

Research Article

College Students' Choice Behavior of Electric Two-Wheeled Vehicle

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Many countries have made great efforts to boost the use of electric vehicles in recent years; for example, advanced countries including Norway and the Netherlands in Europe and the United States have enhanced people's willingness to use electric vehicles by means of appropriate subsidies and suppression of private vehicles. In Asia, Taiwan has been promoting the policy of replacing traditional fuel two-wheeled vehicles (FTWVs) with electric two-wheeled vehicles (ETWVs) and strengthening the policy by means of replacing a large number of old FTWVs and subsidizing the purchase of ETWVs. This study took college students as the subjects, as they were the first potential group to buy ETWVs, and their concept of environmental sustainability can be shaped for cultivating vehicle use habits. This study applies a questionnaire to probe into the ETWV usage preferences of college students and explores the significant factors affecting college students' purchase of ETWVs. This study uses a mixed logit (MXL) model for estimation. The results of model estimation show that those who are younger, have higher income, have good experience in using ETWVs, and are in user-friendly external traffic environments, are more inclined to choose ETWVs. In the future, government units can formulate policies to promote ETWVs according to the characteristics of different relevant factors.

1. Introduction

Due to the use of biofuels, electrification, and efficient techniques, global transport emissions increased by less than 0.5% in 2019, compared with 1.9% annually since 2000. However, transportation sector still accounts for 24% of CO₂ emissions from fuel combustion. Transport modes including cars, trucks, buses, and two- and three-wheelers are responsible for nearly 75% of transport CO₂ emissions. The result highlights the need for international policies that concentrate on these hard-to-abate subsectors [1]. Electric modes, including electric vehicles (EVs) and ETWVs, have become a policy adopted by governments in response to changes in energy structure and demand. In recent years, while vigorously promoting relevant policies, such as tax credits, parking incentives, purchase subsidies, and other direct measures to benefit consumers in policy development for EVs in the United States, manufacturers have adjusted to the relevant laws and regulations to improve consumer

willingness to enter the market, such as economic incentives and relevant building regulations applicable to EVs.

In addition, the Norwegian government, which has high EV use, not only subsidizes the abovementioned relevant policies but also restricts and adjusts the taxes and regulations of fuel vehicles more strictly and strengthens the construction of hardware facilities in a government-led manner to reduce the total cost of ownership (TCO) of users for EVs and ETWVs. For example, from 2015 to 2017, the Norwegian government adopted the method of building charging stations every 50 km along important road systems to expand the power density of the whole road system, and at least two charging piles are constructed in each charging station to completely meet the demand for long-distance charging of EVs. It also announced that it is scheduled to completely ban the sale of gasoline vehicles before 2025.

According to the statistical results of the Department of Air Quality Protection and Noise Control, Environmental Protection Administration (Taiwan) TEDS10.1

(Environmental Protection Administration, 2020), the impact of domestic mobile pollution sources on air quality accounts for about one-third, while the emission of PM_{2.5} from various pollution sources accounts for 26% of transport vehicles, which shows that, in order to fight against air pollution and climate change in Taiwan, diesel vehicles and automobiles must undergo low-carbon transformation. In addition, according to the survey report of the Department of Statistics, Ministry of Transportation and Communications [2], FTWVs have become the largest transportation mode used by Taiwanese when going out (accounting for 46.6%), and FTWVs produce harmful pollutants every year, which account for 10% of the total national emissions, making FTWVs the main source of air pollution in urban areas. Under the strategy of energy saving and carbon reduction, ETWVs can keep the maneuverability and convenience of the original FTWVs and become the main means of transportation to replace the FTWVs.

There are three sources of government ETWV purchase subsidy in Taiwan (Industrial Development Bureau. Electric Vehicle Industry: <https://www.lev.org.tw/subsidy/result.aspx>) to replace old vehicles or new purchase: (i) Industrial Development Bureau, (ii) Environmental Protection Administration, and (iii) local county and city governments (see Table 1 for classification). According to the statistics of the Industrial Development Bureau, the number of ETWV subsidies applied for in Taiwan increased from single digits in 2009 to more than 90,000 vehicles in 2020, and the application rate climbed from 0.05% yearly to 1.44% in 2019, indicating that the vehicle purchase subsidy strategy has achieved certain results. Therefore, in order to understand the influence of subsidy measures on college students' choice of ETWVs, this study explored college students' choice behavior of FTWVs and ETWVs under various subsidy measures through the scenario design of a SP questionnaire.

Referring to the abovementioned survey report [2], the analysis results show that the most important factor affecting users' purchase or replacement of ETWVs is the "reasonable price of ETWVs," indicating that the price of ETWV does affect users' purchase intention; if we compare the differences in the repurchase characteristics of the above group, 25.7% of the group members will buy ETWVs a second time; 78.8% of the original ETWV users still buy ETWVs for the second time. This shows that users of ETWVs have a high degree of goodwill and loyalty, and if the usage environment for ETWVs can be further improved, ETWV users will be more willing to buy ETWVs.

There are 1.2 million college students in 2020, which accounts for 5% of Taiwan population [3]. Considering that college students are potential ETWV buyers, this study intended to understand the important factors of college students' choice of ETWVs by exploring the behavior of this group, and the results can be applied to developing effective marketing strategies for ETWVs. Moreover, this study added the types of subsidy measures available in the scheme development situation in order to explore the influence of subsidy measures on college students' choice of ETWVs.

At present, the promotion of ETWVs in Taiwan is mainly dominated by the governmental purchase subsidies,

manufacturers' incentives and subsidies, and parking concessions that are granted to consumers; however, there is still a lack of overall consideration and planning for the characteristics, charging requirements, and friendly environment that ETWV users pay attention to. This study is aimed to explore the important factors affecting the purchase of ETWVs (alternatives include traditional fuel and electric two-wheeled vehicles) from the perspective of college students. Among them, it is worth emphasizing that this study took college students as the research subjects, as college students are one of the main potential groups that buy ETWVs as their first vehicle, which means that the cognition and attitude of environmental sustainability have a far-reaching and long-term impact on this group. If they can cultivate their habits of using ETWVs, their contribution to the overall environmental reduction of carbon should be quite significant. It is also worth mentioning that the variables used in this study include a number of subsidy measures (such as purchase subsidy, exemption from specific taxes, and parking fee reduction). Therefore, the impact of subsidy measures on college students' choice behavior of ETWV types can be explored.

2. Literature Review

In order to understand the preferences and characteristics of ETWV users, this study conducted a literature review of ETWVs, which was used as a reference for the design of the follow-up questionnaire. As ETWVs become one of the alternatives to traditional fuel vehicles, their growth rate is quickly increasing. Zhu et al. [4] explored the willingness to buy (WTB) and willingness to pay (WTP) of consumers purchasing ETWVs and adopted the contingent valuation method (CVM). The results showed that respondents pay more attention to the actual costs of ETWV, such as selling price, charging rate, warranty fees, and tax incentives, and achieving the highest speed. However, the education level and the number of family members of the respondents will affect the WTB and WTA of ETWV, and it was estimated that the WTA amount of ETWV is MOP 1315.54 (1 MOP = US\$0.13).

Bakker [5] found that the ETWV has a crucial influence on urban transportation planning; however, traditional traffic planning often ignores the ETWV because of its current unpopularity. This study collected the development policies of China, Vietnam, the Netherlands, and other countries for discussion, and the results show that if appropriate measures can effectively improve the utilization rate of ETWVs, such as implementing low emission areas, phasing out traditional motorcycles and improving the traffic-related legal framework, the main planning principle of urban planning will be to increase the attractiveness and safety of ETWVs.

Guerra [6] studied ETWVs as an alternative to traditional fuel vehicles. In order to understand the Solo region of Indonesia, he designed five attributes of ETWVs and traditional FTWVs through a survey questionnaire. According to the price, speed, endurance mileage, and charging time, he invited respondents to check their

TABLE 1: Amount of subsidy for purchasing ETWVs in Taiwan.

Subsidy unit	Subsidy item	Amount of subsidy	
		Lightweight ETWV	Heavy duty ETWV
Industrial Development Bureau	New purchase	US \$252.6	US \$252.6
Taiwan Environmental Administration	Replace the old with the new	US \$108.3	US \$36.1
Local county and city governments	New purchase	US \$144.4~324.8	US \$36.1~180.4
	Replace the old with the new	US \$72.2~324.8	US \$72.2

preferred type of transport and applied the mixed logit model for estimation. The results showed that, while it was feasible to implement the ETWV market in the Solo region, the price and performance of ETWVs must be able to compete with traditional FTWVs to gain a market share. Regarding the speed, endurance mileage, charging time, and price, respondents were willing to pay 7–13% more fees to buy ETWVs that feature 10 km more endurance range than the original design, a faster speed by 10 km/hr, and a charging time shortened by one hour. At the same time, the survey results also pointed out that charging time is actually the most important influencing factor, which indicates that improving charging technology and strengthening charging facilities can effectively improve willingness to use.

Thuy and Hong [7] studied and investigated the willingness and attitude of high school students in Ha Noi, Vietnam, to use ETWVs. In order to determine the reasons and preferences that affect students' willingness to use ETWVs, this study used the Theory of Planned Behavior (TPB), and the results showed that the attitude or preference factors of high school students' tendency to use ETWVs included perceived economic benefits, convenience of use, friendly environment feeling, and fashionable appearance design. However, high school students' willingness or purpose to use ETWV is influenced by three factors: individual subjective preference or benchmark, attitude preference to use ETWV, and attractiveness of ETWVs to high school students.

Ferrara et al. [8] explored the usage preference of FTWVs and ETWVs in India and designed five schemes for face-to-face interviews to investigate transportation preferences. The results showed that for individual users, the price and performance of ETWVs are the most subjective direct influencing factors, and when the price and performance of ETWVs reach a certain degree (such as improved battery charging technology), they will have enough attraction for individual users. Other environmental factors that influence the choice of individual users to use ETWVs include the integrity or improvement of the charging infrastructure.

Lee et al. [9] probed into the promotion of E-scooter sharing (ESS) and compared two types of users: one group tended to use the ESS service for commuting, and the other group used ESS service in the first mile and the last mile. The results showed that the socioeconomic characteristics of individuals tend to be younger, have higher income, prefer green energy, are less satisfied with the quality of current public transport services, and they tend to use ESS service frequently.

Eccarius and Lu [10] compared the difference between traditional FTWVs and ETWVs. According to the research results, although fuel driven two-wheeled vehicles have a large impact on air pollution, and ETWVs can meet the needs of most users, the sustainability of ETWVs is not comparable to that of FTWVs. Although the popularization and application of ETWVs are still not as large as that of traditional ETWVs at present, it is a great advantage for the sustainable development of the future environment; thus, it was suggested that ETWVs should be encouraged at the initial stage, and then, the usage restrictions of FTWVs should be gradually adjusted.

Javid et al. [11] investigated the travelers' adoption behavior towards EVs using the theoretical background of the norm activation model (NAM) theory. The collected data were analyzed using factor analysis and structural equation modeling methods. The results showed that car ownership of travelers has a positive correlation with the ownership and usage of EVs. Several approaches were suggested to promote the ownership and usage of EVs. Miralinaghi et al. [12] proposed a framework to address the relationship between consumers' vehicle-purchasing propensities and their route choices, locations of EV-charging, and ICEV-refueling stations. The study can guide the metropolitan transport agencies to establish specific locations and capacities for EV stations. Miralinaghi and Peeta [13] designed a robust multiperiod tradable credit scheme (TCS) to incentivize travelers to shift from internal combustion engine vehicles to zero-emissions vehicles over a long-term planning horizon to reduce vehicular emissions. The robust design can accommodate the uncertainty in forecasting travel demand over years. The proposed TCS design reduced vehicular emission rates under different travel demand scenarios compared to that does not consider demand uncertainty.

3. Methods

The discrete choice model, mixed logit (MXL), that can take preference heterogeneity of individuals into account has been recognized as the most popular econometric method [14]. MXL model also can accommodate with the correlation amongst choice sets drawn from the same respondent. The utility function of the i th alternative for the n th individual can be defined as

$$U_{in} = V_{in} + \varepsilon_{in} = \beta_n' x_{in} + \varepsilon_{in}, \quad (1)$$

where V_{in} is the deterministic utility, ε_{in} is the stochastic component, and β_n is the vector of estimated parameters of the explanatory variable x_n . β_n is assumed to be randomly varied over individuals, and the probability density function

$f(\beta) = (\beta_n \in \beta)$ is represented by parameter θ as the mean and covariance. According to Jou and Yeh [15], the unconditional choice probability of individual n choosing alternative i is given in the following equation:

$$P_{in} = \int L_{in}(\beta_n) f(\beta) d\beta = \int \left(\frac{e^{\beta x_{in}}}{\sum_{j=1}^J \beta x_{jn}} \right) f(\beta) d\beta, \quad (2)$$

where $L_{in}(\beta_n)$ is the probability of a multinomial logit (MNL) model and P_{in} is the weight of the MNL probability. The heterogeneity of individuals can be captured through fixed socioeconomic characteristics by decomposing β_n into b_k and $\varphi * z$. The details are shown in

$$U_{in} = \beta_n' x_{in} + \varepsilon_{in} = (b_k + \varphi * z)' x_{in} + \varepsilon_{in}, \quad (3)$$

where b_k are random parameters and z represent the attributes of individual n , and φ is the parameter vector of attributes z . If b_k are the parameters of the attributes of the alternatives, Jou et al. [16] indicated that $\varphi * z$ interacts among alternatives and individuals and includes market segmentation effects, such as socioeconomic characteristics of individuals or observed heterogeneity.

To understand the impact of a percentage change in an attribute on the change in the probability of choosing a specific TWV's scheme, we apply the direct and cross elasticities specified in Jou and Yeh [15], expressed as

$$e_{x_{jnk}}^{in} = - \int \beta_k L_{jn}(\beta) \left[\frac{L_{in}(\beta)}{P_{in}} \right] f(\beta) d\beta, \quad (4)$$

where β_k is the k th element of β . The percentage change in probability depends on the correlation between $L_{in}(\beta)$ and $L_{jn}(\beta)$ over different values of β .

4. Survey Design and Data Analysis

4.1. Survey Design. In order to understand the preference of college students who buy ETWVs for the first time in Taiwan, the questionnaire design was divided into four parts. The first part is a survey of college students' main trip activities and behaviors, the second part is a survey of college students' ETWV use characteristics, the third part is a survey of socioeconomic data, and the fourth part is a hypothetical scenario, all of which are described as follows:

- (1) Part I: main trip activity behavior of college students.

The main trip activity behavior survey of college students includes the following: respondents' trip purpose, travel time, origins and destinations, the number of times of general school use, and the transfer/use of transit stations. Please refer to Section 4.2.2 for more details.

- (2) Part II: ETWV use characteristics.

This part is aimed at the types of two-wheeled vehicles held (used) by college students, whether they are new vehicles, the use time (year), the mileage (kilometers), and the records of related variable costs (including fuel costs, maintenance costs, and parking costs). The data in this part can facilitate follow-up

studies of college students' choice of variables for the purchase of ETWVs.

- (3) Part III: socioeconomic characteristics.

The survey of individual socioeconomic characteristics includes the following: (1) gender: male or female; (2) age: from 18 to 23 years old or others (open answers), with a total of 7 sections; (3) residential area: including 29 districts in Taichung city; (4) average monthly income of individuals (including petty cash, part-time jobs, and allowances); (5) average monthly income of household: from below US \$720 to above US \$5038, with every US \$720 being an interval; (6) family members: 1 to 6 or more; (7) types of vehicles at home: check the number of motorcycles and cars, respectively; (8) preference for limiting the maximum service life of ETWVs; (9) whether there is a ETWV in the household; (10) whether the individual has ever used a ETWV.











- (4) Part IV: hypothetical scenarios.

The design of the attributes and attribute levels is critical for a choice experiment. We specified five two-wheeled vehicle types with the following attributes provided: maximum capacity, license plate, horsepower, top speed, driving range, recharge time, list price, maintenance cost, fuel cost/recharge cost/battery replacement/rental prices, battery warranty, purchase subsidy, and tax breaks. These attributes were identified as crucial factors influencing the adoption of ETWVs by college students. According to Taiwan's current policy, the incentive policy attributes include purchase subsidy, reduced parking fees, and tax breaks. The incentive's current values were used as a reference point to set attribute levels of the five options and were ensured the rationality of our experimental approach.

Each incentive attribute was designed to three levels, +25%, +50%, and +75%, with respect to its reference point. The base purchase subsidy of ETWV-I and ETWV-II is US \$ 517.00 and US \$ 585.00, respectively. The base reduced parking fee is fixed at US\$ 0.67. The base tax break is US\$ 15. The base tax break is US\$ 46.67. To promote the usage of ETWVs, the practice policy of the parking and tax breaks fee in Taiwan is now free. Therefore, the scenario of ETWV-I and ETWV-II is set at zero.

According to the presented scenarios, the interviewees were asked to answer the types of vehicles they would like to buy in the future. To understand the important considerations for college students to buy ETWVs, the attributes adopted in the experimental design of this study are shown in Table 2. In the selection of the experimental design situations, the orthogonal method was used to reduce the combination of scenarios. Each attribute had two or three levels of values in the nine variable attributes (other attributes are fixed), resulting in $(2^1 \times 3^8)$ scenarios. The number of scenarios was further reduced to 18 groups of scenarios. In order to avoid respondents filling in too many scenarios at

TABLE 2: Attributes' values and levels for five different vehicle types.

	SC-I (100 cc)	SC-II (125 cc)	MT (150 cc)	ETWV-I	ETWV-II
Vehicle types					
Maximum capacity (people)	2	2	2	2	2
License plate	Written in black on a white background 	Written in black on a white background 	Written in black on a white background 	Written in white on a green background 	Written in black on a white background 
Horsepower (hp)	7~8	5.2~8.8	8.5~18.4	1.35~5	5~8.58
Top speed (km/h)	90~100	105~110	120	45	90
Driving range (km)	100	140	150	100	110
Recharge time (h)	—	—	—	4~6	Replacement
List price (US \$)	1600~2600	1630~2800	2470~5260	2400~2730	2460~4300
Maintenance cost (US \$/year)	66.67	83.33	100	33.33	36.67
Fuel cost (F), recharge cost (R), battery replacement/rental prices (B; US \$/year)	Short trip*: 83.3 (F) Long trip*: 166.7 (F)	Short trip: 93.3 (F) Long trip: 183.3 (F)	Short trip: 100 (F) Long trip: 193.3 (F)	Short trip: 5.3 (R) + 216.7 (B*) Long trip: 11.7 (R) + 166.7 (B*)	Short trip: 200 (B**) Long trip: 240 (B**)
Battery warranty	Unlimited, NA	Unlimited, NA	Unlimited, NA	30,000 km/3 yr 60,000 km/5 yr 90,000 km/8 yr +25% base +50% base +75% base	30,000 km/3 yr 60,000 km/5 yr 90,000 km/8 yr +25% base +50% base +75% base
Purchase subsidy (US \$)	0	0	0		
Parking fees (US \$/h)	+25% base +50% base +75% base	+25% base +50% base +75% base	+25% base +50% base +75% base	0	0
Tax breaks (US\$/year)	+25% base +50% base +75% base	+25% base +50% base +75% base	+25% base +50% base +75% base	0	0

the same time, each interviewee filled in two groups of scenarios in the questionnaire. Moreover, this study classified five types of two-wheeled vehicles, SC-I, SC-II, MT, ETWV-I, and ETWV-II, in order for the respondent to choose one among five alternatives. SC-I, SC-II, and MT are FTWVs; ETWV-I and ETWV-II are ETWVs.

This study mainly discussed the behavior of college students choosing two-wheeled vehicles in different situations. The subjects were mainly college students in central Taiwan (including Tunghai University, Feng Chia University, Chung Shan Medical University, China Medical University, Asia University, Chaoyang University of Technology, National Taichung University of Science and Technology, National Chung Hsing University, and Hungkuang University). They engaged in one-to-one interviews, and a total of 902 valid samples were collected.

4.2. Sample Representativeness and Data Analyses

4.2.1. Sample Representativeness Analysis. This study conducted sample representativeness analysis according to the data investigated by the Department of Statistics, Ministry of Transportation and Communications in the Survey Report

on Vehicle Usage [17], and college students aged 18–45 and with junior college to graduate school education were screened out to verify the sample average. The common items between Survey Report and our study include “weekly fuel consumption amount,” “annual maintenance amount,” and “monthly parking cost.” Therefore, sample representativeness tests were performed in terms of the three items.

(1) Weekly fuel cost:

The average weekly fuel consumption of the sample in this study was about US\$3.65/week. Based on the survey results of the Survey Report on Vehicle Usage (2018), the average was US\$ 3.66/week. After further verifying the average of this study and survey report, it was found that the null hypothesis is accepted in the significant level of 5%, which shows that there was no difference between the samples of this study and the survey report in this project.

(2) Annual maintenance amount:

The average number of samples in this study was US \$68.25/year, and the average number in this survey report was US \$70.10/year. Further average testing showed that the null hypothesis is accepted in 5% of

the significant level, which shows that there was no difference in the use characteristics between the samples in this study and the same population reported in the survey.

(3) Monthly parking cost:

In the item of monthly parking cost amount, the average number of the sample in this study was US \$2.54/month, and the average number of the survey report was US \$2.58/year. Further verification of the average number of this study sample and the aforementioned vehicle use survey report showed that the result is in the significant level of 5%, which shows that there is no significant difference between the sample in this study and the survey report.

Analysis of the usage characteristics of this study and the Survey Report on Vehicle Usage (2018) showed no significant difference between the survey results of this study and the survey report under the above three vehicle usage characteristics, which shows that the samples of this study are representative (as shown in Table 3).

4.2.2. Data Analysis

(1) *Analysis of the Main Trip Activities of Using Vehicles.* Analysis of the main activities of vehicle use shows that most college students have two main activities, commuting, which accounts for about 66%, followed by eating, working, or leisure (accounting for about 30%); regarding the purpose of secondary activities, eating and working account for about 63%. In addition, further analysis of college students' vehicle use shows that most vehicles are used for more than 5 minutes, accounting for about 80%; the driving distance of each trip is concentrated in 1~less than 3 km (accounting for about 32%), followed by driving distance which is less than 10 km (accounting for about 84%), and the driving time of each trip is less than 30 minutes (accounting for about 93%). Motorcycles are mostly used for short-distance trips; the average driving speed is between 40 and 70 kph (accounting for 80%), which shows that driving speed is not slow, which may be related to the characteristics of college students' riding habits.

According to the results of exploring the main activities of college students, the number of vehicle use days is mostly more than 5 days (about 72%). Among these results, 7 days account for 45%, which is most noteworthy, as it shows that the short-distance travel service of urban mass transportation for college students may not meet their needs at present; for example, the restrictions on operating hours and boarding places (inconvenient to take public transportation accounts for 19%), low accessibility (high vehicle mobility accounts for 57%, and using vehicles can shorten travel time accounts for 20%), or high boarding costs (low cost of using vehicles accounts for 1.4%). Therefore, more flexible operating hours and higher density of boarding locations would promote a higher usage of public transportation.

This study further explored the transport modes of college students, not including two-wheeled vehicles. Under

the purpose of a single trip, 80% no longer transfer or use other means of transportation, among which the main reasons are short distance (no transfer demand), short trip length, uncertain transfer time, and extra waiting time, which lead to no use of other means of transportation (about 19%), and the inconvenience of vehicle parking when transferring is another main reason (about 15%). These results show that college students give priority to convenience for short-distance travel.

(2) *Analysis of the Use Characteristics of Two-Wheeled Vehicles.* This part analyzed the related characteristics of vehicles used by college students and found that most of the vehicle types used are 125cc, accounting for about 63%; more than 98% of the engines used are four-stroke engines; the purchase amount of vehicles used is between US \$1799 and US \$2879, accounting for about 56%. Most college students spend about US \$2.5–4.6 per week on fuel, accounting for about 53%. Other variable costs, such as monthly parking fees and annual maintenance costs, are concentrated in less than US\$1.8 (about 57%) and US\$53.9 (about 60%), respectively. The aforementioned analysis results also show that, in addition to the possible burden of the purchase amount, the burden of other variable costs can be ignored, as they account for less than 5% of the average monthly income of individuals. Moreover, as two-wheeled vehicles are more convenient than other means of transportation, college students rely on two-wheeled vehicles as their main means of transportation. If the exploration of environmental pollution sources is the starting point, further exploring the important influencing factors of college students' choice of ETWVs will be key to reduce environmental pollution sources.

However, analysis of college students' two-wheeled vehicle ownership and use status showed that more than 73% of college students had just purchased their vehicles, and most were purchased within the last 2 years (about 57%). The usage (accumulated) mileage of newly purchased vehicles was mostly less than 15,000 km, which shows that most users are short-distance users, which is consistent with the aforementioned statistical analysis. On the other hand, if it is a second-hand vehicle, the service life is averaged within 10 years (about 93%).

(3) *Analysis of Personal Data.* Analysis results of the basic personal data collected from the survey in this study are shown in Table 4. Among them, the proportions of males and females are 45% and 55%, respectively, and the age distribution is mostly 19~21 years old (about 22%, 26%, and 19%, respectively, for a total of about 67%), which mainly includes sophomores to the senior year of university. About 72% of college students earn less than US\$360 a month. About 84% of college students have two-wheeled vehicles that are 5–20 years, which highlights that the expected holding time of vehicles after purchase is quite long, and it is necessary to have greater incentives to promote and motivate users to purchase their ETWVs in the future. In addition, the cross analysis of ETWV holding time and riding experience was further analyzed, and it was found that about

TABLE 3: Results of the samples' representative tests.

Item	Average		Z-value	Result
	This study	Survey Report on Vehicle Usage (2018)		
Weekly fuel consumption amount	US \$3.65	US \$3.66	Z = 0.09	Accept the null hypothesis H_0
Annual maintenance amount	US \$68.25	US \$70.1	Z = 1.12	
Monthly parking cost	US \$2.54	US \$2.58	Z = 0.33	

TABLE 4: Basic data analysis.

Title	Question item	Sample (percentage)	Title	Question item	Sample (percentage)	
Gender	Male	405 (44.9)	Monthly income of households	Below US \$720	43 (4.8)	
	Female	497 (55.1)		US \$720–1, 439	96 (10.6)	
Age	18	72 (8)		US\$1439–2159	189 (21)	
	19	194 (21.5)		US\$2159–2879	156 (17.3)	
	20	232 (25.7)		US\$2879–3598	143 (15.9)	
	21	175 (19.4)		US\$3598–4318	99 (11)	
	22	123 (13.6)		US\$4318–5038	64 (7.1)	
	23	52 (5.8)		Above US\$5038	112 (12.4)	
Personal monthly income	Above 24	54 (6)		Number of family members (including oneself)	1	2 (0.2)
	Below US\$0.018	162 (18)			2	14 (1.6)
	US\$0.018–0.036	488 (54.1)	3		95 (10.5)	
	US\$0.036–0.05	116 (12.9)	4		422 (46.8)	
	US\$0.05–0.07	93 (10.3)	5		246 (27.3)	
	US\$0.07–0.09	12 (1.3)	6 and above		123 (13.6)	
Vehicle service life	US\$0.09–0.11	19 (2.1)	Number of vehicles	1	127 (14.1)	
	US\$0.11–0.13	5 (0.6)		2	299 (33.1)	
	Above US\$0.13	7 (0.8)		3	290 (32.2)	
	Less than 5 years	20 (2.2)		4 and above	186 (20.6)	
	5–10 years	215 (23.8)		0	96 (10.6)	
	10–15 years	319 (35.4)		1	453 (50.2)	
Household car ownership	15–20 years	224 (24.8)	2	275 (30.5)		
	20–25 years	82 (9.1)	3	56 (6.2)		
	Over 25 years	42 (4.7)	4 and above	22 (2.4)		

64% of college students have no ETWV and no relevant riding experience, while about 26% of college students have relevant riding experience, but do not own a ETWV, which shows that college students are willing to try new types of transportation, as shown in Table 5.

5. Model Estimation and Elasticity Analysis

This study divided the vehicle selection schemes in the SP situation into five categories: “Scheme I: SC-I (100 cc),” “Scheme II: SC-II (125 cc),” “Scheme III: MT (150 cc),” “Scheme IV: ETWV-I,” and “Scheme V: ETWV-II.” This section calibrated the MXL model first, and then the elasticity analysis was carried out on the estimated model.

5.1. Explanatory Variables for the Model. The definition, mean, standard deviation, and maximum and minimum values are explained according to the explanatory variables of each model, and the relevant explanations are detailed in Table 6, where the last column is other studies using similar variables.

5.2. Model Estimation Results. The estimation results of the MXL model are shown in Table 7, in which the significant variables include “age,” “gender,” “personal income,” “variable cost of vehicles,” “acceptable price of ETWV,” “classification of main reasons for using vehicles,” “looking forward to try/reuse ETWV again,” and “tendency to choose ETWVs if you want to buy vehicles in the future.” The influence of each variable on college students’ choice of vehicles is described as follows. On the whole, younger students tend to buy FTWVs with larger cc (SC-II and MT). In addition to buying fuel vehicles with higher cc, the male students also tend to choose ETWV-II. With higher personal income, people are more willing to buy ETWV-II vehicles. When the variable costs of a vehicle (including fuel cost, maintenance cost, and parking cost) are higher, college students are less inclined to buy a specific fuel vehicle (SC-II). In addition, people who use two-wheeled vehicles due to the inconvenience of mass transportation are less inclined to buy ETWV-I; people who use two-wheeled vehicles due to their high mobility and convenience for other activities are also less inclined to buy ETWV-I. When buying two-wheeled vehicles in the future, those who will directly choose

TABLE 5: ETWV's holding time and riding experience.

Holding or not of ETWV riding experience	No	Yes	Total
No	576 (63.9)	232 (25.7)	808 (89.6)
Yes	10 (1.1)	84 (9.3)	94 (10.4)
Total	586 (65.0)	316 (35.0)	902 (100)

TABLE 6: Description of significant variables in the models.

Explanatory variable	Average mean	Standard deviation	Min	Max	Value setting	References
Gender	0.55	0.49	0	1	0: female, 1: male	Lee et al. [9]; Brückmann et al. [18]; Eccarius and Lu [10]
Age of junior college students	20.63	2.08	18	45	18–45 years old, adopt the actual filled-in value for setting	Lee et al. [9]; Brückmann et al. [18]; Eccarius and Lu [10]
Family size	4.46	1.11	1	12	1–12 persons/household, adopt the actual filled-in value for setting	Brückmann et al. [18]
Personal monthly income	845.29	435.04	360.88	2887.04	Adopt the actual filled-in value for setting	Lee et al. [9]; Brückmann et al. [18]; Eccarius and Lu [10]
Variable cost of two-wheeled vehicle	272.9	117.5	61.4	776.6	Variable cost = fuel cost + maintenance cost + parking fee, which is the value after adding the checked values	Eccarius and Lu [10]
Vehicle purchase price	2124.9	866.9	288.7	7939.4	Adopted the median of the checked value for setting	Eccarius and Lu [10]
Vehicle fuel cost per week	101.651	56.183	22	317	Adopted the median of the checked value for setting	Eccarius and Lu [10]
Reason for choosing traditional vehicles_the price of ETWVs is too high	0.351	0.478	0	1	1: reason for choosing traditional FTWVs_the price of ETWVs is too high 0: otherwise	Thuy and Hong [7]
Reason for choosing traditional vehicles_poor endurance of ETWVs	0.386	0.487	0	1	1: reason for choosing traditional FTWVs_poor endurance of ETWVs 0: otherwise	Thuy and Hong [7]
Reason for choosing electric vehicle_there is a car purchase subsidy	0.240	0.427	0	1	1: reason for choosing ETWVs_those who have purchase subsidies; 0: otherwise	Thuy and Hong [7]
Reasons for choosing electric vehicle_the price of electric car is reasonable	0.053	0.225	0	1	1: reason for choosing ETWVs_the price of ETWV is reasonable 0: otherwise	Thuy and Hong [7]
Choose electric vehicle reason_fuel tax/license tax exemption	0.192	0.394	0	1	1: reason for choosing ETWVs_fuel tax/license tax exempt 0: otherwise	Thuy and Hong [7]

TABLE 6: Continued.

Explanatory variable	Average mean	Standard deviation	Min	Max	Value setting	References
Reasons for choosing electric vehicle_good operating efficiency (horsepower, speed, driving distance, etc.)	0.079	0.270	0	1	1: reason for choosing ETWVs_those with good operating efficiency (horsepower, extreme speed, driving distance, etc.) 0: otherwise	Thuy and Hong [7]
It is my duty to take practical actions and buy ETWVs to protect the environment and limit greenhouse gas emissions	3.775	1.068	1	5	1: strongly disagree 2: partly disagree; 3: neutral 4: partly agree 5: strongly agree	Thuy and Hong [7]
I look forward to trying/using ETWVs again	3.534	1.007	1	5	1: strongly disagree 2: partly disagree 3: neutral 4: partly agree 5: strongly agree	Huang [7]; Thuy and Hong [7]; Eccarius and Lu [10]
I think at the current price of ETWVs, it has provided good value	3.044	0.940	1	5	1: strongly disagree 2: partly disagree 3: neutral 4: partly agree 5: strongly agree	Thuy and Hong [7]; Eccarius and Lu [10]
The government cash subsidy policy is very attractive for me to buy ETWVs	3.421	1.046	1	5	1: strongly disagree 2: partly disagree 3: neutral 4: partly agree 5: strongly agree	Eccarius and Lu [10]
I think using ETWVs can improve the quality of going out	3.441	0.927	1	5	1: strongly disagree 2: partly disagree 3: neutral 4: partly agree 5: strongly agree	Thuy and Hong [7]; Huang [7]; Eccarius and Lu [10]
The acceptable price of ETWV	1917.2	824.34	0	1082.6	Adopt the actual filled-in value for setting	—
High household income (greater than the sample average US\$2835/month) + male + agreed to spend more money on ETWVs for environmental protection	0.114	0.318	0	1	0: those who do not belong to this group 1: those who belong to this group	—
High household income (greater than the sample average US\$2835/month) + male + agree that electric car is the first choice to buy a car in the future	0.062	0.241	0	1	0: those who do not belong to this group 1: those who belong to this group	—

TABLE 7: Estimation results of MXL model.

Alternative	Variable	Coefficient	Standard deviation	b/ St.Er.	$ P[Z > z]$	PDF function
Random variable	I will choose ETWV if I want to buy a vehicle (in the future) (ETWV-II)	1.91	0.43	4.40	0.00	Normal
Fuel vehicle 100 cc (SC-I)	—	—	—	—	—	—
	Constant	3.11	0.34	9.11	0.00	Fixed
Fuel vehicle 125 cc (SC-II)	Age	-0.19	0.07	-2.92	0.00	Fixed
	Gender	0.61	0.23	2.68	0.01	Fixed
	Vehicle variable cost	-0.89	0.26	-3.43	0.00	Fixed
	Constant	0.42	0.40	1.05	0.30	Fixed
Fuel vehicle 150 cc (MT)	Age	-0.31	0.08	-3.74	0.00	Fixed
	Gender	2.87	0.32	8.92	0.00	Fixed

TABLE 7: Continued.

Alternative	Variable	Coefficient	Standard deviation	b/ St.Er.	P[Z > z]	PDF function
Regular lightweight electric vehicle (ETWV-I)	Constant	-4.43	0.67	-6.60	0.00	Fixed
	Use vehicle only_inconvenient to take public transportation	-1.05	0.43	-2.45	0.01	Fixed
	Main reason, high mobility and convenience for other activities	-0.96	0.31	-3.09	0.00	Fixed
	I will choose ETWV if I want to buy a vehicle (in the future)	1.63	0.17	9.63	0.00	Fixed
Heavy duty electric vehicle (ETWV-II)	Constant	-10.24	3.19	-3.21	0.00	Fixed
	Gender	0.87	0.40	2.20	0.03	Fixed
	Personal income	0.31	0.17	1.84	0.07	Fixed
	Acceptable price of ETWV	0.21	0.10	1.99	0.05	Fixed
Standard deviation of parameter allocation	I look forward to trying/reusing ETWV	0.50	0.29	1.73	0.08	Fixed
	I will choose ETWV if I want to buy a vehicle (in the future) (ETWV-II)	0.75	0.34	2.18	0.03	—
	LL (0)			-1231.091		
	LL (β)			-980.531		
	ρ^2			0.204		

TABLE 8: Elasticity analysis of socioeconomic and vehicle use characteristics.

Variable	Fuel vehicle			ETWV	
	100 cc SC-I	125 cc SC-II	150 cc MT	Lightweight ETWV-I	Heavy duty ETWV-II
Age (SC-II)	0.313	-0.358	0.313	0.313	0.204
Age (MT)	0.215	0.215	-0.852	0.215	0.140
Gender (SC-II)	-0.135	0.205	-0.135	-0.135	-0.089
Gender (MT)	-0.576	-0.576	1.006	-0.576	-0.383
Gender (ETWV-II)	-0.051	-0.051	-0.051	-0.051	0.269
Personal monthly income (ETWV-II)	-0.083	-0.083	-0.083	-0.083	0.399
Variable cost (SC-II)	0.299	-0.376	0.299	0.299	0.199
Acceptable price of ETWV (ETWV-II)	-0.128	-0.128	-0.128	-0.128	0.579

TABLE 9: Elasticity analysis of the policy promotion strategy.

Variable	Fuel vehicle			ETWV	
	100 cc SC-I	125 cc SC-II	150 cc MT	Lightweight ETWV-I	Heavy duty ETWV-II
Use only vehicles_people with inconvenience due to public transportation (ETWV-I)	0.019	0.019	0.019	-0.175	0.006
Use only vehicles_high mobility and convenience for other activities (ETWV-I)	0.062	0.062	0.062	-0.485	0.021
If I want to buy a motorcycle now (in the future), I will choose an electric vehicle (ETWV-I)	-0.883	-0.883	-0.883	4.218	-0.284
I look forward to trying/using the electric vehicle again (ETWV-II)	-0.211	-0.211	-0.211	-0.211	0.881
If I want to buy a motorcycle now (in the future), I will choose an electric vehicle (ETWV-II)	-0.834	-0.834	-0.834	-0.834	3.686

ETWVs will tend to choose ETWV-I and ETWV-II. Moreover, the higher the price of ETWV, the more likely college students are to choose ETWV-II. Finally, those expecting to try/reuse ETWVs tend to buy ETWV-II. The main advantage of using MXL model is that random parameters can be tested, and the unobservable heterogeneity of individuals can be further explained by setting random parameters. The coefficient of “if you want to buy vehicles in the future, you tend to choose heavy duty ETWVs” has

normal distribution and is statistically significant, which shows that college students’ purchase of heavy duty ETWVs will be influenced by the heterogeneity of college students’ tendency to buy ETWVs in the future.

5.3. *Elasticity Analysis.* Further elasticity analysis was carried out for socioeconomic, vehicle use characteristics, attitude tendency, and incentive policy, which are all explained, as follows:

(1) Socioeconomic and vehicle use characteristics:

Table 8 shows the percentage of change in the probability of each option when the value of each variable changes by 1% (or 1 unit). The analysis results show that, when the age of college students is higher, they are less inclined to buy SC-II and MT, and the purchase probability of other vehicle types will increase by 0.14%~0.313%. Males tend to buy SC-II, MT, and ETWV-II, while the purchase probability of other vehicle types will decrease by 0.089%~0.576%. If the monthly income of individuals is higher, they will be more inclined to buy ETWV-II, and the purchase probability of other vehicle types will decrease by 0.083%. If the variable costs of vehicles are higher, they are less inclined to buy SC-II, but the purchase probability of other vehicles will increase by 0.199%~0.299%. Finally, people who are willing to pay higher amounts for ETWVs tend to buy ETWV-II, but the purchase probability of other types will decrease by 0.128%.

(2) Analysis of attitude tendency:

Table 9 shows the percentage change in the probability of each option when the value of each variable changes by 1% (or 1 unit). The analysis results show that, if you belong to the group that uses vehicles due to the inconvenience of public transportation, you will be less inclined to buy ETWV-I, and the purchase probability of other vehicle types will increase by 0.006%~0.019%. By the same token, if you belong to the group that uses vehicles due to its high mobility and convenience to engage in other activities, you will be more inclined not to buy ETWV-I, and the purchase probability of other vehicles will increase by 0.021%~0.062%. If members of this group want to buy a vehicle in the future, they will choose the group of ETWVs and be more inclined to buy ETWV-I and ETWV-II vehicles, but the purchase probability of other vehicle types will be reduced by 0.284%~0.883%. In addition, the ETWV-II is more likely to be purchased in the category of "looking forward to try/reuse ETWVs," but the purchase probability of other vehicles will be reduced by 0.211%.

6. Conclusions and Suggestions

At present, the ETWVs available in the current market cannot effectively attract consumers who are buying ETWVs for the first time, which may lead to a sales window due to high selling price, insufficient establishment of related equipment (charging or maintenance), and limited experience/trust in ETWVs. Therefore, in this study, the potential groups (college students) of buying ETWVs in the future were investigated by questionnaire, and their choice preferences were explored, in order to know whether the potential consumers or ethnic groups have different dependence and usage requirements for ETWVs, as

compared with fuel-driven vehicles. According to the abovementioned research and analysis, the results are summarized as follows.

6.1. Conclusions

- (1) According to the results of MXL estimation, the factors that influence the choice of the fuel vehicle scheme include "age," "gender," and "variable costs of vehicles." The factors that influence the choice of the ETWV vehicle scheme include "gender," "personal income," "acceptable price of ETWV," "If I want to buy a vehicle now (in the future), I will choose an electric vehicle," and "I look forward to trying/using an electric vehicle."
- (2) In addition, the coefficient of the random parameter "If I want to buy a vehicle now (in the future), I will choose an electric vehicle (ETWV-II)" in the MXL is normal distributed and significant, which shows that college students hope to have different choices for ETWVs through vehicle purchase schemes in the future.
- (3) Moreover, college students who choose the fuel vehicle scheme can be divided into three ethnic groups: male, younger, and those who prefer heavy duty fuel vehicles; for those who choose the ETWV vehicle scheme, there are four groups: male, college students with higher personal disposable income, willing to pay a higher amount for ETWV, and expecting or trying to use it.
- (4) The results of elasticity analysis show that the probability of ETWV purchase (including ETWV-I and ETWV-II) will increase under specific groups; for example, groups with socioeconomic or usage characteristics, such as males, those with higher personal income, and those who are willing to pay a higher price for a ETWV, will have a higher probability of a ETWV purchase by 0.199%~0.579%.
- (5) According to the results of attitude tendency analysis of elastic analysis, the groups with higher purchase probability of a ETWV (including ETWV-I and ETWV-II) can be subdivided into two categories: those who belong to the category "I expect to try/use ETWVs again" and those who belong to the category "I will choose ETWVs if I want to buy vehicles now (in the future)," both of which have higher purchase probabilities of ETWV by 0.881%~4.2182%.
- (6) Practically speaking, the carbon emission of FTWVs is 0.055 kg/km which is twofold of the one of ETWVs which is 0.0265 kg/km [19]. According to the data shown in MOTC [2], the average of total distance traveled by TWs per year is around 3000 km. There are 1.2 million college students in 2020, which accounts for 5% of Taiwan population [3]. If we assume, ideally, at least 80% of the college students use ETWVs, the environment will benefit from the reduction of emissions by at least 82,000 tons of carbon emission per year.

6.2. *Suggestions.* The following suggestions are summarized according to the above conclusions:

- (1) Develop marketing strategies for different age groups:

The younger group of college students have a higher probability of buying ETWV-I and ETWV-II by 0.140%~0.313%, respectively, and this phenomenon shows that age has an impact on the purchase probability of ETWVs. In the future, efforts should be made to promote test drives of ETWVs. When introducing related activities or marketing strategies, it is suggested to subdivide the age groups of college students; for example, high school graduates, freshmen, and sophomores can be introduced to market lightweight ETWVs as short-distance commuting modes around campus, which will enable college freshmen to become familiar with the driving mode first. At the same time, their first vehicle can be purchased at a lower price, which is conducive to the promotion and use of ETWVs.

For junior to graduate students, as they are familiar with the various places around campus (e.g., restaurants and famous shops) and have a wider range of activities, as compared with freshmen and sophomores, heavy duty ETWVs can be marketed for college students of this age group. The endurance, power, and price of heavy duty ETWVs are larger than those of lightweight ETWVs, thus college students can travel locally, commute, and even travel around the island, which will improve the purchase probability of heavy duty ETWVs.

- (2) Gender-oriented promotion strategies:

According to the premise of choosing the ETWV scheme, male college students are more willing to buy ETWVs, which shows that some usage characteristics of ETWVs can attract male groups, thus it is suggested that the promotion of ETWVs can be designed to attract the younger male group of college students to improve their purchase intention. For example, Gogoro 2 Rumbler was designed to attract male users by using favorable color matte coating (silver and black) and 12-inch multifunctional tires which can accommodate different terrain. On the other hand, since the preference rate of ETWVs for female users is lower, more actions are applied to promote ETWVs by the industries. For example, the weight of vehicle, the angle of handles, the height of chair, and the space of storage were adjusted according to the figure of female users.

- (3) Plan to promote vehicles to different groups:

According to the results of this study, the higher the personal income of college students, the higher the probability of choosing ETWV. This phenomenon shows that the family economic status or personal disposable income should be relatively abundant. Therefore, it is suggested to design and plan different

ETWV promotions according to different stages; for example, ETWV equipment, power, and matching monthly fee schemes can be differentiated to meet the use needs of college students at different income levels. Moreover, exclusive monthly fee schemes or vehicle purchase schemes can be designed for college students, meaning students with different statuses can be provided with different purchase preferential schemes to improve their ETWV purchase intention.

- (4) Different warranty and rate schemes:

In the factor of variable costs, when the variable costs of a vehicle are higher, the probability of buying ETWV will increase by about 0.199%~0.299%. This phenomenon shows that, when the variable costs of traditional fuel vehicles are too high, the disposable income of college students will decrease, thus reducing the variable costs of ETWVs can attract college students to purchase. Specific practices can be matched with different warranty schemes under the combination of different rate schemes; for example, the basic scheme is designed for basic usage (fixed mileage in a single month), the “no regular return to the factory maintenance scheme”, medium usage (such as 300–600 km mileage in a single month) with the “regular back-to-factory maintenance scheme,” or high usage (600–1000 km mileage in a single month) with the “regular back-to-factory maintenance and limited warranty scheme.” Thus, combinations of different warranties and rate schemes can increase the purchase probability of ETWVs.

- (5) Strengthen the use experience and experience feedback of experienced and new users:

Regarding the groups that are willing to pay higher prices for ETWVs, their concepts and perceptions of ETWVs are supportive and positive, thus it is suggested that freshmen can be targeted in follow-up promotion strategies. New ETWV usage experience or “ETWV Experience Meeting of Special Groups” can be held among students who are about to become graduate students (for example, when a manufacturer’s new mobile phone is published, invitations will be sent to experienced members or new members to experience the functions of the new mobile phone through invitation, which achieves good use experience and promotes purchase), thus these two groups were selected. Regarding freshmen who are willing to pay a higher amount for ETWVs, the use experience and experience feedback of their first vehicle will often affect the type selection of replacement vehicles in the future, thus, if effective marketing and experience can be carried out for such groups, the willingness to buy ETWVs should be enhanced; regarding college students who are about to become graduate students, meaning the change from university stage to academic research stage, as they are familiar with the surrounding environment and the service life of vehicles is limited, if we can

match the strategies mentioned in points 1 to 4 above to promote different combination schemes, we can also effectively improve the willingness to buy ETWVs for students who are willing to pay higher prices.

In addition, for the groups of “I look forward to trying/using ETWVs again,” “If I want to buy a vehicle now (in the future), I will choose ETWVs,” “I have a good impression of ETWVs,” and “I tend to use ETWVs,” the development of different promotion strategies can be coordinated with the above-mentioned similar “ETWV Experience Meeting of Special Groups (that is, ETWV club activities organized by manufacturers),” meaning user groups who have used or owned ETWVs in the past can be targeted. While those who have used (or held) ETWVs in the past have good experience in using ETWV, they may not be familiar with the new models, new rate schemes, and accessory combinations, thus such features can be used to promote new models to increase the purchase intention of ETWVs.

- (6) Reinforce the gap of public transportation by ETWVs:

For the group of “only use vehicles due to the inconvenience of public transportation,” as public transportation is underdeveloped in some areas, this group will tend to use vehicles. However, as underdeveloped public transportation is often located in remote or sparse areas in peripheral business districts, lightweight ETWVs are not preferred to be purchased and used. In this regard, private transport modes that feature mobility, endurance, and a good warranty are favored by college students, such as 100 cc fuel-driven vehicles, heavy duty 150 cc vehicles, or even heavy duty ETWV-II. Therefore, at this stage, public bike sharing (PBS) is often adopted for “the last mile” in Taiwan. In addition to PBS, E-scooter sharing (ESS) services have been deployed for short- and medium-range (3~6 km) connections, but the ETWV models are mainly ETWV-I models. If ETWV-II or above can be introduced in the future to provide a faster driving experience to reach the destination, it should effectively improve the willingness of college students to use or purchase heavy duty ETWVs.

- (7) The sample target was the college student who was riding FTWVs at the time of survey conducted.

The questionnaire asked, which alternative they would choose if they were going to replace the old one (FTWV)? Five alternatives including 3 types of FTWVs and 2 types of ETWVs were presented. As such, the ownership of TWVs remains the same, except the emissions are reduced. Meanwhile, promoting programs should keep on for all of the groups. In this way, a synergy of public transit, shared mobility, and EVs will be more effective.

Data Availability

Data can be available upon request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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