



ISSN: 2508-7894

KJAI website: <http://acoms.kisti.re.kr/kjai>Doi: <http://dx.doi.org/10.24225/kjai.2023.11.3.7>

Investigating Factors that affect Attitude on Electric Vehicles for Global Climate Change and Environmental Policy

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Received: April 10, 2022. Revised: May 02, 2023. Accepted: May 22, 2023.

Abstract

Purpose: The purpose of this study is to investigate how consumers perceive electric vehicles and factors that affect attitude, satisfaction, and intention to use electric vehicles and to explore policy issues regarding climate change and global environment. By classifying actual and potential users, this study developed the following research questions: i) factors including economic feasibility, sociality, environmental sustainability, inefficiency, inconvenience, convenience, and uncertainty affect attitude to electric vehicles; ii) attitude to electric vehicles affects actual consumers' satisfaction; and iii) attitude to electric vehicles affects potential users' intention to use. **Research design, data and methodology:** This study conducted an online survey and applied factor and regression analyses and ANOVA to test hypotheses. **Results:** The results of this study found that economic feasibility and convenience factors significantly affect attitude in both cases of actual and potential users. How actual users perceive efficiency of electric vehicles negatively and uncertain issues such as battery technology affect attitude to electric vehicles. **Conclusions:** This study provides policy implications that foster promotional policies for the adoption of electric vehicles for environment and regulate negative aspects. This study also provides managerial implications for manufacturers to develop better technology competences to enhance reliability on electric vehicles.

Keywords: Electric Vehicles, Environment Policy, Attitude, Satisfaction, Intention to Use

Major Classification Code: M30, M31, M38, M39

1. Introduction

The world has experienced climate disasters due to climate change over the past few years, therefore, there is the need to prepare better policies to respond climate issues (Ramli et al., 2021). To resolve climate change and environmental concerns, countries have accelerated the declaration of carbon neutrality, which is the long-term policy plan for ultimate greenhouse gas reduction. Governments in countries have prepared regulations regarding greenhouse gas reduction in every industrial sector including the transportation industry sector based on the perspective of environmental policy. Reducing greenhouse gas emissions in the transportation sector has become an imperative policy issue for obligation (Gulzari

et al., 2022). Since there is a strong need to reduce greenhouse gas in the transportation sectors, electric and hydrogen vehicles change the paradigm shift in the automobile industry and increase the attention in environmentally friendly vehicles (Ju et al., 2021).

Electric vehicles can contribute to sustainable outcomes as an alternative, if consumers adopt it as environmentally friendly innovations (Barbarossa et al., 2017). Policymakers encourage the spread of all-electric mobility, regardless of vehicle-specific technologies (i.e., fully electric vehicles and hybrids) (Armenio et al., 2021). These policies could help achieve a reduction of greenhouse gas in the transportation sector (Manjunath & Gross, 2017). Several incentives such as free parking, not paying a specific vehicle tax, and subsidy for purchase, have been introduced (Nanaki & Koroneos, 2016) in the

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case of adoption of an electric vehicle. The transition from conventional vehicles to electric vehicles is having a direct impact on the operations of automobile manufacturers and auto parts suppliers (Shillington et al., 2021). The shift in consumer behavior from conventional vehicles to electric vehicles, along with changes in automobile manufacturers, has accelerated the growth in demand for electric vehicles. Therefore, it is very important for companies that develop environmentally friendly vehicles to take the lead in technology development by accurately reflecting and supplementing consumer needs on changes in consumer perception (Bakar & Hasan-Basri, 2017). However, there are practical limitations to expand the supply of electric vehicles due to limited budgets and regulatory policies and concerns associated with customer behavioral changes including reluctant intention to use due to issues such as reduced subsidies, lack of charging infrastructure, long charging times, and accidents because of fire problems (Danielis et al., 2020).

The purpose of this study is to explore positive and negative factors of electric vehicles and to investigate how those factors affect consumer attitude, satisfaction and potential buyers' intention to use. Electric vehicles were selected in this study among various environmentally friendly vehicles, because they are currently the most widely adopted environmentally friendly vehicles. The number of consumers using electric vehicles is also growing rapidly. Further, government policies to encourage the use of electric vehicles and automobile manufacturers to increase electric vehicle production can also be seen as accelerating this phenomenon. By analyzing the differences in perceptions of actual and potential users, this study also examines how to reduce potential users' concerns about electric vehicles to foster adoption rate of electric vehicles. Therefore, the ultimate goal of this study is to enhance customer satisfaction on electric vehicles and increase adoption rates with preparation of better policies on electric vehicles. This study classifies actual and potential users of electric vehicles and proposed the following research questions: 1) how do variables such as economic factors, social factors, environmental factors, inefficiency, convenience, and uncertainty affect overall attitudes toward electric vehicles? 2) how do attitude affect users' satisfaction in the case of actual users of electric vehicles? and 3) how do attitude affect potential intention to purchase electric vehicles in the case of potential users? This study provides implications on promoting and regulating policies for development and adoption of electric vehicles. Therefore, this study can be seen as a process evaluation in which users evaluate the policies currently being implemented. In addition, it can be seen as a preliminary evaluation in terms of setting the overall direction of development of the electric vehicle industry through evaluation and implementation of policy proposals accordingly.

2. Literature Review

Environmentally friendly vehicles can be defined as vehicles with improved technology to reduce greenhouse gas and harmful emissions as compared to conventional vehicles (Ju et al., 2021). Electric vehicles are defined as vehicles powered by an electronic motor, using electricity stored in an on-board battery which has to be charged, typically by plugging the vehicle in to a recharging point connected to the local electricity grid (European Environment Agency (EEA), 2022). Electric vehicles have been developed with the invention and development of storage batteries and have rapidly spread by reducing smell, vibration and noise, as compared to gasoline vehicles (Wilson, 2022). Electric vehicles are considered to be one of essential ways for sustainability, particularly in the perspective of environment (Lee & Cho, 2021). Governments of major countries have prepared detailed standards for reducing carbon emissions in recent years to achieve carbon neutrality because it is an essential part of responding to climate change (IEA, 2022). Accordingly, global automobile manufacturers are also rapidly pushing for large-scale electric vehicle production, because electric vehicles have been identified as one of the major opportunities to reduce greenhouse gas emissions in the transportation sector and fossil fuel consumption (Abouee-Mehrzi et al., 2021).

In the case of products with new technologies such as electric vehicles, the completeness of the technology and the acceptance of consumers are very important (Vassileva & Campillo, 2017). Previous studies have shown that perceived factors have a direct influence on the attitudes towards adoption of technology (Chen & Chang, 2012; Davis et al., 1989). Therefore, it is very important to analyze the positive and negative factors of electric vehicles (Egbue & Long, 2012; Williamson et al., 2007). The challenge for the electric vehicle industry is to build market share and consumer demand beyond the domination of internal combustion engines for personal transportation for a century (Carley et al., 2013). An effective way to get consumers to adopt electric vehicles is to gain knowledge of electric vehicles, which is an essential prerequisite for the transition (Noppers et al., 2014). Previous studies have recognized that technology, safety, convenience, economic, and social factors, as well as environmental issues were related to consumers' purchase of electric vehicles (Bireselioglu et al., 2018; Rezvani et al., 2015). According to Ju et al. (2021), positive factors for using electric vehicles include low maintenance costs and economic benefits such as government subsidies, which can dilute negative aspects such as relatively expensive prices. Ozaki and Sevastyanova (2010) have addressed how consumers consider the environmental-friendly factors of electric vehicles as an important reason for their purchase even though there are subsidies of purchasing electric vehicles. The short mileage due to the lack of battery capacity (Degirmenci & Breitner, 2017), insufficient charging

infrastructure, and long charging times (Liao et al., 2017) are also considered as negative factors in the purchase of electric vehicles. Therefore, this study analyzes the perceived factors of electric vehicles on attitude by classifying actual and potential users of electric vehicles.

3. Hypotheses Development

This study investigates the effects of positive and negative factors on attitude toward electric vehicles and effects of attitude on satisfaction and intention to use electric vehicles. This study proposes factors including economic feasibility, sociality, environmental sustainability, inefficiency, inconvenience, convenience, and uncertainty of electric vehicles. This study develops hypotheses by classifying actual users who have experience using electric vehicles and potential users who have no experience in using electric vehicles. Further, it is expected that the promoting and regulatory policies based on analysis of perception will help derive policy implications and increase usage and purchase intention of electric vehicles.

3.1. Effects of Economic Factor on Overall Attitude

Schmelzer & Miess (2015) analyzed that the high price of electric vehicles increases the average vehicle price and negatively affects consumption. Previous studies addressed that the purchase cost of expensive electric vehicles had a negative effect on electric vehicle preference (Hidrue et al., 2011; Jensen et al., 2013). However, the operating costs of electric vehicles, particularly fuel and maintenance costs, tended to be lower than internal combustion engine vehicles (Brase, 2019). Liao et al., (2017) found that reducing taxes on the purchase of electric vehicles is very effective in favoring electric vehicles, while the details of these patterns depend on the vehicle model, local fuel/electricity rates, driving patterns, and other factors (Lee & Lovellette, 2011). Therefore, this study hypothesizes the effects of economic factors on overall attitudes toward electric vehicles of actual and potential users. This study used “a” for hypothesis of actual users and “b” for potential users.
H1a~b: Perceived economic factors of electric vehicles affect overall attitude of actual and potential users.

3.2. Effects of Social Factor on Overall Attitude

Electric vehicle usage viewed by others can influence electric vehicle acceptance (White & Sintov, 2017). Previous studies examine that social values can be measured by investigating perceived values of consumers (Brown, 2006; Sheth et al., 1991; Sweeney & Soutar, 2001). Electric vehicles can be regarded as the more technology advanced products than the conventional

internal combustion engine vehicles. Maya et al. (2011) have stated that people behave according to the social acceptance of a certain behavior when making decisions. Vongurai (2020) have examined the relationship between environmental concern and social influences. According to Noppers et al. (2014), people tend to be motivated to adopt sustainable innovations because of their positive environmental and symbolic attributes. Therefore, it is necessary to study how such innovations influence consumer’s electric vehicle adoption behavior. Therefore, this study hypothesizes the effects of social factors on overall attitudes toward electric vehicles.

H2a~b: Perceived social factors of electric vehicles affect overall attitude of actual and potential users.

3.3. Effects of Environmental Factor on Overall Attitude

Environmental factors are significant issues and motivations for users in purchasing electric vehicles and supporting the development of the electric vehicles by the government. Wang et al. (2018) have investigated the factors of electric vehicle purchase intention of potential consumers and found that moral responsibility for environmental protection was the main influencing factor. López-Gamero et al. (2000) have examined that perceived environmental factors are key issues to drive consumers to adopt electric vehicles. The sustainability of environmental factors promotes adoption of green products (Chen, & Chang, 2013). In this regard, as a sustainable innovation, electric vehicles reduce CO₂ emissions and fuel consumption (Jiang et al., 2017). Rezvani et al. (2015) have reported that consumers are more environmentally conscious and willing to purchase electric vehicles because of their environmental benefits. Previous studies have also argued that environmental awareness is a key factor that can influence perceptions of electric vehicles, which in turn influence intentions to use such types of vehicles (Moons & Pelsmacker, 2012; Sefora et al., 2019). Therefore, this study hypothesizes the effects of environmental factors on overall attitudes toward electric vehicles.

H3a~b: Perceived environmental factors of electric vehicles affect overall attitude of actual and potential users.

3.4. Effects of Inefficiency on Overall Attitude

Development of battery technology is key drive an electric vehicle and is regarded as a significant factor for adoption by consumers. Potential consumers are less motivated to purchase an electric vehicle due to concerns about short mileage, which is considered as a major factor hindering the spread of electric vehicles (Degirmenci & Breitner, 2017; Ju et al., 2021). Degirmenci and Breitner (2017) have analyzed that the short mileage of electric vehicles is caused by a lack of battery technology and negatively affects preferences. On the other hand, electric

vehicle consumers felt satisfaction through adaptation to the mileage and stated that mileage anxiety is not actually a big problem in electric vehicles (Franke et al., 2012). According to Vassileva and Campillo (2017), the initial mileage anxiety has decreased over time because knowledge and confidence improved as the driving time increased. Other issues related to inefficiency included fuel efficiency and charging/discharging efficiency based on season or weather. Therefore, this study hypothesizes the effects of inefficiency on overall attitudes toward electric vehicles.

H4a~b: Perceived inefficiency of electric vehicles affects the overall attitude of actual and potential users.

3.5. Effects of Inconvenience and Convenience on Overall Attitude

How consumers perceive convenience of using electric vehicles might include accessibility of charging facilities, charging time, and performance of electric vehicles that can be experienced while using electric vehicles. The disadvantage of electric vehicles includes a separate battery charging infrastructure and long charging times (Zhang et al., 2016). Long charging time and the lack of charging infrastructure are considered to be main obstacles to the adoption of electric vehicles (Liao et al., 2017). However, since electric vehicles operate with electric power without generating the noise (Degirmenci & Breitter, 2017) is considered as an advantage. Therefore, this study considers how people perceive inconvenient aspects such as charging facilities and charging time of electric vehicles and convenient aspects such as reduced noise. Therefore, this study hypothesizes the effects of inconvenience such as battery charging facilities and charging time and convenience factors such as performance on overall attitudes toward electric vehicles.

H5a~b: Perceived inconvenience aspects of electric vehicles affect the overall attitude of actual and potential users.

H6a~b: Perceived convenience aspects of electric vehicles affect the overall attitude of actual and potential users.

3.6. Effects of Uncertainty on Overall Attitude

Zubaryeva et al. (2012) have addressed that the lack of stability for the battery is perceived as an uncertainty in purchasing electric vehicles. Inconsistent promotional policies regarding electric vehicles such as subsidies, tax benefits might cause uncertainty when users make decision to purchase electric vehicles. According to Nepomuceno et al. (2014), perceived risk includes uncertainty in relation to the use of products or services, which negatively affects purchasing behavior. In addition, disruptions in the supply of raw materials for batteries and automotive semiconductors due to global supply chain problems are causing significant delays in the receipt of

purchased electric vehicles. Therefore, this study hypothesizes the effects of uncertainty (e.g., inconsistent promotional policies) on overall attitudes toward electric vehicles.

H7a~b: Perceived uncertainty of electric vehicles affects the overall attitude of actual and potential users.

3.7. Effects of Attitude on Satisfaction and Intention

Previous studies proposed to use the term attitude to refer to the evaluation of an object, concept, or behavior along a dimension of favor or disfavor, good or bad, like or dislike (Ajzen & Fishbein 2000; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Previous studies (Ajzen & Fishbein 2000; Fishbein & Ajzen, 1975) have addressed that people's evaluations of, or attitudes toward, an object are determined by their accessible beliefs about the object or attribute. Oliver (1980) addressed relationships among attitude, consumer satisfaction, and purchase intentions. Perceived positive attitudes influence behavioral intentions to use, and individuals may have conscious plans to perform specific behaviors (Brezavšček et al., 2017). Therefore, this study hypothesizes that attitude toward electric vehicles affects user satisfaction in the case of actual users, while attitude affects purchase intention in the case of potential users.

H8: Positive attitude toward electric vehicles affects higher levels of user satisfaction.

H9: Positive attitude toward electric vehicles affects higher levels of intention to use.

4. Methodology

4.1. Data Collection

This study collected data via an online survey. The survey was distributed through an online community (web portal NAVER's electric vehicle club) and SNSs. The questionnaire includes warm-up questions, main questions, and demographic questions. This study developed several questions for major factors such as economic feasibility, sociality, environmental sustainability, inefficiency, inconvenience, convenience, and uncertainty. This study applied a 5-point Likert scale of 1 – strongly disagree and 5 – strongly agree for major variables. The total of 134 respondents completed the survey. Among respondents, 78 respondents have experiences of electric vehicles and 55 respondents do not have experiences of electric vehicles. The response rate is 32.9%. Table 1 summarized demographic characteristics of respondents.

Table 1: Summary of Demographics

	Actual users (%)	Potential users (%)
Gender		

Male	78.2	50.9
Female	21.7	49.1
Age		
21-24 years old	1.3	1.8
25-29 years old	0	5.5
30-34 years old	26.9	30.9
35-39 years old	16.7	25.5
40-44 years old	33.3	21.8
45-49 years old	10.3	12.7
50-54 years old	7.7	1.8
55-59 years old	1.3	0
More than 60 years old	2.6	0
Education		
High school	2.6	1.8
2-year associated degree	11.5	7.3
Bachelor degree	59	56.4
Master degree	20.5	32.7
Ph.D	6.4	1.8
Average Annual Salary (KRW)		
Below 10,000,000	0	5.5
Between 10,000,000 ~ 20,000,000	1.3	0
Between 20,000,000 ~ 30,000,000	3.8	3.6
Between 30,000,000 ~ 40,000,000	16.7	14.5
Between 40,000,000 ~ 50,000,000	12.8	12.7
Between 50,000,000 ~ 60,000,000	17.9	25.5
Between 60,000,000 ~ 70,000,000	17.9	12.7
	29.5	25.5

4.2. Data Analysis

The validity was checked by using factor analysis by applying the extraction method with a varimax rotation of Kaiser. Principal component analysis was used as the method for extraction with maximum iterations for convergence as 25. This study applied factors that Eigenvalues are greater than 1.00. KMO was .767 in the case of actual users and 0.712 in the case of potential users. Bartlett’s test of Sphericity showed significant at 1%. Communalities were above 0.70. In order to check reliability, this study conducts Cronbach’s alpha. In the case of actual users, Cronbach’s alpha showed 0.838 for economic factor, 0.776 for sociality factor, 0.691 for environment factor, 0.924 for inefficiency factor, 0.673 for inconvenience factor, 0.569 for convenience factor, and 0.776 for uncertainty factor. In the case of potential users, Cronbach’s alpha showed 0.713 for economic factor, 0.649 for sociality factor, 0.884 for environment factor, 0.756 for inefficiency factor, 0.444 for inconvenience factor, 0.420 for convenience factor, and 0.668 for uncertainty factor.

This study applies multiple regression analyses using factor scores to test hypotheses. Table 2 and 3 show effects of factors on attitude in cases of actual and potential users. The results of ANOVA showed that the overall model is significant with *R-square* = .591 and *F* = 12.592 in the case of actual users and *R-square* = .335 and *F* = 3.165 in the case of potential users. This study checked multi-collinearity and found that there was no

multi-collinearity based on VIF.

Table 2: Effects of Factors on Attitudes of Actual Users

Variables (Independent → dependent)	Standardized Coefficient (t-value-Sig)
Economic Feasibility → Attitude (H1a)	.262 (2.631**)
Sociality → Attitude (H2a)	.150 (1.377)
Environmental Sustainability → Attitude (H3a)	.020 (.192)
Inefficiency → Attitude (H4a)	.353 (3.471**)
Inconvenience → Attitude (H5a)	.053 (.541)
Convenience → Attitude (H6a)	.468 (4.565***)
Uncertainty → Attitude (H7a)	.413(4.256***)

*** p < 0.01, ** p < 0.05, denotes statistical significance

Table 3: Effects of Factors on Attitudes of Potential Users

Variables (Independent → dependent)	Standardized Coefficient (t-value-Sig)
Economic Feasibility → Attitude (H1b)	.259 (1.758*)
Sociality → Attitude (H2b)	.016 (0.113)
Environmental Sustainability → Attitude (H3b)	.015 (0.100)
Inefficiency → Attitude (H4b)	.158 (0.986)
Inconvenience → Attitude (H5b)	.015 (0.99)
Convenience → Attitude (H6b)	.395 (2.710**)
Uncertainty → Attitude (H7b)	.56(0.443)

*** p < 0.01 denotes statistical significance

Table 4 and 5 show the result of regression analysis for the effect of attitude on actual users’ satisfaction and potential users’ intention to purchase an electric vehicle. The results of ANOVA show that the overall model is significant with *R-square* = .550 and *F* = 72.163 in the case of actual users and *R-square* = .525 and *F* = 45.358 in the case of potential users.

Table 4: Effects of Attitudes on Actual Consumers’ Satisfaction

Variable (Independent → dependent)	Standardized Coefficient (t-value-Sig)
Attitude → Satisfaction (H8)	0.742 (8.495***)

*** p < 0.01, ** p < 0.05, * p < 0.1 denotes statistical significance

Table 5: Effects of Attitudes on Intention to Purchase of Electric Vehicle

Variable (Independent → dependent)	Standardized Coefficient (t-value-Sig)
Attitude → Intention (H9)	0.725 (6.735***)

*** p < 0.01 denotes statistical significance

5. Conclusion

5.1. The Summary of Findings

The purpose of this study is to explore factors that affect attitude, satisfaction, and intention to use electric vehicles in cases of actual and potential users. The results of this study found that economic feasibility and convenience factors showed significance on attitude in both cases of actual and potential users of electric vehicles. The results also found that effects of inefficiency and uncertainty showed significance on attitude in the case of actual users. Therefore, H1a, 4a, 6a, and 7a were accepted in the case of actual users. H1b and 6b were accepted in the case of potential users. Among factors, convenience factor showed strong effect size followed by economic feasibility in both cases of actual and potential users. Effects of factors including sociability, environmental sustainability, and inconvenience on attitudes did not show significance in both cases of actual and potential users. Therefore, H2a, 2b, 3a, 3b, 5a, and 5b were not accepted. Effects of inefficiency and uncertainty on attitude did not show significance in the case of potential users. Therefore, H4b and H7b were also rejected.

The results implied that the use of electric vehicles helps reduce fuel costs, management and maintenance costs, helps gain subsidies and deduct tax related costs. Actual users perceived that the cost of electric vehicle is higher than internal combustion engine vehicles, while potential users perceived that the use of electric vehicles helps reduce overall costs related to electric vehicles. The results also implied that the use of electric vehicles helps provide a comfortable driving feeling because of reduced noise and good performance. Actual users perceived the use of vehicles with shorter mileage, relatively lower charging/discharging efficiency, and poor fuel efficiency due to battery reasons caused by season, weather, etc. Actual users perceived the use of vehicles with uncertainties, including battery technology, delays in receiving electric vehicles due to reasons such as semiconductor and raw material of battery supply disruptions, and inconsistent promotional policies such as subsidies, tax benefits, etc. The results implied that both potential and actual users do not perceive the use of electric vehicles as a social issue. Actual users did not perceive electric vehicles as a social trend. Both potential and actual users did not perceive that the use of electric vehicle helps resolve environmental issues and carbon neutrality. Both potential and actual users' attitudes on electric vehicles were not affected by the perceived lack of infrastructure for charging facilities and longer charging time. The results of this study also showed that effects of attitude on satisfaction for actual users and effects of attitude on intention to use for potential users were significant. Therefore, H8 and H9 were accepted.

5.2. Policy and Managerial Implications

By exploring how proposed factors affect attitude and how attitude affects consumer satisfaction and potential users' intention to use of electric vehicles, this study proposed policy implications. This study suggests the importance and expected implications of policies for the government, local governments, and automobile manufacturers by examining perceived effects by actual and potential users. First, economic feasibility was found to have a positive effect on the attitudes of electric vehicles by both actual and potential users. Both actual and potential users chose economic benefit as the positive factor in purchasing an electric vehicle. Therefore, it is necessary for the government to continue promoting policies that help increase users' purchase intentions by providing and addressing financial benefits. Managerially, automobile manufacturers should target consumers by applying better strategies such as providing more information and promotional activities that highlight convenience, economic factors, etc. On the other hand, it should be noted that various factors of electric vehicles did not affect potential users' attitudes despite the growing proportion of electric vehicles in total vehicle sales. In particular, sociality, environmental sustainability, and inconvenience factors showed insignificance for both actual and potential users, while those factors might increase consumer satisfaction and intention to use through policy improvement. Even though the effects of sociability factor on attitude were not significant for both groups of actual and potential users, the usage of electric vehicles might be enhanced by promoting aspects highlighting social issues, particularly targeting Generation Y, called Millennials (people who born from 1981 to 1996 according to Thigpen and Tyson, 2021) who show interests on sustainability and have economic capability to own a vehicle. The results of this study also showed that approximately 78% of actual users are in that cohorts of Generation Y. Therefore, it is expected that automobile manufacturers should consider to apply promotional strategies targeting to Generation Y. Among promotional tools, automobile manufacturers might consider encouraging social factors such as social responsibilities and the trend to adopt electric vehicles.

Although environmental sustainability did not show significance on attitudes toward the electric vehicles, while 34.5% of respondents of potential users answered that realization of carbon neutrality and conformity to eco-friendliness are important aspects, if they consider to purchase an electric vehicle. There are also claims that doubt eco-friendliness of electric vehicles (Hawkins et al., 2012). At the center of the controversy, the problem is caused by the battery which is a key component of electric vehicles. In addition, electric vehicles do not emit carbon dioxide while driving, while they are inevitably generated in the process of producing vehicles and electricity. Therefore, in order to resolve these doubts, it is necessary to transparently disclose data to prove the eco-friendliness

of electric vehicles, such as eco-friendly electricity production, carbon footprint of battery production, and the emission of pollutants during the manufacturing process of electric vehicles as discussed in previous studies (Dillman et al., 2020; Ellingsen et al., 2016; Verma et al., 2021). The results regarding inefficiency and uncertainty factors of electric vehicles are important in terms of managerial implication because they can positively influence users' attitudes through better marketing strategies by automobile manufacturers. Since electric vehicles are generally perceived as next-generation vehicles with new technologies, enhanced reliability will help increase adoption rate by potential users. Additionally, the results of this study found that 64 out of 134 respondents mentioned insufficient charging infrastructure and long charging times as the biggest concerns. This can become a more significant problem as the number of electric vehicle consumers increases. Therefore, it is necessary for automobile companies to develop technologies that can reduce charging time along with the implementation of policies to install more charging facilities with the assistance of government policies. It is also interesting to note that electric vehicle users also consider potential benefits. By considering rapid growth of market share of electric vehicles, related policies should be better prepared.

5.3. Limitation and Future Study

This paper has limitations. The sample size could be improved in the future study. Additional research is needed to explore other factors to measure the satisfaction of actual consumers or intention to use of potential consumers. Given the differences across countries, future research might consider researches in different countries. Lastly, this paper was limited to the characteristics of electric vehicles. Future research could analyze consumer satisfaction and intention to use based on different types of products and brands.

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