International Journal of Sustainable Development and Planning
Vol. 20, No. 8, August, 2025, pp. 3533-3540
Journal homepage: http://iieta.org/journals/ijsdp

Reducing Carbon Emissions Through EVs Preference: Evidence from Suburban East Coast Malaysia

Nizam Ahmat[1], Mohd Nasir Nawawi[1], Roseliza Mat Alipiah[1], Jumadil Saputra[2,3,4,5,6,7*], Muhammad Najit Sukemi[1]

[1] Department of Economics, Faculty of Business, Economics and Social Development, Universiti Malaysia Terengganu, Kuala Nerus 21030, Malaysia
[2] Department of Economics, Faculty of Economics and Business, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia
[3] Department of Economics, Faculty of Economics and Business, Universitas Brawijaya, Malang 65145, Indonesia
[4] Department of Economics, Faculty of Economics and Business, Universitas Muhammadiyah Yogyakarta, Bantul 55183, Indonesia
[5] Department of Management, Faculty of Economics and Business, Universitas Dian Nusantara, Jakarta Barat 11470, Indonesia
[6] Department of Economics, Faculty of Economics and Business, Universitas Teuku Umar, Aceh Barat 23681, Indonesia
[7] Department of Management, Faculty of Economics and Business, Universitas Informatika dan Bisnis Indonesia, Bandung 40285, Indonesia

Corresponding Author Email: drjusaa@gmail.com

https://doi.org/10.18280/ijsdp.200833

Received: 13 July 2025
Revised: 15 August 2025
Accepted: 20 August 2025
Available online: 31 August 2025

Keywords:
consumers' preferences, electric vehicle attributes, CO_2 emissions, discrete choice, experiment design

ABSTRACT

Electric vehicles (EVs) signify a shift from traditional fossil fuel-burning vehicles and were introduced to address consumers' dependence on fossil fuels, rising emission levels, and other environmental issues. This study empirically analyses the key determinants of consumer behavior regarding environmental air quality issues and vehicle characteristics, which significantly influence the preference for EVs. The current work was conducted in the suburbs of the East Coast of Malaysia, specifically in the Kuala Nerus district of Terengganu. Notably, 220 respondents selected their preferred vehicle type in February 2021. The survey data were elicited using an experiment card. Prices, charging time, and the level of CO_2 emission reduction were found to be the primary catalysts for consumers' preference for EVs over conventional vehicles (petrol combustion) in Kuala Nerus, Terengganu, based on the multinomial logit model. Furthermore, gender status and increased level of income and education were identified as demographic factors with a high probability (positive sign and significant at 5%) for the respondents' EV adoption and choice in Kuala Nerus, Terengganu. Relevant authorities should implement appropriate measures to increase EV consumption and energy efficiency and reduce carbon emissions and fossil fuel energy dependence in the Malaysian automotive industry.

1. INTRODUCTION

The transportation sector is a key contributor to greenhouse gas emissions and global air quality concerns [1]. Nevertheless, the global EV market share of approximately 1% proves minimal despite efforts to shift to green motors [2]. The drastic increase in transportation activities, oil consumption, and greenhouse gas emissions following the rise in global living standards has led to environmental degradation [3]. Most EV-oriented works highlighted the need to reduce transport-induced CO_2 emissions to achieve ambitious CO_2 targets significantly. Regardless, the high usage of internal combustion engine vehicles worldwide (specifically in emerging nations) hinders their achievement [4]. The EVs are Key to addressing fossil fuel dependence, increased emission levels, and other global environmental issues. The low air quality in Malaysia is attributed to the pollutants emitted by motor vehicles.

As reported by the 2018 Environmental Quality Report, motor vehicles that use petrol or diesel engines accounted for 79% of air pollution and led to a subsequent 2.71% increase in global greenhouse gas emissions in the same year, with 82.64% of Malaysian households owning at least one motor vehicle [5]. Traffic congestion has increased by nearly 200% [6]. Moreover, the flow of vehicular traffic on Malaysian roads potentially contributes to fossil fuel energy consumption and the deterioration of environmental air quality [7]. As such, EVs must be popularized to decrease the impact of motor vehicle dependence on fossil energy sources and toxic emissions into the atmosphere [8]. Vehicle manufacturers have recently transitioned to producing green vehicles via hybrid or electric technology engines to improve energy efficiency.

The promotion of eco-friendly vehicles reduces their

traditional counterparts' negative impact on the environment, which facilitates the attainment of energy conservation objectives and ensures environmental responsibility in the community [8]. In this regard, the government aims to introduce 6.13% and 2.6% of electric and hydrogen fuel cell vehicles, respectively, by 2025 [9]. Given the high demand for internal combustion engine vehicles rather than eco-friendly motor vehicles in Malaysia, it is crucial to produce and adopt electric, plug-in hybrid, and hydrogen fuel cell vehicles to promote green vehicles, support governmental efforts, and improve the overall automotive sector [9].

The demand for EVs merely accounted for 2% of the 600,000 motor vehicle sales recorded in 2018 [10]. From a scholarly perspective, EVs viably address greenhouse gas emissions [11]. This solution coincides with the 11th Sustainable Development Goal to ensure urban sustainability and human well-being. Malaysia is an emerging nation with a low demand for EVs despite their societal benefits, such as increased air quality and low CO_2 emissions. Notwithstanding, green vehicles are increasingly adopted as an environmentally-sustainable alternative in Malaysia [12]. For example, the Low Carbon Mobility Blueprint (2021-2030) was implemented to increase local EV adoption by exempting import duty.

The key advantage of environmentally-friendly vehicles lies in the absence of air pollutants. Several studies on consumer preferences based on green vehicle attributes (fuel type, transmission, and vehicle size) have been conducted in developed countries. Nevertheless, extensive literature highlighted the paucity of domestic research on consumers' preferences for EV attributes [13, 14], specifically those from the suburbs in the eastern region of Malaysia. The studies, as mentioned earlier, mainly provide evidence of consumers' willingness to accept a higher value for green vehicle characteristics in developed nations. Increased ownership costs for green vehicles and inadequate infrastructure potentially explain the low demand for green vehicles in Malaysia [15]. Hence, this research expanded the current body of knowledge in developing countries.

Governments must stimulate the use of green vehicles among consumers by implementing relevant policies and regulations and allocating subsidies to reduce parking and charging fees, as well as road tolls [16, 17]. On another note, investing in charging infrastructure proves more effective in gaining user interest in EV adoption [18, 19]. From the perspectives of automotive consumers and producers, implementing appropriate government interventions and policies (EV rebates) plays a key role in environmental conservation. Numerous studies have been performed to increase consumer awareness of EV technology in developed nations [20-22]. The current work advances the understanding of consumers' knowledge level and the value they are willing to allocate for improved air quality (EV characteristics) while supporting the country's sustainable development agenda.

However, studies involving the eastern coastal states in Malaysia remain limited. Kuala Nerus, being close to the state capital of Terengganu, benefits from spillover effects in terms of mobility and offers opportunities to promote sustainability in the East Coast of Malaysia. A fast-developing district in Terengganu with a growing population and increasing vehicle ownership. Traffic congestion has become more noticeable, particularly in that district, due to the rising number of private vehicles. More importantly, mobility patterns are characterized by heavy reliance on private cars and motorcycles due to limited public transportation. Thus, the existing car fleet is contributing significantly to air pollution. The current fleet also reflects the case study region's dependence on conventional fuel transport due to the nascent development of electric vehicle infrastructure. Additionally, this study provides an opportunity for a deeper understanding of the main attributes that can drive consumer decisions regarding electric cars. Therefore, investigations into the key determinants of consumer preferences for EV attributes in Kuala Nerus may elicit outcomes that contradict those of past works conducted in emerging nations.

The following sections are presented as follows: Section 2 outlines the literature review on the key factors influencing consumers' preference for EVs; Section 3 highlights the research methodology and analytical approaches used; Section 4 presents the analysis outcomes, with emphasis on key findings; and Section 5 denotes the outcome implications before concluding the study.

2. LITERATURE REVIEW

This section is divided into the four key factors influencing consumers' EV preference, with emphasis on financial, technological, infrastructural, and policy-based attributes. Past works have incorporated alternative-specific constants (ASC) into the consumer preference model to determine the combined influence for all aspects of a decision not considered in the choice experiment. The intended factors are presented below.

2.1 Financial attribute

One of the factors influencing consumers' decision-making is financial attributes. Potential buyers would make plans based on the vehicle's cost of driving from one place to another and the price of a green vehicle. In this vein, the charging /gas/petrol/diesel cost is one of the selected vehicle characteristics. Consumers are likely to choose EVs with low operating costs. In line with past works, consumers prefer vehicles with low fuel/battery costs [21] and a long lifespan [23]. In particular, consumers prefer economy-sized vehicles due to lower operating costs [21, 22, 24-43]. A user favors eco-friendly vehicles owing to relatively cheaper fuel costs and fewer financial burdens [44].

The price of the green vehicle itself influences its purchase [21, 23, 32, 33, 35, 36, 45-47]. Simply put, consumers are less willing to buy expensive eco-friendly transportation [29-31, 48]. An American study involving three sizes of green vehicles revealed price as the most important factor after fuel costs and vehicle range [49]. Likewise, Cordera et al. [50] highlighted the consumers' concern about the final price over the ensuing benefits. The EV prices must be reduced to attract consumers and meet their demand [31]. Nevertheless, Cordera et al. [50] highlighted that social norms (risk-taking attitudes or collective effectiveness, confidence, and personal beliefs) can drive consumers to pay a high price for these vehicles.

2.2 Technology attribute

Technology-specific elements are one of the factors influencing consumers before they decide to purchase an eco-friendly vehicle. The release of CO_2, charging time, and green battery durability were some of the key factors influencing the vehicle technology's environmental performance. This criterion is based on emission reduction, which constitutes part

of environmental measurement [28, 34, 37, 39]. The extent to which ecological values influence consumer decisions to buy green vehicles must be seriously considered. Regardless, this contribution affects the small demand growth for green vehicles. Beak et al. [37] revealed the insignificance of reduced vehicle emission rates in selecting EVs. Similar to findings in Canada [34, 42], Germany [23, 39, 40, 42], the US [24], China [18, 21, 29], UK [51], Australia [36], Denmark [52], and Korea [10, 53] concurred with the low value of consumer willingness to pay (WTP) for the CO_2 emission factor.

Furthermore, charging time influences consumers' green vehicle purchase decisions [18, 25, 28, 33, 34, 36-38, 40, 42, 43, 46, 48, 52, 54, 55]. An increase in charging time potentially reduces vehicle utility despite consumers' preference for EVs with low charging times [50]. The studies conducted in China disclosed that fast or slow charging time is not a significant choice for green vehicle users. Chinese consumers were more comfortable charging their vehicles at home than at charging stations [29]. A green vehicle's battery life also constitutes part of the vehicle selection factor, owing to maintenance cost issues. Increased battery durability is associated with reduced maintenance costs [50]. The role of the trade-off of battery replacement cost in a certain period can be explored via battery endurance [56]. Previous research has presented various measurements of battery durability in the form of years [33], a range of travel [57] or warranty [42].

2.3 Government policies and incentives

The government promotes green vehicles in various ways, including legislation and government incentives [24, 27, 42, 29, 57], taxes [39, 40], and policies that aid EV users via free parking, non-financial incentives, and relevant policies [18, 29, 30, 48]. Purchase decisions are associated with government incentives [24], which influences the value of benefits when selecting a green vehicle [27]. Chen and Hwang [49] and Huang and Qian [29] highlighted EV consumers' preference for one-time cash subsidies. Regardless, this incentive was not worth the price of the vehicle [42] and offered no beneficial value [27]. Other policies include non-financial aids that significantly reduce travel time, such as free parking, free tolls, high-occupancy vehicle lane (HOV-lane) access, and limited traffic lanes reserved for the exclusive use of vehicles [34, 48].

Higher tax exemptions and tax relief are also considered key factors. Unlike conventional vehicles, newly-registered EVs are exempt from vehicle tax until 2030 [39, 40]. With the projected rise in automobile taxes and gasoline prices in Germany, individuals intending to register a new car after 2021 might anticipate an increased tax burden, particularly when internal combustion engines emit more than 95g/km of CO_2. Overall, a vehicle with high emission levels tends to be more expensive. Of the various policies implemented to promote EV adoption, only the annual tax cut resulting from usage cost-cutting policies appears to hold relevance. Previous research has highlighted the relative insignificance of free parking and toll reductions. The viability of various tax reduction methods reflects consumers' reaction to changes in taxes versus other expenses. Thus, governmental policies have been initiated and implemented to promote EV production and adoption [58]. The success and efficiency of these policies are contingent upon consumers' sound understanding of EVs.

2.4 Infrastructure attribute

Infrastructure attributes entail the availability of charging infrastructure. While conventional vehicles (CV) require regular refueling, EVs allow consumers to depend on home charging as long as the travel distance falls within the EV range. This feature applies to the majority of people [59]. According to Brownstone et al. [60], users prefer recharging at home rather than refueling at petrol bunks, following its convenience during evaluation periods. As EVs primarily depend on charging facilities, it is impossible to constantly use EVs without access to charging stations at home or work. Hence, future EV ownership can be improved by 2030 following an increase in super vehicle charging points.

2.5 Social demographic factors

This section discusses the importance of socio-demographic factors in determining the priority of green vehicle purchase intention. Previous studies of green vehicle selection indicate the significant influence of demographic factors on consumers. Berneiser [39] claimed that socio-demographic factors have an inconsistent or little influence on the willingness to purchase a green vehicle, which mainly depends on the experience and knowledge of green vehicles. The effect of this socio-economic variable (whether positive, negative, or insignificant) remains unclear [54]. Notwithstanding, this influence is key to gauging the preference in choosing between conventional and green vehicles [49].

Young and educated people typically intend to buy eco-friendly vehicles [34]. Dumortier and Buerger [61] Research in the metropolitan area of the US corroborated this statement. Essentially, an increase in age reduces consumers' probability of buying green vehicles. On another note, most of those inclined to purchase a green vehicle were identified as middle-aged men with high levels of environmental consciousness, income, and education. Notwithstanding, these socio-demographic elements depend on other priority factors. Some researchers in New South Wales, Australia, stated that Generation Y (born between 1981 and 1996) seeks better designs with minimal environmental impacts, while that of Z (born between 1997 and 2012) considers green vehicles as transportation with optimal security [43]. The number of children, household income, and vehicles owned significantly influence the purchase of a green vehicle.

In line with Ghasri et al. [43], couples with children are more inclined to buy in buying environmentally friendly vehicles due to safety factors. Furthermore, household income is unable to reflect the desire for a green vehicle. Naghavi et al. [62] stated that an individual favors vehicles using hybrid and gasoline engines over EVs. In addition, an Italian study using this discrete selection technique highlighted the significant relationship between the number of household vehicles and the purchaser's plan for eco-friendly transportation. A high number of vehicles owned translates into a high user WTP for the next green vehicle [54]. Following past research, socio-demographic factors can influence consumers to buy eco-friendly vehicles in various ways. Despite being frequently considered as individual variables in preference-driven studies, the socio-economic and demographic factors' effect on EV preferences remains inconclusive. It is uncertain whether the effects of gender, age, income, education, and family size on consumer preferences towards EV attributes are positive or negative.

3. MATERIALS AND METHODS

The EV preference studies generally consider vehicle alternatives, such as financial, technical, charging station, and regulatory attributes, alternative-specific constants (ASC) in the satisfaction function, and the combined effect of the options. Notably, these alternatives are absent in the hypothetical choice. Relevant works depend on stated preference (SP) data following the scarcity of EVs. Empirical information was gathered through choice experiments, in which participants selected one option from several alternatives. The attribute level, which varies among the alternatives, can be hypothesized.

3.1 Research design

The current survey contains 17 questions per respondent, nine of which constitute the choice experiment. Respondents were asked to state their gender, age, education level, number of vehicles per household, income, number of family members, daily travel distances, and willingness to buy EV cars. The choice experiment was presented in part two of the questionnaire. Respondents were given nine scenarios for three-mode alternatives, characterized by the following six attributes on three levels each (see Table 1).

Table 1. Attribute description, level of attribute value, and sources of references

Attribute Variable Descriptions	Petrol Vehicle (Status quo)	Hybrid Vehicle	Full Electric Vehicle
Average market prices of vehicles 1500 cc	RM70,000	i) +12.5% ii) +25% iii) +37.5%	i) +62.5% ii) +75% iii) +87.5.5%
CO_2 emission (g) for 25 km travel	3040 g	i) -50% ii) -60% iii) -70%	i) -70% ii) -80% iii) -90%
Battery warranty	2 years	i) 1 year ii) 4 years iii) 5 years	i) 7 years ii) 9 years iii) 12 years
Government incentive	No incentive	i) no inventive ii) reducing sales tax iii) reducing sales tax + road tax moderate	i) reducing sales tax ii) reducing sales tax + very low road tax iii) reducing sales tax + very low road tax + rebate charging 20%
Travel cost per month for 25 km travel	RM150	i) RM142.5 ii) RM127.5 iii) RM112.5	i) RM27.6 ii) RM18.4 iii) RM9.2
Refuel time/ fast Charge time for 50 km	2 minutes	i) 2 minutes ii) 4 minutes iii) 6 minutes	i) 30 minutes ii) 45 minutes iii) 60 minutes

Note: Attribute price refers to [63]; CO_2 refers to [64]; government incentive refers to [14]; battery warranty refers to [65]; refuel/charging time refers to [36]; and travel cost calculation refers to [65, 66].

Based on previous studies, the key attributes influencing EV preferences include price and travel cost, environmental benefits, battery warranty, and government incentives. Price and travel cost remain the most critical factors, as consumers are highly sensitive to both purchase costs and daily travel expenses [63, 65]. Environmental benefits, particularly CO_2 reduction and shorter charging times, further shape consumer decisions regarding EVs compared to conventional vehicles [64, 36]. In addition, battery warranty enhances consumer confidence by reducing perceived risk [65], while government incentives play an important role in strengthening adoption choices [14]. Collectively, these attributes represent the most significant factors determining EV preference in East Coast Malaysia.

This research employed paper questionnaires, which were distributed to respondents in the Kuala Nerus district, Terengganu, for data collection. The respondents were purposively sampled from three main areas: UMT, Kuala Nerus Administrative Complex, and UNIZA. The number of samples was determined via the G-power software, which set a power level of 0.85 with an effect size of 0.15. Consequently, a minimum sample size of 121 people was achieved [67]. Recommendations: This study employed a larger sample of 220 people.

$$Y_{ij} = B_i V_{ij} + \in_{ij} \quad (1)$$

where, Y_{ij} = Individual i from alternative j; V_{ij} = number of attribute 'i'' from alternative 'j', where i = 1,2,…k. Bi = parameter to be estimated, where i=1,2,…k. Based on Koppelman and Bhat [68], Eq. (1) is expressed as follows:

$$P_{ij} = EXP^{(Yij)} / \sum_{j \in M} EXP^{(Yim)} \quad (2)$$

where, Y_{ij} is mode 'j' for individual i; Y_{im} is any mode 'm' in the choice set available to individual 'i'; P_{ij} denotes the probability an individual i selects mode j; and M signifies the total number of travel modes present in the choice set for 'i'.

3.2 Method of estimation

The conditional regression logit model served to estimate the choice experiment outcomes as a discrete variable with three options (multinomial). Furthermore, the respondents considered the characteristics of each choice alternative (price, travel duration, and travel cost). They were tasked to choose the best option that meets the desired features.

4. RESULTS

Nine out of the 10 survey respondents agreed to participate in the study, with a response rate of 88%. Notably, 225 individuals addressed the survey questionnaire. As five of the questionnaires were removed owing to incomplete responses, the remaining 220 were subjected to further analysis. Table 2 presents the socio-economic profiling outcomes.

Table 2 presents a mean sample age of 35. In terms of gender, 60.5% and 39.5% of the respondents were women and men, respectively. The gender ratio is 110 men per 100 women. Malaysia suggests a greater proportion of men than the national average. Regarding marital status, 21% were single, while 79% were married. Approximately 63.6% of the

sample had between 1 and 4 children, 28% had no children, and 8% had more than five children. Furthermore, 41% were between 19 and 29 years old, 30.5% of them ranged from 30 to 40 years old, 15% were between 41 and 50 years old, and 13.1% were over 50 years old. Based on education classification, 5.5% of them demonstrated a lower education level in primary schools, 33.3% graduated from secondary schools, 22.1% held a diploma or high school certificate, and 34.1% were Bachelor's/ Master's or PhD holders.

Table 2. Result of respondents' socio-demographic profile (N=220)

Demography	Category	Frequency	Percentage (%)
Gender	Male	87	39.5
	Female	133	60.5
Age	18-29	91	41.4
	30-40	67	30.5
	41-50	33	15.0
	More than 50	29	13.1
Vehicle per household	1 vehicle	44	20.0
	2-3 vehicles	134	60.9
	More than 3 vehicles	42	18.1
Education level	Primary school	12	5.5
	Secondary school	80	33.3
	Diploma/STPM	53	22.1
	Degree and above	75	34.1
Income	Les the RM1001	50	22.7
	RM1001-RM3000	96	43.6
	RM3001-RM5000	47	21.4
	More than RM5000	27	12.3
Family member	Less or equal to 2 people	72	32.7
	3-4 people	66	30.0
	More and equal 5 people	82	37.3
Daily travel distance (miles)	< 10	75	34.1
	10-30	47	21.4
	31-50	50	22.7
	> 50	48	22.1
Willing to buy EV cars	Yes	193	87.7
	No	27	12.3

The research respondents primarily constituted private and public sector employees who used automobiles for daily commutes. This finding implies a higher education level compared to the general population. Regarding income distribution, most of the respondents (43.6%) earned a monthly income ranging from RM 1001 to RM 3000. This outcome coincides with the average monthly income of RM 3000, as documented in 2018. The respondents also disclosed the number of vehicles owned in their household. Approximately 20% of the respondents possessed one car, 60.9% owned 2 or 3 cars, and 18.1% owned 4 or more cars per household. Regarding daily travel distance, 34.5% of the individuals travelled under 10 miles a day, 21.4% of them traveled 10 to 30 miles a day, 22.7% traveled between 31 and 50 miles a day, and 22.1% traveled more than 50 miles a day. Table 3 presents the multinomial logit model's estimation outcomes.

Table 3. Result of multinomial logit estimation

Attribute Variables	Coefficient	Z-Statistics
Prices	-0.0002**	-1.912
CO_2	-0.00072**	-3.063
Charging time	0.0091	1.688
Battery warranty	-0.0054	-0.742
Travel costs	-0.0028**	-4.803
Government policy	0.0352	0.503
Demography Variables		
ASC hybrid	-0.7953	-1.468
Gender	0.8973**	7.09
Age	0.2182**	2.224
Income	-0.0152	-0.105
Education	0.4190**	2.995
No. of household	0.2181**	2.224
No. of vehicles	0.0158	0.118
ASC EV	1.0802	0.983
Gender	0.7992**	6.285
Age	0.2552**	2.592
Income	-0.2816**	-1.919
Education	1.0102**	7.166

Note: ** is significant at level $p < 0.05$.

The LR and p-value of 250.57 and 0.00, respectively, suggest a significant model (see Table 3). The estimated coefficient of attributes involving prices, environmental concern (CO_2), and travel cost proved negative and significant at 5%. Demographic factors of gender and number of households for consumer preference were positively significant in the choice of hybrid cars compared to conventional ones, but negatively so in the number of vehicles per household. In terms of EVs, demographic factors can significantly affect consumer preferences at 5% compared to the conventional car, excluding several vehicles per household (negative and significant at 5%). The attribute variables of CO_2 emissions, prices, and travel costs significantly and negatively impacted the multinomial logit model. Prices adversely influenced the respondents' likely selection of EVs and hybrid vehicles compared to their non-environmental counterparts. Our results suggest that CO_2 emissions significantly reduce the probability of choosing conventional vehicles and reveal that environmental attributes play a key role in consumer preferences. This finding is supported by studies conducted in Germany [69] and China [70]. However, financial attributes may be linked to income sensitivity, such as high car-ownership costs and limited EV charging infrastructure. This contrasts with more emerging economies, where consumer choices are more strongly influenced by green principles and government incentives.

Battery charging time, another attribute affecting consumer preference towards EVs, proved significant at the 10% significance level. Improved charging facilities increase the probability of users' preference for EV characteristics. Based on this study, the governments' attribute policy related to taxes and subsidies and the vehicle battery's warranty period had little impact on user preferences. Demographic variables of gender, age, education, and the number of households significantly influenced consumers' choice of hybrid cars compared to conventional vehicles. Excluding the number of cars per household, all the variables proved significant at the 5% level. In line with past works, the respondents' demographic profile can influence users' choice behavior towards green rather than non-green vehicles.

5. CONCLUSIONS AND FURTHER RESEARCH

Given the rising global greenhouse gas levels, current advancements in the EV sector prove to be immensely beneficial. Various technological options are being explored to facilitate the transition to more eco-friendly vehicles. Sustainable mobility can be achieved in the future using technologies resembling EVs to address the issues resulting from traditional fossil fuel-powered vehicles. Overall, prices, charging time, and the level of CO_2 emission reduction significantly affected consumers' preference for EVs over petrol combustion vehicles in Kuala Nerus, Terengganu. Demographic factors revealed a high probability of EV adoption and choice among the respondents. Local policymakers should create appropriate interventions and regulations in the automotive industry to increase EV usage as a means of enhancing energy efficiency and minimizing carbon release and fossil fuel dependence.

ACKNOWLEDGMENT

We thank Universiti Malaysia Terengganu (UMT) for providing funding support for this project (UMT/TAPE-RG-2020/55261).

REFERENCES

[1] Syamni, G., Yusuf, Z., Wardhiah, W., Rizal, M., Ansari, R., Teniro, A. (2023). The effect of energy sources and CO2 emission on Indonesia's economic growth in different regime. Frontiers in Business and Economics, 2(1): 46-53. https://doi.org/10.56225/finbe.v2i1.194

[2] Ramadhani, J.S., Muis, A.R.C., Amalia, N.R., Rokhaniyah, H. (2025). Investigating the strategic cooperation for a greener tomorrow in Saudi Aramco's liquefied natural gas (LNG) pathway to sustainable energy. International Journal of Advances in Social Sciences and Humanities, 4(1): 31-42. https://doi.org/10.56225/ijassh.v4i1.390

[3] Berggren, C., Magnusson, T. (2012). Reducing automotive emissions—The potentials of combustion engine technologies and the power of policy. Energy Policy, 41: 636-643. https://doi.org/10.1016/j.enpol.2011.11.025

[4] Fritz, M., Plötz, P., Funke, S.A. (2019). The impact of ambitious fuel economy standards on the market uptake of electric vehicles and specific CO_2 emissions. Energy Policy, 135: 111006. https://doi.org/10.1016/j.enpol.2019.111006

[5] Nawi, A.S., Ahmad, B.S., Mahmood, W., Nurathirah, S., Hamid, B.A. (2013). Determinants of passenger car sales in Malaysia. World Applied Sciences Journal, 23: 67-73. https://doi.org/10.5829/idosi.wasj.2013.23.eemcge.22013

[6] Azhari, A., Mohamed, A.F., Latif, M.T. (2016). Carbon emission from vehicular source in selected industrial areas in Malaysia. International Journal of the Malay World and Civilisation, 4(1): 89-93. https://doi.org/10.17576/jatma-2016-04si1-10

[7] Haryati, N. (2019). Priority of development infrastructure in Tamalanrea City Makassar. In Proceedings of the First International Conference on Materials Engineering and Management - Engineering Section (ICMEMe 2018). https://doi.org/10.2991/icmeme-18.2019.18

[8] Nyga-Łukaszewska, H., Aruga, K. (2020). Energy prices and COVID-immunity: The case of crude oil and natural gas prices in the US and Japan. Energies, 13(23): 6300. https://doi.org/10.3390/en13236300

[9] Byun, H., Shin, J., Lee, C.Y. (2018). Using a discrete choice experiment to predict the penetration possibility of environmentally friendly vehicles. Energy, 144: 312-321. https://doi.org/10.1016/j.energy.2017.12.035

[10] Lim, K., Kim, J.J., Lee, J. (2020). Forecasting the future scale of vehicle to grid technology for electric vehicles and its economic value as future electric energy source: The case of South Korea. Energy and Environment, 31(8): 1350-1366. https://doi.org/10.1177/0958305X19898283

[11] Ghosh, A. (2020). Possibilities and challenges for the inclusion of the electric vehicle (EV) to reduce the carbon footprint in the transport sector: A review. Energies, 13(10): 2602. https://doi.org/10.3390/en13102602

[12] Asadi, S., Nilashi, M., Iranmanesh, M., Ghobakhloo, M., Samad, S., Alghamdi, A., Almulihi, A., Mohd, S. (2022). Drivers and barriers of electric vehicle usage in Malaysia: A DEMATEL approach. Resources, Conservation and Recycling, 177: 105965. https://doi.org/10.1016/j.resconrec.2021.105965

[13] Bazrbachi, A., Sidique, S.F., Shamsudin, M.N., Radam, A., Kaffashi, S., Adam, S.U. (2017). Willingness to pay to improve air quality: A study of private vehicle owners in Klang Valley, Malaysia. Journal of Cleaner Production, 148: 73-83. https://doi.org/10.1016/j.jclepro.2017.01.035

[14] Basri, H. (2019). Assessing determinants of dividend policy of the government-owned companies in Indonesia. International Journal of Law and Management, 61(5/6): 530-541. https://doi.org/10.1108/IJLMA-09-2017-0215

[15] Rahmani, D., Loureiro, M.L. (2019). Assessing drivers' preferences for hybrid electric vehicles (HEV) in Spain. Research in Transportation Economics, 73: 89-97. https://doi.org/10.1016/j.retrec.2018.10.006

[16] Langbroek, J.H.M., Franklin, J.P., Susilo, Y.O. (2016). The effect of policy incentives on electric vehicle adoption. Energy Policy, 94: 94-103. https://doi.org/10.1016/j.enpol.2016.03.050

[17] Mersky, A.C., Sprei, F., Samaras, C., Qian, Z.S. (2016). Effectiveness of incentives on electric vehicle adoption in Norway. Transportation Research Part D: Transport and Environment, 46: 56-68. https://doi.org/10.1016/j.trd.2016.03.011

[18] Li, J. (2023). Compatibility and investment in the us electric vehicle market. Doctoral dissertation. MIT Sloan School of Management. https://www.mit.edu/~lijing/documents/papers/li_evcompatibility.pdf.

[19] Springel, K. (2021). Network externality and subsidy structure in two-sided markets: Evidence from electric vehicle incentives. American Economic Journal: Economic Policy, 13(4): 393-432. https://doi.org/10.1257/pol.20190131

[20] Guo, M., Huang, W. (2023). Consumer willingness to recycle the wasted batteries of electric vehicles in the era of circular economy. Sustainability, 15(3): 2630. https://doi.org/10.3390/su15032630

[21] Nienhueser, I.A., Qiu, Y. (2016). Economic and environmental impacts of providing renewable energy for electric vehicle charging—A choice experiment study. Applied Energy, 180: 256-268. https://doi.org/10.1016/j.apenergy.2016.07.121
[22] Noel, L., de Rubens, G.Z., Sovacool, B.K., Kester, J. (2019). Fear and loathing of electric vehicles: The reactionary rhetoric of range anxiety. Energy Research and Social Science, 48: 96-107. https://doi.org/10.1016/j.erss.2018.10.001
[23] Larson, P.D., Viáfara, J., Parsons, R.V., Elias, A. (2014). Consumer attitudes about electric cars: Pricing analysis and policy implications. Transportation Research Part A: Policy and Practice, 69: 299-314. https://doi.org/10.1016/j.tra.2014.09.002
[24] Greene, M. (2018). Socio-technical transitions and dynamics in everyday consumption practice. Global Environmental Change, 52: 1-9. https://doi.org/10.1016/j.gloenvcha.2018.05.007
[25] Guerra, E. (2019). Electric vehicles, air pollution, and the motorcycle city: A stated preference survey of consumers' willingness to adopt electric motorcycles in Solo, Indonesia. Transportation Research Part D: Transport and Environment, 68: 52-64. https://doi.org/10.1016/j.trd.2017.07.027
[26] Hannan, M.A., Azidin, F.A., Mohamed, A. (2014). Hybrid electric vehicles and their challenges: A review. Renewable and Sustainable Energy Reviews, 29: 135-150. https://doi.org/10.1016/j.rser.2013.08.097
[27] Hasan, S., Simsekoglu, Ö. (2020). The role of psychological factors on vehicle kilometer travelled (VKT) for battery electric vehicle (BEV) users. Research in Transportation Economics, 82: 100880. https://doi.org/10.1016/j.retrec.2020.100880
[28] Hidrue, M.K., Parsons, G.R., Kempton, W., Gardner, M.P. (2011). Willingness to pay for electric vehicles and their attributes. Resource and Energy Economics, 33(3): 686-705. https://doi.org/10.1016/j.reseneeco.2011.02.002
[29] Huang, Y., Qian, L. (2018). Consumer preferences for electric vehicles in lower tier cities of China: Evidences from south Jiangsu region. Transportation Research Part D: Transport and Environment, 63: 482-497. https://doi.org/10.1016/j.trd.2018.06.017
[30] Huang, Y., Yona, A., Takahashi, H., Hemeida, A.M., Mandal, P., Mikhaylov, A., Senjyu, T., Lotfy, M.E. (2021). Energy management system optimization of drug store electric vehicles charging station operation. Sustainability, 13(11): 6163. https://doi.org/10.3390/su13116163
[31] Chen, Y., Jha, S., Raut, A., Zhang, W., Liang, H. (2020). Performance characteristics of lubricants in electric and hybrid vehicles: A review of current and future needs. Frontiers in Mechanical Engineering, 6. https://doi.org/10.3389/fmech.2020.571464
[32] Jreige, M., Abou-Zeid, M., Kaysi, I. (2021). Consumer preferences for hybrid and electric vehicles and deployment of the charging infrastructure: A case study of Lebanon. Case Studies on Transport Policy, 9(2): 466-476. https://doi.org/10.1016/j.cstp.2021.02.002
[33] Krause, R.M., Lane, B.W., Carley, S., Graham, J.D. (2016). Assessing demand by urban consumers for plug-in electric vehicles under future cost and technological scenarios. International Journal of Sustainable Transportation, 10(8): 742-751. https://doi.org/10.1080/15568318.2016.1148213
[34] Abotalebi, E., Scott, D.M., Ferguson, M.R. (2019). Why is electric vehicle uptake low in Atlantic Canada? A comparison to leading adoption provinces. Journal of Transport Geography, 74: 289-298. https://doi.org/10.1016/j.jtrangeo.2018.12.001
[35] Ščasný, M., Zvěřinová, I., Czajkowski, M. (2018). Electric, plug-in hybrid, hybrid, or conventional? Polish consumers' preferences for electric vehicles. Energy Efficiency, 11(8): 2181-2201. https://doi.org/10.1007/s12053-018-9754-1
[36] Smith, B., Olaru, D., Jabeen, F., Greaves, S. (2017). Electric vehicles adoption: Environmental enthusiast bias in discrete choice models. Transportation Research Part D: Transport and Environment, 51: 290-303. https://doi.org/10.1016/j.trd.2017.01.008
[37] Beak, Y., Kim, K., Maeng, K., Cho, Y. (2020). Is the environment-friendly factor attractive to customers when purchasing electric vehicles? Evidence from South Korea. Business Strategy and the Environment, 29(3): 996-1006. https://doi.org/10.1002/bse.2412
[38] Beck, A., Henneberger, J., Schöpfer, S., Fugal, J., Lohmann, U. (2017). HoloGondel: In situ cloud observations on a cable car in the Swiss Alps using a holographic imager. Atmospheric Measurement Techniques, 10(2): 459-476. https://doi.org/10.5194/amt-10-459-2017
[39] Berneiser, J., Senkpiel, C., Steingrube, A., Gölz, S. (2021). The role of norms and collective efficacy for the importance of technoeconomic vehicle attributes in Germany. Journal of Consumer Behaviour, 20(5): 1113-1128. https://doi.org/10.1002/cb.1919
[40] Schulze Darup, A., Piulachs, X., Guille, M. (2018). Consumer preferences for electric vehicles in Germany. International Journal of Transport Economics, 45: 1-6. https://doi.org/10.19272/201806701006
[41] Ji, D., Gan, H. (2022). Effects of providing total cost of ownership information on below-40 young consumers' intent to purchase an electric vehicle: A case study in China. Energy Policy, 165: 112954. https://doi.org/10.1016/j.enpol.2022.112954
[42] Ferguson, M., Mohamed, M., Higgins, C.D., Abotalebi, E., Kanaroglou, P. (2018). How open are Canadian households to electric vehicles? A national latent class choice analysis with willingness-to-pay and metropolitan characterization. Transportation Research Part D: Transport and Environment, 58: 208-224. https://doi.org/10.1016/j.trd.2017.12.006
[43] Ghasri, M., Ardeshiri, A., Rashidi, T. (2019). Perception towards electric vehicles and the impact on consumers' preference. Transportation Research Part D: Transport and Environment, 77: 271-291. https://doi.org/10.1016/j.trd.2019.11.003
[44] Xu, Y., Yang, K., Zhou, J., Zhao, G. (2020). Coal-biomass co-firing power generation technology: Current status, challenges and policy implications. Sustainability, 12(9): 3692. https://doi.org/10.3390/su12093692
[45] Adhikari, M., Ghimire, L.P., Kim, Y., Aryal, P., Khadka, S.B. (2020). Identification and analysis of barriers against electric vehicle use. Sustainability, 12(12): 4850. https://doi.org/10.3390/su12124850
[46] Peters, A., Dütschke, E. (2014). How do consumers perceive electric vehicles? A comparison of German

consumer groups. Journal of Environmental Policy and Planning, 16(3): 359-377. https://doi.org/10.1080/1523908X.2013.879037

[47] Chekima, B., Wafa, S.A.K.S.A., Igau, O.A., Chekima, S., Sondoh, S.L.J. (2016). Examining green consumerism motivational drivers: Does premium price and demographics matter to green purchasing? Journal of Cleaner Production, 112: 3436-3450. https://doi.org/10.1016/j.jclepro.2015.09.102

[48] Hoen, A., Koetse, M.J. (2014). A choice experiment on alternative fuel vehicle preferences of private car owners in the Netherlands. Transportation Research Part A: Policy and Practice, 61: 199-215. https://doi.org/10.1016/j.tra.2014.01.008

[49] Chen, J.S., Hwang, H.Y. (2015). Control strategy for two-mode hybrid electric vehicle by using fuzzy controller. International Journal of Computer and Information Engineering, 9(7): 1662-1669. https://doi.org/10.5281/ZENODO.1107241

[50] Cordera, R., dell'Olio, L., Ibeas, A., Ortúzar, J.D. (2018). Demand for environmentally friendly vehicles: A review and new evidence. International Journal of Sustainable Transportation, 13(3): 210-223. https://doi.org/10.1080/15568318.2018.1459969

[51] Schuitema, G., Anable, J., Skippon, S., Kinnear, N. (2013). The role of instrumental, hedonic and symbolic attributes in the intention to adopt electric vehicles. Transportation Research Part A: Policy and Practice, 48: 39-49. https://doi.org/10.1016/j.tra.2012.10.004

[52] Sovacool, B.K., Martiskainen, M., Hook, A., Baker, L. (2019). Decarbonization and its discontents: A critical energy justice perspective on four low-carbon transitions. Climatic Change, 155(4): 581-619. https://doi.org/10.1007/s10584-019-02521-7

[53] Parsons, G.R., Hidrue, M.K., Kempton, W., Gardner, M.P. (2011). Can vehicle-to-grid revenue help electric vehicles on the market? Working Papers 11-21. University of Delaware, Department of Economics.

[54] Danielis, R., Rotaris, L., Giansoldati, M., Scorrano, M. (2020). Drivers' preferences for electric cars in Italy. Evidence from a country with limited but growing electric car uptake. Transportation Research Part A: Policy and Practice, 137: 79-94. https://doi.org/10.1016/j.tra.2020.04.004

[55] Alberini, A., Bigano, A., Ščasný, M., Zvěřinová, I. (2018). Preferences for energy efficiency vs. renewables: What is the willingness to pay to reduce CO2 emissions? Ecological Economics, 144: 171-185. https://doi.org/10.1016/j.ecolecon.2017.08.009

[56] Ba, S., Lisic, L.L., Liu, Q., Stallaert, J. (2013). Stock market reaction to green vehicle innovation. Production and Operations Management, 22(4): 976-990. https://doi.org/10.1111/j.1937-5956.2012.01387.x

[57] Jin, L., Slowik, P. (2017). Literature review of electric vehicle consumer awareness and outreach activities. Working Paper 2017-03. International Council on Clean Transportation. https://theicct.org/wp-content/uploads/2021/06/Consumer-EV-Awareness_ICCT_Working-Paper_23032017_vF.pdf.

[58] Siraj, F., Mehra, P. (2023). The influence of financial incentives and other socio-economic factors on two-wheeler EV adoption in the NCR region. In Advances in Finance, Accounting, and Economics. IGI Global, pp. 248-279. https://doi.org/10.4018/978-1-6684-8810-2.ch013

[59] Tamor, M.A., Milačić, M. (2015). Electric vehicles in multi-vehicle households. Transportation Research Part C: Emerging Technologies, 56: 52-60. https://doi.org/10.1016/j.trc.2015.02.023

[60] Brownstone, D., Bunch, D.S., Train, K. (2018). Joint mixed logit models of stated and revealed preferences for alternative-fuel vehicles. In Controlling Automobile Air Pollution. Routledge, pp. 299-322. https://doi.org/10.4324/9781351161084-16

[61] Dumortier, J., Buerger, C. (2024). The impact of weather on the racial composition of traffic stop and citation issuance in the United States. Journal of Urban Affairs, 1-18. https://doi.org/10.1080/07352166.2024.2388050

[62] Naghavi, M., Abajobir, A.A., Abbafati, C., Abbas, K.M., et al. (2017). Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: A systematic analysis for the Global Burden of Disease Study 2016. The Lancet, 390(10100): 1151-1210. https://doi.org/10.1016/s0140-6736(17)32152-9

[63] Lebeau, R.T., Glenn, D.E., Hanover, L.N., BeesdoBaum, K., Wittchen, H.U., Craske, M.G. (2012). A dimensional approach to measuring anxiety for DSM5. International Journal of Methods in Psychiatric Research, 21(4): 258-272. https://doi.org/10.1002/mpr.1369

[64] Tanaka, T., Narazaki, M., Kishimoto, T. (2014). IL-6 in inflammation, immunity, and disease. Cold Spring Harbor Perspectives in Biology, 6(10): a016295. https://doi.org/10.1101/cshperspect.a016295

[65] Bera, R., Maitra, B. (2021). Analyzing prospective owners' choice decision towards plug-in hybrid electric vehicles in urban India: A stated preference discrete choice experiment. Sustainability, 13(14): 7725. https://doi.org/10.3390/su13147725

[66] Sanguesa, J.A., Torres-Sanz, V., Garrido, P., Martinez, F.J., Marquez-Barja, J.M. (2021). A review on electric vehicles: Technologies and challenges. Smart Cities, 4(1): 372-404. https://doi.org/10.3390/smartcities4010022

[67] Cohen, L.H., Towbes, L.C., Flocco, R. (1988). Effects of induced mood on self-reported life events and perceived and received social support. Journal of Personality and Social Psychology, 55(4): 669-674. https://doi.org/10.1037/0022-3514.55.4.669

[68] Koppelman, F.S., Bhat, C. (2006). A self instructing course in mode choice modeling: Multinomial and nested logit models. U.S. Department of Transportation, Federal Transit Administration. https://www.caee.utexas.edu/prof/bhat/courses/lm_draft_060131final-060630.pdf.

[69] Gerhardt, M.V., Kanberger, E.D., Ziegler, A. (2023). The relevance of life-cycle CO2 emissions for vehicle purchase decisions: A stated choice experiment for Germany. VfS Annual Conference 2023 (Regensburg): Growth and the "soziale Frage", Verein für Socialpolitik / German Economic Association. https://ideas.repec.org/p/zbw/vfsc23/277675.html.

[70] Dong, Y. (2025). Environmental perception and willingness to pay for electric vehicles: An analysis using the lens model. SAGE Open, 15(2). https://doi.org/10.1177/21582440251335517