

Factors Associated with Adoption Intention of Proton e-MAS: A Multi-Dimensional Analysis of Malaysian Consumers

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DOI: <https://doi.org/10.47772/IJRISS.2026.100900202>

Received: 26 August 2026; Accepted: 31 August 2026; Published: 06 October 2026

ABSTRACT

This paper presented a condensed research framework for examining the factors associated with adoption intention towards Proton e.MAS among current electric vehicle (EV) users in Klang Valley, Malaysia. Although EV registrations and government support had increased, adoption continued to be associated with practical concerns related to travel distance, driving range, purchase price, charging duration, charging infrastructure, and incentive policies. Existing Malaysian studies had primarily investigated general EV purchase intention, while limited empirical work had focused on Proton e.MAS as a national EV brand and had integrated behavioural, product, and contextual dimensions within a single model. The study was informed by an adapted Theory of Planned Behaviour perspective. Adoption intention served as the dependent variable; travel distance represented the behavioural dimension; driving range, price, and charging time represented the product attributes; and charging infrastructure and incentive policies represented the contextual factors.

A quantitative cross-sectional design was employed. Structured questionnaires were distributed through online and offline platforms to 375 EV users aged 18 years and above who held valid driving licences and lived, worked, or regularly travelled within Klang Valley. Purposive sampling, a five-point Likert scale, expert pretesting, and a 30-respondent pilot study were utilised. The data were analysed using SPSS Version 27 through descriptive statistics, reliability analysis, Pearson correlation, and multiple regression. The findings indicated that product and contextual factors were positively associated with adoption intention, while the association of travel distance varied according to users' mobility patterns and perceptions of range adequacy. The study provided practical implications for Proton, charging service providers, and Malaysian policymakers while contributing to the growing body of EV adoption research in an emerging-market context.

INTRODUCTION

Electric vehicle adoption accelerated as governments, manufacturers, and consumers responded to climate commitments, technological advances, and changing mobility needs. Global EV sales increased substantially between 2021 and 2024, particularly in China, Europe, and the United States, demonstrating that electric mobility had transitioned from a niche market toward mainstream transportation (International Energy Agency, 2024).

In Malaysia, government incentives, rising environmental awareness, and improvements in battery technology supported market growth, while Proton's introduction of the e.MAS brand represented an important milestone for the domestic automotive industry (Malaysian Green Technology and Climate Change Corporation, 2024; Proton New Energy Technology Sdn. Bhd., 2025; Amran et al., 2025).

Despite this progress, EV adoption remained constrained by high upfront costs, limited driving range, charging duration, insufficient or unevenly distributed charging facilities, and uncertainty regarding policy support (Pamidimukkala et al., 2024; He et al., 2022; Umair et al., 2024; Tsai et al., 2024). These concerns were particularly important for current EV users because they evaluated vehicles through their actual experiences with charging, range planning, operating costs, and daily travel. Klang Valley was considered a suitable setting because Kuala Lumpur, Selangor, and Putrajaya accounted for a large proportion of registered EVs and charging activity in Malaysia (Umair et al., 2024; Malaysian Investment Development Authority, 2025).

The literature increasingly recognised that EV adoption was multidimensional. Travel characteristics could influence whether an EV suited daily mobility patterns (Siahaan et al., 2024), while product attributes such as range, price, and charging time shaped perceptions of practicality, affordability, and convenience (He et al., 2022; Higuera-Castillo et al., 2023; Wang et al., 2023). External conditions, particularly charging infrastructure and incentive policies, further determined whether adoption was feasible (Umair et al., 2024; Hoogland et al., 2024; Chen et al., 2025). However, many Malaysian studies investigated general EV purchase intention rather than a specific national EV brand, and the combined influence of behavioural, product, and contextual factors on Proton e.MAS adoption remained underexplored (Proton New Energy Technology Sdn. Bhd., 2025; Umair et al., 2024; Mohd Noor et al., 2025).

Malaysia's policy environment attempted to reduce EV ownership barriers through tax exemptions, charging-related relief, and support for charging-equipment development. At the same time, the market remained uneven because urban centres enjoyed greater infrastructure accessibility than many peripheral areas. The concentration of EV registrations in Kuala Lumpur and Selangor made Klang Valley a useful setting for examining how experienced users responded to a newly introduced national EV brand (Malaysian Green Technology and Climate Change Corporation, 2024; Umair et al., 2024; Malaysian Investment Development Authority, 2025).

Proton e.MAS benefited from domestic brand familiarity, local distribution, and national policy visibility, but these advantages did not automatically translate into adoption. Current EV users were likely to compare Proton e.MAS with established domestic and international alternatives based on practical ownership criteria. A focused study was therefore conducted to identify whether mobility fit, vehicle attributes, and external support could explain their willingness to consider the brand.

Problem Statement

The market success of Proton e.MAS depended on more than consumer awareness. Potential adopters needed to evaluate whether the vehicle supported their travel needs, offered sufficient driving range, provided acceptable charging time, and represented reasonable value. They also considered the availability of charging facilities and the usefulness of government incentives. Previous Malaysian research confirmed that price, infrastructure readiness, consumer attitudes, and charging accessibility associated with EV purchase intention, but limited evidence specifically examined Proton e.MAS or simultaneously investigated the six practical factors proposed in this study (Umair et al., 2024; Mohd Noor et al., 2025; Syed Mansor & Anuar, 2025). This study addressed the gap by integrating travel distance, driving range, price, charging time, charging infrastructure, and incentive policies into a single model focusing on current EV users in Klang Valley.

The behavioural issue concerned the compatibility between users' travel distance and EV capability. Drivers with predictable short- or medium-distance journeys found EV use more convenient, whereas frequent long-distance users experienced greater journey-planning burdens. The product issue focused on whether driving range, price, and charging time provided sufficient value and convenience. The contextual issue examined whether charging accessibility and government incentives reduced the practical and financial barriers to adoption. Examining these dimensions separately enabled the study to identify which barriers were the main predictors.

Research Objectives and Questions

The study was guided by the following objectives:

1. To investigate the association between travel distance and adoption intention towards Proton e.MAS among EV users in Klang Valley.
2. To examine the association of product attributes, namely driving range, price, and charging time, on adoption intention towards Proton e.MAS.
3. To determine the association of contextual factors, namely charging infrastructure and incentive policies, on adoption intention towards Proton e.MAS.

Correspondingly, the study addressed the following research question:

- How are travel distance, product attributes, and contextual factors associated with adoption intention towards Proton e.MAS among current EV users in Klang Valley?

Scope of Study

The study employed a cross-sectional quantitative design and did not seek to establish causal inference. In addition, the current study focused on current fully electric vehicle users aged 18 years and above who possessed valid driving licences and lived, worked, or regularly travelled within Klang Valley. The dependent variable was adoption intention towards Proton e.MAS. The six predictors were grouped into three dimensions: travel distance as a behavioural factor; driving range, price, and charging time as product attributes; and charging infrastructure and incentive policies as contextual factors. The research adopted a quantitative, cross-sectional, questionnaire-based design. The study did not examine actual purchase behaviour, non-EV users, organisational performance, or technical battery testing.

LITERATURE REVIEW

Theory of Planned Behaviour (TPB)-Informed Extended Framework

The Theory of Planned Behaviour (TPB) explained behavioural intention through attitude, subjective norm, and perceived behavioural control (Ajzen, 1991). It was widely applied in EV research because adoption involved both favourable evaluation and perceived ability to perform the behaviour (Fishbein & Ajzen, 2010; Buhmann et al., 2024). Nevertheless, this study did not directly measure all original TPB constructs. Instead, it was informed by a TPB-informed extended framework perspective in which EV-specific factors were treated as antecedents of evaluation and perceived feasibility. Product attributes were considered relevant to favourable or unfavourable evaluations of Proton e.MAS, while travel distance, charging infrastructure, and incentive policies were considered relevant to perceptions of whether adoption was practical and achievable.

This adaptation was consistent with recent EV studies that extended behavioural theories by incorporating price value, range anxiety, infrastructure readiness, and policy incentives (Higuera-Castillo et al., 2023; Mohd Noor et al., 2025; Vafaei-Zadeh et al., 2022). The framework therefore retained behavioural intention as the central outcome while incorporating factors directly relevant to the Malaysian EV environment. Accordingly, this study does not constitute a direct empirical test of the original TPB model; rather, it applies a TPB-informed extended framework to examine EV-specific factors associated with adoption intention.

Justification of the Selected Dimensions

The study selected behavioural, product, and contextual dimensions to capture complementary EV-specific considerations associated with consumers' adoption intention towards Proton e.MAS. These dimensions were not treated as direct measures or substitutes for the original Theory of Planned Behaviour (TPB) constructs of attitude, subjective norm, and perceived behavioural control. Instead, they represented external

considerations relevant to consumers' evaluation of EV adoption within the Malaysian context.

The behavioural dimension comprised travel distance, reflecting the compatibility between consumers' regular mobility patterns and the practical use of an EV. The product dimension comprised driving range, price, and charging time, representing consumers' evaluations of vehicle practicality, affordability, and charging convenience. The contextual dimension comprised charging infrastructure and incentive policies, reflecting external conditions related to charging accessibility and financial or policy support.

Collectively, these dimensions provided an EV-specific framework for examining adoption intention towards Proton e.MAS without assuming that they operationalised the original TPB constructs. Their inclusion was consistent with the study's TPB-informed perspective, in which practical mobility requirements, product-related considerations, and external supporting conditions were examined as factors associated with behavioural intention.

Table 1 Justification of Selected Dimensions

Dimension	Variables	Justification
Behavioural	Travel distance	Captures the compatibility between consumers' regular mobility patterns and practical EV use.
Product	Driving range, price, charging time	Captures EV-specific evaluations of vehicle practicality, affordability, and charging convenience.
Contextual	Charging infrastructure, incentive policies	Captures external conditions related to charging accessibility and financial or policy support.

Adoption Intention

Adoption intention referred to a consumer's willingness and readiness to consider, choose, purchase, use, or recommend a technology. Within the Theory of Planned Behaviour (TPB), intention was recognised as the immediate antecedent of behaviour (Ajzen, 1991). In this study, adoption intention referred specifically to the willingness of current EV users to consider Proton e.MAS as their future vehicle, adopt it when appropriate, choose it over a conventional vehicle, or recommend it to others. Adoption intention was considered more appropriate than actual adoption because Proton e.MAS was a relatively new national EV brand, and many consumers remained at the evaluation stage of the decision-making process.

Behavioural Factor: Travel Distance

Travel distance refers to the distance and mobility patterns associated with consumers' regular daily and occasional journeys. In the EV context, travel distance reflects the extent to which an individual's typical mobility requirements are compatible with the practical use of an electric vehicle. Consumers with shorter or predictable travel patterns may perceive EV use as more manageable, whereas those who frequently undertake longer journeys may experience greater concerns regarding journey planning and range adequacy (Siahaan et al., 2024; Krishnan & Koshy, 2021). In this study, travel distance is conceptualised specifically as a mobility-related consideration and is distinguished from driving range, which represents the perceived distance capability of the vehicle itself. Accordingly, the study proposes:

H1: Travel distance has a significant relationship with adoption intention towards Proton e.MAS.

Product Attributes

Driving range refers to the distance an electric vehicle can travel on a sufficiently charged battery before recharging is required. In this study, driving range represents consumers' perceptions of whether the range capability of Proton e.MAS is adequate for their regular mobility requirements. Adequate driving range can

reduce range-related concerns and increase consumers' confidence in completing routine and longer journeys (He et al., 2022; Higuera-Castillo et al., 2023). Unlike travel distance, which reflects consumers' mobility patterns, driving range represents the perceived functional capability of the vehicle. Accordingly, the study proposes:

H2a: Driving range has a significant relationship with adoption intention towards Proton e.MAS.

Price refers to consumers' perceptions of the acquisition cost and overall monetary value associated with Proton e.MAS. It reflects whether the vehicle is perceived as affordable and reasonably priced relative to the benefits and value it provides. Although EV ownership may provide potential savings in energy and routine maintenance costs, the initial purchase price remains an important consideration in consumers' evaluation of EV affordability (Pamidimukkala et al., 2024; Umair et al., 2024; Mohd Noor et al., 2025). In this study, price is therefore conceptualised as a product-related financial evaluation, distinct from incentive policies, which represent external financial or policy support provided by the government. Accordingly, the study proposes:

H2b: Price has a significant relationship with adoption intention towards Proton e.MAS.

Charging time refers to the duration required to recharge an electric vehicle battery to a usable or desired charge level. In this study, charging time represents consumers' perceptions of the temporal convenience of the charging process, including whether the time required for charging is acceptable and compatible with their regular mobility routines. Longer charging durations may be perceived as less convenient than conventional vehicle refuelling, particularly when users have time-sensitive travel requirements (Tsai et al., 2024; Wang et al., 2023). Charging time is conceptually distinguished from charging infrastructure: charging time concerns the duration of the charging process, whereas charging infrastructure concerns the availability, accessibility, and reliability of charging facilities. Accordingly, the study proposes:

H2c: Charging time has a significant relationship with adoption intention towards Proton e.MAS.

Contextual Factors

Charging infrastructure refers to the availability, accessibility, reliability, and geographical distribution of facilities that support electric vehicle charging, including home, workplace, public AC, and DC fast-charging facilities. In this study, charging infrastructure represents the external charging environment available to EV users, rather than the duration required to charge the vehicle.

An adequate and accessible charging network can improve the practicality and convenience of EV use by providing consumers with greater opportunities to recharge their vehicles across different locations (Umair et al., 2024; Malaysian Investment Development Authority, 2025; Hoogland et al., 2024). Thus, charging infrastructure is conceptually distinct from charging time: infrastructure reflects where and how readily charging can be accessed, whereas charging time reflects how long the charging process takes. Accordingly, the study proposes:

H3a: Charging infrastructure has a significant relationship with adoption intention towards Proton e.MAS.

Incentive policies refer to government-initiated financial and non-financial measures designed to support electric vehicle ownership and use, including tax exemptions, subsidies, rebates, registration benefits, financing support, and charging-related incentives. In this study, incentive policies represent external institutional and policy support that may reduce the financial and practical barriers associated with EV ownership.

This construct is conceptually distinguished from price: price represents consumers' evaluation of the vehicle's acquisition cost and value, whereas incentive policies represent external support mechanisms provided through the policy environment (Chen et al., 2025; Xue et al., 2023). Accordingly, the study proposes:

H3b: Incentive policies have a significant relationship with adoption intention towards Proton e.MAS.

Conceptual Framework and Hypotheses

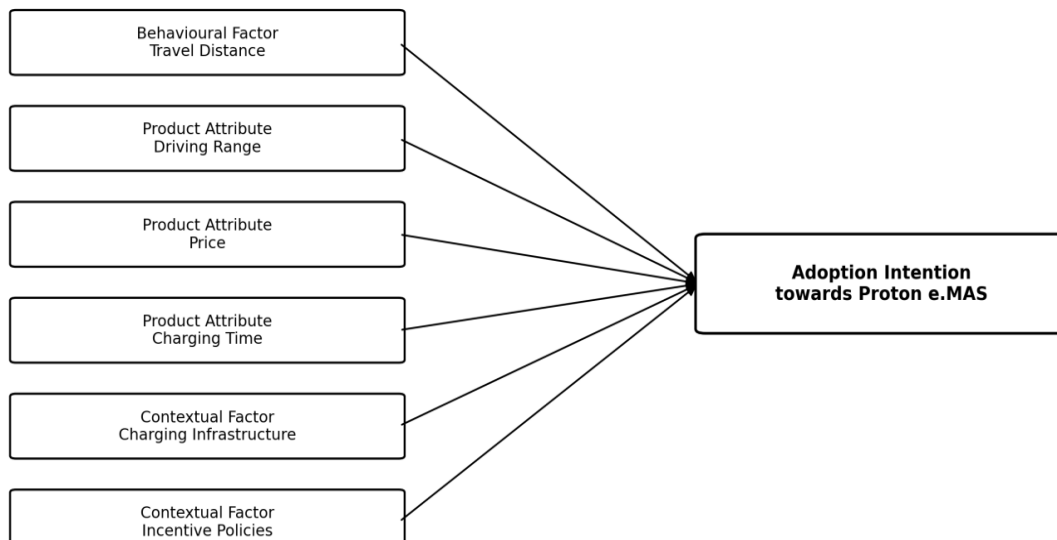


Fig. 1 Proposed Conceptual Framework

Table 2 Summary of Hypotheses

Hypothesis	Proposed relationship
H1	Travel distance → Adoption intention
H2a	Driving range → Adoption intention
H2b	Price → Adoption intention
H2c	Charging time → Adoption intention
H3a	Charging infrastructure → Adoption intention
H3b	Incentive policies → Adoption intention

METHODOLOGY

Research Design and Population

A quantitative cross-sectional research design was employed to examine the relationships between travel distance, driving range, price, charging time, charging infrastructure, incentive policies, and adoption intention towards Proton e.MAS. The unit of analysis was the individual EV user. The target population comprised current fully electric vehicle users aged 18 years and above who held valid Malaysian driving licences and lived, worked, or regularly travelled within Klang Valley. Current EV users were selected because their direct experience with EV ownership or regular usage enabled them to provide informed evaluations of mobility requirements, vehicle range, charging duration, charging accessibility, ownership costs, and policy support.

Official JPJ registration statistics identified 15,316 registered EVs across Kuala Lumpur, Selangor, and Putrajaya during the 2021–2025 period. However, these registration figures were not treated as an exact estimate of the number of eligible individual EV users, as vehicle registrations represent registered vehicles

rather than unique individual users. Accordingly, EV registration statistics were used only to provide contextual information on the geographical concentration of EVs and were not used as the population denominator for determining the required sample size. The figures were instead used as a contextual reference to indicate the geographical concentration of EV registrations within Klang Valley and to guide the geographical distribution of respondent recruitment. Accordingly, the target population of the study was defined based on the respondent eligibility criteria rather than equating the number of registered EVs with the number of individual EV users.

Table 3 Ev Registration Reference For Klang Valley

Area	Registered EVs	Share (%)
Kuala Lumpur	11,366	74.21
Selangor	3,945	25.76
Putrajaya	5	0.03
Total	15,316	100

Sampling and Data Collection

Purposive sampling was applied because respondents were required to satisfy specific inclusion criteria. Eligible participants were required to: (1) be aged 18 years or above; (2) possess a valid Malaysian driving licence; (3) currently own or actively use a fully electric vehicle; and (4) live, work, or regularly travel within Klang Valley. The proportional registration figures for Kuala Lumpur and Selangor guided the recruitment process and were not a probability quota; however, they served as practical recruitment targets rather than probability-based quotas.

As the exact number of unique eligible EV users in Klang Valley could not be reliably established from vehicle-registration records, sample adequacy was determined using an a priori statistical power analysis rather than treating registered vehicles as individual members of the target population. Using G*Power, the analysis was specified for a multiple regression model with six predictors, a significance level of $\alpha = 0.05$, a statistical power of 0.95, and a medium anticipated effect size ($f^2 = 0.15$). The analysis indicated a minimum required sample of 146 respondents. The final sample of 375 valid respondents therefore substantially exceeded the minimum requirement, indicating that the sample size was adequate for the planned multiple regression analysis.

Data were collected over approximately 14 weeks using both online and offline questionnaires. The online survey was distributed through Google Forms, social media platforms, messaging applications, EV communities, and automotive forums. Offline data collection was conducted at charging stations, vehicle dealerships, automotive exhibitions, shopping malls, and other EV-related locations. Screening questions and branching logic were incorporated to exclude ineligible respondents. Anonymous participation, neutral questionnaire wording, identical online and paper-based survey formats, attention-check questions, and systematic data-cleaning procedures were implemented to minimise response bias and common-method bias (Lay et al., 2023; Holtom et al., 2022; Stadtmüller et al., 2021; Spencer et al., 2022).

In addition to the procedural measures implemented to minimise potential common-method bias, including anonymous participation, neutral wording, consistent questionnaire formats, and attention checks, common-method bias was statistically assessed using Harman's single-factor test. All measurement items were entered simultaneously into an unrotated exploratory factor analysis to examine whether a single factor accounted for a substantial proportion of the total variance.

Instrument, Pretest, and Pilot Study

The questionnaire consisted of demographic and screening sections followed by measurement items for seven constructs: adoption intention, travel distance, driving range, price, charging time, charging infrastructure, and incentive policies. All construct items were measured using a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The measurement items were adapted from previous EV adoption and purchase-intention studies and modified to reflect the specific context of Proton e.MAS (He et al., 2022; Hoogland et al., 2024; Mohd Noor et al., 2025; Syed Mansor & Anuar, 2025; Vafaei-Zadeh et al., 2022).

Particular attention was given to the conceptual and operational distinction among the six predictor constructs. Travel distance captured respondents' regular mobility requirements, whereas driving range represented the perceived distance capability of the vehicle. Price reflected consumers' evaluation of vehicle affordability and value, while incentive policies represented external financial and policy support. Charging time was operationalised specifically in terms of the duration and temporal convenience of the charging process, whereas charging infrastructure captured the availability, accessibility, reliability, and distribution of charging facilities. The predictor measures were conceptually distinguished from adoption intention, which represented respondents' willingness or intention to consider Proton e.MAS.

Prior to the main data collection, the questionnaire was reviewed by five academic experts to assess item clarity, relevance, construct coverage, and contextual suitability. Particular attention was given to whether the adapted items adequately represented their intended constructs and whether the wording created potential conceptual overlap across constructs. Feedback from the expert review was used to refine the wording and contextual relevance of the questionnaire items.

Subsequently, a pilot study involving 30 eligible EV users was conducted to assess the clarity of the questionnaire and the preliminary internal consistency of the measurement scales. Cronbach's alpha was used as an initial reliability assessment, with values of 0.70 or above considered acceptable. The pilot study served as a preliminary assessment of instrument reliability before the main survey. Construct validity of the measurement model was subsequently assessed using the full study sample through factor loadings, composite reliability, average variance extracted (AVE), and discriminant validity analysis.

Table 4 Measurement Items and Sources

Construct	Code	Sample item	Source
Adoption intention	AI1	I intend to consider Proton e.MAS as my future vehicle.	(Mohd Noor et al., 2025; Vafaei-Zadeh et al., 2022)
	AI2	I would consider choosing Proton e.MAS when purchasing my next vehicle.	
	AI3	I am willing to consider Proton e.MAS as an option for my future vehicle.	
	AI4	I intend to consider Proton e.MAS when making a future vehicle purchase decision.	
	AI5	There is a strong possibility that I would consider Proton e.MAS for my future vehicle.	
Travel distance	TD1	The distances I regularly travel are suitable for the practical use of Proton e.MAS.	(He et al., 2022; Siahaan et al., 2024)

	TD2	My typical daily travel distance can be accommodated by Proton e.MAS.	
	TD3	The distances involved in my routine journeys are compatible with using Proton e.MAS.	
	TD4	My regular travel patterns are suitable for the practical use of Proton e.MAS.	
	TD5	My usual travel distances would allow me to use Proton e.MAS conveniently.	
Driving range	DR1	The driving range of Proton e.MAS is sufficient for my regular travel needs.	(He et al., 2022; Higuera-Castillo et al., 2023)
	DR2	Proton e.MAS provides sufficient driving range for my daily journeys.	
	DR3	The driving range of Proton e.MAS would allow me to complete most of my regular trips without recharging	
	DR4	The available driving range of Proton e.MAS is adequate for my mobility requirements.	
	DR5	I consider the driving range of Proton e.MAS sufficient for both routine and occasional journeys.	
Price	PR1	The price of Proton e.MAS is reasonable relative to the value it provides.	(Mohd Noor et al., 2025; Syed Mansor & Anuar, 2025)
	PR2	The purchase price of Proton e.MAS is acceptable to me.	
	PR3	Proton e.MAS offers good value for its purchase price.	
	PR4	The price of Proton e.MAS is reasonable considering its features and benefits.	
	PR5	The overall cost of Proton e.MAS represents acceptable value for money.	
Charging time	CT1	The time required to charge Proton e.MAS is acceptable for my regular travel routine.	(Tsai et al., 2024; Wang et al., 2023)
	CT2	The charging duration of Proton e.MAS is reasonable for my daily mobility needs.	
	CT3	The time needed to recharge Proton e.MAS would be manageable within my normal routine.	

	CT4	The charging speed of Proton e.MAS would provide an acceptable level of time convenience.	
	CT5	The amount of time required to recharge Proton e.MAS is acceptable to me.	
Charging infrastructure	CI1	Public charging facilities are sufficiently accessible in the areas where I regularly travel.	(Malaysian Investment Development Authority, 2025; Hoogland et al., 2024)
	CI2	EV charging facilities are available at locations that are convenient for my regular journeys.	
	CI3	Public charging facilities are sufficiently distributed across the areas where I travel.	
	CI4	Available charging facilities are sufficiently reliable for regular EV use.	
	CI5	I can conveniently access charging facilities when travelling within my usual areas.	
Incentive policies	IP1	The available government incentives provide meaningful financial support for EV ownership.	(Chen et al., 2025; Xue et al., 2023)
	IP2	Government incentives help reduce the financial burden associated with EV ownership.	
	IP3	Current government incentives provide meaningful benefits to EV users.	
	IP4	Existing EV-related policies provide useful support for EV ownership.	
	IP5	Government support makes the financial requirements of EV ownership more manageable.	

Data Quality and Ethical Controls

Participation was voluntary and anonymous. The questionnaire explained the purpose of the research, participant eligibility requirements, confidentiality measures, and respondents' right to withdraw from the study at any time without penalty. No personally identifiable information was collected. Both the online and offline versions of the questionnaire used identical wording and response order to minimise mode effects. Timestamps, incomplete responses, implausibly short completion times, repetitive response patterns, and failures in attention-check questions were reviewed before data analysis. These procedures were implemented to enhance the credibility and quality of the data without altering respondents' substantive responses.

Data Analysis

The data were coded and analysed using IBM SPSS Statistics Version 27. Data screening addressed missing responses, patterned answers, duplicate submissions, univariate and multivariate outliers, and normality. Descriptive statistics and frequency analyses were conducted to summarise respondent characteristics and the levels of each construct. Prior to hypothesis testing, the measurement properties of the constructs were assessed to establish reliability and construct validity. Internal consistency and convergent validity were subsequently assessed using Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE), while discriminant validity was evaluated using the Fornell–Larcker criterion. Pearson correlation analysis examined the strength and direction of the bivariate relationships between the study variables, while multiple regression analysis estimated the unique statistical association between each predictor and adoption intention while accounting for the other predictors in the model (Hair et al., 2022; Tabachnick & Fidell, 2019; Papageorgiou, 2022). The proposed regression model was specified as follows:

$$AI = \beta_0 + \beta_1TD + \beta_2DR + \beta_3PR + \beta_4CT + \beta_5CI + \beta_6IP + \varepsilon$$

where AI denoted adoption intention, TD denoted travel distance, DR denoted driving range, PR denoted price, CT denoted charging time, CI denoted charging infrastructure, and IP denoted incentive policies. Statistical significance was evaluated at $p < 0.05$. Variance Inflation Factors (VIFs) were examined to identify potential multicollinearity among the independent variables, while the overall regression model was evaluated using the coefficient of determination (R^2), the ANOVA F-test, and standardised beta (β) coefficients.

TABLE 5 SUMMARY OF DATA ANALYSIS PROCEDURES

Analysis	Purpose
Frequency and descriptive statistics	Profile respondents and summarise construct levels.
Cronbach's alpha	Assess internal consistency; $\alpha \geq 0.70$ expected.
Outlier and normality checks	Identify unusual cases and assess distributional assumptions.
Pearson correlation	Examine direction and strength of bivariate relationships.
Multiple regression and ANOVA	Estimate the unique statistical association of each predictor and evaluate overall model significance

FINDINGS AND DISCUSSION

Respondent Profile and EV Usage Characteristics

A total of 375 valid responses were included in the analysis. The respondents comprised current electric vehicle users who lived, worked, or regularly travelled within Klang Valley. This sampling profile was consistent with the study's focus on experienced EV users, who were considered more capable of evaluating practical issues associated with driving range, charging duration, infrastructure accessibility, and EV ownership costs.

Of the respondents, 56.0% were male and 44.0% were female. The largest age group consisted of respondents aged between 35 and 44 years (32.8%), followed by those aged between 25 and 34 years (29.1%). Approximately 27.5% were aged between 45 and 54 years, while the remaining respondents were distributed across the younger and older age categories.

Geographically, 72.8% of the respondents lived, worked, or regularly travelled in Kuala Lumpur, 26.4% were primarily associated with Selangor, and 0.8% were from Putrajaya. This distribution broadly reflected

the concentration of registered EVs within Klang Valley.

In terms of EV ownership experience, 38.4% of the respondents had used an EV for less than one year, 40.3% had between one and three years of EV experience, and 21.3% had more than three years of ownership or regular usage experience. Most respondents reported an average daily travel distance of between 30 and 60 kilometres (41.6%), while 27.2% travelled fewer than 30 kilometers per day. Approximately 22.1% travelled between 61 and 100 kilometres, and 9.1% regularly travelled more than 100 kilometres per day.

Home charging was the most frequently reported primary charging method (48.5%), followed by public charging facilities (31.7%) and workplace charging (19.8%). These usage characteristics indicate that the respondents possessed sufficient practical EV experience to provide meaningful evaluations of the factors examined in this study.

The respondent profile is particularly relevant because the study deliberately focuses on current EV users rather than general consumers. Their evaluations of Proton e.MAS are therefore informed by actual ownership and usage experience, particularly about charging behaviour, travel planning, range adequacy, and infrastructure availability.

Measurement Model Assessment

TABLE 6 RELIABILITY AND DESCRIPTIVE STATISTICS

Construct	Loading Range	Cronbach's Alpha	CR	AVE
Travel Distance	0.71-0.82	0.812	0.84	0.57
Driving Range	0.76-0.88	0.884	0.89	0.62
Price	0.73-0.85	0.856	0.87	0.58
Charging Time	0.72-0.84	0.839	0.86	0.55
Charging Infrastructure	0.79-0.90	0.901	0.91	0.67
Incentive Policies	0.75-0.87	0.873	0.88	0.6
Adoption Intention	0.81-0.91	0.914	0.92	0.7

As shown in Table 6, all constructs demonstrated satisfactory reliability and convergent validity. Factor loadings ranged from 0.71 to 0.91, while Cronbach's alpha values ranged from 0.812 to 0.914. Composite reliability values ranged from 0.84 to 0.92, and all AVE values exceeded 0.50, ranging from 0.55 to 0.70. These results provide evidence of satisfactory internal consistency, construct reliability, and convergent validity. The operationalisation also maintained clear conceptual boundaries among the constructs. Travel distance captured respondents' regular mobility patterns, whereas driving range represented the perceived distance capability of the EV. Charging time focused exclusively on charging duration, speed, and temporal convenience, while charging infrastructure captured the availability, accessibility, reliability, and distribution of charging facilities. Price represented vehicle cost and value considerations, whereas incentive policies represented external financial and policy support. Importantly, charging-time items did not incorporate charging-infrastructure availability or adoption intention, thereby reducing conceptual overlap between the predictor constructs and the dependent variable.

TABLE 7 DISCRIMINANT VALIDITY – FORNELL-LACKER CRITERION

Construct	TD	DR	PR	CT	CI	IP	AI
Travel Distance	0.755						
Driving Range	0.548	0.787					
Price	0.421	0.486	0.762				
Charging Time	0.463	0.571	0.438	0.742			
Charging Infrastructure	0.397	0.612	0.451	0.583	0.819		
Incentive Policies	0.352	0.429	0.536	0.411	0.474	0.775	
Adoption Intention	0.436	0.628	0.517	0.493	0.651	0.468	0.837

Discriminant validity was assessed using the Fornell–Larcker criterion. As presented in Table 7, the square root of the AVE for each construct, shown by the diagonal values, was greater than its corresponding correlations with the other constructs. The results therefore indicate adequate discriminant validity among the seven constructs. In particular, travel distance remained empirically distinct from driving range, while charging time was distinguishable from charging infrastructure and adoption intention. This provides additional support for the conceptual and empirical distinctiveness of the constructs employed in the study.

Specifically, the square root of the AVE for charging time (0.742) exceeded its correlation with charging infrastructure (0.583) and adoption intention (0.493), providing further evidence that charging time was empirically distinct from infrastructure availability and behavioural intention.

TABLE 8 RELIABILITY AND DESCRIPTIVE STATISTICS

Construct	Item	Cronbach's Alpha	Mean	SD
Travel Distance	5	0.812	3.68	0.69
Driving Range	5	0.884	4.1	0.61
Price	5	0.856	3.74	0.72
Charging Time	5	0.839	3.88	0.66
Charging Infrastructure	5	0.901	4.19	0.58
Incentive Policies	5	0.873	3.91	0.67
Adoption Intention	5	0.914	4.07	0.6

The descriptive results indicate generally favourable perceptions of Proton e.MAS and the wider EV ecosystem. Charging infrastructure recorded the highest mean score ($M = 4.19$, $SD = 0.58$), suggesting that respondents regarded access to reliable charging facilities as a particularly important consideration. Driving range also recorded a relatively high mean ($M = 4.10$, $SD = 0.61$), followed by adoption intention ($M = 4.07$, $SD = 0.60$).

Price recorded a comparatively lower mean score ($M = 3.74$, $SD = 0.72$). Although still above the midpoint of the scale, this result suggests that affordability and perceived value remain relatively more contested

considerations among EV users compared with infrastructure and vehicle range.

Pearson Correlation Analysis

Pearson correlation analysis was performed to assess the direction and strength of the bivariate relationships between the six independent variables and adoption intentions. All correlations with adoption intention were positive.

TABLE 9 PEARSON CORRELATION WITH ADOPTION INTENTION

Predictor	r	p-values	Interpretation
Travel Distance	0.214	<0.001	Weak positive
Driving Range	0.582	<0.001	Moderate positive
Price	0.463	<0.001	Moderate positive
Charging Time	0.391	<0.001	Moderate positive
Charging Infrastructure	0.612	<0.001	Strongest positive relationship
Incentive Policies	0.347	<0.001	Moderate positive

Charging infrastructure exhibited the strongest bivariate relationship with adoption intention ($r = 0.612$, $p < 0.001$), followed by driving range ($r = 0.582$, $p < 0.001$). This indicates that respondents with more favourable perceptions of charging accessibility and vehicle range were substantially more likely to express an intention to consider Proton e.MAS.

Travel distance recorded the weakest relationship with adoption intention ($r = 0.214$, $p < 0.001$). Although statistically significant at the bivariate level, the relatively small correlation suggests that mobility distance alone may not be sufficient to explain adoption when other product and contextual factors are taken into consideration.

Common Method Bias Assessment

Common-method bias was assessed using Harman's single-factor test. The results showed that the first unrotated factor accounted for 38.64% of the total variance. As this value was below the commonly applied 50% threshold, no single factor accounted for the majority of the variance. This finding suggests that common-method bias was unlikely to be a dominant concern in the present study.

Multiple Regression and Hypothesis Testing

Multiple regression analysis was conducted to determine the unique contribution of travel distance, driving range, price, charging time, charging infrastructure, and incentive policies to adoption intention. The overall regression model was statistically significant, $F(6, 368) = 78.05$, $p < 0.001$. The model explained 56.0% of the variance in adoption intention ($R^2 = 0.560$; Adjusted $R^2 = 0.553$), indicating substantial explanatory power within the context of the study. The Durbin-Watson statistics were 1.93, indicating no serious autocorrelation problem. Variance Inflation Factor values ranged from 1.31 to 1.89, remaining below conventional thresholds and suggesting that multicollinearity did not adversely affect the regression estimates.

TABLE 10 MULTIPLE REGRESSION RESULTS PREDICTING PROTON.EMAS ADOPTION INTENTION

Hypothesis	Predictor	Standardised β	t-value	p-value	VIF	Decision
H1	Travel Distance	0.078	1.81	0.071	1.31	Not supported
H2a	Driving Range	0.268	6.07	<0.001	1.76	Supported
H2b	Price	0.176	4.21	<0.001	1.58	Supported
H2c	Charging Time	0.116	2.67	0.008	1.49	Supported
H3a	Charging Infrastructure	0.309	6.84	<0.001	1.89	Supported
H3b	Incentive Policies	0.098	2.3	0.022	1.43	

Model statistics: $R^2 = 0.560$; Adjusted $R^2 = 0.553$; $F(6, 368) = 78.05$, $p < 0.001$.

Five of the six proposed hypotheses were therefore supported.

Behavioural Compatibility: The Role of Travel Distance

Multiple regression analysis was conducted to determine the unique contribution of travel distance, driving range, price, charging time, charging infrastructure, and incentive policies to adoption intention. The overall regression model was statistically significant, $F(6, 368) = 78.05$, $p < 0.001$. The model explained 56.0% of the variance in adoption intention ($R^2 = 0.560$; Adjusted $R^2 = 0.553$), indicating substantial explanatory power within the context of the study. The Durbin-Watson statistics were 1.93, indicating no serious autocorrelation problem. Variance Inflation Factor values ranged from 1.31 to 1.89, remaining below conventional thresholds and suggesting that multicollinearity did not adversely affect the regression estimates.

Product Value Proposition: Driving Range, Price, and Charging Time

The results indicate that all three product attributes were significantly associated with adoption intention, although the strength of their associations differed.

Driving Range and Functional Confidence

Driving range was the second strongest predictor in the model ($\beta = 0.268$, $p < 0.001$). This indicates that the perceived ability of Proton e.MAS to support daily and intercity travel is an important statistical predictor of adoption intention. The result suggests that consumers evaluate vehicle range not merely as a technical specification but as a source of functional confidence. When users believe that the available driving range is sufficient for their routine mobility requirements, uncertainty surrounding recharging and journey completion is reduced. The finding is particularly meaningful among current EV users because their assessment of range adequacy is based on accumulated ownership experience. Such users are familiar with the practical consequences of battery depletion, route planning, charger availability, and differences between advertised and real-world driving conditions. The result therefore reinforces previous EV research indicating that sufficient range is associated with lower range anxiety and greater confidence in electric mobility. Previous research similarly identifies range adequacy as an important factor associated with EV practicality and consumer acceptance.

Price and Perceived Value

Price is also positively and statistically significantly associated with adoption intention ($\beta = 0.176$, $p < 0.001$). This suggests that affordability remains important even among consumers who already possess experience with EV technology. However, the result should not be interpreted solely in terms of the absolute acquisition price. Consumers are likely to evaluate Proton e.MAS in relation to its total value proposition, including expected operating-cost savings, maintenance requirements, battery assurance, vehicle features, financing arrangements, and long-term ownership benefits. The relatively smaller regression coefficient for price compared with driving range and charging infrastructure also suggests that consumers may be willing to accept a higher acquisition price when the vehicle provides sufficient functional benefits and is supported by a reliable charging ecosystem. The result is consistent with the manuscript's conceptualization of price as a combination of acquisition cost and perceived value rather than price alone.

Charging Time and Temporal Convenience

Charging time was positively and statistically significantly associated with adoption intention ($\beta = 0.116$, $p = 0.008$), after accounting for the other predictors in the regression model. Although its regression coefficient was smaller than those of driving range and price, the result demonstrates that charging convenience remains relevant to consumer evaluation. The finding reflects the temporal dimension of EV ownership. Unlike conventional refuelling, charging requires users to incorporate waiting time into their daily routines. Therefore, faster charging, convenient destination charging, and compatibility with home or workplace charging arrangements may reduce the perceived inconvenience associated with EV ownership. For Proton e.MAS, this implies that consumer communication should not focus exclusively on battery size or maximum range. Information regarding charging speed, charging compatibility, realistic charging duration, and access to fast-charging networks may also be relevant to consumers' adoption considerations.

Contextual Readiness: Charging Infrastructure and Incentive

Both contextual factors were significantly associated with adoption intention, although charging infrastructure demonstrated a stronger statistical association.

Charging Infrastructure as the Dominant Predictor

Charging infrastructure emerged as the strongest predictor in the entire model ($\beta = 0.309$, $p < 0.001$). This result provides an important insight: consumers do not evaluate Proton e.MAS solely as an automotive product; they evaluate it as part of a wider electric mobility ecosystem. Reliable and accessible charging facilities may be associated with lower uncertainty regarding vehicle usability and greater consumer confidence in the practicality of EV ownership. The high mean score for charging infrastructure further reinforces its importance among experienced EV users. The result also has important theoretical implications. From a TPB-informed extended framework perspective, charging infrastructure represents an external condition that may strengthen perceived behavioural feasibility. When chargers are readily available, strategically located, functional, and convenient to use, consumers may perceive greater control over their ability to operate an EV successfully. The finding is consistent with the theoretical rationale in the paper, which positions charging infrastructure as a contextual factor associated with whether EV adoption is perceived as practical and achievable.

Incentive Policies Supporting Rather Than Prominent Predictor

"Incentive policies demonstrated a positive but comparatively modest statistical association with adoption intention ($\beta = 0.098$, $p = 0.022$). The result suggests that government incentives continue to play a role in supporting EV adoption, particularly by reducing financial barriers and signalling institutional commitment to electric mobility. Nevertheless, the smaller coefficient indicates that incentives alone may not be sufficient to generate strong adoption intention among experienced EV users. Once consumers possess direct experience with EV ownership, tangible factors such as charging accessibility, driving range, and vehicle value may become more influential than temporary fiscal benefits. This finding therefore suggests that

policy support should extend beyond purchase incentives. A comprehensive EV policy environment should integrate financial support with infrastructure expansion, accessible financing, charging-related benefits, consumer information, regulatory certainty, and long-term policy consistency.

Relative Importance of Behavioural, Product, and Contextual Factors

A comparison of the regression coefficients provides a broader interpretation of the multi-dimensional model.

TABLE 11 RELATIVE IMPORTANCE OF THE THREE DIMENSIONS

Dimension	Variables	Strongest Predictor	Interpretation
Behavioural	Travel Distance	Travel Distance, $\beta = 0.078$	Limited unique influence
Product	Driving Range, Price, Charging Time	Driving Range, $\beta = 0.268$	Strong product-value
Contextual	Charging Infrastructure, Incentive Policies	Charging Infrastructure, $\beta = 0.309$	Strongest overall dimension

The results indicate that contextual and product-related considerations are more influential than travel distance in explaining Proton e.MAS adoption intention.

The strongest individual predictor was charging infrastructure, followed by driving range. Together, these findings suggest that consumers place substantial emphasis on whether the vehicle can provide adequate mobility and whether the surrounding ecosystem can support its operation.

This pattern reveals an important characteristic of EV decision-making. Consumers do not evaluate Proton e.MAS solely based on brand familiarity, vehicle price, or government support. Instead, they assess whether complete ownership proposition is viable.

In practical terms, adoption appears to depend on three sequential questions:

1. Can the vehicle meet my mobility requirements?
2. Does the product provide sufficient value and convenience?
3. Does the external EV ecosystem make ownership practical?

The results indicate that the second and third questions may be especially influential among current EV users.

Theoretical Interpretation Through a TPB-Informed Extended Framework Perspective

The findings provide empirical support for using an TPB-informed extended framework perspective to understand Proton e.MAS adoption intention. However, the study does not directly test the original TPB constructs of attitude, subjective norm, and perceived behavioural control. Instead, the six EV-specific factors represent external considerations that may shape consumers' evaluations of desirability and behavioural feasibility.

Product attributes such as driving range, price, and charging time may contribute to favourable or unfavourable evaluations of Proton e.MAS. In contrast, travel distance and charging infrastructure reflect the practical feasibility of integrating the vehicle into consumers' mobility routines. Incentive policies represent an institutional condition capable of reducing financial constraints and strengthening confidence in the broader EV environment.

The findings therefore suggest that EV adoption intention is better understood as the outcome of an integrated evaluation rather than a response to a single technological or financial factor. In particular, the strong effects of charging infrastructure and driving range demonstrate that consumer intention is closely tied to perceived mobility assurance.

Accordingly, the theoretical contribution of this study lies not in replacing the Theory of Planned Behaviour, but in demonstrating how EV-specific product, behavioural, and contextual considerations can complement a behavioural-intention framework in an emerging-market setting. This interpretation is consistent with the study's original positioning of product attributes and contextual conditions as antecedent considerations surrounding adoption feasibility and evaluation.

Overall, the findings show that Proton e.MAS adoption intention is primarily influenced by the interaction between vehicle capability and ecosystem readiness. Charging infrastructure represents the strongest contextual requirement, while driving range constitutes the main predictor product attribute. Price, charging time, and incentive policies remain relevant supporting factors, whereas travel distance appears to have limited independent explanatory power once consumers' evaluations of the product and EV ecosystem are taken into account.

CONTRIBUTIONS, LIMITATIONS, AND CONCLUSION

Academic Contribution

The study contributed to EV adoption research in several important ways. First, it provided empirical evidence on the factors associated with adoption intention towards Proton e.MAS, thereby extending the EV adoption literature beyond the conventional examination of electric vehicles as a general product category to the context of a specific Malaysian national EV brand. Second, the findings demonstrated the relative importance of behavioural, product, and contextual factors in explaining adoption intention. Charging infrastructure emerged as the strongest predictor, followed by driving range, highlighting the importance of ecosystem readiness and functional vehicle capability in shaping consumers' adoption decisions. Price, charging time, and incentive policies were also significantly associated with adoption intention, whereas travel distance did not demonstrate a statistically significant unique association after accounting for the other predictors. These findings indicated that experienced EV users placed greater emphasis on vehicle practicality, affordability, charging convenience, and external ecosystem support than on travel distance alone.

Third, the study contributed to a TPB-informed extended framework perspective by demonstrating how EV-specific product and contextual conditions complemented the behavioural-intention framework. Rather than directly testing the original TPB constructs, the findings showed that factors related to vehicle capability and external support could shape the perceived desirability and feasibility of adopting Proton e.MAS. Overall, the study provided a more context-specific understanding of EV adoption among current EV users in an emerging Southeast Asian market and established a useful empirical basis for future comparisons across consumer groups, EV brands, geographical regions, and national contexts.

Automotive and Infrastructure Contribution

For Proton and automotive distributors, the findings provide practical guidance for strengthening the market positioning of Proton e.MAS. Since charging infrastructure emerged as the strongest predictor of adoption intention, followed by driving range, greater emphasis should be placed on enhancing consumers' confidence in the overall ownership experience rather than focusing solely on vehicle features. Proton should therefore communicate realistic driving range performance, provide transparent battery assurance and warranty information, and strengthen collaboration with charging network providers to improve consumers' confidence in long-term EV ownership. As price also demonstrated a significant influence on adoption intention, competitive financing schemes, trade-in programmes, ownership cost comparisons, and value-added service packages may further enhance the perceived value of Proton e.MAS. In addition, the significant effect of charging time suggests that promoting fast-charging compatibility and convenient

charging solutions could improve consumers' perceptions of vehicle practicality.

For charging service providers, the findings highlight the critical importance of developing a reliable and accessible charging ecosystem. As charging infrastructure was identified as the strongest statistical predictor of adoption intention, priority should be given to improving charger availability, operational reliability, payment simplicity, and strategic charger placement across residential areas, workplaces, commercial centres, and major intercity travel routes. A well-distributed charging network can reduce uncertainty associated with EV ownership and strengthen consumers' confidence in adopting Proton e.MAS. Furthermore, closer collaboration between automotive manufacturers and charging operators could improve route planning, charging integration, and the overall ownership experience, thereby supporting the continued growth of electric mobility in Malaysia.

Government and Policy Contribution

The findings provide important implications for government agencies and policymakers in strengthening Malaysia's EV ecosystem. Although incentive policies was significantly associated with adoption intention, their relatively smaller effect compared with charging infrastructure suggests that financial incentives alone may not be sufficient to accelerate EV adoption. Government agencies should therefore maintain relevant fiscal measures, such as tax exemptions, purchase incentives, charging-related relief, low-interest financing, and registration benefits, while placing greater emphasis on developing a reliable and accessible charging ecosystem.

Given that charging infrastructure emerged as the strongest predictor of adoption intention, greater policy attention should be directed towards accelerating the expansion and strategic distribution of charging facilities, particularly across residential areas, workplaces, commercial centres, and major intercity routes. Local authorities could further support this development by strengthening EV-ready building requirements, facilitating charger installation approvals, and encouraging charging infrastructure development in areas with limited accessibility. Greater coordination among government agencies, local authorities, automotive manufacturers, and charging service providers would also help ensure that infrastructure development corresponds with consumers' mobility needs. Collectively, the findings suggest that an integrated policy approach combining sustained financial support with infrastructure readiness may be more effective than relying predominantly on incentives. Such an approach could reduce both financial and accessibility barriers, strengthen consumer confidence in EV ownership, and support Malaysia's transition towards a more sustainable and lower-carbon mobility ecosystem.

LIMITATIONS AND FUTURE RESEARCH

Several limitations should be considered when interpreting the findings of this study. First, the study focused exclusively on current EV users in Klang Valley and employed purposive sampling. Although this approach enabled the study to capture informed evaluations from consumers with direct EV ownership and usage experience, the findings may not be generalisable to non-EV users or consumers in other regions of Malaysia. Second, the cross-sectional design captured respondents' perceptions at a single point in time and therefore did not account for changes in adoption intention as EV technology, charging infrastructure, vehicle pricing, and government policies evolve.

Third, the study examined adoption intention towards Proton e.MAS rather than actual purchase behaviour. Consequently, a significant intention to adopt may not necessarily be translated into subsequent vehicle purchase decisions. Finally, although the study was informed by an adapted Theory of Planned Behaviour (TPB) perspective, the original TPB constructs of attitude, subjective norm, and perceived behavioural control were not directly examined. The findings should therefore be interpreted as evidence of the influence of EV-specific behavioural, product, and contextual factors on adoption intention rather than as a direct empirical test of the complete TPB-informed extended framework.

Future research could extend the study to other Malaysian states and incorporate both current EV users and non-EV users to determine whether the relative importance of charging infrastructure, driving range, price,

charging time, and incentive policies differs across consumer groups. Longitudinal studies could further examine whether changes in charging infrastructure, vehicle technology, pricing, and policy support alter adoption intention over time. Future studies could also investigate actual Proton e.MAS purchase behaviour and incorporate attitude, subjective norm, and perceived behavioural control as explicit constructs to provide a more comprehensive test of the TPB-informed extended framework in the Malaysian EV context.

Conclusion

This study examined behavioural, product, and contextual factors associated with adoption intention towards Proton e.MAS among current EV users in Klang Valley. The findings revealed that charging infrastructure showed the strongest positive association with adoption intention, followed by driving range. Price, charging time, and incentive policies were also positively and significantly associated with adoption intention, whereas travel distance did not demonstrate a statistically significant unique association after accounting for the other predictors.

Overall, the findings indicate that EV adoption is primarily shaped by ecosystem readiness, vehicle capability, affordability, and charging convenience. The study contributes to a TPB-informed extended framework understanding of EV adoption and highlights the importance of coordinated efforts among Proton, charging service providers, and policymakers to strengthen vehicle value, expand reliable charging infrastructure, and maintain effective policy support. These efforts are essential for enhancing consumer confidence and supporting Malaysia's transition towards sustainable electric mobility.

Acknowledgment

The authors would like to acknowledge the support provided by the Pusat Pengurusan Penyelidikan dan Inovasi (CRIM) Universiti Teknikal Malaysia Melaka (UTeM), for funding this paper under project number PJP/2025/FPTT/PERSPEKTIF/SA0079. The authors also gratefully acknowledge the financial support and facilities provided by the Fakulti Pengurusan Teknologi dan Teknousahawanan, and the Centre of Technopreneurship Development (C-TeD), UTeM, for their direct and indirect contributions.

REFERENCES

1. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.
2. Amran, A. N. Q., Ma'aram, A., & Sutopo, W. (2025). The prediction model for electric vehicles adoption rate in Malaysia. *Journal of Transport System Engineering*, 1–8.
3. Buhmann, K. M., Rialp-Criado, J., & Rialp-Criado, A. (2024). Predicting consumer intention to adopt battery electric vehicles: Extending the Theory of Planned Behavior. *Sustainability*, 16(3), 1284.
4. Bujang, M. A., Omar, E. D., Foo, D. H. P., & Hon, Y. K. (2024). Sample size determination for conducting a pilot study to assess reliability of a questionnaire. *Restorative Dentistry and Endodontics*, 49(1).
5. Chen, P., Selamat, M. H., & Lee, S.-N. (2025). The impact of policy incentives on the purchase of electric vehicles by consumers in China's first-tier cities. *Sustainability*, 17(12), 5319.
6. Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior*. Psychology Press.
7. Hair, J. F., Hult, T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling* (3rd ed.). Sage.
8. He, S., Luo, S., & Sun, K. K. (2022). Factors affecting electric vehicle adoption intention: The impact of objective, perceived, and prospective charger accessibility. *Journal of Transport and Land Use*, 15(1), 779–801.
9. Higuera-Castillo, E., Singh, V., Singh, V., & Liébana-Cabanillas, F. (2023). Factors affecting adoption intention of electric vehicle: A cross-cultural study. *Environment, Development and Sustainability*.
10. Holtom, B., Baruch, Y., Aguinis, H., & Ballinger, G. A. (2022). Survey response rates: Trends and a

- validity assessment framework. *Human Relations*, 75(8), 1560–1584.
11. Hoogland, K., Kurani, K. S., Hardman, S., & Chakraborty, D. (2024). If you build it, will they notice? Public charging density, charging infrastructure awareness, and consideration to purchase an electric vehicle. *Transportation Research Interdisciplinary Perspectives*, 23, 101007.
12. International Energy Agency. (2024). *Global EV outlook 2024*. IEA.
13. Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610.
14. Krishnan, V. V., & Koshy, B. I. (2021). Evaluating the factors influencing purchase intention of electric vehicles in households owning conventional vehicles. *Case Studies on Transport Policy*, 9(3).
15. Lay, W., Gauhar, V., Castellani, D., & Teoh, J. Y. C. (2023). Tips and pitfalls in using social media platforms for survey dissemination. *Société Internationale d'Urologie Journal*, 4(2), 118–124.
16. Malaysian Green Technology and Climate Change Corporation. (2024). *Malaysia on track for EV revolution*.
17. Malaysian Investment Development Authority. (2025). *Powering the future: Accelerating Malaysia's EV charging revolution for sustainable mobility*.
18. Mohd Noor, N. A., Muhammad, A., Isa, F. M., Shamsudin, M. F., & Abaidah, T. N. A. T. (2025). The electric vehicle revolution: How consumption values, consumer attitudes, and infrastructure readiness influence the intention to purchase electric vehicles in Malaysia. *World Electric Vehicle Journal*, 16(10), 556.
19. Pamidimukkala, A., Kermanshachi, S., Rosenberger, J. M., & Hladik, G. (2024). Barriers and motivators to the adoption of electric vehicles: A global review. *Green Energy and Intelligent Transportation*, 3(2), 100153.
20. Papageorgiou, S. N. (2022). On correlation coefficients and their interpretation. *Journal of Orthodontics*, 49(3), 359–361.
21. Proton New Energy Technology Sdn. Bhd. (2025). *PROTON launches Proton e.MAS 5, Malaysia's first affordable electric vehicle*.
22. Siahaan, R., Simamora, N., & Sitindaon, C. (2024). Exploring electric car adoption intent: Role of current travel characteristics among daily car users. *Transactions on Transport Sciences*, 15(2), 47–53.
23. Spencer, N. H., Syrdal, D. S., Coates, M., & Huws, U. (2022). Assessing bias in online surveys using alternative survey modes. *Work Organisation, Labour & Globalisation*, 16(1).
24. Stadtmüller, S., Beuthner, C., & Silber, H. (2021). *Mixed-mode surveys*. GESIS Survey Guidelines.
25. Syed Mansor, H. S., & Anuar, H. S. (2025). Price perception, charging infrastructure and environmental consciousness that influence adoption of electric vehicle: Malaysia perspectives. *Journal of Technology and Operations Management*, 20(2), 21–37.
26. Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Pearson.
27. Tsai, J.-F., Wu, S.-C., Kathinthong, P., Tran, T.-H., & Lin, M.-H. (2024). Electric vehicle adoption barriers in Thailand. *Sustainability*, 16(4), 1642.
28. Umair, M., Hidayat, N. M., Ali, N., Nasir, M., Hakomori, T., & Abdullah, E. (2024). A review of Malaysia's current state and future in electric vehicles. *Journal of Sustainable Development of Energy, Water and Environment Systems*, 12(4), 1–35.
29. 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 & Management*, 43, 100784.
30. Wang, J., Huang, C., He, D., & Tu, R. (2023). Range anxiety among battery electric vehicle users: Both distance and waiting time matter. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 67(1).
31. Xue, Y., Zhang, Y., Wang, Z., Tian, S., Xiong, Q., & Li, L. Q. (2023). Effects of incentive policies on the purchase intention of electric vehicles in China: Psychosocial value and family ownership. *Energy Policy*, 181, 113732.
32. Yusoff, M. S. B., Arifin, W. N., & Hadie, S. N. H. (2021). ABC of questionnaire development and validation for survey research. *Education in Medicine Journal*, 13(1), 97–108.