
ELECTRIC VEHICLE ADOPTION AND SUSTAINABILITY IN THE URBAN CITY: A TECHNOLOGY ACCEPTANCE MODEL ANALYSIS

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Abstract

This study aims to operationalize the theory of Technology Acceptance Model (TAM) with self- image motives as symbolic meaning for Electric Vehicle (EVs) adoption. EVs in urban city like Jakarta is expected to grow in near future, the vehicle contributes to the reduction of air pollution and greenhouse. Unlike the conventional, EVs has emerged as sustainable transportation one. However, switching mode speed of consumer mobility and the acceptance of new technology is still undefinable and required to explore deeply on the potential buyer segments of EVs based on integrative approach of 'perceived benefits-attitude-intention'. This research applied the theory of TAM to construct the model of EVs adoption. The mediating role of pro-environmental motives and pro-innovative motives are examined. This study also aims to synthesize evidence on self-image in various aspects of electric vehicle motives. Data were collected from various Scopus database indexed from 2019-2023 and direct in-dept interview with EVs drivers to set an agenda of debate on self-image and adoption of electric vehicle. The findings confirm that the consumer intention to adopt EVs were significant and positively effects the attitude. They are two distinct sets of consumer motives toward EVs adoption are pro-environmentalist and pro-innovativeness. This study provides new grounding for the existing EVs literature. The implications are recommended, which may offer deeper insight for policymaker and prominent scholars to encourage EVs adoption and direct the future research for global urban city.

Keywords: Electric Vehicle, Sustainability, TAM analysis

Introduction

The market of electric vehicle (EV) in Indonesia is picking momentum to grow with increasing demand, greater intention to drive, and improving charging infrastructure. Several initiatives have been taken by government to decarbonize the road transport systems and promote the adoption of EV. The total population of Indonesia is around 270 million people (BPS, 2022) are expected to drive 13 million EV by 2030 and to create net zero emission (NZE) by 2060 (ESDM, 2023). EV are categorized into cars and e-scooters (Bösehans et al., 2023), both products are characterized by mass and low-cost mobility transportation. However, EVs popularity are increased due to its concern on environmental issues and unique innovation provided (Li et al., 2022; Ju & Hun Kim, 2022). The Indonesia government is susceptible country to environmental changes. The govt expects to decrease the people consumption of fossil energy for vehicle due its high contribution of carbon dioxide (CO₂) emissions. Study done by (Shakeel, 2022) on climate change prove several decrease that attach the human health contributed by carbon dioxide from fossil fuels and contaminated floodwater.

The development and adoption of EV technology has increased around the globe with more than 450 EV cars model (Hopkins et al., 2023). The EVs ecosystems highlighted the importance of saving energy consumption, promotes environmentally friendly e-mobility and economically sustainable, the Indonesian EV industry is still nascent and newly industrialized which along the government vision for 2045. The report from Indonesia ministry of energy and mineral resources, cited that they are around 63.105 EVs operated in Indonesia (ESDM, 2023), and 1.500 EVs are operated in Jakarta. The trends of driving EVs has increased significantly due to the tax subsidies, benefits, regulations and financial incentive policies provided by the government. The urban city like Jakarta, Bandung, Semarang, Surabaya, Medan, and Makassar affects transition and wider adoption of EVs because of availability of public charging station as well as home-charging infrastructure (Utami et al., 2020).

In general, the consumer awareness of electric vehicle as vehicle technology advancement and slower accept the technology innovation as alternate fuel options (Jaiswal et al., 2022). Concerning the global initiative

of climate change and greenhouse, the principle government like Jakarta have either initiated EVs promotion or contemplating the policies related to the greenhouse mobility (Habich-Sobiegalla et al., 2018; Ghadikolaei et al., 2021; Cruz-Jesus et al., 2023). Electric vehicle are viewed as future vehicle with high innovation in technology (Schiavo et al., 2021) and else, innovation can elevate environment sustainability (Cruz-Jesus et al., 2023). In this regards, future EVs could become a real competitor in automotive industry. Even though lower energy densities, EVs is still identified with high price (Tang et al., 2023) and higher charging time (Murugan & Marisamynathan, 2022), yet the upcoming new models in electric vehicle has changed the market demand and consumer acceptance of technology (Singh et al., 2023).

Jakarta air quality (2023) report the air quality is satisfactory and moderate with 127 that measure the type of air pollution called PM 2.5 (AQI, 2023). Jakarta has experienced the clean air during covid-19, that why the government supposed to improve air quality and seen as the benefits of EVs. Moreover, stronger regulatory “push” the EVs market development. Previous issues discuss in the market is about charging station and its infrastructure. Public charging station (Limon et al., 2023) plays an important role in distributing electricity to EVs battery and must be widely accessible and located in major spaces of public transportation point in Jakarta such as Wang Plaza, Humble house, Cheongdam garden, Hotel Mercure, Lippo Mall puri, Lippo mall kemang, Lippo Pluit village, and Hotel Santika Premier (Carmudi, 2023).

In this direction, the present study on electric vehicle implies the analysis of technology acceptance from drivers’ perspective and uses in-dept interviews to fill the gap and reveals the self-image motives behind the attitude, behavior intention, and EV adoption in urban city like Jakarta. According to Li (2022) self-image refer to the individual point of view in the form of human activities (Li, Wang, Gong, et al., 2022). Self-image may distinct the people from its environment in encouraging the specific products during its purchase intention. Purchase intention behavior may affected by motivating factors of actual adopters such as battery charge, driving range, and convenience charging station (Salari, 2022). The perspective of products response may lead to self-stimulation as a symbol of wisdom and virtue by their function, form, color, and size (Li, Wang, Gong, et al., 2022). However, consumer often employs symbolic meaning of products for their self-image and behavior and ensure the quality and function of EVs could fulfil their demands. Thus, consumer self-image may lead to stronger early adopters in electric vehicle market industry (Priessner et al., 2018; van Heuveln et al., 2021; Plananska & Gamma, 2022).

Earlier researchers introduce Technology Acceptance Model (TAM) as driven factor for consumer purchase behavior toward adopting electric vehicle and acceptance of technology has been explained in various literature of sustainable transportation (Habich-Sobiegalla et al., 2019; Tanwir & Hamzah, 2020; Dutta & Hwang, 2021; Loengbudnark et al., 2022; Limon et al., 2023). However, some scholars critically argued the green product and perceived green value as subjected to environmental concern and pro-environmentalist (Hamzah & Tanwir, 2021). The classical approach of TAM, pioneered by Davis (1989) to considers the positive cognitive beliefs based on technology innovation and attributes (Jaiswal et al., 2021). Other theory namely theory of reasoned action (TRA) (Fishbein and Ajzen, 1980), and theory of planned behavior (TPB) (Ajzen, 1991) also employed cognitive behavioral theories as well (Jaiswal et al., 2022). Most of the theories stressed on the cognitive measure such as financial incentives (Munshi et al., 2022), social equity (Hopkins et al., 2023), price sensitivity (Öztaş Karlı et al., 2022), and psychological attributes (Li, Wang, & Xie, 2022) to describe user behavioral intention to adopt electric vehicle.

The study done by Jaiswal (2022) extent the theory of acceptance technology into TAM2 which include subjective norms as an external construct. Tanwir and Hamzah (2020) have studied the significance of trust in the preference of electric vehicle and the acceptance of EVs technology such as battery charging time, navigation systems, cooling systems, and other physical attributes of vehicle (Tanwir & Hamzah, 2020). TAM theory has covered perceived usefulness or benefits, perceived ease of use, and behavioral intentions as the major components that donates to the degree of technology acceptance. Vafaei-Zadeh et al., (2022) have discuss the impact of perceive usefulness of technology has impact on attitude. EV technology may be used to change the automotive industry and set new target consumers with incentive policies (Utami et al., 2020). Butt & Singh, (2022) have studied extended TAM into two predictors called perceived usefulness and ease of use to identify behavioral intention of consumers in using new technology and innovation.

This research provides ground study for scholars not just understand the reason for adoption of electric vehicle, but also in terms of providing theoretical analysis of technology acceptance and challenges in adoption of EV for future green transportation. The comprehensive framework of this study exposes the elements of environmental and innovation issues between technology acceptance and image of drivers. The antecedents of EV adoption may result to high quality research literature. This paper is organized to present the review of user technology acceptance model which represent the literature and theoretical background. Next research methodology is discussed and the finding or results of the analysis. Finally, the theoretical and practical contribution are elaborated and presented before conclusion.

Research Method

For the purpose of this analysis, a definition of adoption of electric vehicle is suggested as:

“The individual intention to adopt electric vehicle is because of their self-image motives, and mediates by pro-environmental, and pro-innovative. While TAM analysis covers consumer attitude, perceived usefulness, and ease of use.”

The benefits to adopt EV is not only to reduce carbon dioxide (CO2) emissions and create greenhouse, but also to save the cost of transportation fuel consumption, received subsidies, and taxation cost in compare to the conventional one.

A review of academic literature has been undertaken in this research to understand the role of self-image toward adoption of electric vehicle and recognize the TAM analysis as the body of the research in this area. The researcher identifies the literature through Scopus database and google scholars. The keywords are electric vehicle adoption, sustainability, and TAM analysis. Papers are screened carefully and addressed based on the scope and object of the research. At the same time, a few random EV drivers were interviewed and surveyed about the experience of using electric vehicles.

This is qualitative research methods which attempt to understand the role of self-image as symbolic meaning of adoption of electric vehicle. However, the mediating role of pro-environmentalist and pro-innovativeness are also examined. Data were collected through in-dept interview with the drivers of electric vehicle in Jakarta. Finally, data were analyzed through qualitative content analysis, and then classified based on consumer categories.

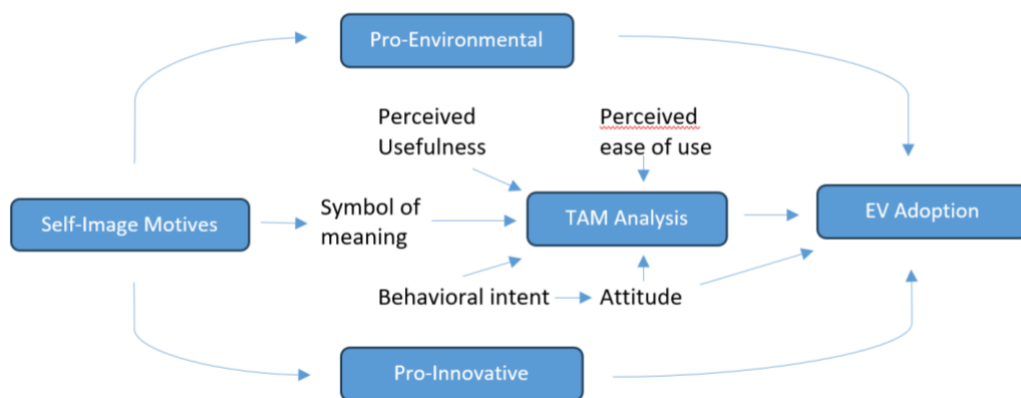


Fig.1. Dynamic relationship diagram between self-image and EV adoption
Source: The authors.

Results and Discussions

The findings of this research critically review the user of TAM analysis as the body of the knowledge concerning the environmental issues and innovativeness in the provision of EV adoption. While self-image described as symbolic meaning of products for early adopters (Li, Wang, Gong, et al., 2022). Self-image reflects on how customers perceived usefulness, and ease of use of the products (Vafaei-Zadeh et al., 2022). Vafaei-Zadeh (2022) stressed on self-image with environmental issues such fuel saving energy and reduction of carbon dioxide (CO2) emissions. However, self-image could ensure the behavior intent while conforming their self-motives (Li, Wang, Gong, et al., 2022) in choosing a specific product for symbol of meaning.

In the context of EV adoption, they are two types of motives namely pro-environmental motives and pro-innovative motives (Li, Wang, Gong, et al., 2022). Foroughi et al., (2023) suggest pro-environmental individual may find better-suited alternative vehicle for their environment care and protection. Shanmugavel & Balakrishnan, (2023) study on e-vehicle finds some variable such as environmental knowledge, environmental concern, and environmental responsibility significantly impact behavior intention while aligned with personal norm. However, the study is just exhibited the positive relationship between environmental concern and behavioral intent (Upadhyay & Kamble, 2023). Looking at EV demand in the market, environmental issues plays an important role in buying decision of customers, because some of them are concern on the personal norm and social norm (Shanmugavel & Balakrishnan, 2023). Another research done by Hamzah & Tanwir, (2021) overcome pro-environment as self-interest in buying decision process. Both self-image and self-interest may be deemed to be highly skewed towards pro-environmental behavior of individual while deciding to EV adoption.

The study of EV adoption also consolidates pro-innovative as the dimension of self-images. The consumer often choose the technology and spec of products as an intelligent information for the user before prefer to buy (Li, Wang, Gong, et al., 2022). Study done by Gulzari et al., (2022) suggest innovation with green experience of eco-friendly cars. Innovation may focus on quality and value offered to customer (Gulzari et al., 2022) at the same time enhancing brand position in market and EV industry. Another study done by (Habich-Sobieggalla et al., 2019) find battery charging time and live as innovation diffusion in EV technology. Consumers in Jakarta city, concern about the important of longer battery life (Habich-Sobieggalla et al., 2019) and driving range. Public charging infrastructure is considered to be social equity (Hopkins et al., 2023) in EV adoption, the study further discuss the charging point and cost which is accessible to every EV drivers in urban city.

Conclusions

The previous research on EVs adoption and self-image is just proposing the framework associated with symbolic meanings of EVs (Li, Wang, Gong, et al., 2022) but not clearly defining the user acceptance of technology. This research filled the gap. However, pro-environmentalist claimed environmental issues plays a viral role in customer buying decision as well as adoption of EVs in their homes. Pro-environmental its self can lead to behavior intent which related to their satisfaction of adopting EVs. In short, consumer intention to adopt EVs is significantly affect their attitude.

Today, with technology breakthrough, the benefits of electric vehicle will expand the user experience. Moreover, supported with the government financial incentives and tax subsidies will absolutely improve the consumer encouragement towards EVs adoption. The attitude followed by self-motives may increase the target sales of EVs marketers. Finally, the consumer will aware about future sustainable transportation and fulfill the need of their speed mobility. This research limit is self into the urban city mobility with environmental concern and innovation. To have better understanding of consumer adoption of EVs, future study must be generalized into larger scope such as provincial level with longitudinal study and differ the role of demographic factors such as gender, education, age, and family income, thus enriching our research findings.

References

- Bösehans, G., Bell, M., Thorpe, N., & Dissanayake, D. (2023). Something for every one? - An investigation of people's intention to use different types of shared electric vehicle. *Travel Behaviour and Society*, 30(September 2022), 178–191. <https://doi.org/10.1016/j.tbs.2022.09.004>
- Butt, M. M. H., & Singh, J. G. (2022). Factors Affecting Electric Vehicle Acceptance, Energy Demand and Co2 Emissions in Pakistan. *SSRN Electronic Journal*, 2(3), 100081. <https://doi.org/10.2139/ssrn.4153365>
- Cruz-Jesus, F., Figueira-Alves, H., Tam, C., Pinto, D. C., Oliveira, T., & Venkatesh, V. (2023). Pragmatic and idealistic reasons: What drives electric vehicle drivers' satisfaction and continuance intention? *Transportation Research Part A: Policy and Practice*, 170(December 2022), 103626. <https://doi.org/10.1016/j.tra.2023.103626>
- Dutta, B., & Hwang, H. G. (2021). Consumers purchase intentions of green electric vehicles: The influence of consumers technological and environmental considerations. *Sustainability (Switzerland)*, 13(21). <https://doi.org/10.3390/su132112025>
- Foroughi, B., Nhan, P. V., Iranmanesh, M., Ghobakhloo, M., Nilashi, M., & Yadegaridehkordi, E. (2023). Determinants of intention to use autonomous vehicles: Findings from PLS-SEM and ANFIS. *Journal of Retailing and Consumer Services*, 70(September 2022), 103158. <https://doi.org/10.1016/j.jretconser.2022.103158>
- Ghadikolaie, M. A., Wong, P. K., Cheung, C. S., Zhao, J., Ning, Z., Yung, K. F., Wong, H. C., & Gali, N. K. (2021). Why is the world not yet ready to use alternative fuel vehicles? *Heliyon*, 7(7), e07527. <https://doi.org/10.1016/j.heliyon.2021.e07527>
- Gulzari, A., Wang, Y., & Prybutok, V. (2022). A green experience with eco-friendly cars: A young consumer electric vehicle rental behavioral model. *Journal of Retailing and Consumer Services*, 65(November 2021), 102877. <https://doi.org/10.1016/j.jretconser.2021.102877>
- Habich-Sobieggalla, S., Kostka, G., & Anzinger, N. (2018). Electric vehicle purchase intentions of Chinese, Russian and Brazilian citizens: An international comparative study. *Journal of Cleaner Production*, 205, 188–200. <https://doi.org/10.1016/j.jclepro.2018.08.318>
- Habich-Sobieggalla, S., Kostka, G., & Anzinger, N. (2019). Citizens' electric vehicle purchase intentions in China: An analysis of micro-level and macro-level factors. *Transport Policy*, 79(March 2018), 223–233. <https://doi.org/10.1016/j.tranpol.2019.05.008>
- Hamzah, M. I., & Tanwir, N. S. (2021). Do pro-environmental factors lead to purchase intention of hybrid vehicles? The moderating effects of environmental knowledge. *Journal of Cleaner Production*, 279. <https://doi.org/10.1016/j.jclepro.2020.123643>

- Hopkins, E., Potoglou, D., Orford, S., & Cipcigan, L. (2023). Can the equitable roll out of electric vehicle charging infrastructure be achieved? *Renewable and Sustainable Energy Reviews*, 182(July 2022), 113398. <https://doi.org/10.1016/j.rser.2023.113398>
- Jaiswal, D., Deshmukh, A. K., & Thaichon, P. (2022). Who will adopt electric vehicles? Segmenting and exemplifying potential buyer heterogeneity and forthcoming research. *Journal of Retailing and Consumer Services*, 67(March), 102969. <https://doi.org/10.1016/j.jretconser.2022.102969>
- Jaiswal, D., Kaushal, V., Kant, R., & Kumar Singh, P. (2021). Consumer adoption intention for electric vehicles: Insights and evidence from Indian sustainable transportation. *Technological Forecasting and Social Change*, 173(November 2020), 121089. <https://doi.org/10.1016/j.techfore.2021.121089>
- Ju, N., & Hun Kim, S. (2022). Electric vehicle resistance from Korean and American millennials: Environmental concerns and perception. *Transportation Research Part D: Transport and Environment*, 109(July), 103387. <https://doi.org/10.1016/j.trd.2022.103387>
- Li, L., Wang, Z., Gong, Y., & Liu, S. (2022). Self-image motives for electric vehicle adoption: Evidence from China. *Transportation Research Part D: Transport and Environment*, 109(July), 103383. <https://doi.org/10.1016/j.trd.2022.103383>
- Li, L., Wang, Z., & Xie, X. (2022). From government to market? A discrete choice analysis of policy instruments for electric vehicle adoption. *Transportation Research Part A: Policy and Practice*, 160(March), 143–159. <https://doi.org/10.1016/j.tra.2022.04.004>
- Limon, M. H., Debnath, B., & Bari, A. B. M. M. (2023). Exploration of the drivers influencing the growth of hybrid electric vehicle adoption in the emerging economies: Implications towards sustainability and low-carbon economy. *Sustainable Operations and Computers*, 4(March), 76–87. <https://doi.org/10.1016/j.susoc.2023.04.002>
- Loengbudnark, W., Khalilpour, K., Bharathy, G., Taghikhah, F., & Voinov, A. (2022). Battery and hydrogen-based electric vehicle adoption: A survey of Australian consumers perspective. *Case Studies on Transport Policy*, 10(4), 2451–2463. <https://doi.org/10.1016/j.cstp.2022.11.007>
- Munshi, T., Dhar, S., & Painuly, J. (2022). Understanding barriers to electric vehicle adoption for personal mobility: A case study of middle income in-service residents in Hyderabad city, India. *Energy Policy*, 167(March), 112956. <https://doi.org/10.1016/j.enpol.2022.112956>
- Murugan, M., & Marisamynathan, S. (2022). Elucidating the Indian customers requirements for electric vehicle adoption: An integrated analytical hierarchy process – Quality function deployment approach. *Case Studies on Transport Policy*, 10(2), 1045–1057. <https://doi.org/10.1016/j.cstp.2022.03.017>
- Öztaş Karlı, R. G., Karlı, H., & Çelikyay, H. S. (2022). Investigating the acceptance of shared e-scooters: Empirical evidence from Turkey. *Case Studies on Transport Policy*, 10(2), 1058–1068. <https://doi.org/10.1016/j.cstp.2022.03.018>
- Plananska, J., & Gamma, K. (2022). Product bundling for accelerating electric vehicle adoption: A mixed-method empirical analysis of Swiss customers. *Renewable and Sustainable Energy Reviews*, 154(February 2021), 111760. <https://doi.org/10.1016/j.rser.2021.111760>
- Priessner, A., Sposato, R., & Hampl, N. (2018). Predictors of electric vehicle adoption: An analysis of potential electric vehicle drivers in Austria. *Energy Policy*, 122(July), 701–714. <https://doi.org/10.1016/j.enpol.2018.07.058>
- Salari, N. (2022). Electric vehicles adoption behaviour: Synthesising the technology readiness index with environmentalism values and instrumental attributes. *Transportation Research Part A: Policy and Practice*, 164(July), 60–81. <https://doi.org/10.1016/j.tra.2022.07.009>
- Schiavo, F. T., Calili, R. F., de Magalhães, C. F., & Fróes, I. C. G. (2021). The meaning of electric cars in the context of sustainable transition in Brazil. *Sustainability (Switzerland)*, 13(19), 1–24. <https://doi.org/10.3390/su131911073>
- Shakeel, U. (2022). Electric vehicle development in Pakistan: Predicting consumer purchase intention. *Cleaner and Responsible Consumption*, 5(March), 100065. <https://doi.org/10.1016/j.clrc.2022.100065>
- Shanmugavel, N., & Balakrishnan, J. (2023). Influence of pro-environmental behaviour towards behavioural intention of electric vehicles. *Technological Forecasting and Social Change*, 187(December 2022), 122206. <https://doi.org/10.1016/j.techfore.2022.122206>
- Singh, H., Singh, V., Singh, T., & Higuera-Castillo, E. (2023). Electric vehicle adoption intention in the Himalayan region using UTAUT2 – NAM model. *Case Studies on Transport Policy*, 11(December 2022), 100946. <https://doi.org/10.1016/j.cstp.2022.100946>
- Tang, Y., Zhang, Q., Liu, B., Li, Y., Ni, R., & Wang, Y. (2023). What influences residents' intention to participate in the electric vehicle battery recycling? Evidence from China. *Energy*, 276(March). <https://doi.org/10.1016/j.energy.2023.127563>
- Tanwir, N. S., & Hamzah, M. I. (2020). Predicting purchase intention of hybrid electric vehicles: Evidence from an emerging economy. *World Electric Vehicle Journal*, 11(2). <https://doi.org/10.3390/WEVJ11020035>
- Upadhyay, N., & Kamble, A. (2023). Examining Indian consumer pro-environment purchase intention of

- electric vehicles: Perspective of stimulus-organism-response. *Technological Forecasting and Social Change*, 189(February), 122344. <https://doi.org/10.1016/j.techfore.2023.122344>
- Utami, M. W. Dela, Yuniaristanto, Y., & Sutopo, W. (2020). Adoption Intention Model of Electric Vehicle in Indonesia. *Jurnal Optimasi Sistem Industri*, 19(1), 70–81. <https://doi.org/10.25077/josi.v19.n1.p70-81.2020>
- Vafaei-Zadeh, A., Wong, T. K., Hanifah, H., Teoh, A. P., & Nawaser, K. (2022). Modelling electric vehicle purchase intention among generation Y consumers in Malaysia. *Research in Transportation Business and Management*, 43(February 2021), 100784. <https://doi.org/10.1016/j.rtbm.2022.100784>
- van Heuveln, K., Ghotge, R., Annema, J. A., van Bergen, E., van Wee, B., & Pesch, U. (2021). Factors influencing consumer acceptance of vehicle-to-grid by electric vehicle drivers in the Netherlands. *Travel Behaviour and Society*, 24(August 2020), 34–45. <https://doi.org/10.1016/j.tbs.2020.12.008>