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# Analyzing the Impact of Thai Government Policy Perceptions on the Adoption of Electric Vehicles: An Empirical Study and Measurement Model

Ahmed Al-Sayed<sup>1\*</sup>, Omar Khalifa<sup>1</sup>

## Abstract

This research investigates how perceptions of Thai government policies affect the willingness to adopt electric vehicles (EVs). Shifting toward EVs plays a key role in cutting greenhouse gas emissions and addressing climate change, in line with international sustainability targets. The study fills important gaps by examining the various dimensions of how people view government policies and their effects on EV adoption intentions within emerging economies, with a specific focus on Thailand. Data were collected through a survey of 3,770 participants nationwide from January to March 2024. The questionnaire evaluated several aspects of government policy perceptions, such as commitment and implementation efficiency, social welfare considerations, communication efforts, overall policy effectiveness, and tax-related advantages. The analysis applied techniques including Exploratory Factor Analysis (EFA), second-order confirmatory factor analysis (CFA), and structural equation modeling (SEM) to confirm the measurement constructs related to perceived government support and to test their impact on intentions to purchase or use EVs. Results indicate that concrete government actions—especially those that expand EV charging infrastructure and establish transparent regulatory frameworks—alongside clear, effective policy communication strongly shape public readiness to embrace EVs. The study also underscores the vital influence of perceived governmental dedication and financial incentives on consumer choices. Drawing on these conclusions, the research suggests that policymakers should focus on rapidly scaling up charging networks, making the government's resolve more visible to the public, and strengthening direct monetary support to accelerate EV uptake. These insights enrich the literature on EV adoption dynamics in developing countries and provide actionable guidance for authorities aiming to advance eco-friendly transport systems.

**Keywords** Policies, Second-order CFA, Structural equation modeling, Government communication, Government commitment

\*Correspondence:

Ahmed Al-Sayed  
ahmed.sayed@gmail.com

<sup>1</sup> Department of Smart Grid Engineering, Faculty of Engineering, Alexandria University, Alexandria, Egypt

## Introduction

### Research context

Electric vehicles (EVs) represent a cornerstone of contemporary strategies to transform transportation systems, especially amid worldwide initiatives to curb climate change [1]. By serving as a low-emission alternative to traditional fossil-fuel vehicles, EVs deliver substantial reductions in greenhouse gas and other harmful pollutant emissions [2]. This shift supports key Sustainable Development Goals (SDGs) [3], notably SDG 13 (Climate Action) through lower carbon

emissions and improved urban air quality, and SDG 7 (Affordable and Clean Energy) by promoting the use of renewable energy in transport. As nations globally pursue greater environmental sustainability and resilience, EVs stand out as an essential innovation for building cleaner, more durable mobility systems [4-7].

Equally important is how the public perceives government actions and policies regarding EVs, as these perceptions heavily influence the pace of technology adoption. Favorable opinions about policy measures can boost trust in EVs and accelerate their acceptance [8]. Such perceptions encompass beliefs about the government's level of dedication to green transport, the smoothness and reliability of policy rollout, and the practical advantages offered—such as monetary subsidies and expanded charging facilities [9]. Gaining insight into these viewpoints is crucial for designing policies that not only encourage EV growth but also resonate with societal needs and expectations. By analyzing public sentiment toward these initiatives, decision-makers can refine approaches to maximize EV penetration while ensuring broad societal approval [6].

## Thai government initiatives supporting EVs

Thailand has adopted a forward-looking strategy to promote both the manufacturing and use of electric vehicles, primarily through the “30@30” framework and the more recent EV 3.5 package. These programs are central to the country's plan to become a prominent player in the global EV sector and to move toward a low-emission economic model.

### The 30@30 policy

Launched under the guidance of the National Electric Vehicle Policy Committee, the 30@30 policy aims to position Thailand as a significant center for the manufacturing of zero-emission vehicles (ZEVs) [10]. Its primary target is for ZEVs to represent at least 30% of the nation's total vehicle output by 2030. Beyond strengthening the automotive sector, this initiative contributes to national goals of lowering greenhouse gas levels and achieving carbon neutrality by 2050.

Specific production objectives include 725,000 electric passenger cars and pickup trucks, 675,000 electric motorcycles, and 34,000 electric buses and trucks. The policy also prioritizes infrastructure development, aiming to install 12,000 public fast-charging stations for EVs and 1,450 battery-swapping stations for electric motorcycles.

### EV 3.5 measures

Approved for rollout from 2024 to 2027, the EV 3.5 policy builds on earlier efforts and intensifies support for EV production and consumer uptake through a range of incentives [11]. Core components include:

- **Monetary subsidies:** These vary by vehicle category and battery capacity. For instance, electric passenger cars priced below THB 2 million with batteries of 50 kWh or more qualify for a THB 100,000 subsidy in the initial year, with the subsidy tapering over the subsequent three years. Comparable incentives apply to electric motorcycles and pickup trucks to enhance affordability.
- **Tax relief:** The measures feature sharp cuts in import tariffs and excise duties. For ready-to-use EVs priced under THB 2 million, import duties may drop by as much as 40% during the first two years, while excise taxes on electric cars priced below THB 7 million fall from 8% to 2%.
- **Encouragement of local manufacturing:** The policy promotes domestic EV and component production by setting compensatory output requirements that offset imports, thereby nurturing a strong local EV ecosystem.

Together with infrastructure development and supportive regulations, these steps are designed to invigorate Thailand's EV market, assist traditional manufacturers in transitioning to electric models, and draw additional investment, reinforcing the country's status as a regional EV manufacturing leader [12].

## Identified research gap and study aims

Although earlier research has explored various facets of EV adoption and policy outcomes, a clear shortfall persists in understanding how multiple layers of government policy perception shape adoption intentions, especially in developing markets such as Thailand. For example, Kongklaew *et al.* [13] outlined obstacles to EV uptake in Thailand without delving into the role of policy perceptions in forming those obstacles. Likewise, Wattana and Wattana [12] evaluated the broader effects of EV support policies on transport and power systems but overlooked public views of those policies. This limitation stands out, particularly as Philip *et al.* [1] stressed the value of studying perceptions in markets where EV adoption lags.

The present study bridges this shortfall by creating an integrated measurement framework that captures diverse elements of policy perception—including perceived commitment, operational efficiency, welfare impacts, communication quality, and tax advantages. In contrast to prior work [9, 14] that typically concentrated on isolated policy tools, this broader perspective reveals more intricate connections between policy views and adoption intentions. The framework extends insights from Jain *et al.* [8], who advocated for holistic models in EV research. By centering on Thailand—a major automotive hub in Southeast Asia—the study sheds light on region-specific dynamics in emerging economies, building on calls from Srivastava *et al.* [6] and Liu *et al.* [7] for localized investigations. It also complements energy-focused analyses, such as those by Paudel *et al.* [2].

The application of sophisticated methods, including second-order confirmatory factor analysis and structural equation modeling, distinguishes this work by enabling a detailed examination of both direct and mediated relationships among latent variables. This rigorous methodology addresses recommendations from Lodhia *et al.* [5] and others for stronger analytical approaches in policy-related EV studies, going beyond simpler direct-effect models seen in works like Hasan [15] and Zhang *et al.* [16]. Through these advancements, the research enhances theoretical knowledge of EV adoption processes and delivers concrete recommendations for effective policymaking in Thailand and comparable settings.

**Objective 1:** Develop a measurement framework for evaluating perceptions of government policies on electric vehicle adoption. The primary goal is to create a reliable and valid model that measures how the Thai public views policies promoting EV. This framework incorporates multiple dimensions, including perceived governmental resolve, implementation quality, and concrete benefits such as financial aid and infrastructure improvements. To achieve this, the study employs second-order confirmatory factor analysis (CFA). This technique verifies the proposed structure of policy perceptions and confirms the instrument's psychometric properties, ensuring it accurately represents the interconnected aspects of these views.

**Objective 2:** Examine the determinants shaping views of government policies and assess their effects on electric vehicle uptake. The second aim of this research is to analyze the factors that shape public views of government policies and to evaluate the subsequent influence of these views on decisions to adopt electric vehicles. This examination incorporates various elements, including demographic characteristics, prior familiarity with EVs, and the nature of government messaging about EVs. Structural equation modeling (SEM) serves as the core analytical tool here, given its strength in exploring linkages among unobservable variables. This technique enables the identification of both immediate and mediated influences of perceived policy support on intentions to adopt EVs, yielding a thorough depiction of the underlying mechanisms.

To achieve the outlined objectives, the study primarily relies on confirmatory factor analysis (CFA) and structural equation modeling (SEM) as its key analytical approaches. These methods were selected for their proficiency in managing intricate, multifaceted constructs and in simultaneously validating proposed associations [17]. Second-order CFA is particularly appropriate, as it facilitates the evaluation of overarching latent variables (e.g., a general sense of government backing) formed by several subordinate factors (e.g., views on dedication, societal advantages, and outreach efforts) [18]. This layered perspective delivers deeper insight into the multifaceted character of policy-related opinions. Meanwhile, SEM excels at simultaneously assessing numerous hypothesized connections within an integrated framework while

accounting for measurement errors [19]. Such capability is essential for this investigation, which probes the interactions among diverse policy perception aspects and their combined role in driving EV adoption intentions. SEM further supports the examination of both straightforward and circuitous pathways, offering a fuller portrayal of adoption drivers [20]. The reliability of these techniques is reinforced by their frequent application in comparable investigations of technology uptake and policy viewpoints. For example, Theerathitichaipa et al. [21] applied second-order CFA to substantiate a model of transport-related elements, and Watthanaklang et al. [22] utilized SEM to assess opinions on public transit standards. These examples illustrate the suitability of such approaches for disentangling sophisticated patterns in mobility studies. Additionally, integrating second-order CFA with SEM strengthens the framework by mitigating risks such as multicollinearity and shared-method variance, issues often encountered in questionnaire-driven inquiries [17]. Through these techniques, the research ensures a thorough and reliable evaluation of the data, yielding trustworthy findings on the role of perceived government policies in promoting EV intentions in Thailand.

## Research questions and contributions

In pursuit of the stated objectives, this investigation addresses the following core questions:

RQ1: In what ways do various facets of perceived government policies affect intentions to adopt electric vehicles in Thailand?

RQ2: Which components of governmental backing exert the strongest influence on shaping intentions to adopt EVs?

These questions address critical gaps in existing research on EV uptake, especially in developing economies such as Thailand.

The study delivers multiple important advancements to both conceptual models and real-world applications in the domain of electric vehicle adoption:

- Theoretical advancements: It refines measurement frameworks by developing a detailed instrument to gauge public views on government EV-related policies, thereby deepening theoretical insights into policy-driven technology acceptance. It also advances methodological practices by deploying sophisticated tools, such as second-order confirmatory factor analysis and structural equation modeling, to dissect intricate associations in policy perception research.
- Practical advancements: It provides policymakers with evidence-based guidance on strategies to elevate public support and accelerate EV integration, facilitating the design of more targeted and effective interventions. It provides strategic guidance for automotive companies on leveraging perceptions of government policies in promotional efforts to heighten consumer interest and uptake. It bolsters broader environmental progress by guiding policies that promote low-impact mobility choices, consistent with global targets for emissions reductions and energy efficiency.

## Literature Review

### Examination of governmental encouragement for electric vehicle uptake

The decision to adopt electric vehicles (EVs) is strongly shaped by how citizens view governmental assistance, which encompasses a range of efforts from crafting regulations to disseminating information and delivering tangible benefits. Grasping these viewpoints is essential for evaluating the extent to which official measures shape personal choices to adopt EVs [23].

#### Views on governmental dedication and implementation capability

Beliefs about the extent of governmental resolve and the competence of its actions play a central role in generating public trust and assurance toward EV-related strategies. Survey statements such as “I perceive the government’s efforts to promote electric cars as effective” and “The level of commitment demonstrated by the government affects my confidence in using electric cars” capture attitudes toward the government’s dedication to EV advancement. Strong agreement with these statements implies that perceptions of high commitment and proficient execution significantly boost individuals’ readiness to embrace electric vehicle technology [9].

### Views on governmental support and benefits

Governmental support for EV adoption includes monetary subsidies, assistance programs, and other direct financial support offered to prospective owners. Items such as “I am aware of government welfare or financial assistance available for purchasing or using electric cars” gauge the degree of public knowledge, which can exert considerable influence on buying behavior. The successful promotion and delivery of these support programs tend to increase adoption by reducing economic barriers to EV ownership [24].

### Influence of governmental regulations

The immediate effects of official policies on people’s attitudes and actions are assessed via statements like “Government policies promoting electric car usage have a positive impact on my worldview” and “I believe government policies supporting electric cars are crucial factors in their adoption”. These items assess how effective citizens perceive the rules and programs intended to stimulate EV adoption, suggesting that well-structured, supportive measures can make EVs substantially more appealing to potential consumers [5].

### Influence of Governmental Messaging

Clear, consistent, and open communication by authorities about EV advantages, available incentives, and related policies is a key driver of favorable public opinion. Aspects such as the precision, regularity, and candor of these messages—measured through items like “Government communication and campaigns about electric cars affect my perspective” and “The clarity and transparency of government communication affect my confidence in using electric cars”—are vital for raising awareness, improving comprehension, and cultivating an environment conducive to EV acceptance [5].

### Influence of tax incentives

Fiscal advantages constitute a major pillar of government support for EVs, directly affecting their affordability to buy and maintain. Items such as “Tax benefits provided by the government positively influence my decision to choose electric cars” examine the role of these economic relief measures in shaping buyer preferences. Favorable impressions of tax relief can powerfully motivate consumers to choose EVs over conventional fuel-based alternatives [14, 25, 26].

### Intention to adopt electric vehicles

Ultimately, the willingness to use EVs arises directly from the factors described above. This construct is captured through items such as “Knowing that the government supports electric cars increases my intention to use this technology” and “I am inclined to consider electric cars as a suitable option because of government support”. These statements illustrate the combined impact of governmental initiatives on personal behavioral inclinations, underscoring the critical importance of well-coordinated, multifaceted official support for achieving widespread EV adoption [15, 27].

Recent developments in EV policy across nations underscore the adaptive nature of government support. In China—the global leader in EV volume—the authorities have moved away from straightforward cash subsidies toward a dual-credit mechanism that obliges manufacturers to achieve specific quotas of new energy vehicles [28]. Norway, which boasts one of the highest EV penetration rates worldwide, has begun reducing certain generous perks, including value-added tax exemptions, as EVs now account for over half of new vehicle sales [29]. These cases demonstrate how governments worldwide continually refine their approaches in response to market development and changing national objectives. As

previously noted, Thailand's evolving policy framework follows a comparable pattern, adjusting incentives to accelerate consumer uptake while simultaneously building a competitive local EV manufacturing base.

## Hypotheses

The formulated hypotheses examine the relationships between diverse aspects of perceived governmental support for electric vehicles (EVs) and individuals' willingness to adopt them. These propositions provide the theoretical foundation for understanding how policy design, implementation, and communication influence consumer choices regarding EV technology.

### Hypothesis 1: perceptions of government commitment and efficiency → intention to use EVs

H1 asserts that more positive evaluations of the government's dedication and operational effectiveness in advancing electric vehicles lead to greater intention to adopt EVs [30]. Specifically, when the public regards the authorities as strongly committed and capable—evidenced by active regulatory measures and vigorous promotion—it increases the likelihood that people will seriously consider and ultimately opt for EVs [31].

### Hypothesis 2: perceptions of government welfare → intention to use EVs

H2 assesses whether favorable perceptions of government-provided financial supports—including subsidies, tax reductions, and similar incentives—positively affect EV adoption intentions [32]. The hypothesis maintains that heightened awareness and approval of these economic aids act as key motivators, rendering EVs more attainable and cost-effective for prospective buyers [33, 34].

### Hypothesis 3: effects of government policy → intention to use EVs

H3 focuses on the broader consequences of governmental regulations (beyond purely financial tools) for EV adoption intentions. This includes efforts to build charging networks, establish enabling legal frameworks, and provide overarching regulatory backing [28]. The proposition holds that clear, robust, and supportive policies markedly increase the perceived convenience and practicality of EV ownership, thereby strongly encouraging adoption [35, 36].

### Hypothesis 4: effects of government communication → intention to use EVs

H4 investigates the influence of high-quality governmental messaging on individuals' EV adoption intentions. This encompasses official efforts to inform citizens about EV advantages, incentive availability, and technological developments [37]. Well-executed communication is expected to enhance confidence, alleviate perceived risks and uncertainties, and consequently elevate the likelihood of choosing EVs [38, 39].

### Hypothesis 5: effects of tax benefits → intention to use EVs

H5 targets the specific role of perceived tax-related advantages in directly shaping EV adoption intentions [40, 41]. The hypothesis proposes that measures such as reduced purchase duties, lower annual registration fees, or other fiscal relief make EVs more financially attractive. These cost reductions are considered a primary factor in the decision-making process among potential EV purchasers [42, 43].

## Materials and Methods

### Survey instrument construction and data acquisition

The questionnaire was developed to collect in-depth information on views of government policies related to EVs and personal intentions to adopt them. It was structured into three core sections: demographic details, perceptions of governmental policies, and intention to adopt EVs.

The demographics portion gathered information on participants' age, gender, educational attainment, employment category, and geographic location of residence.

The government policy perceptions section featured 18 items designed to measure five separate dimensions: government commitment and efficiency, government welfare, effects of government policy, government communication, and tax benefits. Illustrative items included "I perceive the government's efforts to promote electric cars as effective" (linked to commitment) and "I am aware of government financial assistance available for purchasing electric cars" (linked to welfare).

The section assessing intention to use EVs contained three items, one example being: "I am inclined to consider electric cars as a suitable option because of government support."

Every item within the policy perceptions and intention segments was rated on a seven-point Likert scale, with 1 indicating "strongly disagree" and 7 indicating "strongly agree" (Table 1).

**Table 1.** Statistical summary.

| Item                                                                               | Measures                                                                                                                     | M     | SD    | SK     | KU     |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------|-------|--------|--------|
| Perceptions of government commitment and efficiency (Cronbach's $\alpha = 0.955$ ) |                                                                                                                              |       |       |        |        |
| I1                                                                                 | I perceive the government's efforts to promote electric cars as effective.                                                   | 4.029 | 1.562 | -0.069 | -0.855 |
| I2                                                                                 | Government initiatives and campaigns encourage me to choose electric cars.                                                   | 4.133 | 1.523 | -0.087 | -0.780 |
| I3                                                                                 | I believe the government is committed to promoting sustainable transportation through electric cars.                         | 4.158 | 1.556 | 0.019  | -0.691 |
| I4                                                                                 | The government's level of commitment affects my confidence in using electric cars.                                           | 4.132 | 1.588 | 0.014  | -0.777 |
| I5                                                                                 | I feel confident in the government's long-term commitment to supporting electric cars.                                       | 4.129 | 1.582 | 0.032  | -0.776 |
| Perceptions of government welfare (Cronbach's $\alpha = 0.925$ )                   |                                                                                                                              |       |       |        |        |
| I6                                                                                 | I am aware of government welfare or financial assistance available for purchasing or using electric cars.                    | 3.973 | 1.581 | -0.038 | -0.731 |
| I7                                                                                 | Knowledge of government financial assistance programs influences my decision to consider electric cars.                      | 4.084 | 1.507 | -0.006 | -0.687 |
| I8                                                                                 | The availability of government incentives stimulates my interest in electric cars as a viable option.                        | 4.089 | 1.490 | -0.037 | -0.621 |
| Effects of government policy (Cronbach's $\alpha = 0.941$ )                        |                                                                                                                              |       |       |        |        |
| I9                                                                                 | Government policies promoting the use of electric cars have a positive impact on my worldview.                               | 4.166 | 1.512 | -0.120 | -0.513 |
| I10                                                                                | I believe government policies supporting electric cars are crucial factors in their adoption.                                | 4.180 | 1.491 | -0.074 | -0.598 |
| I11                                                                                | Adjusting to government regulations inspires me to consider electric cars                                                    | 4.119 | 1.471 | -0.038 | -0.561 |
| I12                                                                                | Government initiatives, such as the construction of charging infrastructure, are important for the success of electric cars. | 4.148 | 1.489 | -0.089 | -0.675 |

| Effects of government communication (Cronbach's $\alpha = 0.826$ ) |                                                                                                       |       |       |        |        |
|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------|-------|--------|--------|
| I13                                                                | Government communication and campaigns about electric cars affect My perspective.                     | 4.562 | 1.526 | -0.113 | -0.553 |
| I14                                                                | I rely more on government-provided information to make decisions about electric cars.                 | 4.482 | 1.619 | -0.194 | -0.618 |
| I15                                                                | The clarity and transparency of government communication affect my confidence in using electric cars. | 4.571 | 1.553 | -0.074 | -0.651 |
| Effects of Tax Benefits (Cronbach's $\alpha = 0.940$ )             |                                                                                                       |       |       |        |        |
| I16                                                                | Government tax benefits positively influence my decision to choose electric cars.                     | 4.184 | 1.541 | -0.051 | -0.706 |
| I17                                                                | I consider tax benefits for electric car owners as significant advantages.                            | 4.238 | 1.536 | -0.095 | -0.626 |
| I18                                                                | Tax incentives for electric car users encourage me to adopt this technology.                          | 4.246 | 1.550 | -0.059 | -0.678 |
| Intention to use electric vehicles (Cronbach's $\alpha = 0.932$ )  |                                                                                                       |       |       |        |        |
| I19                                                                | Knowing that the government supports electric cars increases my intention to use this tool.           | 4.030 | 1.556 | -0.110 | -0.664 |
| I20                                                                | I am inclined to consider electric cars as a suitable option because of government support.           | 4.057 | 1.528 | -0.075 | -0.625 |
| I21                                                                | Government support is crucial in enhancing my positive attitude towards using electric cars.          | 4.109 | 1.543 | -0.059 | -0.643 |

Note: M = mean, SD = standard deviation, SK = skewness, and KU = kurtosis.

Between January and March 2024, a total of 4,000 questionnaires were distributed across Thailand's five primary regions: Northern, Northeastern, Central, Eastern, and Southern. After thorough data validation and cleaning, 3770 usable responses remained available for the analysis.

The allocation of these surveys was intentionally aligned with the regional patterns of electric vehicle (EV) registrations. For instance, the Central region—including Bangkok, which accounts for 28.91% of the nation's EV charging stations—received a matching proportion of the questionnaires, roughly 1156 forms. The remaining four regions were assigned survey numbers using the same principle, based on their respective shares of EV infrastructure and vehicle registrations.

To assemble a well-balanced, representative group of potential EV users, specific eligibility criteria were applied. Participants had to be at least 18 years old (to meet legal driving age), possess a valid driver's license (indicating active involvement in personal vehicle use), and reside in one of the targeted regions (to preserve geographic coverage). The sample deliberately included both existing EV owners and individuals considering future purchase, allowing the research to reflect viewpoints from people at various points along the adoption continuum and to gain a fuller picture of how policies are perceived across adoption stages.

Recruitment took place at conventional gasoline stations that also featured EV charging points. This strategy effectively captured responses from both current EV drivers (who frequent these hybrid locations) and conventional fuel users who might be open to switching, thereby gathering insights from people with differing degrees of familiarity with and interest in electric vehicles.

As shown in **Table 2**, the final sample exhibited considerable demographic variety across several dimensions:

- Gender: 61.5% male, 38.5% female.
- Age groups: 9.0% under 25 years, 33.4% aged 25–34 years, 24.4% aged 35–44 years, 28.4% aged 45–54 years, and 4.8% aged 55 years and older.
- Occupations: included government workers (16.3%), private-sector employees (30.8%), business owners (29.8%), and other categories.
- Residential location: 64.2% lived in urban areas.

This urban skew aligns with the greater concentration of EV charging facilities in cities. Overall, the broad demographic coverage strengthens the study's capacity to conclude that it applies to varied segments of Thai society, which is vital for assessing the widespread effects of public policies on electric vehicle uptake.

**Table 2.** Demographic profile.

| Demographic characteristic | Category                | Percentage | Frequency |
|----------------------------|-------------------------|------------|-----------|
| Gender                     | Male                    | 61.5%      | 2320      |
|                            | Female                  | 38.5%      | 1450      |
| Age group                  | Below 25 years          | 9.0%       | 338       |
|                            | 25-34 years             | 33.4%      | 1260      |
|                            | 35-44 years             | 24.4%      | 919       |
|                            | 45-54 years             | 28.4%      | 1071      |
|                            | Over 55 years           | 4.8%       | 182       |
|                            |                         |            |           |
| Educational level          | Primary School          | 7.8%       | 292       |
|                            | High School             | 15.6%      | 587       |
|                            | Vocational Training     | 26.6%      | 1004      |
|                            | Bachelor's Degree       | 38.7%      | 1458      |
|                            | Master's Degree         | 11.0%      | 414       |
|                            | Doctoral Degree         | 0.4%       | 15        |
| Occupation                 | Government Worker       | 16.3%      | 615       |
|                            | Private Sector Employee | 30.8%      | 1160      |
|                            | Business Owner          | 29.8%      | 1125      |
|                            | Farmer                  | 6.6%       | 250       |
|                            | Student                 | 4.7%       | 176       |
|                            | General Employee        | 11.0%      | 413       |
|                            | Other                   | 0.8%       | 31        |
|                            |                         |            |           |

|                             |                            |       |      |
|-----------------------------|----------------------------|-------|------|
| <b>Residential area</b>     | Rural Area                 | 35.8% | 1351 |
|                             | Urban Area                 | 64.2% | 2419 |
| <b>Driver status</b>        | Not a Regular Driver       | 22.2% | 836  |
|                             | Regular Driver             | 77.8% | 2934 |
| <b>Vehicle engine type</b>  | Internal Combustion Engine | 49.2% | 1856 |
|                             | Hybrid                     | 11.9% | 450  |
|                             | Plug-in Hybrid             | 11.5% | 435  |
|                             | Electric Vehicle           | 27.3% | 1029 |
| <b>Vehicle category</b>     | Pickup Truck               | 15.9% | 601  |
|                             | Car                        | 55.1% | 2078 |
|                             | SUV                        | 21.1% | 794  |
|                             | Pickup Passenger Vehicle   | 5.5%  | 207  |
|                             | Other Pickup Truck         | 2.4%  | 90   |
| <b>Primary driving area</b> | Urban Areas                | 65.4% | 2467 |
|                             | Rural Areas                | 34.6% | 1303 |

Note: Total sample size (N) = 3770

## Data analysis

### Data analysis procedure

This study's analytical process is carried out using a clear, step-by-step, and rigorously structured methodology. To begin with, all questionnaire responses are carefully preprocessed. This stage involves thorough data cleaning, imputation or removal of missing values where appropriate, and checks to confirm that the data distributions satisfy normality requirements [19]. These initial steps are indispensable for creating a reliable, suitable dataset ready for advanced statistical analysis.

The core analysis employs a range of statistical techniques designed to provide a complete and robust evaluation of the theoretical constructs and research hypotheses outlined in the study (Figure 1).

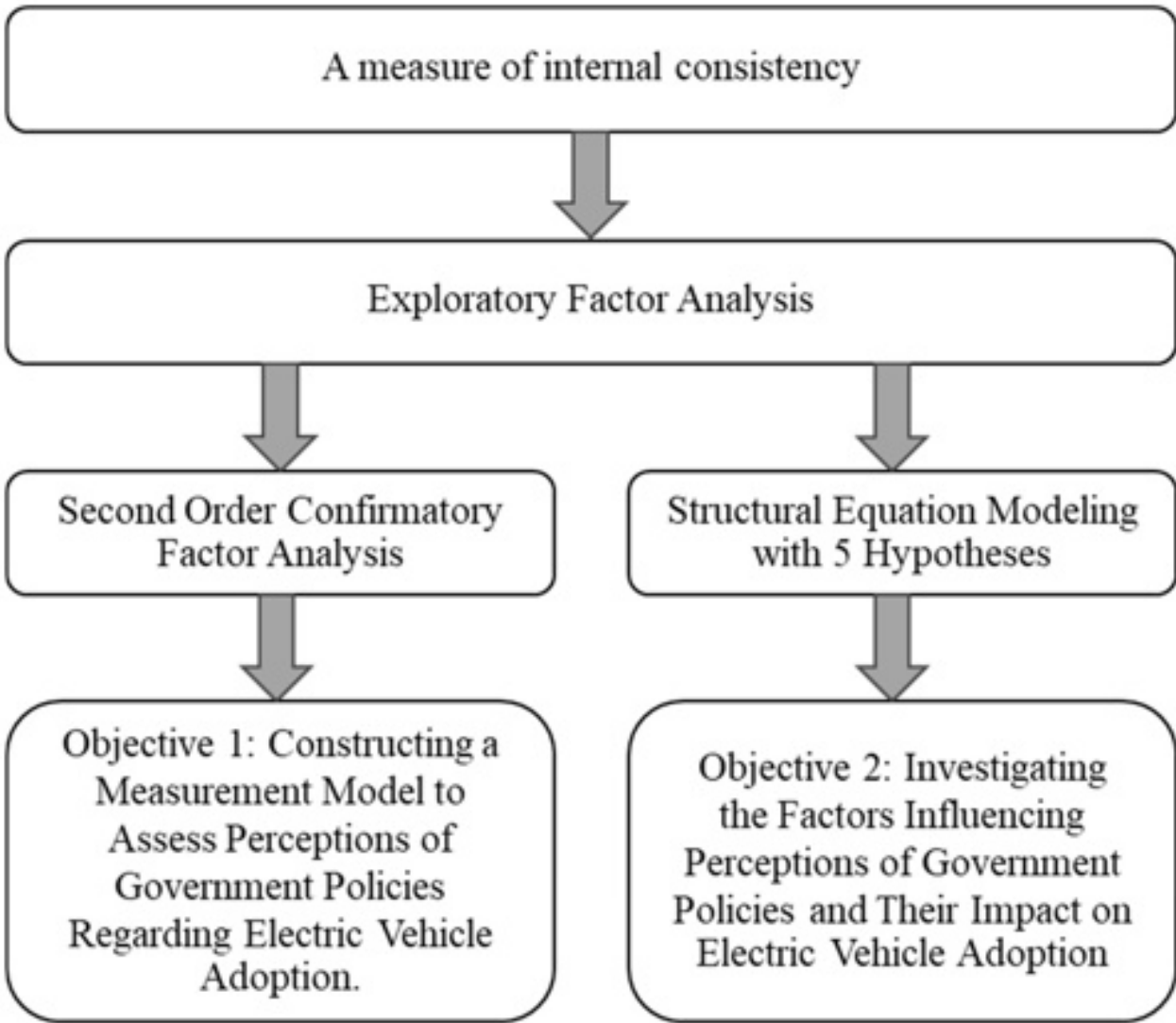


**Figure 1.** Data analysis procedures.

Measure of internal consistency

The reliability of the questionnaire scales was examined by computing Cronbach’s alpha for each group of related items. This coefficient evaluates the degree of internal consistency, showing the extent to which the items within a scale measure the same underlying concept cohesively [44]. Values of Cronbach’s alpha exceeding 0.7 are generally viewed as acceptable, signifying strong internal reliability among the items belonging to each factor. Establishing this reliability is a key step to verifying that the survey items consistently capture the intended theoretical constructs [17].

Internal consistency was determined using Cronbach’s alpha ( $\alpha$ ), a standard and widely recognized reliability index in social science studies. The formula is given by  $\alpha = (k/(k - 1)) \times (1 - (\sum \sigma_i^2 / \sigma_t^2))$ , where  $k$  represents the number of items,  $\sigma_i^2$  denotes the variance of each item  $i$ , and  $\sigma_t^2$  is the variance of the composite (total) score. A threshold of  $\alpha > 0.7$  is commonly accepted as indicating satisfactory internal consistency for the items within each factor [17]. This assessment confirms that the items effectively and reliably reflect the constructs they aim to measure.

Exploratory Factor Analysis (EFA)

An Exploratory Factor Analysis (EFA) was conducted to investigate the latent factor structure underlying the questionnaire items. This method identifies the number of latent factors that best account for the observed variables' correlations and helps determine appropriate item groupings. EFA was applied to confirm factor loadings and to ensure that items cluster under distinct factors, each corresponding to a specific aspect of the measured constructs, such as views on government policy effectiveness or communication approaches [18].

Principal axis factoring combined with oblique (promax) rotation was used to extract and interpret the underlying dimensions. The general factor model can be written as  $X = \Lambda F + \varepsilon$ , where  $X$  is the vector of observed indicators,  $\Lambda$  is the factor loading matrix,  $F$  contains the common factors, and  $\varepsilon$  represents unique error terms. Loadings above 0.5 were regarded as meaningful and significant [17]. The suitability of the data for factor analysis was evaluated using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. This process revealed the number and composition of factors based on inter-item correlations.

### Second-Order Confirmatory Factor Analysis (CFA)

Following the exploratory phase, a second-order Confirmatory Factor Analysis (CFA) was performed to confirm and refine the factor structure identified in the EFA. This higher-order modeling approach evaluates overall model fit while examining how first-order factors relate to a broader second-order latent construct. In this stage, construct validity and reliability were further assessed by calculating Average Variance Extracted (AVE) and Composite Reliability (CR) [21].

The second-order CFA framework can be expressed as  $\eta = \Gamma \xi + \zeta$  and  $y = \Lambda \eta + \varepsilon$ , where  $\eta$  denotes the first-order factors,  $\xi$  is the higher-order (second-order) factor,  $\Gamma$  contains the path coefficients from the second-order to first-order factors,  $\zeta$  represents disturbances,  $y$  stands for the observed indicators,  $\Lambda$  is the loading matrix for the first-order factors, and  $\varepsilon$  denotes measurement errors. This technique rigorously tests model fit and clarifies the hierarchical relationships among variables and latent constructs, offering deeper insight into the multifaceted nature of policy-related perceptions.

### Structural Equation Modeling (SEM)

Structural Equation Modeling (SEM) served as the primary method for testing the proposed theoretical relationships among the constructs [18]. SEM enables the simultaneous estimation of complex direct and indirect pathways involving both observed and latent variables, making it well-suited for examining how perceived government policies influence electric vehicle adoption intentions through various mediating mechanisms [15, 20].

The measurement model for each construct can be represented as follows:

$$X_i = \lambda_i \xi + \delta_i \quad (1)$$

Where  $X_i$  is the observed variable,  $\lambda_i$  is the factor loading,  $\xi$  is the latent construct, and  $\delta_i$  is the measurement error.

The structural model can be represented as follows:

$$\eta = B\eta + \Gamma\xi + \zeta \quad (2)$$

Where  $\eta$  is the vector of endogenous variables,  $B$  is the matrix of path coefficients between endogenous variables,  $\Gamma$  is the matrix of path coefficients from exogenous to endogenous variables,  $\xi$  is the vector of exogenous variables, and  $\zeta$  is the vector of residuals.

### Validity of the statistical models

Model validity and goodness-of-fit were evaluated using multiple established fit indices and validity metrics. Construct Reliability (CR) was calculated using  $CR = (\sum \lambda_i)^2 / [(\sum \lambda_i)^2 + \sum (1 - \lambda_i^2)]$ , where  $\lambda_i$  represents standardized factor loadings. Average Variance Extracted (AVE) was calculated as  $AVE = \sum \lambda_i^2 / n$ , where  $n$  is the number of indicators per construct.

The following criteria indicated acceptable model fit:  $\chi^2/df$  ratio below 3, RMSEA below 0.08, CFI above 0.95, SRMR below 0.08, and TLI above 0.95 [18]. These combined indices provide a comprehensive evaluation of both measurement and structural model quality, thereby reinforcing the trustworthiness of the results.

Collectively, these analytical procedures establish a solid methodological foundation for processing the survey data, ensuring the conclusions are both dependable and valid. The approach supports a detailed examination of the drivers behind electric vehicle adoption in Thailand [22]. Such techniques—EFA, CFA, and SEM—are standard in social science research for handling complex latent structures and testing theoretical frameworks. Comprehensive explanations and application guidelines appear in numerous advanced methodology texts [17, 18]. All analyses were conducted using Mplus 7 [45].

Although second-order CFA and SEM deliver considerable analytical strength, certain limitations should be noted. Multicollinearity among predictors was assessed using Variance Inflation Factors (VIF); all VIFs remained below 5, confirming that multicollinearity did not pose a meaningful problem. Another consideration is potential sample selection bias. Despite stratified sampling to achieve regional representativeness across Thailand, recruitment at gas stations with EV chargers may have disproportionately included early adopters or individuals already exposed to EV infrastructure. Efforts to reduce this bias included balancing the sample between current EV owners and non-owners, though some residual selection bias cannot be ruled out entirely.

## Results and Discussion

Descriptive statistics for the questionnaire items, summarized in Table 1, offer an overview of central tendencies and variability. Items measuring perceptions of government commitment and operational efficiency yielded mean scores of 4.029–4.158, indicating generally favorable attitudes toward governmental EV promotion efforts. Standard deviations ranged from 1.471 to 1.619, reflecting moderate variability in responses. Skewness and kurtosis statistics hovered near zero for most items, suggesting approximate normality in the data distribution, albeit with minor departures in a few cases.

Results from the Exploratory Factor Analysis, presented in Table 3, revealed five clear and interpretable factors that together accounted for a substantial portion of variance in respondents' attitudes and adoption intentions toward electric vehicles. These factors were labeled as: perceptions of government commitment and efficiency, government welfare considerations, impacts of government policies, government communication effectiveness, and tax-related incentives. All items exhibited strong and significant loadings on their assigned factors, supporting the measurement model's construct validity. The variance explained by individual factors ranged from 13.251% to 23.096%, demonstrating a robust and well-defined factor solution.

**Table 3.** Results of exploratory factor analysis.

| Code | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 |
|------|----------|----------|----------|----------|----------|
| I1   | 0.683    |          |          |          |          |
| I2   | 0.645    |          |          |          |          |
| I3   | 0.697    |          |          |          |          |
| I4   | 0.725    |          |          |          |          |
| I5   | 0.728    |          |          |          |          |

|                                    |        |        |        |        |        |
|------------------------------------|--------|--------|--------|--------|--------|
| I6                                 |        | 0.779  |        |        |        |
| I7                                 |        | 0.739  |        |        |        |
| I8                                 |        | 0.719  |        |        |        |
| I9                                 |        |        | 0.606  |        |        |
| I10                                |        |        | 0.601  |        |        |
| I11                                |        |        | 0.663  |        |        |
| I12                                |        |        | 0.576  |        |        |
| I13                                |        |        |        | 0.744  |        |
| I14                                |        |        |        | 0.778  |        |
| I15                                |        |        |        | 0.788  |        |
| I16                                |        |        |        |        | 0.639  |
| I17                                |        |        |        |        | 0.659  |
| I18                                |        |        |        |        | 0.614  |
| Eigenvalues                        | 12.605 | 1.060  | 0.697  | 0.576  | 0.418  |
| % of variance explained            | 23.096 | 17.386 | 15.819 | 15.762 | 13.251 |
| Reliability (Cronbach's alpha)     | 0.955  | 0.925  | 0.941  | 0.826  | 0.940  |
| Measure of sampling adequacy (KMO) | 0.969  |        |        |        |        |

Note: Factor 1: perceptions of government commitment and efficiency (PCEs), Factor 2: perceptions of government welfare (PGWs), Factor 3: effects of government policy (EGPs), Factor 4: effects of government communication (EGCs), and Factor 5: effects of tax benefits (ETBs).

The findings from the second-order confirmatory factor analysis, presented in **Table 4** and **Figure 2**, further confirm the factor structure initially identified via exploratory factor analysis. This analysis provides robust evidence supporting the proposed model, as evidenced by strong factor loadings and satisfactory overall fit measures.

The Average Variance Extracted (AVE) estimates fall between 0.613 and 0.855, while the Composite Reliability (CR) coefficients range from 0.826 to 0.947. All of these values exceed the widely recommended thresholds, thereby confirming the constructs' solid convergent validity and internal consistency.

Furthermore, the model fit indices—including RMSEA, CFI, TLI, and SRMR—indicate an excellent fit between the hypothesized model and the observed data, reinforcing the suitability and soundness of the derived factor structure.

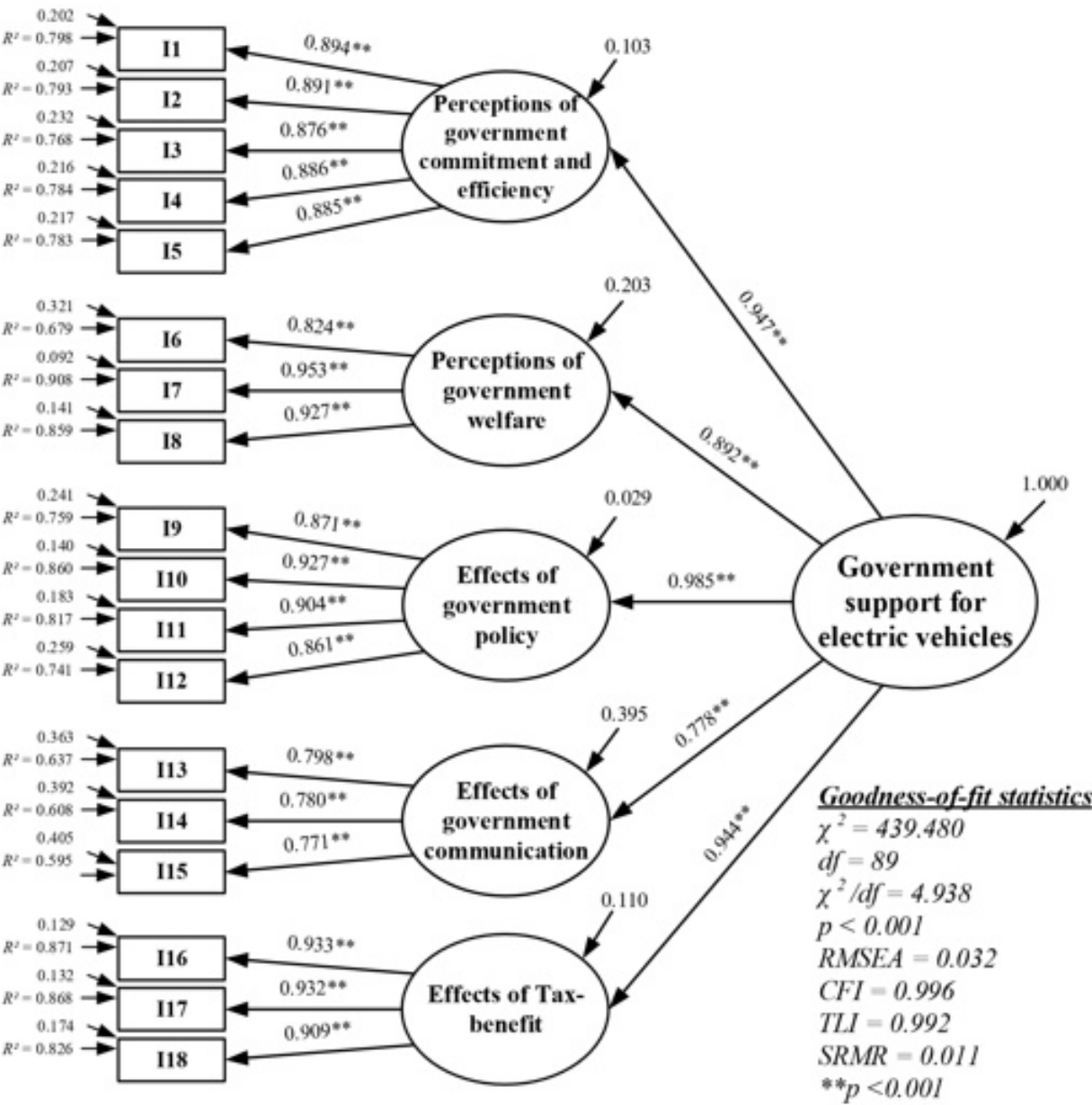


Figure 2. Second-order CFA result.

Table 4. Second-order confirmatory factor analysis results.

| Constructs and indicators                                                     | Standardized estimates | Standard error | t-value    | R <sup>2</sup> |
|-------------------------------------------------------------------------------|------------------------|----------------|------------|----------------|
| Perceptions of government commitment and efficiency (AVE = 0.786, CR = 0.948) |                        |                |            |                |
| I1                                                                            | 0.894                  | 0.004          | 223.508 ** | 0.798          |
| I2                                                                            | 0.891                  | 0.004          | 217.440 ** | 0.793          |

|                                                                    |       |       |            |       |
|--------------------------------------------------------------------|-------|-------|------------|-------|
| I3                                                                 | 0.876 | 0.005 | 189.448 ** | 0.768 |
| I4                                                                 | 0.886 | 0.004 | 205.948 ** | 0.784 |
| I5                                                                 | 0.885 | 0.004 | 198.721 ** | 0.783 |
| Perceptions of government welfare (AVE = 0.816, CR = 0.930)        |       |       |            |       |
| I6                                                                 | 0.824 | 0.006 | 147.038 ** | 0.679 |
| I7                                                                 | 0.953 | 0.002 | 383.328 ** | 0.908 |
| I8                                                                 | 0.927 | 0.003 | 308.096 ** | 0.859 |
| Effects of government policy (AVE = 0.794, CR = 0.939)             |       |       |            |       |
| I9                                                                 | 0.871 | 0.005 | 193.105 ** | 0.759 |
| I10                                                                | 0.927 | 0.003 | 284.271 ** | 0.860 |
| I11                                                                | 0.904 | 0.004 | 252.139 ** | 0.817 |
| I12                                                                | 0.861 | 0.005 | 168.324 ** | 0.741 |
| Effects of Government communication (AVE = 0.613, CR = 0.826)      |       |       |            |       |
| I13                                                                | 0.798 | 0.008 | 101.003 ** | 0.637 |
| I14                                                                | 0.780 | 0.008 | 94.476 **  | 0.608 |
| I15                                                                | 0.771 | 0.008 | 91.629 **  | 0.595 |
| Effects of Tax Benefits (AVE = 0.855, CR = 0.947)                  |       |       |            |       |
| I16                                                                | 0.933 | 0.003 | 302.119 ** | 0.871 |
| I17                                                                | 0.932 | 0.003 | 335.320 ** | 0.868 |
| I18                                                                | 0.909 | 0.004 | 245.528 ** | 0.826 |
| Government support for electric vehicles (AVE = 0.832, CR = 0.961) |       |       |            |       |
| Perceptions of government commitment and efficiency                | 0.947 | 0.003 | 323.464 ** | 0.897 |
| Perceptions of government welfare                                  | 0.892 | 0.004 | 207.424 ** | 0.797 |
| Effects of government policy                                       | 0.985 | 0.002 | 454.165 ** | 0.971 |
| Effects of government communication                                | 0.778 | 0.009 | 90.656 **  | 0.605 |
| Effects of tax benefits                                            | 0.944 | 0.003 | 299.427 ** | 0.890 |

Note: \*\* significant at  $\alpha = 0.001$ .

The structural equation modeling (SEM) findings, displayed in **Table 5** and **Figure 3**, offer a detailed examination of the interconnections among the studied constructs.

The evaluation of the model substantiates most of the proposed relationships, revealing statistically significant links from perceptions of government dedication to several key dimensions—namely efficiency, welfare provision, policy impact, communication quality, and perceived tax advantages—as well as to individuals' intention to adopt electric vehicles.

All standardized path coefficients were positive, indicating that these influences consistently and favorably exerted directionally consistent effects.

Moreover, the model's fit statistics, including RMSEA, CFI, and TLI, indicate a very strong alignment with the empirical data. This supports the conclusion that the theorized framework effectively captures the underlying patterns and illustrates how government-related factors shape public willingness to adopt electric vehicles.

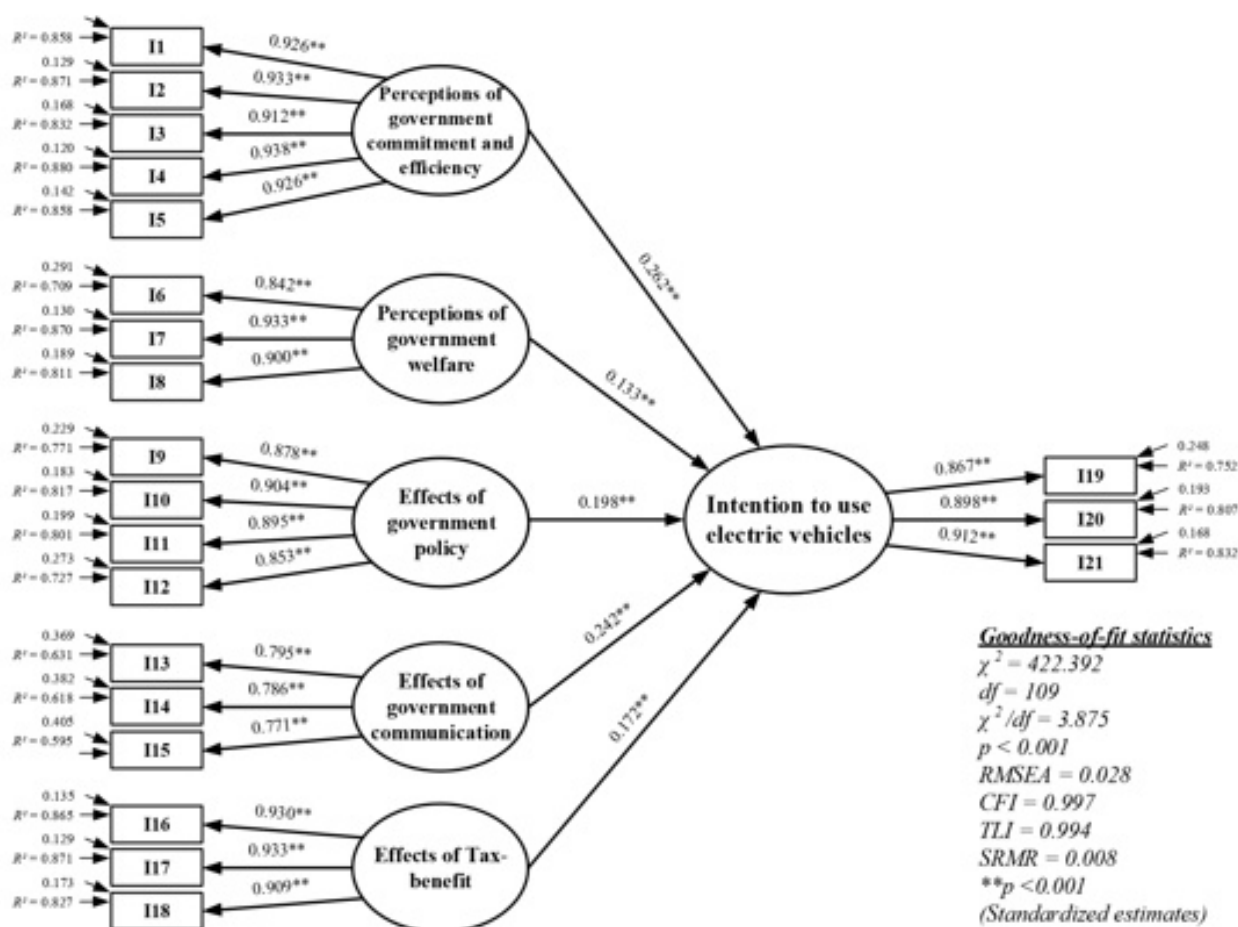


Figure 3. SEM result.

Table 5. SEM results.

| Constructs and indicators                                                     | Standardized estimates | Standard error | t-value       | R <sup>2</sup> |
|-------------------------------------------------------------------------------|------------------------|----------------|---------------|----------------|
| Measurement model                                                             |                        |                |               |                |
| Perceptions of government commitment and efficiency (AVE = 0.859, CR = 0.968) |                        |                |               |                |
| 11                                                                            | 0.926                  | 0.006          | 164.740<br>** | 0.858          |

|                                                               |       |       |               |       |
|---------------------------------------------------------------|-------|-------|---------------|-------|
| I2                                                            | 0.933 | 0.006 | 166.277<br>** | 0.871 |
| I3                                                            | 0.912 | 0.006 | 161.095<br>** | 0.832 |
| I4                                                            | 0.938 | 0.003 | 296.852<br>** | 0.880 |
| I5                                                            | 0.926 | 0.003 | 275.463<br>** | 0.858 |
| Perceptions of government welfare (AVE = 0.796, CR = 0.921)   |       |       |               |       |
| I6                                                            | 0.842 | 0.006 | 150.803<br>** | 0.709 |
| I7                                                            | 0.933 | 0.004 | 235.124<br>** | 0.870 |
| I8                                                            | 0.900 | 0.005 | 190.406<br>** | 0.811 |
| Effects of government policy (AVE = 0.779, CR = 0.934)        |       |       |               |       |
| I9                                                            | 0.878 | 0.004 | 203.466<br>** | 0.771 |
| I10                                                           | 0.904 | 0.004 | 224.939<br>** | 0.817 |
| I11                                                           | 0.895 | 0.004 | 215.603<br>** | 0.801 |
| I12                                                           | 0.853 | 0.005 | 162.403<br>** | 0.727 |
| Effects of government communication (AVE = 0.615, CR = 0.827) |       |       |               |       |
| I13                                                           | 0.795 | 0.008 | 101.728<br>** | 0.631 |
| I14                                                           | 0.786 | 0.008 | 97.865 **     | 0.618 |
| I15                                                           | 0.771 | 0.008 | 93.130 **     | 0.595 |
| Effects of Tax Benefits (AVE = 0.854, CR = 0.946)             |       |       |               |       |
| I16                                                           | 0.930 | 0.003 | 303.050<br>** | 0.865 |
| I17                                                           | 0.933 | 0.003 | 345.318<br>** | 0.871 |
| I18                                                           | 0.909 | 0.004 | 247.639<br>** | 0.827 |
| Intention to use electric vehicles (AVE = 0.797, CR = 0.922)  |       |       |               |       |
|                                                               |       |       |               |       |

|                                                                                |       |       |               |       |
|--------------------------------------------------------------------------------|-------|-------|---------------|-------|
| I19                                                                            | 0.867 | 0.005 | 174.729<br>** | 0.752 |
| I20                                                                            | 0.898 | 0.004 | 218.375<br>** | 0.807 |
| I21                                                                            | 0.912 | 0.004 | 244.323<br>** | 0.832 |
| Structural model (hypothesis path)                                             |       |       |               |       |
| H1: Perceptions of government commitment and efficiency → Intention to use EVs | 0.262 | 0.019 | 14.071 **     |       |
| H2: Perceptions of government welfare → Intention to use EVs                   | 0.133 | 0.041 | 3.210 **      |       |
| H3: Effects of government policy → Intention to use EVs                        | 0.198 | 0.065 | 3.049 **      |       |
| H4: Effects of government communication → Intention to use EVs                 | 0.242 | 0.016 | 14.717 **     |       |
| H5: Effects of tax benefits → Intention to use EVs                             | 0.172 | 0.034 | 5.090 **      |       |

Note: \*\* significant at  $\alpha = 0.001$ .

## Measurement framework for government policies influencing electric vehicle adoption

**Perceptions of Government Dedication and Operational Effectiveness:** This dimension captures how the public evaluates the government's resolve and capability in advancing the electric vehicle (EV) sector. Items such as "I view the government's initiatives to encourage electric vehicle use as successful" (loading = 0.894) and "The degree of dedication shown by the government shapes my trust in adopting electric vehicles" (loading = 0.886) exhibit very strong loadings. These results highlight that beliefs about the government's seriousness and competence play a central role in fostering consumer assurance [4]. Such views are typically shaped through official announcements and observable government activities, which strengthen the link between perceived dedication and greater EV acceptance [5].

**Perceptions of Government Financial Assistance:** In this area, statements like "I know about the financial aid or subsidies offered by the government for buying or operating electric vehicles" (loading = 0.824) and "Awareness of governmental financial support programs affects how seriously I consider purchasing an electric vehicle" (loading = 0.953) display robust loadings. This emphasizes that the mere availability of assistance programs is insufficient; public knowledge and comprehension of them are equally vital [46]. Clear dissemination of information regarding these incentives is therefore essential to amplify their influence [47].

**Impact of Government Policies:** The construct labeled "Impact of Government Policies" shows solid factor loadings, especially evident in items such as "Policies encouraging electric vehicle adoption positively shape my overall perspective" (loading = 0.871) and "I regard government measures backing electric vehicles as vital drivers of their uptake" (loading = 0.927). High loadings on practical elements, including "Government efforts to build charging networks are critical to the progress of electric vehicles" (loading = 0.861), indicate that visible, real-world policies—particularly those enhancing usability—are seen as particularly powerful [48]. This suggests that concrete measures directly affecting everyday EV experiences exert the strongest sway over public views and behavioral choices [49].

**Influence of Government Messaging:** The role of clear government outreach emerges in items such as “Official messages and promotional efforts regarding electric vehicles shape my viewpoint” (loading = 0.798) and “The straightforwardness and openness of government messaging influence my sense of trust in adopting electric vehicles” (loading = 0.771).

Although these values are modestly lower than those for tangible policy outcomes or financial perks, they remain meaningful. This implies that while immediate advantages may prompt quicker decisions, the broader foundation of understanding and trust cultivated through government messaging remains indispensable for widespread acceptance [50].

**Influence of Tax Incentives:** The construct “Influence of Tax Incentives” exhibits exceptionally high loadings, underscoring the strong influence of fiscal measures on EV purchase decisions. Items including “Tax advantages offered by the government strongly encourage my preference for electric vehicles” (loading = 0.933) and “I see tax reductions for electric vehicle owners as major benefits” (loading = 0.932) stand out prominently. These results demonstrate that tax relief is not merely recognized but serves as a primary consideration in consumers’ economic evaluations, rendering EVs far more appealing [13, 51].

Within the higher-order construct “Government Backing for Electric Vehicles,” which integrates all the underlying dimensions, second-order confirmatory factor analysis loadings indicate the relative weight each component carries in shaping perceptions of EV adoption. The specific loadings are: Impact of Government Policies (0.985), Perceptions of Government Financial Assistance (0.892), Influence of Tax Incentives (0.944), Perceptions of Government Dedication and Operational Effectiveness (0.947), and Influence of Government Messaging (0.778).

The dominant loading of 0.985 for Impact of Government Policies reveals that concrete actions—such as expanding charging facilities and enacting supportive regulations—are viewed by the public as the single most decisive element [36]. This prominence likely arises from the direct, observable improvements these measures bring to EV practicality and convenience. Close behind are Perceptions of Government Dedication and Operational Effectiveness (0.947) and the Influence of Tax Incentives (0.944), both with nearly comparable significance. Together, these suggest that citizens highly prize both reliable long-term governmental backing and meaningful cost reductions [52, 53]. Perceptions of Government Financial Assistance (0.892) remain important, particularly for overcoming initial purchase price hurdles common in places like Thailand [44].

In contrast, the Influence of Government Messaging registers the lowest loading at 0.778. While still relevant, it appears to operate more indirectly, primarily reinforcing awareness and strengthening the effects of more hands-on interventions [54, 55]. Overall, these rankings indicate that the most effective government strategies emphasize practical, barrier-reducing actions, with well-designed communication playing a valuable supporting role [37, 56].

## Determinants shaping perceptions of government actions on electric vehicle adoption

The measurement structure for “Intention to Adopt Electric Vehicles” shows that public readiness to adopt EVs is substantially driven by perceptions of government support across multiple dimensions. Notably high loadings appear on items such as “Government backing plays a key role in strengthening my favorable attitude toward electric vehicle use” (loading = 0.912), illustrating a clear connection between supportive policy perceptions and increased willingness to adopt [41].

Hypothesis 1: Perceptions of Government Commitment and Efficiency → Intention to Use EVs (loading = 0.262).

This result supports the idea that beliefs about governmental resolve and execution efficiency meaningfully affect people’s readiness to use EVs. Even at a moderate level, the loading highlights how visible, competent government involvement enhances confidence in supporting systems and infrastructure [57].

Hypothesis 2: Perceptions of Government Welfare → Intention to Use EVs (loading = 0.133).

The more modest loading suggests that subsidy-related measures contribute to adoption intentions, though their influence appears less immediate. This may stem from incomplete awareness or delayed appreciation of such programs unless accompanied by strong outreach [41].

Hypothesis 3: Effects of Government Policy → Intention to Use EVs (loading = 0.198).

This moderate effect confirms that well-executed, visible policies—especially those addressing infrastructure and regulatory barriers—directly encourage EV uptake intentions [27].

Hypothesis 4: Effects of Government Communication → Intention to Use EVs (loading = 0.242).

The comparatively strong loading here emphasizes the vital function of transparent, consistent communication in raising awareness, dispelling doubts, and reinforcing positive views of EVs [58].

Hypothesis 5: Effects of Tax Benefits → Intention to Use EVs (loading = 0.172).

This finding affirms that tax relief matters but is not the overriding driver. Substantial and clearly promoted financial advantages help make EVs more competitive, yet their sway depends on scale and visibility [14, 16].

Overall, the analysis shows that perceptions of government dedication and operational effectiveness are the strongest predictors of EV adoption intentions in the Thai setting. This carries important policy lessons: when citizens view the government as sincerely committed and capable of delivering on EV-related promises, they tend to feel greater security regarding long-term support, infrastructure continuity, and reduced adoption risks. This sense of reliability helps overcome uncertainties tied to emerging technologies.

These observations are consistent with prior work while adding depth. Earlier studies, such as those by Zhang *et al.* [16], have established policy support as a major influence on EV intentions in China. Yet, the present research delves deeper by dissecting perceptions across distinct facets. The prominence of perceived dedication aligns with Huang *et al.* [27] in Taiwan, but extends that work through a finer-grained breakdown of support components. Notably, unlike the findings of Zhou *et al.* [14], which emphasized financial incentives, the current results indicate that trust in governmental strategy may outweigh direct monetary perks in Thailand. Additionally, the meaningful contribution of messaging echoes Qian and Gkritza [37] on the value of information dissemination, while further clarifying its position within the broader framework of perceived government support and its downstream effects on adoption intentions.

## Conclusion

This investigation assessed how perceptions of Thai government policies shape the uptake of electric vehicles (EVs) through a robust measurement framework and a data-driven examination. A detailed survey instrument was used to gauge multiple facets of policy perceptions, with responses from 3,770 individuals representing key areas across Thailand. The analysis incorporated sophisticated statistical approaches, including Exploratory Factor Analysis (EFA), second-order Confirmatory Factor Analysis (CFA), and Structural Equation Modeling (SEM), to assess the reliability of the government support constructs and their effects on consumers' willingness to adopt EVs.

The study yields several important conclusions. In addressing RQ1, the measurement model outcomes (Table 4) from the second-order CFA affirmed the validity and consistency of all dimensions: Impact of Government Policies, Perceptions of Government Dedication and Operational Effectiveness, Influence of Tax Incentives, Perceptions of Government Financial Assistance, and Influence of Government Messaging. Among these, Impact of Government Policies and Perceptions of

Government Dedication and Operational Effectiveness registered the strongest loadings, signaling that respondents viewed them as the most critical elements.

For RQ2, the SEM results (Table 5) established meaningful positive relationships between each aspect of perceived government policy and EV adoption intentions. The most pronounced effect stemmed from Perceptions of Government Dedication and Operational Effectiveness, underscoring the vital importance of concrete, observable government involvement in driving EV acceptance.

Drawing from these results, the following policy suggestions are ordered by their demonstrated influence (based on factor loadings) and likely contribution to accelerating EV uptake. By focusing on high-impact areas aligned with public views, Thai authorities can more effectively spur EV growth, supporting objectives related to ecological protection, cleaner cities, energy conservation, and lower greenhouse gas outputs in line with international and domestic sustainability ambitions.

1. Strengthen and broaden core government policies: With tangible policies showing the greatest sway in the SEM, authorities should prioritize intensifying EV-supportive measures, especially by scaling up charging infrastructure and creating supportive regulations for consumers and producers alike. Specific steps could include: (1) Boosting Charging Station Deployment — Formulate a nationwide strategy with defined goals for expanding public charging points in malls, lots, and residential/workplace sites, while providing incentives to private entities and developers for installation. (2) Streamlining Approval Procedures — Accelerate and simplify permitting for charging infrastructure to enable swift nationwide rollout.
2. Bolster perceived government dedication and execution efficiency: Given its high loading and strong link to intentions, efforts should emphasize making the government's resolve more apparent. This involves announcing explicit EV targets, allocating resources to EV advancements, and delivering prompt execution of related programs. Possible initiatives: (1) Transparent Commitment Updates — Frequently release public reports on advancements in electrifying public transit and official vehicle fleets to build credibility in sustainable mobility efforts. (2) Streamlined Incentive Processing — Minimize administrative hurdles in delivering rebates, grants, or other EV purchase supports to foster greater confidence and engagement.
3. Prioritize clear and impactful communication on ev advantages and support: Messaging plays a foundational role in shaping attitudes and trust. Authorities should roll out broad-based outreach efforts to inform citizens about EV merits and the specifics of available aids. Suggested actions: (1) Widespread Awareness Initiatives — Deploy multi-channel programs showcasing environmental, cost-saving, and convenience gains of EVs, incorporating real-user stories for relatability. (2) Ongoing Policy Briefings — Leverage platforms like social networks, official portals, and announcements to deliver timely details on policy evolutions and their direct advantages for prospective and existing EV owners.
4. Refine tax relief and monetary support: Although slightly less dominant than core policies or perceived dedication, fiscal perks remain essential. Making these more compelling and user-friendly can markedly elevate adoption. Key measures: (1) Enhanced Tax Structures — Introduce progressive relief favoring pioneers and efficient models to heighten appeal. (2) Upfront Purchase Assistance — Expand direct rebates to lower entry costs, potentially adding bonuses for replacing older, polluting vehicles with EVs.
5. Advance supportive welfare initiatives: Despite a comparatively lower effect, bolstering direct aid programs can ease entry barriers for many. This encompasses amplified purchase subsidies, tax cuts, and exchange grants. Potential steps: (1) Affordable Financing — Introduce reduced-rate loans tailored for EV buyers to widen accessibility. (2) Ecosystem Grants — Offer funding or relief to firms building battery production, recycling, or related facilities to fortify the overall EV landscape.

The results point to opportunities for refining Thailand's established "30@30 Policy" (aiming for 30% zero-emission vehicle production by 2030) and "EV 3.5 Measures" (offering varied incentives from 2024–2027). While these frameworks

provide a strong base for EV momentum—including infrastructure emphasis under 30@30 and consumer/manufacture support in EV 3.5—adjustments informed by this research could further enhance their success.

- **Amplifying infrastructure and rules:** The 30@30 initiative promotes Thailand as an EV manufacturing hub, with a focus on infrastructure. Yet, findings call for bolder expansion of charging networks to alleviate range concerns and broaden usability.
- **Elevating outreach and openness:** EV 3.5 delivers notable aids, but greater impact could arise from improved dissemination—transparent, regular updates on benefits would deepen understanding and reliance, boosting uptake.
- **Fine-tuning economic supports:** Direct perks like tax cuts and subsidies feature prominently in EV 3.5, but scaling, targeting (e.g., lower-income groups), or accessibility enhancements could amplify reach.

Integrating these proposals with current efforts would reinforce policy coherence, better align with user expectations, and hasten sustainable automotive progress, solidifying Thailand's position as a regional EV leader.

To heighten the visibility of commitment and strengthen financial aid, a comprehensive strategy is advisable. For commitment, introduce a prominent “EV Roadmap” outlining clear 5–10-year milestones with quarterly progress disclosures, supported by a cross-agency coordination body to showcase unified governmental resolve. For finances, implement graduated incentives that peak for early movers and taper later, alongside a “feebate” mechanism that uses levies on high-pollution vehicles to finance EV rebates [59]. Pairing this with dedicated low-rate EV loan partnerships with banks would deliver tangible commitment alongside practical economic relief, addressing core findings.

For decision-makers, the emphasis on perceived dedication/efficiency signals the need to visibly sustain long-term EV backing and showcase concrete infrastructure gains. The role of messaging calls for sustained, broad campaigns that clarify policies and benefits. Regular model-based assessments, using this study's framework, would enable ongoing refinements to optimize influence on intentions. Adopting these steps could markedly improve the effectiveness of EV promotion, raising adoption and advancing clean transport goals.

The patterns observed here mirror those in other settings, indicating partial transferability. The primacy of perceived dedication/efficiency in Thailand echoes Li *et al.* [60] in China, who found that policy support influences purchase intentions. The weight of tax/financial aids aligns with Zhou *et al.* [14] in China and Filippini *et al.* [32] in Nepal. Messaging's significance aligns with Qian and Gkritza [37] in the United States regarding informational effects. These overlaps suggest that core elements—perceived backing, monetary relief, and outreach—consistently matter, though priority may shift by context, offering wider relevance for global EV strategies.

While illuminating for Thailand, the single-country scope restricts broader extrapolation amid varying cultural, economic, and governance differences. Thailand's distinct auto sector, policy environment, and social patterns may uniquely mold responses. Future work could pursue multinational comparisons, especially contrasting EV maturity and policy styles, to distinguish Thailand-specific insights from universal ones. Exploring interactions among social norms, personal values, culture, and policies would enrich understanding, potentially through mixed-methods research with qualitative depth.

Incorporating behavioral economics could further deepen analysis, as traditional models often presume rationality, yet choices frequently diverge due to biases [61]. Examining loss aversion or present bias in incentive responses would offer nuance. Policymakers could apply behavioral insights to nudge desirable actions [62], while subtle framing tweaks might boost policy impact [63].

Notably, the current model omitted demographics (age, gender, education, urban/rural status, income), which prior studies, such as Huang *et al.* [27], have linked to intentions. Including such controls in future analyses would strengthen the robustness of findings.

## Acknowledgements

None

## Conflict of interest

None

## Financial support

This research project is supported by the Science Research and Innovation Fund [ Agreement No. FF67/P1—021].

## Ethics statement

None

Received: 03 Oct 2024

Revised: 09 Nov 2024

Accepted: 18 Dec 2024

Published online: 20 March 2025

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