

Managing Conditional Electric Vehicle Adoption Intention in Malaysia: Evidence from Non-Owner Drivers

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ABSTRACT

Electric-vehicle (EV) adoption requires more than environmental awareness; potential users must also perceive that charging, financial, and technological conditions make ownership workable. This study examines conditional EV adoption intention among 384 Malaysian licensed drivers who did not own an EV. Four positively worded managerial conditions—infrastructure readiness, financial attractiveness, technological readiness, and environmental value—were assessed through a cross-sectional questionnaire. All four correlated positively with conditional adoption intention ($r=.685$ to $.791$, $p<.001$) and remained significant in a simultaneous regression that explained 72.7% of the variance in intention ($R^2=.727$). Environmental value had the largest unstandardized coefficient ($B = .380$), ahead of financial attractiveness, infrastructure readiness, and technological readiness; notably, infrastructure readiness recorded the highest mean agreement but the weakest correlation with intention, suggesting a ceiling effect once reliable charging is treated as a baseline expectation rather than a differentiator. Managers and policymakers should therefore coordinate reliable charging, transparent total-cost propositions, credible technology assurances, and verifiable environmental value, with the last carrying particular weight. Because the outcome items explicitly describe improved conditions, the results represent conditional receptiveness rather than unconditional purchase intention or actual adoption.

Keywords— electric vehicles; adoption intention; charging infrastructure; financial incentives; technology readiness; environmental value; Malaysia

INTRODUCTION

Electric vehicles offer a pathway for reducing transport-related emissions and petroleum dependence, but market transition depends on whether prospective users regard ownership as practicable. Malaysian research identifies infrastructure, cost, technology, environmental concern, trust, and perceived value as recurring determinants of adoption intention [1], [2], [11], [12]. Systematic reviews further classify EV purchase antecedents into consumer characteristics, vehicle attributes, and EV-related policies. Adoption, in other words, works as an interacting socio-technical system rather than resting on a single motive [3], [13], [18].

This study examines licensed Malaysian drivers who did not own an EV. The dependent items ask whether respondents would consider adoption if subsidies, charging coverage, charging time, driving range, or environmental benefits improved. The outcome is therefore labeled conditional adoption intention. This distinction prevents the study from overstating hypothetical receptiveness as an unconditional intention or actual

purchase, a particularly important boundary because EV research commonly combines purchase, behavioral, and usage intentions under the broader label of adoption [3], [13].

This study contributes a managerial-condition perspective, treating infrastructure readiness, financial attractiveness, technological readiness, and environmental value as favorable conditions that coordinated actors can strengthen. Earlier Malaysian studies have modeled general purchase intention, facilitating conditions, price value, environmental concern, and range anxiety [11], [12]; this study focuses specifically on non-owner drivers and on receptiveness conditional upon improvements in the ownership system, asking whether each condition is associated with conditional adoption intention and which condition carries the largest coefficient in the available model.

LITERATURE REVIEW AND HYPOTHESES

A. Infrastructure Readiness

Charging access, reliability, and location shape the convenience, perceived behavioral control, and risk of EV ownership. Evidence distinguishes objective accessibility from perceived and prospective accessibility; all can matter, while the latter two are especially relevant to non-owners who must anticipate future usability [4]. Malaysian evidence also links facilitating conditions to Battery Electric Vehicle (BEV) acceptance [12], and Malaysian and regional reviews identify limited coverage and ecosystem readiness as central constraints [5], [6]. Readiness should therefore encompass usable coverage, uptime, interoperability, payment, and real-time information, not charger counts alone.

H1: Infrastructure readiness is positively associated with conditional EV adoption intention.

B. Financial Attractiveness

Consumers evaluate purchase price alongside energy, maintenance, financing, insurance, battery risk, depreciation, and resale value. Malaysian evidence shows that price value can strengthen purchase intention [11], while systematic reviews place financial incentives and other EV-related policies among the main antecedents of adoption [3], [13]. Incentives can reduce the initial gap, but their predictability, eligibility, and ease of access determine whether nominal support is perceived as financially attractive. Financial readiness should therefore be communicated through transparent total ownership cost scenarios rather than the purchase price alone.

H2: Financial attractiveness is positively associated with conditional EV adoption intention.

C. Technological Readiness

Driving range, charging time, battery durability, safety, and service support influence confidence in EV use. These concerns combine objective performance with uncertainty about unfamiliar technology. A Malaysian study found that facilitating conditions supported adoption while respondents continued to report battery-range anxiety [12]. Broader evidence similarly shows that technology readiness, instrumental vehicle attributes, and environmental values jointly shape adoption behavior [14], while regional studies associate performance assurance, compatibility, and knowledge with acceptance [5], [9].

H3: Technological readiness is positively associated with conditional EV adoption intention.

D. Environmental Value

Environmental concern can give EV adoption moral, symbolic, and functional value, but perceived benefits depend on electricity generation, battery production, and end-of-life management. Malaysian evidence identifies environmental concern as an influential factor in adoption [1], [12], while systematic reviews treat environmental motives as one component within a broader system of vehicle attributes, user characteristics, and policy conditions [3], [13], [18]. Environmental awareness is associated with EV market attention [10], yet cross-country evidence shows that skepticism toward green advertising can weaken perceived green value and purchase intention [15]. Consequently, credible lifecycle claims are more useful than generic green messaging.

H4: Environmental value is positively associated with conditional EV adoption intention.

METHODOLOGY

A. Research Design and Respondents

This study administered a quantitative cross-sectional questionnaire to Malaysian residents who held a valid driving license and did not own an EV. The questionnaire was self-administered online via Google Forms and distributed through social media and messaging platforms, a convenience-based recruitment channel rather than a strict probability-based sampling frame. The minimum sample size was set using the Krejcie and Morgan [19] table for a large population, which specifies 384 respondents for a population in the tens of millions; the analytic sample met this threshold. Respondents were drawn from across Peninsular and East Malaysia, with the largest shares originating from Perak, Negeri Sembilan, and Selangor, and smaller shares from Sabah and Sarawak. The pool skewed toward male respondents, private-sector employees, and individuals aged 23 to 37 with a bachelor's degree and a monthly household income below RM4,500. We collected 408 responses; 24 failed the eligibility screen, leaving 384 valid cases for analysis. Composite means were analyzed through descriptive statistics, Pearson correlations, and simultaneous multiple regression, using a five-point Likert-type scale throughout.

B. Measures and Interpretation

Four (five-item) predictors represented infrastructure readiness, financial attractiveness, technological readiness, and environmental value. Five outcome items measured willingness to consider purchasing an EV if specified conditions improved. All 25 statements were positively worded and scored from 1 (strongly disagree) to 5 (strongly agree). This study calculated composite scores as the arithmetic mean of the five items for each construct.

A 30-person pilot test produced an overall Cronbach's alpha of .974 for all 25 items. Using the archived pilot item correlation matrix and item standard deviations, construct-level alpha coefficients were reconstructed as .931 for infrastructure readiness, .915 for financial attractiveness, .881 for technological readiness, .882 for environmental value, and .905 for conditional adoption intention. Archived item-total screening coefficients ranged from .475 to .893 and exceeded the reported critical value of .361. These results support pilot internal consistency and item screening.

RESULTS

A. Descriptive Statistics and Correlations

None of the four independent variables was treated as optional by respondents. All four cleared 4.35 out of 5, and infrastructure readiness recorded the highest mean of any construct in the study ($M=4.4109$, $SD=.37602$; Table I) — ahead of technological readiness ($M=4.3755$, $SD=.40042$), environmental value ($M=4.3646$, $SD=.38319$), and financial attractiveness ($M=4.3500$, $SD=.41587$). Conditional adoption intention itself averaged 4.3708 ($SD = .38481$), landing almost exactly in the middle of the four predictor means. Non-owner drivers, in short, strongly agree that charging comes first — but they are just as convinced that cost, technology, and environmental credibility matter, too.

Table I. Descriptive Statistics

Construct	Mean	SD
Infrastructure readiness	4.4109	.37602
Financial attractiveness	4.3500	.41587
Technological readiness	4.3755	.40042



Environmental value	4.3646	.38319
Conditional adoption intention	4.3708	.38481

The bivariate picture in Table II tells a different story, though. Environmental value — not infrastructure readiness — correlated most strongly with conditional adoption intention ($r=.791$, $p<.001$), followed by financial attractiveness ($r=.758$, $p<.001$) and technological readiness ($r=.753$, $p<.001$). Infrastructure readiness, despite recording the highest mean score, produced the weakest correlation of the four ($r=.685$, $p<.001$). All four relationships remained strong and significant, but the ordering is worth pausing on: the independent variable respondents rated most important on average was the one that differentiated their intention scores the least. A plausible reading is a ceiling effect — with so much agreement clustered near the top of the scale, infrastructure readiness has less room left to explain who scores higher or lower on conditional intention, whereas environmental value and financial attractiveness carry more of that discriminating power. This sets up the regression analysis in Section IV-B, which tests whether the same ordering holds once all four independent variables compete for explanatory power simultaneously.

Table II. Correlations With Conditional Adoption Intention

Independent Variable	R	P
Infrastructure readiness	.685	<.001
Financial attractiveness	.758	<.001
Technological readiness	.753	<.001
Environmental value	.791	<.001

B. Multiple Regression

Put all four independent variables in the same model, and environmental value pulls further ahead. The simultaneous regression (Table III) explained 72.7% of the variance in conditional adoption intention ($R=.853$, $R^2=.727$, adjusted $R^2=.724$, $SE=.20201$), and all four predictors remained significant at $p<.001$ — H1 through H4 are all supported. Environmental value had the largest unstandardized coefficient by a clear margin ($B=.380$), roughly 1.8 times the size of financial attractiveness ($B=.208$) and infrastructure readiness ($B=.201$), and more than double that of technological readiness ($B=.157$), which recorded the smallest coefficient of the four.

Infrastructure readiness is the variable that moved the most between the two analyses: the weakest bivariate correlate in Table II ($r=.685$) still produced a competitive coefficient in Table III ($B=.201$), on par with financial attractiveness. That pattern is consistent with infrastructure readiness sharing explanatory territory with the other three conditions, rather than acting alone — once technological readiness and environmental value are held constant, infrastructure readiness still adds unique explanatory value, just not the largest share of it. Because standardized beta coefficients, confidence intervals, t-values, and collinearity diagnostics were unavailable, this unstandardized-coefficient ranking should be read as descriptive rather than as a definitive statement of relative importance.

Table III. Simultaneous Regression Results

Predictor	B	P	Decision
Infrastructure readiness	.201	<.001	H1 supported
Financial attractiveness	.208	<.001	H2 supported

Technological readiness	.157	<.001	H3 supported
Environmental value	.380	<.001	H4 supported

DISCUSSION AND IMPLICATIONS

Environmental values lead in both the correlation matrix ($r=.791$) and the regression model ($B=.380$), which is the headline result, but it should not be read as a license to lead with green messaging alone. All four conditions stayed significant at $p<.001$ in the same model, which fits a body of Malaysian and international evidence describing EV adoption as a systemic, multi-condition decision rather than a single-lever one [1], [2], [11], [12], [3], [13], [18]. The more useful reading is sequential: environmental value appears to be the variable that most sharply separates enthusiastic from lukewarm respondents, but it does so on top of a baseline where infrastructure, cost, and technology are already rated above 4.35 out of 5. Credible environmental value, in other words, looks like the persuasive edge — not the foundation — of the ownership proposition.

The infrastructure result carries its own managerial message. A mean of 4.4109, alongside the weakest correlation ($r=.685$) among the four constructs, suggests that respondents already treat reliable charging as close to a non-negotiable baseline: almost everyone agrees it matters, so agreement on infrastructure alone does not distinguish who is more or less receptive. In practice, this means infrastructure investment should be paired with accurate, real-time coverage and uptime information for non-owners, rather than treated as a stand-alone conversion lever [4], since the respondents who need convincing are likely already differentiating on cost, technology, and environmental grounds rather than on charging access.

For financial attractiveness ($B=.208$) and technological readiness ($B=.157$), the smaller — though still significant — coefficients point toward transparent total-ownership-cost communication and real-world range and battery-health evidence as supporting, rather than headline, levers. Environmental claims, given their outsized coefficient, warrant the most scrutiny: they should disclose lifecycle boundaries, energy sources, and battery recovery, because skepticism toward green advertising is known to erode perceived value and purchase intention [15], and an inflated or generic environmental claim risks undermining the very lever that this study's coefficients identify as strongest.

Two cautions temper these results. First, the outcome items restate favorable versions of the same charging, subsidy, range, charging time, and environmental conditions represented in the predictors; this conceptual and wording overlap plausibly inflates both the correlations in Table II and the model fit in Table III ($R^2 = .727$). Second, the coefficient pattern runs counter to mixed prior evidence — Malaysian studies support price value, facilitating conditions, and environmental concern [1], [11], [12], while some international evidence has not found environmental constraints to be significant [7]. The results are therefore best read as evidence of conditional receptiveness under improved conditions, ranked by the variable that most differentiates that receptiveness, rather than as a causal forecast of which lever will generate the most purchases.

CONCLUSION AND LIMITATIONS

Infrastructure readiness, financial attractiveness, technological readiness, and environmental value were positively associated with conditional EV adoption intention among 384 Malaysian non-owner drivers. Coordinated action across charging, finance, technology assurance, and environmental governance is therefore more defensible than isolated promotion. Environmental value recorded the largest unstandardized coefficient, but all four conditions were significant. These conclusions concern stated conditional intention and should not be interpreted as evidence of actual EV purchase or adoption behavior.

The cross-sectional design cannot establish causation or confirm subsequent purchase behavior, and because this study examined only non-owner drivers, the perspectives of existing EV owners are not represented. Recruitment through an online, self-selected channel means the sample is best described as a convenience sample despite meeting the recommended size threshold [19]; it also skewed toward male, private-sector, degree-educated respondents from a subset of Peninsular Malaysian states, with rural areas and Sabah and Sarawak under-represented — a bias common to convenience samples recruited through social media outreach. Common-source

measurement, socially desirable responses, ceiling effects, and overlap in the wording of explicit predictor-outcome pairs may inflate associations. The study is also limited to four managerial conditions; other plausible influences, such as government policy visibility, cultural attitudes, social influence, and brand perception, were outside its scope. Intention is also not the same as behavior: studies examining the attitude-behavior gap [16] and quasi-experimental evidence of actual responses to local incentives [17] underscore the need for behavioral validation.

Future work should address these gaps directly: draw a probability-based sample, or at minimum report recruitment channels, geographic coverage, and demographic composition in full, and extend coverage to rural respondents and to existing EV owners for comparison; validate the measurement model through factor analysis and report standardized beta coefficients, confidence intervals, tolerance, VIF, and effect sizes; word predictor and outcome items independently, and consider carefully designed negatively worded items to reduce automatic agreement; compare adoption intention across income groups, states, urban and rural residents, driving experience, and vehicle-use patterns; and adopt a longitudinal design that links stated intention with later purchases or vehicle registrations. Broader antecedents such as government policy visibility, cultural attitudes, social influence, and brand perception also warrant investigation, and environmental claims, in particular, should be supported by transparent life-cycle information rather than by general appeals to sustainability.

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