pay for Electric Vehicle Conversion (EVC)
ปัจจัยที่ส่งผลต่อความเต็มใจที่จะจ่ายสำหรับซื้อรถยนต์ไฟฟ้าดัดแปลง

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Abstract

An electric vehicle conversion (EVC) is a car modification that converts an existing non-electric vehicle to be a low-cost electric vehicle. However, EVC is still in the development phase, and a plan to commercialize EVC has not been developed. The objective of this research is to determine the willingness to pay to convert a regular gasoline vehicle to an EV and to investigate significant factors affecting the willingness to pay for EVC. A questionnaire survey was developed and distributed randomly to 406 people in Bangkok who have a driver license. The descriptive results show that approximately 69.00% of the respondents are willing to convert a regular gasoline vehicle to an EV. The average price that they are willing to pay for EVC is about 160,931 Baht. The multiple regression analysis was employed with the level of significance of 0.05. The results indicated that the significant factors that affect a customer's willingness to pay are monthly income, education, household size, maintenance cost, age of the owned car, driving distance per day, and environmental awareness. The results of this study are expected to serve as a guideline for policy makers in order to further support the future productions of EVC. Some recommendations were discussed.

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บทคัดย่อ

รถยนต์ไฟฟ้าดัดแปลง คือ การดัดแปลงรถยนต์ที่เป็นเครื่องยนต์สันดาปที่ใช้งานในปัจจุบันให้เป็นรถยนต์ที่ขับเคลื่อนด้วยพลังงานไฟฟ้าที่เกิดจากความร่วมมือของหลายหน่วยงานทั้งภาครัฐและเอกชน ซึ่งในปัจจุบันยังอยู่ในช่วงของการพัฒนาสร้างเป็นรถยนต์ไฟฟ้าดัดแปลงต้นแบบ โดยในอนาคตมีการวางแผนให้สามารถพัฒนาการดัดแปลงดังกล่าวในเชิงพาณิชย์ ซึ่งการศึกษาครั้งนี้มีวัตถุประสงค์เพื่อหามูลค่าความเต็มใจที่จะจ่ายในการดัดแปลงรถยนต์ให้เป็นรถยนต์ไฟฟ้า ตลอดจนวิเคราะห์ปัจจัยที่มีอิทธิพลต่อความเต็มใจจ่าย โดยทำการออกแบบสอบถาม และสำรวจจากกลุ่มตัวอย่าง จำนวน 406 คน ในกรุงเทพมหานครที่มีใบอนุญาตขับรถยนต์ ซึ่งผลจากการศึกษาพบว่า ร้อยละ 69.00 ของผู้ตอบแบบสอบถามเต็มใจที่จะจ่ายสำหรับการดัดแปลงให้เป็นรถยนต์ไฟฟ้า และมีค่าเฉลี่ยของความเต็มใจจ่ายเท่ากับ 160,931 บาท นอกจากนี้ จากผลลัพธ์ของการวิเคราะห์สมการถดถอยพหุคูณที่ระดับนัยสำคัญ 0.05 พบว่า ปัจจัยที่มีอิทธิพลต่อค่าความเต็มใจจ่ายอย่างมีนัยสำคัญ ได้แก่ รายได้ส่วนบุคคลต่อเดือน ระดับการศึกษา จำนวนสมาชิกในครอบครัว จำนวนรถยนต์ที่ครอบครอง ค่าซ่อมบำรุงของรถยนต์ อายุของรถยนต์ที่ครอบครอง ระยะทางขับรถต่อวัน และความตระหนักในสิ่งแวดล้อม ทางผู้วิจัยหวังว่าผลลัพธ์ที่ได้รับจากงานวิจัยนี้จะเป็นแนวทางในการกำหนดนโยบายสำหรับการสนับสนุนการดัดแปลงรถยนต์ไฟฟ้าดัดแปลงในอนาคต

คำสำคัญ: *รถยนต์ไฟฟ้าดัดแปลง รถยนต์ไฟฟ้า ความเต็มใจที่จะจ่าย วิธีสมการถดถอยพหุคูณ*

Introduction

Currently, Electric vehicles (EVs) in Thailand have not received attention from consumers (Chokmaviroj, 2019) and have a high price because EV must be imported from aboard and facing high import tax (Roumsuwan, 2021). According to MGR Online (2020), when comparing two similar sizes between EV and combustion models, the EV is more expensive. For instance, the least expensive 4-seats EV in Thailand is the MG EP, which costs 998,000 Bath (Approximately 30,000 US dollars as of August 9, 2021). It can be driven up to 380 kilometers per charge with a maximum speed of 180 kilometers per hour (Checkraka, 2020a). However, the compatible combustion engine vehicle model like the MG ZS costs 689,000 Baht (Approximately 20,600 US dollars as of August 9, 2021), which is 21.00% less expensive. (Checkraka, 2020b).

So, the Electricity Generating Authority of Thailand (EGAT) and the National Science and Technology Development Agency (NSTDA) collaborated to develop an electric vehicle conversion (EVC) by modifying used gasoline vehicles and converting them into low-cost electric vehicles and the conversion cost, excluding battery, is about 200,000 Thai Baht (Electricity Generating Authority of Thailand, 2019). An EVC is driven by an electric motor instead of its combustion engine and major existing functions in the used vehicle, such as air-conditioner, radio, safety system, and electrical systems, are maintained (Electricity Generating Authority of Thailand, n.d.). In addition, an EVC releases less heat and pollution than a regular gasoline vehicle (Chokmaviroj, 2019). The prototypes were made from a Honda Jazz and Nissan Almera. The Nissan Almera conversion,

the latest prototype of EVC, was completed by using imported EV parts (Chokmaviroj, 2019). Its driving distance is 250 kilometers per charge, with a maximum speed of 150 km per hour and takes about 12 – 15 hours to fully charge (Electricity Generating Authority of Thailand, 2019).

However, the assessment of the willingness to pay for EVC in Thailand has not been conducted because current EVC is still at the developing stage. So, the study of consumer behavior about willingness to pay for EVC, as well as socioeconomic factors and features of EVC can help the Thai government and private sectors to support EV productions in Thailand. Thus, the objective of this study is to assess the willingness to pay for EVC and determine the factors that influence the willingness to pay for ECV. The results of this study are expected to serve as a guideline for policy makers in order to further support the future productions of EVC.

Literature Review

Willingness to pay

Willingness to pay (WTP) is the amount of money that a consumer will pay for one unit of products or services (Raje, Dhobe, & Deshpande, 2002). WTP is estimated based on actual data that were collected from face-to-face surveys (Ramos-Real, Ramírez-Díaz, Marrero, & Perez, 2018). In addition, WTP was used to develop incentives, to make products more attractive to a consumer (Dimatulac, Maoh, Khan, & Ferguson, 2018). The stated preference (SP) method is widely used in the research of WTP for EVs (Potoglou & Kanaroglou, 2007). An SP survey collected answers from respondents by creating hypothetical situations (Dell' Olio, Ibeas, de Oña, & de Oña, 2017).

SP can be classified into two types: choice experiment and contingent valuation method (Boxall, Adamowicz, Swait, Williams, & Louviere, 1996). Choice experiments were used to find the significance of each attribute that affects the WTP for EV (Noel et al., 2019). In addition, Hidrue, Parsons, Kempton, and Gardner (2011) used choice experiments to estimate how much respondents are willing to pay for EVs by creating a scenario for each respondent to choose among a gasoline vehicle and two electric versions having different attribute values. Thus, choice experiments ask for the WTP of the respondents by scenario, but the contingent valuation method asks directly for the WTP (Ramos-Real et al., 2018).

Contingent valuation method

The contingent valuation method (CVM) has been used for the market valuation of non-market and new-to-market products and services (Ramos-Real et al., 2018). In addition, this method was used to estimate the potential market for a product in the near future (Poder & He, 2017). Moreover, the CVM is a widely used method to evaluate the WTP for goods or services because it is more flexible than the hedonic pricing method (Carson & Hanemann, 2005). According to Ramos-Real et al. (2018), the CVM can obtain information by directly interviewing consumers and creating a hypothetical market scenario. Usually, it starts by giving information about a product or service to respondents and then gathers their answers about their WTP for it. Moreover, Poder and He (2017) used the CVM to elicit the WTP and found that respondents are willing to pay more for a one-percent emission reduction (by cleaner cars) when compared to gasoline cars in Quebec and France. The

results indicated that the respondents have a WTP of 5,444, 4,875, and 6,036 US dollars for 62.20%, 50.00%, and 75.00% emission reduction, respectively. In Hungary, Erdem, Şentürk, and Şimşek (2010) studied the WTP premium for hybrid automobiles. They used the CVM and found that the most important factors, including education level, income, and concerns about global warming, have a positive effect on WTP. In China, Xie and Zhao (2018) found that Chinese respondents have more WTP by approximately 32.63 Yuan per month for green electricity, using CVM. According to the aforementioned studies, the CVM is used to find the WTP for green products. Moreover, this method has flexibility and asks directly the respondents' WTP. Therefore, this study used CVM to find the factors and the WTP for EVC.

WTP factors for vehicles in past studies

Past research studies have demonstrated that demographic information has an impact on the willingness to pay for an environmentally-friendly product, especially an alternative fuel vehicle (Ferguson, Mohamed, Higgins, Abotalebi, & Kanaroglou, 2018; Giansoldati, Danielis, Rotaris, & Scorrano, 2018). In addition, Giansoldati et al. (2018) found that demographic variables play an important role in consumers' WTP for an EV.

In 2018, Ramos-Real et al. (2018) found that the educational level positively affects the WTP for an EV. In addition, Poder and He (2017) asserted that a higher educational level has a positive effect on the WTP for a cleaner vehicle. Hence, customers with a higher educational level are likely to pay for an EV. Moreover, Potoglou and Kanaroglou (2007) studied the WTP for clean vehicles, and found that the household size is also a significant demographic factor, in which households with children have a high probability of selecting an EV. Furthermore, Suanmali and Tansakul (2019) found the number of owned vehicles is another important parameter in WTP for a Battery Electric Vehicle in Thailand, in which one additional owned vehicle in a family leads to an increase in the WTP by 100,000 Baht.

According to Ramos-Real et al. (2018), the income level is the most important socioeconomic variable for the WTP for an EV. The results of their study showed that consumers in Spain, with an income level of at least 35,000 Euros, are willing to pay 10,701 Euros more for an EV, compared to other consumers whose income level is less than 35,000 Euros. Potoglou and Kanaroglou (2007) found that the respondents with a higher income level have more WTP for clean vehicles than those with lower income levels. Moreover, many studies concluded that with a higher income, individuals are willing |to pay more for EVs (Tanaka, Ida, Murakami, & Friedman, 2014), clean vehicles (Poder & He, 2017), and hybrid vehicles (Liu, 2014). However, Hidrue et al. (2011) indicated that the income level did not affect the WTP for an EV. Thus, people who have higher income are willing to pay more for EV.

In 2018, Ferguson et al. (2018) indicated that consumers are willing to pay 1,124 US dollars to reduce the annual EV maintenance costs by 100 US dollars. Their study showed that respondents have a higher level of WTP for reducing the annual vehicle maintenance costs of an EV than a gasoline vehicle. In addition, Potoglou and Kanaroglou (2007) found that households have a higher WTP of from 500 to 1,200 US dollars for clean vehicles, to save 100 US dollars in annual maintenance costs. They

found that reducing the annual maintenance costs increases the probability of buying cleaner vehicles (Potoglou & Kanaroglou, 2007) or electric motorcycles (Guerra, 2019). Thus, people are willing to pay more for a vehicle with less annual maintenance costs.

According to Ramos-Real et al. (2018), the mobility characteristics of drivers, i.e. the average driving distance per day, influence the WTP for an EV. Their research indicated that the willingness to pay increases by 73.9 Euros with each increment of 10 km covered per week. However, Giansoldati et al. (2018) found that the average driving distance did not affect the WTP for an EV. Despite contradictory results in past studies, the average driving distance per day was nonetheless included in this study.

Monetary incentives are financial advantages (for example, tax rebates and tax exemptions) that people would receive when purchasing an EV (Potoglouj & Kanaroglou, 2007) or renting an EV (Dimatulac et al., 2018). Respondents are willing to pay an extra 7,175 Euros for alternative fuel vehicles if they obtain a tax exemption in Germany (Hackbarth & Madlener, 2013) and from 2,000 to 5,000 extra US dollars for clean vehicles in Canada (Potoglou & Kanaroglou, 2007). Dimatulac et al. (2018) indicated that Canadian renters of EVs are willing to pay up to 4.31 US dollars more for monetary incentives. Furthermore, Ferguson et al. (2018) revealed that Canadian consumers are willing to pay 902 US dollars more for a hybrid electric vehicle with a 1,000-US-dollar cash incentive. Hence, monetary incentives have a positive effect on WTP.

Non-monetary incentives are non-financial advantages, such as free parking or free access to exclusive lanes, that households would receive with the purchase of an EV (Potoglou & Kanaroglou, 2007) or renting an EV (Dimatulac et al., 2018). In Canada, Ferguson et al. (2018) indicated that individuals would pay from 1,000 to 2,000 US dollars more for having free parking, no tolls, access to a high occupancy vehicle (HOV) lane, and a battery warranty. Likewise, Hackbarth and Madlener (2013) found that respondents are willing to pay an extra 5,925 Euros for permission to use bus lanes and having free parking in Germany. In contrast, Potoglou and Kanaroglou (2007) and Dimatulac et al. (2018) demonstrated that non-monetary incentives, i.e. free parking and the permission to drive on HOV lanes, were not significant for WTP.

According to Ramos-Real et al. (2018), respondents' high level of awareness of the greenhouse gas emission has a positive effect on WTP for an EV in Canary Islands, Spain. In Indonesia, Guerra (2019) found that respondents who have a high level of environmental awareness are willingness to pay more 17.00% for electric motorcycle than other respondents. In addition, Hackbarth and Madlener (2013) found that German car buyers are willing to pay more between 14 Euros and 1,432 Euros for the abatement of one percent of vehicles' CO2 emissions. Likewise, several studies found that people are willing to pay more for a reduction in CO2 emissions from alternative fuel vehicles (Tanaka et al., 2014), clean vehicles (Ferguson et al., 2018; Poder & He, 2017; Potoglou & Kanaroglou, 2007) and electric vehicles (Hidrue et al., 2011). Moreover, Bienias, Kowalska-Pyzalska, and Ramsey (2020) studied the WTP for EV in Poland, and indicated that people who believe that EVs are environmentally friendly and can improve air quality are willing to pay

more for EV. In Thailand, Suanmali and Tansakul (2019) found that people who are willing to pay for an EV are those who have good knowledge about environmental awareness, such as global warming. In addition, Lashari, Ko, and Jang (2021) indicated that people who use EV believe that they contribute to improve the environment and reduce the amount of air pollution, and they have a high probability of purchasing an EV. Therefore, having environmental awareness has a positive effect on WTP.

Population and sampling

The population are people who have a driver license, own a gasoline vehicle, earn a monthly income, and live in the Bangkok Metropolitan Region. According to the City Population (2020), this region has more than 10 million people (or 16.00% of the population of Thailand). In addition, this region has the highest household income in Thailand (National Statistical Office Thailand, 2020). Consequently, the population in this region is likely to have the WTP for EVC. Because the Bangkok Metropolitan Region has accommodated more than 10 million people, this study must use a sampling technique to determine the minimum sample size. The Taro Yamane sampling technique was employed to determine the minimum sample size.

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Equation (1) showed Taro Yamane formula where n is minimum sample size, N is population size and, e is margin of error. After calculating the sample size with a 95.00% confidence level, error (e) of 5.00%, and about 10,765,000 persons (N) in the Bangkok Metropolitan Region, the minimum sample size (n) is 400 persons.

Materials

The instrument used for this study is a five-part questionnaire survey. The survey was developed to discover the factors influencing the WTP for EVC. The first part collected information about driver characteristics (including the average driving distance per day), details of the respondents' vehicles (including maintenance cost), and expected driving range. The second part collected socioeconomic information, including a respondent's education level, monthly income level, and household size. The third part collected information about environment awareness. It was divided into 5 issues: global warming, EVs reducing pollution, alternative energy, fuel reduction, and air pollution. In this part, the respondents' answers can be classified by using a five-point Likert scale from 1 (highly disagree) to 5 (strongly agree).

The fourth part collected information about the WTP for EVC. In this part, a respondent would receive information about an EVC vehicle and a hypothetical event. In this part, the respondent would be asked in a biding game format. A price of 200,000 Baht was first offered to a respondent because the EVC cost is 200,000 Baht (Electricity Generating Authority of Thailand, 2019). If the respondent was willing to pay for EVC at that price, then he or she would be asked whether he/she was willing to pay for a higher price. Likewise, if the respondent was not willing to pay for it, a lower price would be offered to the respondent until he/she was willing to pay for EVC. This data collection method was taken from Mcnamee, Ternent, Gbangou, and Newlands (2010) who used a bidding game

method to find a WTP, and they employed a 10% increase and decrease from each starting bid. In this study, therefore, the bidding game started with the EVC cost or 200,000 Baht and applied the increase or decrease of 10.00% or 20,000 Baht. The overall bidding range was from 100,000 to 300,000 Baht.

The fifth part collected information about monetary incentives (maintenance cost reduction, annual personal tax reduction for people who use an EVC, tax exemptions for EVC), and non-monetary incentives (free parking and reserved charging stations at parking buildings). These incentives might influence the respondents' decision for EVC. This section used closed-ended questions (multiple choice).

Procedure

According to Hill (1998) and Isaac and Michael (1995), the sample size for a pilot study should range from 10 – 30 respondents. In this study, the pilot survey was collected from 30 respondents who were interested in the topic of the EVC and visited the EGAT and NSTDA exhibition booths on the first day at the Bangkok International Motor Show 2019 event in Thailand. In addition, the reliability test was applied on the pilot data using Cronbach's alpha. The Cronbach's alpha method was used to measure the reliability, particularly that of multiple questions in a questionnaire (Laerd Statistics, 2015a). The result of Cronbach's alpha is 0.876, which is acceptable since it is above 70.00% (Tavakol & Dennick, 2011).

This survey used the purposive sampling method for selecting a sample from the population, based on its characteristics and the objective of the study (Crossman, 2020). Self-administered questionnaires were used to collect data from 406 people who have a driver's license, own a gasoline vehicle, and earn a monthly income, and are interested in EVC displayed at the EGAT and NSTDA exhibition booths in the Bangkok International Motor Show 2019 event. Therefore, the possible bias can be reduced because the respondents are people who are interested in and have some knowledge of vehicles in general.

Multiple regression model

Multiple regression analysis is a well-known method that is used to predict unknown values or the dependent variable, based on the value of two or more independent variables (Glantz & Mun, 2011). In addition, the dependent variable should be measured on a continuous scale and the model requires two or more independent variables, which can be either continuous or categorical (Laerd Statistics, 2015b). In this study, multiple regression analysis was used for predicting the amount of money that people are willing to pay for ECV, based on socioeconomic, driver characteristics, and environmental concerns variables. Equation (2) is a multiple regression model, where Y is the dependent variable, $X_1, X_2, \ldots, X_P$ are the predictor or independent variables, $\beta_0, \beta_1, \beta_2, \ldots, \beta_P$ are the regression coefficients, and ε is the random disturbance or error (Chatterjee & Hadi, 2006).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_P X_P + \varepsilon \quad (2)$$

Results

Descriptive statistics

The questionnaire was collected from 406 respondents who stopped by a showcase of ECV in the EGAT and NSTDA exhibition booths at the Bangkok International Motor Show 2019 event in Thailand, from March 27 to April 7, 2019. The descriptive statistics were summarized in Table 1 and Table 2. It was found that the average willingness to pay to convert a regular gasoline vehicle to an EV is 160,931 Baht, based on their knowledge of ECV technology and information that they have received from an exhibition booth.

Table 1 Summary of descriptive statistics of multiple-choice questions

Variable	Value	Frequency
Educational level	Grade 6 or equivalent	39 (10.00%)
	Diploma or equivalent	38 (9.00%)
	Bachelor's degree	235 (58.00%)
	Master's degree or higher	94 (23.00%)
Monthly income level	15,001 - 25,000 Baht	94 (23.00%)
	25,001 - 35,000 Baht	82 (20.00%)
	35,001 – 45,000 Baht	56 (14.00%)
	45,001 - 55,000 Baht	39 (10.00%)
	55,001 - 65,000 Baht	37 (9.00%)
	More than 65,000 Baht	98 (24.00%)

Table 2 Summary of descriptive statistics of open-ended questions

Variable	Mean	Median	SD	Skewness
Household size	4.06	4.00	1.60	0.84
Driving distance per day (kilometers)	67.77	50.00	82.88	5.38
Age of the owned car (years)	7.19	6.00	5.54	1.68
Maintenance cost per year (baht)	14,478.58	10,000.00	16,194.69	3.72
Number of owned cars	2.94	2.00	2.37	5.44
WTP to convert a regular gasoline vehicle to an EV	160,931	160,000	63,951	0.70

Table 3 indicated that more than 70.00% of respondents would like the government to provide incentives, for instance, maintenance cost reduction, tax reduction, tax exemptions, and reserved charging stations at parking buildings.

Table 3 Summary of descriptive statistics of monetary and non-monetary incentives

Incentives	Total
Maintenance cost reduction	332 (83.00%)
Tax reduction	294 (73.50%)
Tax exemptions	301 (75.25%)
Reserved parking	230 (57.20%)
Free parking	223 (55.75%)
Reserved charging stations at parking buildings	321 (80.25%)

Factor analysis

Factor analysis was used to group five-point Likert scale questions about environmental awareness as shown in Table 4. Principal component analysis and Varimax rotation were used. Kaiser-Meyer-Olkin (KMO) is used to measure of how suited the collected data (Glen, 2016). The KMO index ranges from 0 to 1, and the obtained result of KMO is 0.842; indicating that the data are suitable for conducting the factor analysis since the value is above 0.5 (Williams, Brown, & Onsman, 2010). The reliability test using Cornbach's alpha was also conducted and its coefficient is 0.829, as indicated in parentheses.

Table 4 Factor analysis

Factor (0.829)	Mean	SD	Factor loading	Variance explained %
Factor: Environmental awareness				59.71
Global warming	4.75	0.59	0.76	
EVs reduce pollution	4.46	0.73	0.73	
Alternative energy	4.51	0.72	0.82	
Fuel reduction	4.55	0.72	0.77	
Air pollution	4.73	0.63	0.76	

Multiple regression result

The amount of money that people are willing to pay for EVC was set to be a dependent variable. Significant independent variables for the model were monthly income, education level, household size, age of the owned car own (years), driving distance per day (kilometers), maintenance cost per year (10,000 Baht), and level of environmental awareness. In addition, education level data were organized into two different categories: earning at most a bachelor's degree (reference group) and earning higher than a bachelor's degree. Income data were divided into six categories, where the reference

group earns from 15,001 to 25,000 Baht. Only income group 5 (higher than 65,000 Baht) was significantly different from the reference income group.

Table 5 provided the result of multiple regression analysis. The R-squared of 0.273 or 27.30% indicated that the independent variables in this model can explain about 27.30% of the variation in the dependent variable. This implied that there are some other independent variables (not in the model) that might affect the willingness to pay. Moreover, Durbin- Watson equals 1.898, indicating that the model has no correlation between residuals. The values of VIF in Table 5 are also less than 5, indicating no multicollinearity problem in the data.

The regression analysis revealed that the respondents' monthly income has a positive effect on WTP. That is, people who have a monthly income that is higher than 65,000 are willing to pay 42,215 Baht more for EVC when compared to the reference group (15,001-25,000 Baht). The education level also has a positive effect on WTP. That is, people who have higher than a bachelor's degree are willing to pay 47,419 Baht more. Moreover, a household size that is larger by one additional member leads to an increase in the WTP by 7,014 Baht. Thus, people who have a high income of at least 35,000 Baht, with at least a master's degree, and live in a big family are likely to pay more for EVC.

In addition, one additional year of owning a car leads to an increase in the WTP by 2,448 Baht. The driving distance per day influences the dependent variable. One additional kilometer of driving distance per day leads to an increase in the WTP (by 286 Baht). However, the maintenance cost per year of the currently-owned car has a negative effect on WTP. People who own a car with its low maintenance cost per year are willing to pay more for an EVC. On the other hand, if the maintenance cost per year increases by 10,000 Baht per year, the willingness to pay for EVC decreases by 10,096 Baht.

Table 5 Result of Multiple regression

Independent variables	Unstandardized coefficients	Standardized coefficients	t	VIF
Constant	-211,482.546		-3.526***	
Monthly income				
Monthly income (1)	5,989.618	0.029	0.375	1.581
Monthly income (2)	1,013.333	0.004	0.049	1.452
Monthly income (3)	-10,936.556	-0.031	-0.447	1.240
Monthly income (4)	32,196.87	0.092	1.278	1.316
Monthly income (5)	42,215.046	0.197	2.449**	1.648
Education (1)	47,419.627	0.201	3.086***	1.085
Household size	7,014.342	0.140	2.150**	1.087
Age of car own (year)	2,2230.757	0.124	1.940*	1.048
Driving distance per day (kilometer)	293.580	0.178	2.667***	1.127
Maintenance cost per year (10,000 Baht)	-12,125.667	-0.232	-3.514***	1.112
Environmental awareness	57,970.439	0.314	4.697***	1.141

*p < 0.10 , **p < 0.05 , ***p < 0.01

Conclusion and Discussion

In this study, the factors that affect a customer's willingness to pay are monthly income, household size, education, age of currently-owned car, maintenance cost per year, driving distance per day, and environmental awareness. Moreover, the characteristics of the targeted group of people who are interested in EVC and willing to pay more are people who have monthly income of at least 35,000 Baht, have at least a master's degree, have more family members, have positive mindsets toward the environmental-related issues, and drive long distances.

According to the multiple regression model results, the significant factors can explain about 24% of the variation in the amount of money that people are willing to pay. There are additional factors not mentioned in the model that may affect the willingness to pay, for example, the models and fuel types of currently owned vehicles.

The research of Logtenberg, Pawley, and Saxifrage (2018) implied that EV cars have lower maintenance cost as EV can save the annual maintenance cost by 417 USD in Canada; 931 USD and 514 USD for annual maintenance cost of gasoline car and EV, respectively. In addition, the public has little or no information about maintenance cost of EV. Hence, if such information becomes more available to the public, people who currently pay high annual maintenance cost on their gasoline cars may be willing to pay more on an EV. Moreover,

people who are willing to convert their cars to EVCs usually drive long distances. Furthermore, environmental awareness has a positive effect on WTP; if the environmental awareness is increased by 1 level, the willingness to pay increases by 57,970 Baht. Therefore, people with an awareness for the environment are likely to pay for EVC.

At present, the collaboration between the government and business sectors has been developed in Thailand, with positive information and the benefits of such collaboration available on EVC: the expected maintenance cost of an EVC, the driving system, charging method, and charging time. Even though a plan to commercialize EVC has not yet been developed, it is critical to make the public aware of such information. They need more information about EVC and its benefits. A commercialized EVC may thus become available to consumers in the near future.

Recommendation

According to the questionnaire results, more than 70.00% of people would like the government to generate appropriate incentives for EVC, including maintenance cost reduction, tax exemptions for EVC, annual personal tax reduction for people who use EVCs, and reserved charging stations at parking buildings. Currently, an EVC is a new product with less credibility. Its useful life, spare parts, and battery are unknown variables. Thus, incentives for reducing the maintenance cost and changing/charging batteries can affect people's purchasing decisions.

In addition, many countries have successful promoted EV by issuing both monetary and non-monetary incentives. For instance, Norway has been playing a global leadership role in the promotion of EV (Holland, 2020). In 2017, Haugneland, Lorentzen, Bu, and Hauge (2017) found that the main reason to buy an EV of people in Norway was to save their money and the important incentives affecting decision to buy EV were tax and VAT exemption at purchase, and exemptions from road tolls fees. Furthermore, Japan is another country that successfully promotes EV (Nikkei Asia, 2020). According to Alhulail and Takeuchi (2014), important monetary incentives of EV from the Japanese government, including tax exemption and EV subsidy, can increase EV sales.

Hence, to support ECVs to become successful commercial products, the government should provide incentives that support EVC buyers, such as a tax exemption for EVC, provide enough charging stations at parking buildings, provide free municipal parking, and reduce highway tolls. In summary, the future for EVCs in Thailand depends on both the government and private sectors. Continuous support from the government, including research and development and infrastructures related to EVCs, will lead to more affordable EVC for Thai consumers. A policy to reduce the number of combustion vehicles can also stimulate interest in using electric vehicles. In addition, EVC parts and conversion kits cannot be made in Thailand. They are imported from abroad, causing a high EVC cost. Thus, government policies that support research into EVC parts and battery-manufacturing development are needed in Thailand's automotive industry. Research for reducing the charging time, extending battery lifespan, decreasing battery replacement costs, and increasing the efficient driving range of EVC, can reduce EVC cost, reduce fuel consumption, and support economic growth, resulting in more employment.

In the future, further studies can be done on the feasibility of launching EVC commercially. The feasibility should be able to identify the technical capability, potential roadblocks, and offer alternative solutions; while time, cost, legal, and manpower requirements should be investigated in the future to determine if commercializing the EVC is possible with positive economic contribution to both government and private sectors.

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