

Consumer Adoption Of Electric Vehicles: The Influence Of The Psychological Elements And Moderation Effect Of Environmental Concern

B.Gayathiri¹, Inayath Ahamed.S.B²,
K.Ravindran³

¹Kalasalingam Business School
Kalasalingam Academy of Research and Education,
Krishnankoil, Virudhunagar, Tamil Nadu, India.
gayathri@klu.ac.in

²Kalasalingam Business School
Kalasalingam Academy of Research and Education,
Krishnankoil, Virudhunagar, Tamil Nadu, India.
inayathahamed@klu.ac.in

³Kalasalingam Business School
Kalasalingam Academy of Research and Education,
Krishnankoil, Virudhunagar, Tamil Nadu, India.
kravindranmba5@gmail.com

Abstract:

This study considers the adoption of the electric vehicle and psychological elements influencing customers but the environmental concern is moderating variable to change the customer's behaviour. In current years the customer and consumer world were changed to use new innovational products. our generations are knowledgeable to find carbon-free pollution products because its more effective to protect our environmental surroundings. In that way, all products are pollution-free products. The revolution started in the automobile sector to control a carbon-free world. In this paper, the author analyses the relationship between the psychological elements (Attitude, Awareness, and social influence) and the adoption of electric vehicles and finds the relationship between environmental concern is the moderation variable to change the customer's mind. In the findings of the survey, the questionnaire was analyzed by using the statistical software SMART-PLS.

Keywords: Electric vehicle, Customer behaviour, Psychological elements, Environmental concern, Adoption of EV.

1. Introduction:

In current decades years the automotive industry to enter the sustainability world to develop the new business initiatives for market place. In India now a days both Internal combustion engine vehicles ICEs and EV (Berhnhart et al., 2010, chu et al.,2019) competition have been increasing their market place. Many countries are promoting the Electric vehicle in place of ICEVs (chu et al., 2019). In end of the year ICEVs are not sold by the following countries like Norway & Netherlands 2025, India from 2030, France and Britain establish a goal of 2040. Electric vehicle has a different kind of varieties (Hybrid electric vehicle, Battery electric vehicle, Plug – in electric vehicle) in those days the manufactures to produce plug-in electric vehicle because future days the peoples may like to adopt the pure electric vehicle. In Indian market the electric vehicle development are increases gradually. In the year 2022 august the 4,331 vehicles are sold out. TVS is the top manufacturer of Indian automobile industry in the august 2022 they sold 3,845 electric vehicles are sold out at the same time the other brands like Mahindra, Hyundai, BMW, MG and private BYD motors are sold 80 % the many electric vehicle to the customers. TVS NEXON electric vehicle is the highest sale of India in 2022. Due to the report of (McKinsey & company 2017) EVs producers to show how market is viewed. The manufacturers to perceived the high technology, environmentally friendly and economical delight to drive the electric vehicle. Now it self the travel in electric vehicle can be a single charge because the limited range of the battery usage. (chu et al., 2019) and the range of the EVs has a less performance compared to the ICEVs (chu et al., 2019). Electric vehicles usage gets the energy savings and protection of environment (smith et al., 2010, Hofmann et al., 2016, Shi et al., 2016, Ma et al., 2017, chu et al.,2019). This study to identify the awareness for the environmental productivity to adopting the EVs. Main factors of social influencing or peer pressure to modelling the customers mind to adopting the EVS (N.Adnan et al.,2017). Previous years the other countries wanted to adopt the EV because reducing the fossil fuels consumption (J.P. Helveston et al., 2015). Main objective of this study the psychological elements (attitude, awareness and social influence) are impacting the adoption of EVs and environmental concern are responsible to adopting the Electric vehicle. In this study the proposed conceptual model drive by Theory of planned behaviour (TPB) (ajzen 1991) followed to identify the adoption.

2. Literature review

Burghard et al.(2022) said that Sharing vehicles and sharing rides these both services are included in public transport. The perceived ease to use strongly influences both services. The environmental identity positively influences the acceptance of the services. Public transport implements the policies to people and they like to accept these services. Some barriers are removed. Shu et al.(2022) This author provides evidence about the perceived risk that gives the positive effect in the electric vehicle consumption market. The author identifies the result of the manufacturer improving their brand, productivity improvement and performance. Asadi et al.(2020) author said that the result of the study responsibility plays a positive influence on the consumer's intention to adopt the electric vehicle. Government found that PCE,AC,AR significantly affect the Personal norms.Wujin chu et al (2019) The important determinant of Ev purchasing of Chinese early adoption and Korean early adoption is environmental concern. Korean early adoption main determinant is minimizing operating cost. Original purchase motive founded by usage of satisfaction. Xiangqian Huang et. al (2019) In this study the five factors are highly influencing the customer purchasing intention of electric vehicles. The subjective norms and non-monetary policy measures are not highly significant to the purchasing intention. Mainly the author focused on the customer purchasing intention but he did not focus on the actual behavior of purchasing. Rosaria Berliner et.al (2019) In California many of the people are likely to purchase the automated vehicles and they have an average technological knowledge. The Ev buyers and users seem to like purchasing the automated vehicles. At the same time ev market growth increases as desirable. Bernd Herrenkind et.al (2019) In this study the mix of the variables strongly influences the adoption of the autonomous electric vehicle. The public can easily use this transport to migrate from the urban to the city side.

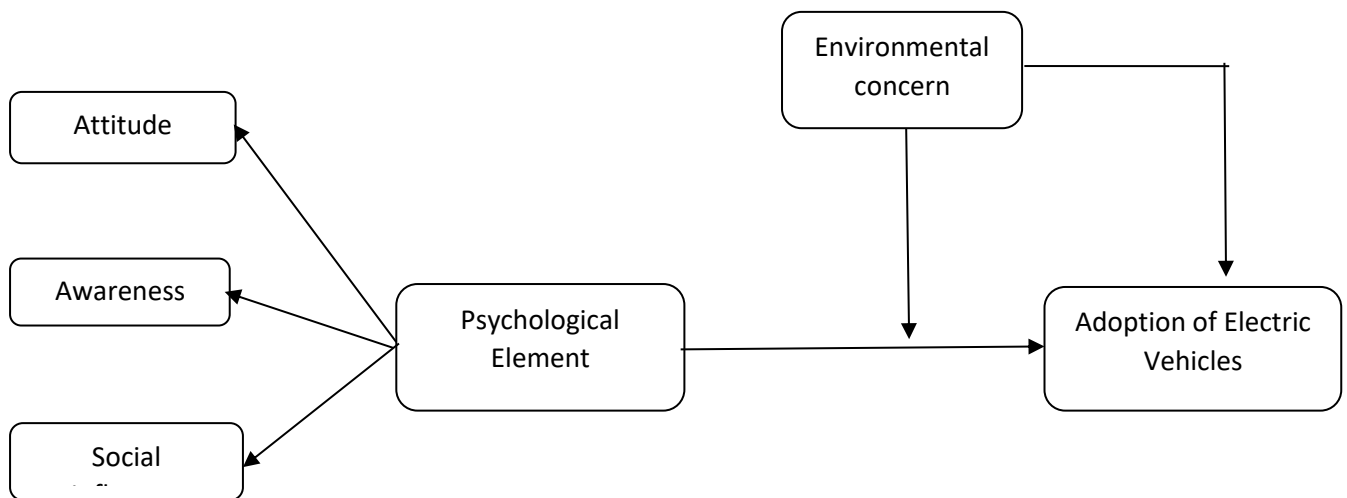
Castillo et. al (2019) The main outcome of the study is easy to use and consumer attitude and the adoption of electric motive vehicles to a larger extent.For consumer behavior the customer attitude is more understandable by this study. The emotion, price, acceleration and low engine noise are the stronger variables to influencing the adoption of the electric motive vehicles. Shalender et.al (2019) The author found the female responders are more willing to buy the electric vehicle compared to the male responders. Environmental concern is the major predator to influence EV adoption. the potential customers to reinforce the adoption of the electric vehicle.The government subsidies decrease the consumers' burden of purchasing the electric

vehicle. Jing et.al (2019) The author understands the traveller's psychology and perspective. The product services and travel management can be improving by the support of the government data basics. In China the knowledge and perceived risk positively attitudes towards adoption of Autonomous vehicles. Adan et al.,(2017) This researcher concluded the consumers are environmental concern and that impacts the adoption of the electric vehicle. Government initiatives to make the people an earlier adopter. Alzaharani et.al (2017) The major findings of the Saudi government develop transportation policies and marketplace for the manufacturer. Significantly the education level increases the environmental concern of fuel usability and decreases the peoples like to prefer the hybrid and plug-in electric vehicle. Saunila et.al. (2017) The major findings institutional sustainability like to support the green innovations. The green innovations allow for environmental sustainability. Both the employees and the customers are increasing clear environment focused motives. Helveston et.al (2015) Author to analyse adoption of BEV in the U.S and China. finally, the China customers prefer to adopt the BEV compared to the U.S customers. The U.S customers adopt both electric vehicles and conventional vehicles. In future the adoption of charger installation technology and the street parking process in electric vehicles.

3. Theoretical background:

Psychological factors are included moral, value, behaviour, attitude. This study considers the psychological elements of attitude, awareness and social influence. In TRA (Theory of Reasoned Action) The author claimed that the most important factors influencing how EVs intend to behave are mindset and subjective norms.. A key psychological factor that directly influences real conduct is behavioural intention (Fishbein and Ajzen 1973, X. Hung .J. Ge 2019). Attitude defines attitude is the main attribute to concern electric vehicle purchase and the adoption (Nazari et al., 2019) Attitude is the major variable to stimulate peoples and educate them about EVs (Lane and Potter, 2007) in Denmark, the researcher said Environmental concern and attitude are revealed towards the usage of EVs. Attitude defines as " attitude is a term it may be the positive or negative assessment for the adoption behavior " (N. Adnan et al., 2017). Buyers having the supportive attitude among the environmental concern that kind of customers are easily to purchasing the Green products (Schuitema et al., 2013 , N. Adnan et al., 2017).

3.1 Conceptual framework:



Customer overall involvement of the precise behaviour is the attitude (X.Hung.J.Ge 2019). The important predictor are attitude and perception is impact the customer adoption behavior towards the EVs(Kahn 2007). In this paper, psychological elements consider attitude is the main predictor to impact the adoption of the Electric vehicle.

Social influence is the critical factor to the customer perception towards the Hybrid electric vehicle (Chorus et al., 2013). In peer pressure and social norms are metaphoric to adopting people (Goody 2014; Hari et al., 2013) word of mouth is also create the impact and give the valuable to Plug in EVs(Rai and Wath 2014) in our family and friends associations having the responsibility based on environmental concern these are influence the adoption of the EVs (Gadenne et al., 2011) in Indonesia their establishing the electric vehicle promotions through the way of social influencing (Belgiawan et al.,2013). In more countries the social influence is the major variable to impact creating to the society and economic growth. Family and friends are influential decision-makers, and they frequently use word-of-mouth to persuade others to buy the things they prefer. It is a dominant aspect of life. Adoption of the new innovations and the technological outcome are more appreciated for social influence (Liao et al., 2017, Racovuli & Timmermans 2016, Jayaraman et al., 2015, Kim et al., 2014). Social influence is created impacts to the individual persons and its give the furthest research to intent the adoption of electric vehicle (V.Singh et al., 2020, Sang & Bekhet 2015, Jeon et al., 2012).

If the new innovation products are running successful in the market place by the way people aware about it. According to P.Larson "Awareness is greater than familiarity which is greater than knowledge"(P.Larson et al., 2014). People got knowledge about the product the moral communication of the product is the awareness because the awareness is the awful result and that's show the customers to adopt the EVs. (Shahla et al., 2020).

Environmental concern in our country the people thinks if the any of the people purchasing the green products who are all purchasing the green products, they are all environmental concern character's. if they have a trust on environmental concern and society that benefits they have a greater purchase intention (M.I. Hamzah, N.S.Tanwir 2021). Environmental concern is a term expressed the environmental problems by the purchase intention of the green products(Mohd Suki,2016 , M.I.Hamzah et al., 2021), the actual findings environmental concern factors are not significantly relationship between the purchasing intention of the green products. According to the bamberg "they mentioned the role of environmental concern is a important component of the model name TPB" Bamberg et al.,2011. The factor influencing customer behaviour changes towards the environmentally friendly products (Fishhein, Ajzen 1980, Hizer et al., 1987 Bamberg 2003, Mohammed et al.,2016).According to chu et al., 2019 Environmental concern is factor to adoption of the electric vehicle but EC(Environmental Concern) is not a moderation factor. The findings of EV benefits is less important than the battery factor (Krupa et al.,2014). The above literature review proposed the hypothesis follow:

H₁: Psychological Elements positively significant in the adoption of electric vehicle.

H₂: Environmental concern is positively significant in the adoption of electric vehicle

H₃ : Environmental concern is Positively moderates the relationship between the psychological element and adoption of the electric vehicle such that increase environmental concern it increase the relationship between the psychological element and adoption of EV.

4. Research Methodology:

4.1 Sample and data collection

In this study voluntary response sampling technique are used and the quantitative survey taken by the peoples. In this survey the

data collected from the online survey platform Google form. The structure questionnaire are framed and share the link by the way of social media platforms and the quick and better response are collected. Totally 358 samples are collected based on the study filtered the samples finally get 153 valid samples to analyzed by SMART PLS (version 4.0)

4.2 Measures

The constructs are identify by the TPB theory of planned behaviour model and questionnaire are adopted from the literature review. The psychological elements are considered as the attitude, awareness and social influence. The attitude is the peoples behaviour based on the purchasing of the Green products. The attitude is measured by three item scale is adopted by the X.Huang et al., (2019 and awareness is the another construct of the psychological element is measured by three item scale adopted by the Carley (2013) the another important construct is social influence it gives the major impact to the adoption of the EVs is measured by the three item scale then it's adopted by the N.Adnan et al., (2017). The moderation factor which are affecting the psychological element and adoption of EVs is Environmental concern. Environmental concern is measured by the four item scale it's adopted by the Goa and Balaji (2016); M.I.Hamzah et al., (2021). The adoption is another construct is measured by four item scale and is adopted by the N.Adnan et al.,(2017). A five point likert scale for the construct of Attitude and Awareness the responders gave the response by the questions from (1) Strongly disagree (5) Strongly agree. A seven point likert scale for the construct of Social influence, Environmental concern and adoption the responders gave the answer the questions from (1) Strongly disagree (7) Strongly agree. All the constructs and items are checked by the expects.

5. Result:

5.1 Description

A total response of this study is 153 male responders are higher comparable to the female responders because male 66% and female 34% only to attend the online survey. The online survey conducted by the current and the previous year students and the working employee in our campus. The student is the major responders 69.9% and the Employees 24.2% Table 1 describes detailed demographical profile of the responders. In this table important groups are taken by the analysis. These groups are analyzed in Statistical tool SPSS (version 21.0).

5.2 Measurement model

In the conceptual framework the major construct is psychological element is formatting the construct namely 'adoption'. When the adoption of EVs included the psychological element. The psychological element create the 3 dimensions attitude, awareness, and social influence the first order and is reflective to formative construct. Researcher check the constructs reliability and validity by the way of composite reliability and Cronbach's alpha. The Cronbach's alpha value above the 0.7 and the average variance extracted (AVE) is above 0.5 in the indicators. So, Table 2 describes the reliability and validity of the construct.

Table 1: Respondent profile.

Responder's profile	Frequency	Percentage %
Gender		
1 Female	52	34%
2 Male	101	66%
Age		
18-25	121	79.1%
26-35	24	15.7%
36-45	2	1.3%
46-50	4	2.6%
Above 60	2	1.3%
Income		
Below 25000	49	32%
25000-50000	56	36.6%
Above 50000	35	22.9%
Above 1 lakh	13	8.5%
Education Qualification		
Higher Education	12	7.8%
Under Graduate	53	34.6%
Post Graduate	83	54.2%
Others	5	3.3%
Occupation		
Students	107	69.9%
Employed	37	24.2%
Own Business	9	5.9%

Table 2: Result of the measurement model

Construct	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	AVE
Adoption	.917	.938	.947	.857
Environment Concern	.891	.907	.925	.756

Psychological Element	.876	.936	.916	.596
-----------------------	------	------	------	------

5.3 Structural Model:

In structural model to evaluate the corresponding Beta value ,T-statistics and R^2 value (N.Adnan et al., 2017; Hair Jr et al.,2016). Researcher calculate 5000 resampling to apply in bootstrapping method to get the P value (N.Adnan et al.,2017). The researcher analysed the first two hypothesis are accepted because they are positively significant. The table 4 describes the Hypothesis 1 the Psychological element and adoption relationship is positively significant the β value is 0.346 and T-statistics value is 4.768 so the adoption of the EVs is based on the Psychological elements included the attitude, awareness and social influence. These dimensions are more impact created by the people mind and to increasing the adoptability of the EVs. The 2nd Hypothesis the environmental concern is directly create the impact of adoption of EVs. Environmental concern and adoption of EVs relationship is positively significant the β value is 0.383 and T- Statistics value is 4.706.

5.4 Moderation Effect of Environmental concern:

The study assessed the moderation role of Environmental concern on the relationship between Psychological element and adoption of EVs without the inclusion of moderation effect ($Pe*Ec$), the R^2 Value for Adoption is 0.637. This shows 63.7% change in Adoption of EVs is accounted by the Psychological element with the inclusion of the interaction term the R^2 value increased to 67.3% this shows an increasing of 3.6% in variance explained in the dependent variable adoption of EVs. Future significant of moderation effect was analyzed , the result revealed a negatively significant of moderating impact of environmental concern on the relationship between Psychological element and adoption of EVs. ($\beta = -0.163$, $t = 4.96$, $P < 0.005$), unsupporting H_3 . This shows that within increase Environmental concern the relationship between Psychological element and Adoption of EVs in weakened moderation analysis presented in Table 4.

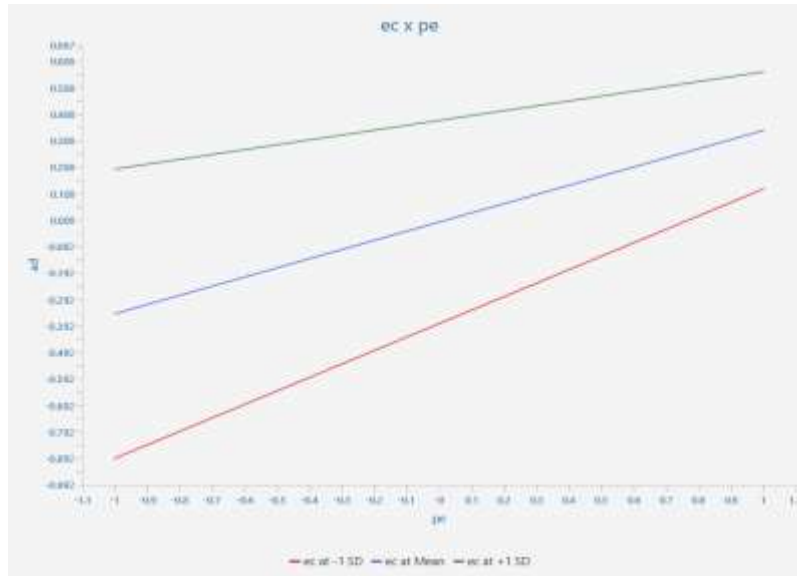
Table 3: Fornell -Lacker criteria:

	AD	EC	PE
Adoption of EVs	0.926		
Environment Concern	0.738	0.87	
Psychological Element	0.765	0.778	0.772

Table 4: Result of the Structural Model

Hypothesis	Relationship	Beta value	STDEV	T-Statistics	Decision	R ²	F ²
H ₁	Pe-> Ad	0.346	0.073	4.768	Supported	0.673	0.120
H ₂	Ec->Ad	0.383	0.083	4.706	Supported		0.177
H ₃	Ec*Pe->Ad	-0.163	0.033	4.96	Unsupported		0.111

5.5 Slope analysis :



Blue is the mean and green is one standard deviation above the mean what does this tell us it tell us that the positive effect its positive because its sloping bottom to top left to right its sloping upward in this direction so the positive relationship between psychological effect an adoption with responders is dampened by environmental concern so we can see the green line is more environmental concern the red line is with less environmental concern so the positive effect has a steeper slope positive slope when there is less environmental concern.

6. Conclusion:

As the researcher conclude Psychological element of the study includes the attitude, awareness and social influence these constructs are impacting the adoption of the electric vehicle. The survey is conducted by the students and working employees in campus by the maximum persons are using both the two wheelers and four wheelers so that persons are gave the response their attitude may be change in future to adopting the electric vehicle. They are well aware about the electric vehicle but they are accepting the friends & families and to more impact are creating the working places. They are sharing their experience and to trust

the colleagues now a days the people to get experience the new innovation products if any of the person suggest the others they give a correct way to their friends. In this study the main factor is environmental concern is plays a moderation role to relationship between the psychological element and adoption of Electric vehicle. The environmental concern could not be moderating the adoption of the electric vehicle if the result shows the environmental concern is increases the adoption is decreases as well as environmental concern is decreases the adoption is increases vice versa. Key findings of this study environmental concern is not create the impact between the psychological element and adoption of electric vehicle. In futures researches should to take the variable environmental concern is mediating factor to adoption of the electric vehicle. Limitation of the study only is adoption of the electric vehicle in small area so future researcher use the actual adoption of electric vehicle in large area and its give the improvement of the Electric vehicle adoption.

Reference:

1. Burghard, U., & Scherrer, A. (2022). Sharing vehicles or sharing rides- Psychological factors influencing the acceptance of carsharing and ridepooling in Germany. *Energy Policy*, 164, 112874..
2. Shu, T., Wang, Z., Lin, L., Jia, H., & Zhou, J. (2022). Customer perceived risk measurement with NLP method in electric vehicles consumption market: empirical study from China. *Energies*, 15(5), 1637.
3. Asadi, S., Nilashi, M., Samad, S., Abdullah, R., Mahmoud, M., Alkinani, M. H., & Yadegaridehkordi, E. (2021). Factors impacting consumers' intention toward adoption of electric vehicles in Malaysia. *Journal of Cleaner Production*, 282, 124474.
4. Chu, W., Im, M., Song, M. R., & Park, J. (2019). Psychological and behavioral factors affecting electric vehicle adoption and satisfaction: A comparative study of early adopters in China and Korea. *Transportation Research Part D: Transport and Environment*, 76, 1-18.
5. Huang, X., & Ge, J. (2019). Electric vehicle development in Beijing: An analysis of consumer purchase intention. *Journal of cleaner production*, 216, 361-372.
6. Berliner, R. M., Hardman, S., & Tal, G. (2019). Uncovering early adopter's perceptions and purchase intentions of automated vehicles: Insights from early adopters of electric vehicles in California. *Transportation research part F: traffic psychology and behaviour*, 60, 712-722.
7. Herrenkind, B., Brendel, A. B., Nastjuk, I., Greve, M., & Kolbe, L. M. (2019). Investigating end-user acceptance of autonomous electric buses to accelerate diffusion. *Transportation Research Part D: Transport and Environment*, 74, 255-276.

8. Higuera-Castillo, E., Molinillo, S., Coca-Stefaniak, J. A., & Liebana-Cabanillas, F. (2020). Potential early adopters of hybrid and electric vehicles in Spain—Towards a customer profile. *Sustainability*, 12(11), 4345.
9. Shalender, K., & Sharma, N. (2021). Using extended theory of planned behaviour (TPB) to predict adoption intention of electric vehicles in India. *Environment, Development and Sustainability*, 23(1), 665-681.
10. Jing, P., Huang, H., Ran, B., Zhan, F., & Shi, Y. (2019). Exploring the factors affecting mode choice Intention of autonomous vehicle based on an extended theory of planned behavior—A case study in China. *Sustainability*, 11(4), 1155.
11. Adnan, N., Nordin, S. M., Rahman, I., & Rasli, A. M. (2017). A new era of sustainable transport: An experimental examination on forecasting adoption behavior of EVs among Malaysian consumer. *Transportation Research Part A: Policy and Practice*, 103, 279-295.
12. Alzahrani, K., Hall-Phillips, A., & Zeng, A. Z. (2019). Applying the theory of reasoned action to understanding consumers' intention to adopt hybrid electric vehicles in Saudi Arabia. *Transportation*, 46, 199-215.
13. Saunila, M., Ukko, J., & Rantala, T. (2018). Sustainability as a driver of green innovation investment and exploitation. *Journal of cleaner production*, 179, 631-641.
14. Helveston, J. P., Liu, Y., Feit, E. M., Fuchs, E., Klampfl, E., & Michalek, J. J. (2015). Will subsidies drive electric vehicle adoption? Measuring consumer preferences in the US and China. *Transportation Research Part A: Policy and Practice*, 73, 96-112.
15. Singh, V., Singh, V., & Vaibhav, S. (2020). A review and simple meta-analysis of factors influencing adoption of electric vehicles. *Transportation Research Part D: Transport and Environment*, 86, 102436.
16. Li, W., Long, R., Chen, H., & Geng, J. (2017). A review of factors influencing consumer intentions to adopt battery electric vehicles. *Renewable and Sustainable Energy Reviews*, 78, 318-328.
17. Wang, S., Wang, J., Li, J., Wang, J., & Liang, L. (2018). Policy implications for promoting the adoption of electric vehicles: do consumer's knowledge, perceived risk and financial incentive policy matter?. *Transportation Research Part A: Policy and Practice*, 117, 58-69.
18. She, Z. Y., Sun, Q., Ma, J. J., & Xie, B. C. (2017). What are the barriers to widespread adoption of battery electric vehicles? A survey of public perception in Tianjin, China. *Transport Policy*, 56, 29-40.
19. Ramos-Real, F. J., Ramírez-Díaz, A., Marrero, G. A., & Perez, Y. (2018). Willingness to pay for electric vehicles in island regions: The case of Tenerife (Canary Islands). *Renewable and Sustainable Energy Reviews*, 98, 140-149.
20. Okada, T., Tamaki, T., & Managi, S. (2019). Effect of environmental awareness on purchase intention and satisfaction pertaining to

electric vehicles in Japan. *Transportation Research Part D: Transport and Environment*, 67, 503-513.