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Electric Vehicle Adoption in Emerging Economies: The Influence of Environmental and Technological Determinants on Consumer Readiness

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***Abstract* - This study explored Malaysian consumer readiness for electric vehicle (EV) adoption, aiming to support a more inclusive and sustainable ecosystem. Framed by the Value-Belief-Norm (VBN) theory and the Technology Readiness Index (TRI) 2.0 framework, the study examined how environmental awareness mediates the effects of eco-friendly values, technological innovation, and charging infrastructure on EV adoption. Using a quantitative survey and random sampling, the findings revealed that technological innovation significantly enhances readiness to adopt EVs, while environmental awareness contributes positively by promoting eco-consciousness and public engagement with sustainability efforts. Environmental awareness sometimes hindered EV adoption, as individuals questioned the actual environmental impact of EVs, including emissions from battery production and energy sources. The study found a weak relationship between eco-friendly attitudes and EV adoption, and no significant effect from charging infrastructure. These findings highlighted the need to improve environmental education and strengthen technological and infrastructure support to promote sustainable transportation.**

***Keywords:* Electric Vehicles (Evs), Readiness to Adopt EV, Environmental Awareness, Eco-Friendly Environmental, Technological Innovation, Charging Infrastructure, Putrajaya, Value-Belief-Norm (VBN) Theory, Technology Readiness Index (TRI) 2.0**

I. INTRODUCTION

The transportation sector contributes significantly to global greenhouse gas emissions, it produces about 24% of direct CO_2 emissions from fuel use (Bibra et al., 2022). There is an urgent need to transition from internal combustion engine vehicles to electric vehicles (EVs) to combat environmental challenges like air pollution and climate change (Priya & Vijayan, 2017). EVs seen as a crucial innovation for addressing these issues. In response, Malaysia introduced the National Energy Transition Roadmap (NETR) in 2023 to drive the country toward net-zero emissions by 2050 (Ministry of Economy Malaysia, 2023), supported by the Low Carbon Mobility Blueprint 2021–2030 (LCMB). The Ministry of Environment and Water has set a target for EVs to make up 15% of the vehicle fleet by 2030 (Papadopoulos & Konstantinou, 2025). These initiatives align with the UN Sustainable Development Goal 13, which emphasizes climate action and sustainable urban development. To encourage EV adoption, the Malaysian government offers tax exemptions and subsidies, including import, excise, and sales tax relief for locally assembled EVs (Menon & Kulshreshtha, 2021).

Additionally, cconsumers in Malaysia benefit from up to RM2,500 in income tax relief for investments in EV charging equipment (Ministry of Finance Malaysia, 2023). These incentives are supported by strategic infrastructure initiatives, including the planned development of 10,000 EV charging stations nationwide by 2025 under the Low Carbon Mobility Blueprint. Malaysia's Voluntary Next Generation Vehicle (NxGV) initiative underscores the government's commitment to making the country a regional EV hub (Ramchurn, 2025) (Bhoyar et al., 2025). However, despite supportive policies, adoption remains limited due to high initial costs, inadequate charging infrastructure, and concerns about safety, reliability, and driving range (Toolib et al., 2023). These challenges compounded by evolving battery technologies and underdeveloped networks. Additionally, behavioral factors such as consumer attitudes, beliefs, and cultural norms still insufficiently addressed in current research (Canlas et al., 2022).

As environmental consciousness grows, there is an increasing need to understand both behavioral and structural factors influencing electric vehicle (EV) adoption. Localised studies are rare despite numerous global studies (Bibra et al., 2022). This paper explores how environmental awareness, technological development and charging infrastructure can influence consumer acceptance of electric cars in urban environments, also considering differences in the social and infrastructural framework. The objective of this study is to examine factors affecting the adoption of electric vehicle (EV) in Putrajaya (Ekambaram & Tripathi, 2025).

Research Objectives

1. To examine the impact of Eco-friendly Environment (EFE), Technological Innovation (TI), and Charging Infrastructure (CI) on Environmental Awareness (EA) toward EVs adoption in Putrajaya.
2. To examine the mediating effect of Environmental Awareness (EA) on consumer readiness to adopt EVs in Putrajaya.
3. To investigate the extent to which Environmental Awareness (EA) mediates the relationship between eco-friendly environment (EFE), Technological Innovation (TI) charging infrastructure (CI), and the consumer readiness to adopt EVs in Putrajaya.
4. To examine the relationship between mediating effect of Environmental Awareness (EA) on consumer readiness to adopt EVs in Putrajaya.
5. To investigate Environmental Awareness (EA) as a mediator between Eco-friendly Environment (EFE), Technological Innovation (TI), and Charging Infrastructure (CI) towards consumer readiness to adopt EVs in Putrajaya.

II. Readiness to Adopt Electric Vehicles (EV)

Customer preparedness refers to the psychological readiness to switch from traditional engine vehicle to EV (Zhou et al., 2023). Although sustainable mobility is progressing, low customer readiness is the main obstacle for the mass adoption of EVs. Infrastructure, regulations, advancement of technology and consumer attitude are the main drivers for acceptance. Sustained barriers such as low environmental consciousness, small number of charging stations, battery durability issues and high ownership costs raise consumer hesitancy and resistance. Also, psychosocial, and socio-cultural factors such as attitudes, beliefs and personal values play a crucial role in the acceptance decision and seldom considered in the literature (Canlas et al., 2022)

Facing heavy investment and accelerated market development, China has emerged as a leader in the global development of EV infrastructure. In Norway and Sweden their efforts for EV promotion backed up by strong policy regulations, targeted incentives, and infrastructure in place. Studies conducted in Thailand pointed to the significant role of charging infrastructure in influencing consumer readiness, and to be the crucial consideration for successful policy and market strategy (Purwanto & Irawan, 2024). Research has empirically investigated situational and psychological factors that might affect the consumer's willingness to accept EVs. (Ismail, 2022) emphasized government assistance, infrastructure, and consumer awareness as essential in the EV propagation of Pulau Langkawi, Malaysia. Nevertheless, the expert interviews and the application of the Analytical Hierarchy Process (AHP) methodology in the study results were not generalizable to broader consumer perspectives. Meanwhile, (Adnan et al., 2017) adopted the Theory of Planned Behavior (TPB) in modeling EV adoption underlined by perceived behavioral control, subjective norm and environmental attitude. However, their work was not empirically validated and relied on literature review to provide only theoretical indication of consumer behavior.

Research in India also identifies that perceived risk acts as a barrier, however it also reveals that the factors such as personal innovativeness, perceived usefulness, and ease of use play a significant role in EV adoption among customers. Nevertheless, these findings need to be generalised cautiously in the context of Malaysia as there are variations in culture and infrastructure. Another research found environmental awareness plays a critical role between attitudes and intention to use (Energy Watch, 2024). In the UK, technological readiness and practical factors, such as driving range and cost, are vital in EV purchase intentions than environmental attitudes (GN Technology and Environmentalism, 2022). Although informative for developed countries, these results may not be entirely applicable to Malaysia because of variations in environmental consciousness and infrastructure. Furthermore, the use of cross-sectional, self-reported data restricts knowledge on behavior in the real world in the course of time. This highlights a research gap in Southeast Asia, especially Malaysia, where more longitudinal, experimental, and context-specific studies needed.

EV adoption in Malaysia is driven by value-for-money, infrastructure preparedness, and environmental consciousness in line with the country's sustainability goals. Effective urban planning and proactive policy making are essential, to tackle issues such as poor charging infrastructure in the developing world (Mphahlele et al., 2023). These results highlight the need to incorporate technological, infrastructural, and behavioral considerations into plans aiming to facilitate the broader adoption of EVs.

Eco-Friendly Environmental

An eco-friendly atmosphere, plays significant role in the fight against global warming, induced due to the release of greenhouse gases (GHGs). The transportation sector's high emissions make adopting electric vehicles essential for reducing environmental damage. EVs significantly reduce tailpipe emanations and dependency on fossil fuels, making them a cornerstone in global efforts to achieve carbon neutrality by 2050 (International Energy Agency, 2023). Beyond transportation, the green buildings including renewable energy sources such as solar and wind, passive lighting design, rainwater harvesting, and wastewater recycling also contributes to sustainable urban environments (United Nations Environment Programme, 2022).

Eco-friendly environments linked to socio-economic development. Environmentally friendly agricultural practices boost productivity and economic benefits by minimizing waste and conserving resources. Similarly, countries with strong environmental policies such as China, Norway, and Sweden shows higher EV adoption, driven by strict regulations, subsidies, and infrastructure investment (Singh et al., 2024). Their commitment to global carbon neutrality aligns with aggressive national policy agendas aimed in decarbonizing transport systems.

Technological Innovation

Technological innovation is a key driver in the automotive industry, with R&D efforts essential for staying competitive and meeting shifting consumer expectations (Ross, 2023). In the electric vehicle (EV) sector, advancements address critical concerns such as range, performance, and reliability, thereby influencing consumer adoption. Industry leaders like Tesla and BYD have propelled the EV market forward through continuous development in electric drivetrains, battery systems, and autonomous technologies (Weber, 2022). Notably, Tesla's collaboration on magnesium-ion batteries marks a significant leap, offering improved energy density and thermal stability over traditional lithium-ion batteries. These innovations enhance driving range, reduce charging time, and boost vehicle efficiency factors that help overcome range anxiety and increase mainstream consumer interest in EVs.

Efficient battery technology is critical for reducing EV costs and achieving price parity with internal combustion engine vehicles. Innovations such as solid-state batteries and regenerative braking enhance efficiency and build consumer trust (Nayyar & Davies, 2023). However, limited driving range, slow charging, and weak infrastructure continue to impede adoption. Public acceptance influenced by perceptions of safety, reliability, and integration with smart urban systems (Jain et al., 2022). Progress also depends on strong policy support, as insufficient R&D funding, infrastructure investment, and standardization hinder EV growth. Aligning public policy with technological innovation is vital for advancing sustainable mobility (International Energy Agency, 2023).

Charging Infrastructure

Charging infrastructure is essential for electric vehicle (EV) adoption, providing the necessary support as petrol stations for conventional cars. It includes components like charging units, connectors, and cables, with systems for power distribution, payment, and safety (Sun, 2024). In Malaysia, charging categorized into three levels slow (Level 1), moderate (Level 2), and fast (Level 3) with charging times ranging from 17 hours to 30 minutes. Type 2 connectors commonly used due to their compatibility with European EVs (EvGuru, 2023). Consumer willingness to adopt EVs significantly influenced by charging convenience, speed, and accessibility, while limitations such as slow charging or limited access can deter adoption (ScienceDirect, 2024). The public charging infrastructure is vital for encouraging EV adoption, particularly among urban dwellers without private parking access (Sánchez-Jiménez et al., 2021). It reduces dependence on home charging and lowers ownership costs by eliminating personal charger installation. Availability of fast public and workplace chargers positively influences EV ownership rates. However, challenges like non-standardized connectors, inconsistent charging speeds, limited app integration, and unclear pricing hinder broader adoption and can erode consumer trust in EV practicality (Khan et al., 2023).

Environmental Awareness

Environmental awareness is a key factor influencing consumer behavior, as greater consciousness often enhances the perceived benefits of adopting electric vehicles (EVs). Despite a variety of environmentally friendly products associated with sustainable initiatives, building trust among consumers in those offerings is still difficult (Latip et al., 2021). Hurdles such as lithium-ion battery manufacturing and environmental problems might deter prospective purchasers (Husain et al., 2023). Environmental considerations are an important driving force behind consumer acceptance of electric vehicles (EVs) because those who are more environmentally conscious and concerned about pollution and climate change have a greater tendency to make environmentally responsible decisions in transport. This highlights the importance of environmental concerns in encouraging EV uptake. Nevertheless, obstacles such as insufficient environmental education, limited public participation and immature charging network must be addressed, emphasizing the importance of policy incentives (Zaino et al., 2024).

Value-Belief-Norm Theory

The Value-Belief-Norm (VBN) theory postulates pro-environmental behaviors of individuals driven by a combination of value orientations, beliefs, and personal norms. Based on Norm Activation Theory, the VBN model, as presented in Fig. 1, extends the environmental decision-making knowledge by connecting subjectively held values, specifically biospheric and altruistic value to the construction of environmental beliefs and the personal norm and finally to form the behavioural intention (Moksin et al., 2023). People with high values for biospheric and altruistic driving forces are those who are more likely to engage in environmentally friendly behaviors (Sanchez-Jimenez et al., 2021).

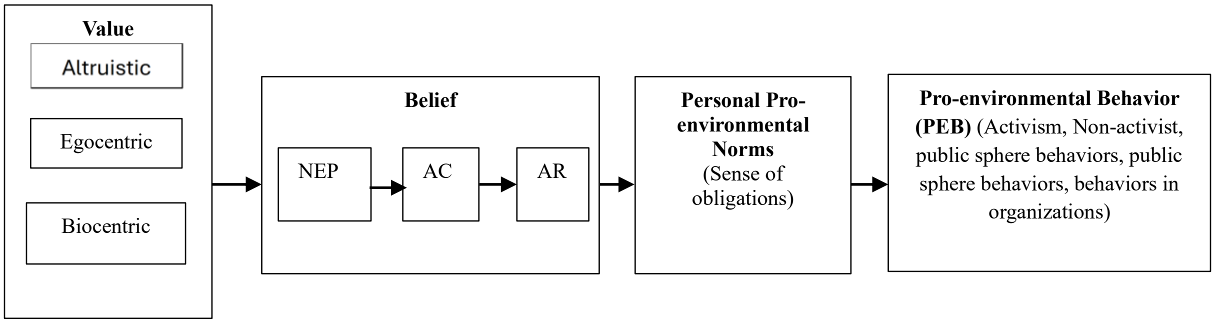

Fig. 1 Value-Belief-Norm (VBN) Theory Model

Source; Adapted from (Stern et al., 1999).

Pro-environmental behavior primarily driven by moral and altruistic values rather than self-interest. The Functionalist Model of Pro-environmental Behavior (FMP) suggests that heightened environmental concern cultivates a moral obligation to adopt sustainable actions like using EVs (Silvia & Krause, 2016). This responsibility reinforced by awareness of ecological harm and belief in individual impact. While developed countries widely apply the Value-Belief-Norm (VBN) theory, developing nations lag in empirical research (Canlas et al., 2022). Environmental awareness mediates personal values and EV adoption, and integrating VBN with the Theory of Planned Behavior (TPB) offers a strong framework for understanding green technology adoption. Factors like beliefs, knowledge, and responsibility are vital in shaping readiness, especially in emerging markets (Husain et al., 2023).

III. Technology Readiness Index (TRI) 2.0 Framework

The Technology Readiness Index (TRI) 2.0 framework as in Fig. 2 measures an individual's willingness to accept recent technologies across four dimensions, optimism, innovativeness, discomfort, and insecurity. Enablers include optimism and innovativeness, which represent positive response toward technology and early adopter, respectively. On the other hand, discomfort and insecurity are negative blockers and are the result of perceived lack of control or knowledge. In contrast, insecurity is distrust in the reliability, duration, or functionality of the technology (Parasuraman & Colby, 2001).

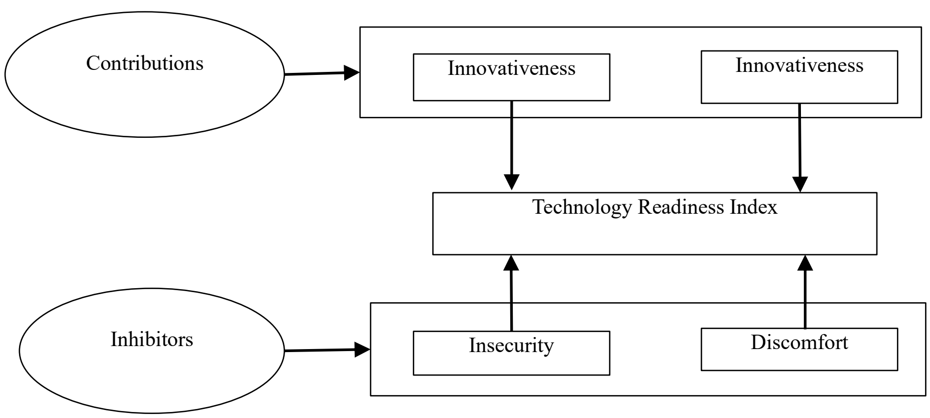

Fig. 2 Technology Readiness Index (TRI) 2.0 Framework

Source; Adapted from (Parasuraman & Colby, 2001)

By integrating the value-belief-norm (VBN) theory and the technology readiness index (TRI) 2.0 framework, this research seeks a more comprehensive perspective towards the adoption of electric vehicle (EV). The VBN theory suggests that environmental values and personal norms stimulate pro-environmental behaviour, whereas TRI 2.0 measures consumer attitudes toward technology with an emphasis on qualities such as optimism and innovativeness, which facilitate adoption and ‘technology anxiety’ or ‘insecurity’ that might impede adoption. This triangular relationship between environmental concern, technology openness provides a multi-faceted view of EV-readiness (Canlas et al., 2022). The study adds to theory by integrating human and technical factors in understanding consumer adoption of EVs.

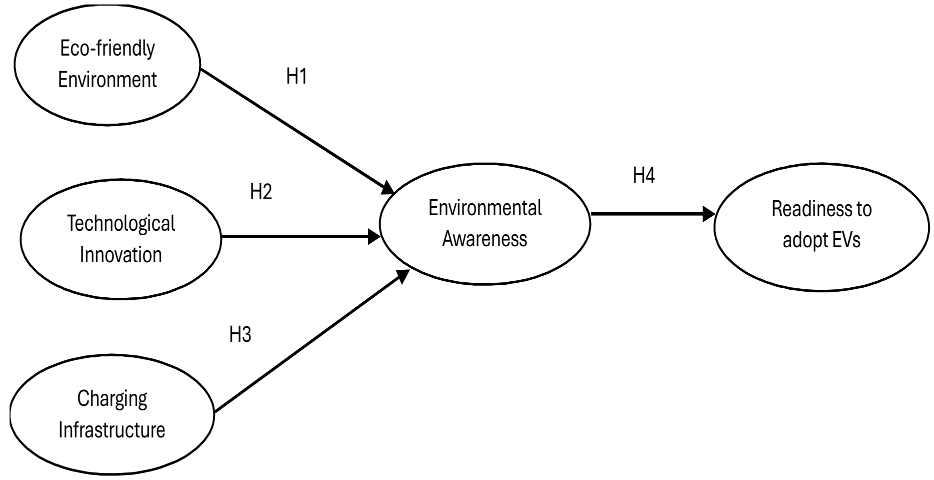

Fig. 3 Conceptual Framework

Based on the conceptual framework, the following hypotheses proposed to examine the individuals' readiness to adopt electric vehicles.

H1: Environmentally friendly environment (EF) has a significant relationship with environmental awareness (EA) towards EVs adoption in Putrajaya.

H2: Technology innovation (TI) has a significant effect to environmental concern on the adoption of EV in Putrajaya.

H3: Charging infrastructure (CI) affects environmental awareness of the intention for an EV adoption in Putrajaya.

H4: The environmental awareness (EA) impacts positively consumers' attitude for an EV adoption in Putrajaya.

H5: Environmental awareness (EA) mediates the relationship between Eco-friendly environment (EF) and Consumer readiness to adopt (RA) EVs in Putrajaya.

H6: Technological innovation (TI) mediates the relationship between Eco-friendly environment (EF) and Consumer readiness to adopt (RA) EVs in Putrajaya.

H7: Charging Infrastructure (CI) is a mediator of the relationship between Eco-friendly environment (EF) and readiness to adopt (RA) of EVs in Putrajaya.

H8: Eco-friendly environment (EF) has significant effects on RA of EV in Putrajaya.

H9: Technology innovation (TI) has a significant impact on Readiness to adopt (RA) EV in Putrajaya.

H10: Readiness for adoption (RA) of EV significantly impacted by Charging Infrastructure (CI) in Putrajaya.

IV. Research Methodology

The research employed quantitative approach to obtain the data by using five points of Likert scale questionnaires. A random sampling technique used to survey consumers who consider buying an EV. The questionnaire consists of six parts. Section A provides demographic information with an inclusive focus (Hughes et al., 2022). In part B, environmental consciousness measured (Suárez-Perales et al., 2021). Section C measured consumer preparedness for electric vehicles (Wolf & Kovács, 2024). Part D tested eco-friendly and preparation (Harun et al., 2021). Section E studied technology for innovation (Pamidimukkala et al., 2023) and Section F analysed attitudes toward charging infrastructure (Alfarizi et al., 2024). This study uses stratified random sampling, focusing on 56,800 residents aged 20–50 in Putrajaya (see Fig 3), selected from a total population of 109,202 (Department of Statistics Malaysia, 2023). This age group chosen for their likelihood to adopt electric vehicles and respond to environmental and technological changes (Dai & Zhang, 2023). A total of 156 valid responses collected from 240 distributed questionnaires (65% response rate), surpassing the minimum requirement of 155 for statistical significance in PLS-SEM. This confirms the dataset's adequacy for analysis.

V. Results and Discussion

Demographic Characteristics of the Sample.

The survey included 156 respondents aged 20 and above, with 57.05% female and 42.95% male. Most were aged 31–40 (39.74%) and held at least a bachelor's degree. A majority (55.7%) drove under 50 km daily, and 62.18% owned one vehicle. Respondents were employed in the private (44.87%) and government (35.9%) sectors. Over half (55.13%) earned below RM5,000 monthly. Ethnic composition was Malay (67.95%), followed by Chinese (23.72%), Indian (6.41%), and Middle East and Africa (1.92%).

Construct Reliability and Validity

The reliability and validity of the measurement model evaluated using Cronbach's alpha, composite reliability, and average variance extracted (AVE). Based on Table I, all the constructs reveal a strong internal consistency. The AVE of

0.50 or more, showing this construct explains at least 50% of the variance of its indicators.

TABLE I MEASUREMENT RESULT FOR CONVERGENT VALIDITY

Factors	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CI	0.895	0.912	0.922	0.703
EA	0.954	0.957	0.965	0.845
EF	0.932	0.936	0.947	0.747
RA	0.942	0.943	0.960	0.857
TI	0.996	0.996	0.998	0.993

Discriminant Validity

Discriminant validity assessed using the Fornell-Larcker criterion and cross-loadings, confirming that each construct was conceptually and empirically distinct. Table II shows indicators consistently loaded highest on its corresponding constructs for instance, CI1 to CI5 on Charging Infrastructure (CI) and EA1 to EA5 on Environmental Awareness (EA), despite high cross-loadings, such as EA3 on Technological Innovation (TI) at 0.989. These findings validate the distinctiveness of the latent variables such as CI, EA, Eco-Friendliness (EF), Readiness to Adopt (RA), and TI, demonstrating sufficient discriminant validity in the model.

TABLE II FURNELL-LARCKER CRITERION

	CI	EA	EF	RA	TI
CI1	0.789	0.181	0.414	0.406	0.197
CI2	0.867	0.368	0.46	0.257	0.367
CI3	0.759	0.304	0.396	0.286	0.308
CI4	0.893	0.31	0.432	0.395	0.308
CI5	0.876	0.322	0.459	0.294	0.318
EA1	0.361	0.907	0.624	0.415	0.815
EA2	0.347	0.932	0.629	0.413	0.887
EA3	0.347	0.939	0.613	0.374	0.989
EA4	0.314	0.916	0.648	0.38	0.826
EA5	0.32	0.902	0.634	0.382	0.772
EF1	0.41	0.706	0.815	0.395	0.687
EF2	0.43	0.568	0.914	0.428	0.503
EF3	0.527	0.55	0.86	0.394	0.544
EF4	0.46	0.563	0.833	0.308	0.521
EF5	0.428	0.542	0.847	0.333	0.503
EF6	0.429	0.576	0.914	0.44	0.51
RA1	0.344	0.362	0.408	0.966	0.324
RA2	0.356	0.375	0.412	0.968	0.335
RA3	0.344	0.445	0.398	0.789	0.436
RA4	0.338	0.372	0.416	0.968	0.332
TI1	0.371	0.936	0.638	0.39	0.996
TI2	0.374	0.925	0.645	0.401	0.994
TI3	0.359	0.941	0.625	0.386	0.998

Cross Loading Analysis

The measurement model analysis in Fig.4 confirms the validity and reliability of the constructs used to examine factors influencing electric vehicle (EV) adoption. All indicators showed strong loadings on their respective constructs, supporting internal consistency and discriminant validity. Readiness to Adopt (RA) had high loadings (0.966–0.968), indicating strong measurement of adoption intent. Environmental Awareness (EA) also showed high loadings (0.902–0.939) and significantly influenced RA (path coefficient = 0.427), highlighting its mediating role. Technological Innovation (TI) exhibited extremely high loadings (0.994–0.998) and strongly impacted EA (0.847), suggesting innovation enhances environmental awareness, which boosts adoption readiness. Eco-Friendliness (EF) showed good loadings (0.815–0.914), positively supporting EA but with limited direct influence on RA. Charging Infrastructure (CI) also loaded well (0.759–0.893) but had a negligible direct effect on RA (-0.026), indicating an indirect role in supporting adoption.

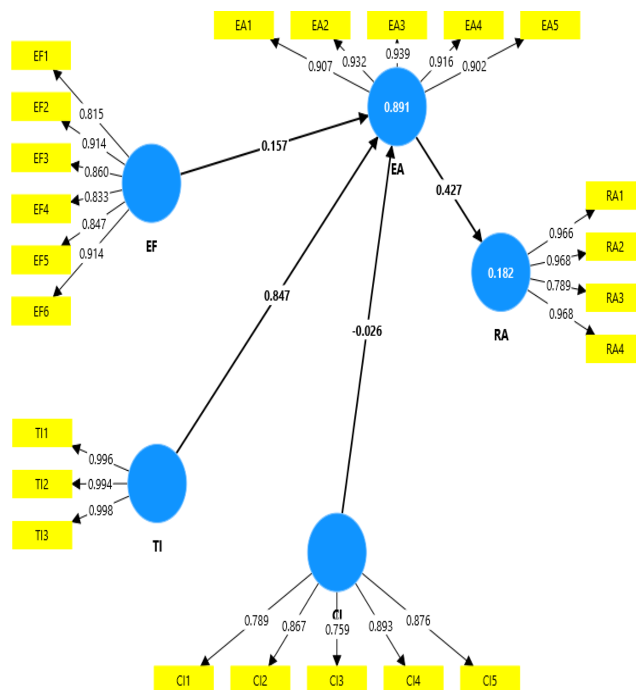

Fig. 4 Measurement Model

TABLE III R SQUARE

	R-square	R-square adjusted
EA	0.891	0.889
RA	0.182	0.177

The R-square depicted in Fig. 4 or Table III, for Environmental Awareness (EA) is remarkably high 89.1%, indicating that Technological Innovation (TI) and Eco-Friendliness (EF) strongly explain consumers' environmental awareness. This means consumers develop greater environmental consciousness mainly when exposed to innovative EV features and perceive EVs as eco-friendly. In contrast, the R-square for Readiness to Adopt (RA) is low 18.2%. This suggests that apart from EA, factors such as EV cost, government incentives, social norms, brand trust, range anxiety, and lifestyle compatibility influence consumers' readiness to adopt EVs.

Although EA positively impacts RA, it appears necessary but not guarantee readiness to adopt EVs because practical barriers such as affordability, infrastructure, and convenience limit consumers' readiness to adopt EVs. CI has a limited direct impact on RA, playing a greater role by improving EV feasibility or consumer confidence, via environmental awareness or perceived convenience. Overall, the modest explanatory power for RA reflects the complexity of EV adoption, formed by a mix of emotional, financial, social, and logistical features. Future research should adopt broader frameworks including psychological, contextual, and structural variables to understand EV adoption readiness.

Path Coefficient Analysis

Table IV presents the path coefficients analysis for the hypothesized relationships within the proposed structural model. Analysis of the structural model through path coefficients provides critical insight into the hypothesized relationships between constructs influencing electric vehicle (EV) adoption.

TABLE IV PATH COEFFICIENT ANALYSIS ON EFFECTS OF CONSTRUCTS ON READINESS TO ADOPT

Factors	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Hypothesis
EFE -> EA	0.157	0.158	0.060	2.627	0.009**	HI (Supported)
TI -> EA	0.847	0.846	0.052	16.299	<0.001**	H2 (Supported)
CI -> EA	-0.026	-0.026	0.031	0.838	0.402	H3 (Not Supported)
EA -> RA	0.427	0.430	0.070	6.135	<0.001**	H4 (Supported)

Note ** significant at 1% level.

The findings reveal that Eco-Friendliness (EFE) significantly enhances Environmental Awareness (EA) (β = 0.157, p = 0.009), indicating that consumers who view EVs as eco-friendly are more environmentally conscious. The strongest relationship in the model is between Technological Innovation (TI) and EA (β = 0.847, t = 16.299, p < 0.001), highlighting that advancements in EV technology notably boost environmental awareness. These results emphasize the importance of ecological messaging and innovation in shaping sustainability perceptions and promoting EV adoption.

The study found Charging Infrastructure (CI) has a negative and statistically non-significant effect on Environmental Awareness (EA) (β = -0.026, p = 0.402), indicating that CI acts more as a practical enabler than an environmental motivator. Conversely, the relationship from Environmental Awareness (EA) to Readiness to Adopt (RA) is positive and significant (β = 0.427, p < 0.001), showing that greater environmental awareness significantly increases consumers' willingness to adopt EVs. This underscores the critical role of environmental consciousness in influencing EV adoption behavior. Findings indicate that Technological Innovation and Eco-Friendliness are key drivers of Environmental Awareness, which in turn significantly boosts Readiness to Adopt EVs. In contrast, Charging Infrastructure, while important, does not directly influence environmental attitudes. This highlights the need for policymakers and marketers to emphasize technology and environmental values in promoting EV adoption.

TABLE V INDIRECT EFFECTS THROUGH MEDIATION ON EFFECTS OF CONSTRUCTS ON READINESS TO ADOPT

Factors	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Hypothesis
CI -> EA -> RA	-0.011	-0.011	0.014	0.818	0.414	H5 (Not Supported)
EF -> EA -> RA	0.067	0.069	0.030	2.229	0.026*	H6 (Supported)
TI -> EA -> RA	0.362	0.363	0.060	6.012	<0.001**	H7 (Supported)

Note: * significant at 5% level

** significant at 1% level

The indirect effects of Charging Infrastructure (CI), Eco-Friendliness (EF), and Technological Innovation (TI) on Readiness to Adopt (RA), as mediated through Environmental Awareness (EA). As in Table V, the findings provide important insights into the underlying mechanisms driving consumer readiness to adopt electric vehicles (EVs), through the lens of environmental consciousness. The indirect effect of CI on RA through EA is non-significant (β = -0.011, p = 0.414), indicating that while charging infrastructure is operationally necessary, it does not shape environmental awareness or motivate EV adoption.

EF has a substantial positive indirect effect on RA via EA (β = 0.067, p = 0.026), signifying that perceiving EVs as eco-friendly enhances environmental consciousness, which increases readiness to adopt EVs. This supports strategies that highlight the environmental benefits of EVs to foster adoption. The strongest indirect effect is from TI to RA through EA (β = 0.362, p < 0.001). Technological innovations such as upgraded battery efficiency and smart features elevate environmental awareness, thereby encouraging adoption. This underscores the value of investing in technological advancements and public education about EV technology. The finding highlights that

Environmental Awareness is a crucial mediator linking positive perceptions and innovations to consumer readiness to adopt EVs.

TABLE VI INDIRECT HYPOTHESIS ON EFFECTS OF CONSTRUCTS ON READINESS TO ADOPT

Factors	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Hypothesis
CI -> RA	-0.011	-0.011	0.014	0.818	0.414	H8 (Not Supported)
EF -> RA	0.067	0.069	0.030	2.229	0.026*	H9 (Supported)
TI -> RA	0.362	0.363	0.060	6.012	<0.001**	H10 (Supported)

Note: * significant at 5% level

** significant at 1% level

Table VI reveals the indirect effects of Charging Infrastructure (CI), Eco-Friendliness (EF), and Technological Innovation (TI) on consumers' Readiness to Adopt (RA) electric vehicles via Environmental Awareness (EA). The indirect effect of CI on RA is negative and not significant ($\beta = -0.011$, $p = 0.414$), suggesting CI functions more as a logistical support than a motivator for environmental behavior. In contrast, EF has a positive and significant indirect effect on RA ($\beta = 0.067$, $p = 0.026$), indicating that perceiving EVs as eco-friendly enhances environmental awareness, thereby increasing adoption willingness. This underscores the importance of promoting EVs' ecological benefits to influence consumer behavior.

The strongest indirect effect is from Technological Innovation (TI) to Readiness to Adopt (RA) ($\beta = 0.362$, $p < 0.001$), indicating a significant and substantial influence. This underscores that innovations like improved batteries, smart features, and charging solutions enhance environmental awareness and consumer preference for EVs. TI proves to be a powerful driver of both product appeal and sustainability perception. In contrast, Charging Infrastructure (CI) plays a weaker indirect role compared to Eco-Friendliness (EF) and especially TI. Overall, Table VI suggests that EV adoption shaped not only by practical utility and infrastructure but also by perceptions of eco-friendliness and technological advancement.

VI. DISCUSSION

The study provides key insights into the psychological and structural drivers of EV adoption in Putrajaya; a smart city focused on sustainability. Using a targeted sample of 156 working professionals aged 20–50, it explores how environmental consciousness, technological innovation, eco-friendliness, and infrastructure influence EV adoption. While the demographic is suitable for vehicle purchase decisions, over half of respondents earn below RM5,000 monthly, indicating that affordability may significantly affect readiness though not directly measured. The low R^2 value for Readiness to Adopt (0.182) suggests that other unmeasured factors, such as cost sensitivity, play a critical role in influencing adoption behavior. Study reveals that consumers who perceive EVs as both technologically advanced and environmentally friendly exhibit stronger environmental awareness, supporting findings by (Dangelico & Vocalelli, 2017) that green innovations foster sustainable behavior. Although Eco-Friendliness (EF) did not directly influence Readiness to Adopt (RA), it significantly affected Environmental Awareness (EA) ($\beta = 0.157$, $p = 0.009$) and had a notable indirect impact on RA ($\beta = 0.067$, $p = 0.026$). Charging Infrastructure (CI), however, showed no significant direct or indirect effect on EA or RA, suggesting it plays a functional rather than motivational role. These findings underscore the importance of combining technological innovation, environmental messaging, and public education with infrastructure development to boost EV adoption in urban settings.

Implications

The study recommends emphasizing the connection between technological innovation and environmental sustainability in public education to boost awareness. EV manufacturers should promote both advanced features and eco-benefits to encourage adoption. While infrastructure is important, supported with consumer reassurance rather than positioned as a main driver. Given income constraints, affordability, and financial incentives are vital to increasing EV adoption.

Limitation

The sample limits its generalizability, and the low R^2 for adoption readiness suggests that additional factors like cost incentives, social influence, and lifestyle fit need to be explored. Future research should expand to multiple cities and use longitudinal methods to understand the evolving dynamics of EV adoption.

Contribution

This study supports Malaysia's EV adoption goals by highlighting key drivers such as environmental awareness, technological innovation, and eco-friendliness. It aligns with national policies like the Low Carbon Mobility Blueprint and SDG Goal 13, offering insights to improve public policy, awareness, infrastructure, and incentive planning for sustainable mobility.

VII. CONCLUSION

This study reveals that while environmental awareness, technological innovation, and eco-friendliness play significant roles in shaping EV adoption readiness among urban residents in Putrajaya, these psychological factors only partially explain adoption behavior. Technological innovation is the strongest influence, through its effect on environmental awareness. In contrast, charging infrastructure does not significantly impact readiness, highlighting that practical availability itself is inadequate to drive adoption. The findings point the need for comprehensive approach that integrates innovation, education, sustainability messaging, and policy support to encourage EV adoption.

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