Master's Thesis in Engineering

Evaluation of Factors Associated with Battery Electric Vehicles Adoption- Cambodia Case

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Sotha Keo

Technology Management, Economics, and Policy Program
College of Engineering
Seoul National University

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지도교수 김연배

이 논문을 공학석사 학위논문으로 제출함

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협동과정 기술경영경제정책 전공

KEO SOTHA

KEO SOTHA 의 공학석사 학위논문을 인준함

2023 년 8 월

위 원 장 _____(인)

부위원장 _____(인)

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Abstract

Climate change has become a serious global issue. The Paris Agreement aims to limit global temperature rise below 2 degrees Celsius; hence, many countries plan to reduce their emission. Correlatively, two sectors have the potential for CO2 emissions in Cambodia. One sector is electricity generation, and the other is transportation. In power generation, Cambodia used clean energy sources, accounting for 61.06% in 2022. However, the transportation sector utilizes 46% of total energy consumption, mostly in the form of petroleum products. Consequently, CO2 emission from the transportation sector in this country is the largest contributor. Cambodia plans to reduce 41.7% of emissions by 2030. Cambodia's Intended Nationally Determined Contributions create two priority actions in the transportation sector. Increasing the use of electric vehicles and bicycles is the priority. Battery electric vehicle (BEV) seems to get more attention from the government to deal with the emission issue. Nevertheless, BEV development is still in the early stage, requiring more development and implementation. The market potential is great, but demand is still limited due to slow adoption. The information about BEV is still limited, and few companies import BEV in this country. Therefore, identifying any factors associated with BEV development is significant since they are keys to promoting BEV to the nation. This study uses the Analytic Hierarchy Process to investigate potential factors influencing BEV adoption of 4-wheel and 2- and 3-wheel vehicles in Cambodia from experts' perspectives. Accordingly, 22 factors are classified into six categories: technology, economics, infrastructure, government support, reliable and environmental electricity supply, and consumer. The results reveal that Government Support significantly influences

BEV adoption in Cambodia for both vehicle types. Financial incentives, policies & standards, adequate electricity generation, and renewable energy sources are the top factors that heavily impact the adoption of BEV. Thus, the economy has a strong influence on 4-wheel but has less effect on 2-wheel and 3-wheel. These findings could give insightful information for policy and shareholders for better BEVs adoption plans.

Keywords: Battery Electric Vehicle, Adoption, Factors Evaluation, Analytic Hierarchy Process

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I. Introduction

I.1 Research Background

Climate change is a serious issue that needs involvement from every country. When addressing climate change, reducing greenhouse gas emissions is essential. The use of sustainable practices across all industries and the transition to low-carbon and renewable energy sources are crucial first steps. The ability to adapt to the changing environment, increase resilience, and deal with its effects is equally vital. By reducing global warming to well below 2°C and pursuing efforts to restrict it to 1.5°C, the Paris Agreement lays out a worldwide framework to avoid severe climate change. It also aims to support nations in their efforts and improve their capacity to deal with the effects of climate change, according to UNFCC. Even if these pledges are supplemented with difficult increases in the scale and ambition of mitigation after 2030, global warming is predicted to exceed 1.5°C above pre-industrial levels under emissions consistent with current pledges. In fewer than 15 years, this additional activity would require reaching net zero CO2 emissions. Even if this is accomplished, temperatures would only be expected to stay below the 1.5°C cutoff if the actual geophysical response ends up being around the low end of the range of currently estimated uncertainty. If global emissions peak before 2030 and significant carbon reductions compared to today are already accomplished by 2030, transition issues can be mitigated (Rogelj et al., 2018).

Cambodia followed in Paris Agreement and prepared the NDC, which indicated the intention to cut down CO2 emissions by 41.7% by 2030 (including FOLU)[1] with a business as usual (BAU) scenario, and the amount is estimated to be around 64.6 million tCO2e/year. The Forestry and Other Land Use (FOLU) sector was projected to emit the highest amount of GHG in 2030. The energy sector is the second highly GHG emissions, so in energy sector needs to reduce emissions by 40% in 2030, and it covers sub-sector: electricity, transportation, and building, as stated in Cambodia's NDC, 2020.[2] The overall GHG emission in 2023 is illustrated in the figure below.

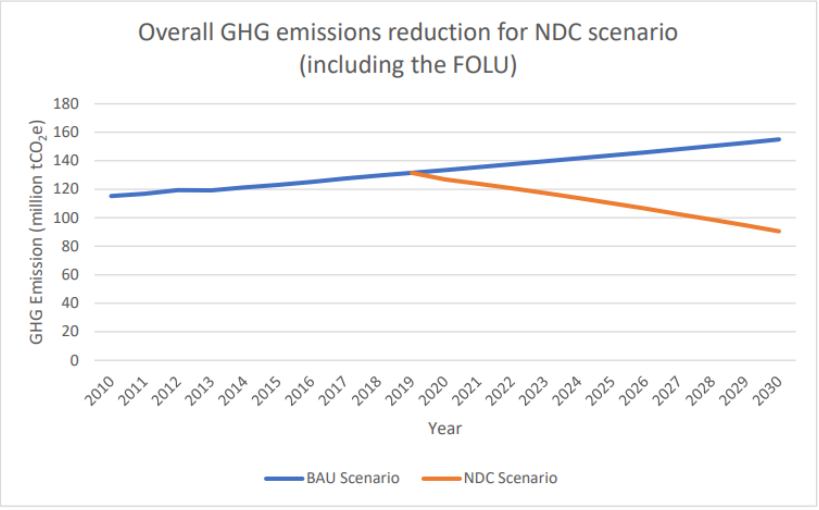

Figure I-1 Overall GHG emissions reduction in Cambodia
(Source: Ministry of Environment, NDC 2020)

In final energy consumption from 2010 to 2018, the sector that consumed the most energy in Cambodia was transportation, and it is still the major sector up to

[1] In the updated NDC, 2020: emissions reduction is estimated by including the FOLU sector

[2] (*Cambodia's Updated Nationally Determined Contribution (NDC)*, 2020)

2050 with an annual growth rate of 5.6%[3] in Energy Outlook 2018-2050. Reducing transportation emissions is a major contributor to overall GHG reduction. The government also prepared a long-term carbon neutrality strategy emphasizing the penetration of electric vehicles. 70% of electric motorcycles, 40% of 4-wheel vehicles, and 30% increase the utilization of public transportation in urban areas by 2050.[4] The effectiveness of electric vehicle (EV) deployment depends on how clean the grid is, and the generation mix is an indicator. With its successful EV adoption, Norway's electricity generation is dominated by hydro, accounting for 92%, and nearly half of the final energy consumption is electricity.[5] In Cambodia, the electricity supply increased 9.17 times from 490 MW in 2008 to 4,495 MW in 2022. The electrification rate is also rising, and 88.41% of households have grid access in 2022.

[3] ERIA, Energy Outlook and Energy Saving Potential in East Asia 2020/ Cambodia Country Report

[4] (Cambodia's Long-Term Strategy for Carbon Neutrality, 2021)

[5] (Executive Summary – Norway 2022 – Analysis, 2022)

Vehicle registration in Cambodia keeps increasing, with an average growth rate of around 11.3% in the last five years, and most vehicles are motorcycles. The total vehicle was approximately 6.7 million in 2022, 5.7 million of which are motorcycles.[6] However, the number of electric vehicle registration is still very few amounts. All electric vehicle types are still under the hundred units in the first semester of 2022.[7]

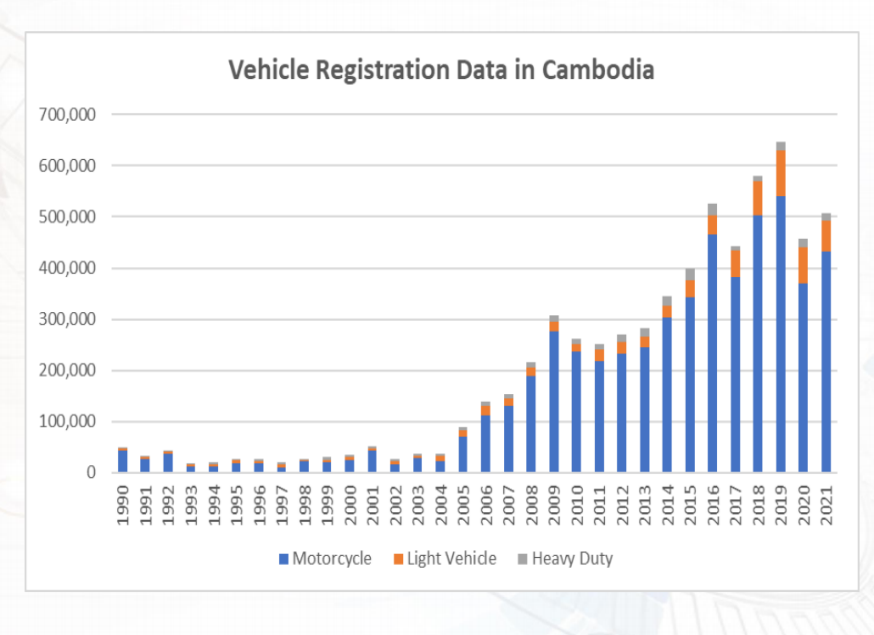

Figure I-2 Vehicle registration data in Cambodia 1990-2021
(Source: Ministry of Public Work and Transportation, EV Roadmap,2022)

[6] Manoj Mathew, Khmer Times,2023
https://www.khmertimeskh.com/501251641/cambodias-vehicle-population-grows-by-11-3/

[7] Ministry of Public Work and Transportation, Yutthavonn KAK, Cambodia EV Roadmap,2022

I.2 Problem Statement

The electrification of transportation has become an essential strategy for achieving carbon neutrality objectives on a global scale. Battery Electric Vehicles (BEVs) are a potential way to cut greenhouse gas emissions, and they have been adopted successfully, mostly in developed countries. For an instant, Norway is usually regarded as being at the forefront of EV adoption. More than half of all new automobile sales in the nation in 2020 were electric vehicles. Strong government incentives like exemption from auto taxes, lower tolls and ferry costs, access to bus lanes, and extensive charging infrastructure are just a few reasons why EV adoption in Norway has been so successful. The rigorous pollution limits and dedication to renewable energy in Norway have also encouraged the adoption of EVs.

The long-term governmental focus on EVs and comprehensive support programs adopted by the nation has dramatically contributed to its success. Similarly, the promotion of EV adoption has advanced significantly in the Netherlands. The country has a highly developed network of public charging stations and a well-established charging infrastructure. The Dutch government provides a variety of incentives, such as tax breaks, financial assistance, and exemptions from paying vehicle registration fees, to promote the adoption of EVs. Another factor in the Netherlands' success in promoting EVs is its lofty goals for phase-outs of internal combustion engines and the expansion of its network of charging stations (Broadbent et al., 2018). China is the only developing country that successfully adopted EVs, considering that the world's largest market for electric automobiles is now China. The nation has enacted several regulations to encourage the use of EVs,

including the creation of a favorable charging infrastructure, exemption from license limits, and purchasing subsidies. China has been successful in promoting EV adoption due to the country's strong government backing and ambitious aims for decreasing pollution and reliance on oil.

Additionally, the existence of domestic automakers dedicated to producing EVs has significantly contributed to expanding the EV market in China (S. Li et al., 2020). Several elements, including extensive infrastructure development, public awareness campaigns, strong government incentives, and supportive regulatory frameworks, can define the success of these nations in promoting the use of electric vehicles. These nations have established a setting favorable to the mass adoption of electric vehicles by implementing an extensive ecosystem for EVs. However, not all countries can achieve that. Some other developed countries still got less EV adoption rate, and some developing nations, such as Cambodia, are having trouble accelerating the adoption of EVs, which is delaying their progress toward carbon neutrality.

Furthermore, the transportation system in each country is different from each other. In developed counties the public transportation system is quite efficient than what in developing countries. The vehicle types of utilization are also various between developed and developing countries. Notably, 4-wheel vehicles are the majority of vehicles in developed countries while in Cambodia the most popular vehicle is 2-wheel vehicles. These indicated the adoption is various from countries, region, and location. It is crucial to consider that the relative important to factors might change depending on preferences, regional features, and market dynamics. For policymakers, businesses, and other stakeholders to create strategies and policy that encourage the adoption of EVs widely, it is essential to comprehend how these

elements interact. Understanding the factors associated with EVs adoption is crucial for developing countries like Cambodia to push the rate of adoption.

I.3 Research Objective and Scope

This study aims to assess the factors influencing the adoption of battery electric vehicles (BEVs) in Cambodia, with an emphasis on cars, tricycles, and motorcycles, by seeking input from experts (most of which belongs are from the government, companies, academia, and NGOs). The study seeks to pinpoint the key factors impacting the adoption of BEVs nationwide. A comprehensive review of existing literature on EVs adoption was conducted to achieve this objective. The literature review concentrated on identifying the main factors influencing people's decisions to choose electric vehicles and the factors that drive and hinder EV adoption.

To offer valuable insights for Cambodia, best practices and strategies for boosting EV adoption that has been adopted in other nations have also been examined. The policy recommendations that come out of this study will address the important factors that have been found to favorably influence adoption. Through this rigorous research, a total of 22 factors that are important to Cambodia's adoption of BEVs were found. These factors cover various topics, including consumer behavior, reliable and environmentally friendly electrical supply, economics, infrastructure, and technology. It is essential to comprehend the importance and effects of each component to create strategies that will effectively encourage the adoption of BEVs across the nation.

By encouraging the use of BEVs, Cambodia could reduce its dependency on fossil fuels, cut greenhouse gas emissions, and help create a cleaner, more sustainable transportation industry. Adopting electric mobility not only for

environmental goals but also for various opportunities for the country, such as business prospects and technological advancement. Policymakers, industry participants, and pertinent organizations will get access to insightful information and recommendations supported by evidence through this study, which will help them in their decision-making and campaigning for the uptake of BEVs in Cambodia. Ultimately, the research's findings will support the sustainable growth of the transportation industry and aid Cambodia's transition to a carbon-neutral economy. The main research questions are:

1. What are the main factors affecting the adoption of BEVs in Cambodia?
2. How to identify factors that vary in terms of their priority and significance?
3. Based on the findings, what policy implication can be proposed to promote BEV adoption in Cambodia

To answer these questions, this study investigates potential factors that influence BEV adoption of 4-wheel and 2- and 3-wheel vehicles in Cambodia from experts' perspectives by using the Analytic Hierarchy Process (AHP). Consequently, 22 factors are selected and classified into six categories: technology, economics, infrastructure, government support, reliable and environmental electricity supply, and consumer. The finding shows that Government Support significantly influences BEV adoption in Cambodia for both vehicle types. Financial incentives, policies & standards, adequate electricity generation, and renewable energy sources are the top factors that heavily impact the adoption of BEV. Factors in the economic part have a strong influence on 4-wheel, yet less effect on 2-wheel and 3-wheel.

I.4 Research Process

In this study, the first step is to address the research objective: identify the factors, measure their priority, and provide policy recommendations to promote BEV Adoption in Cambodia. Through a literature review, the research method was selected. Analysis Hierarchy Process (AHP), created by Thomas L. Saaty, integrates math and psychology to address issues with a structure-based methodology. This method offers the ability to manage complex decision-making problems, incorporate subjective decisions, provide an accountability framework, provide flexibility, and demonstrate the efficiency of the record(R. W. SAATY, 1987). All 22 factors were selected and classified into 6 categories, and the model was built.

Using the model, a structured survey was developed and sent to experts online with data collection from local and regional experts' judgments from government officials who work in the Ministry of Public Works and Transportation, Ministry of Mines and Energy, and experts who work in NGOs, academia, and private companies. All data from experts' evaluation was analyzed, and factors were ranked based on their weight of importance to the adoption. Finally, with the findings, a conclusion was made, emphasizing policy implications to push the BEV adoption rate in Cambodia. The overall research process is illustrated in Figure 3 below.

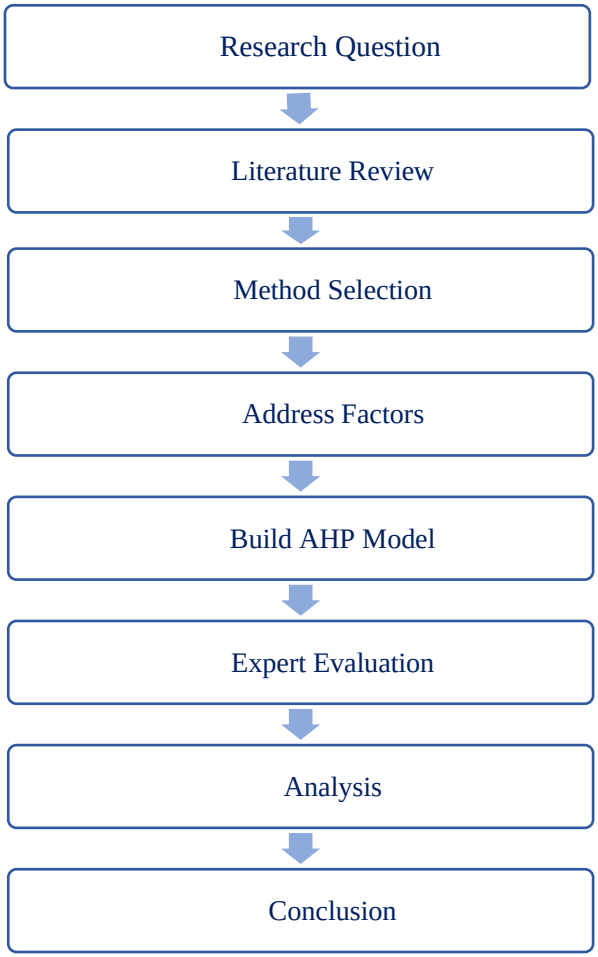

Figure I-3: Research Process

II. Literature Review

II.1 Previous Studies of BEVs Adoption Factors

The climate change is the global issue that require each country contribution. GHG emission form human action is the major cause of global warming. To prevent disaster from global temperature rise, many countries plan to reduce their GHG emission. E-mobility is one of the strategies to reduce emission and sustainable development in transportation sector. To reach the goal, many governments start EVs deployment. The overall EVs share of new car sale is 14% and China is the biggest market for EVs in 2022 account for 60%, followed by Europe, and Unite state according to EIA, EVs outlook, 2023.

The EVs adoption is not simple and smoothly forward. There many previous studies have discovered that many factors influence on the adoption, and they are various from countries. And some county which located in specific weather condition have their own challenges. (Alotaibi et al., 2022) had found factors that impact the EVs adoption in Saudi Arabia and rank those as: charging infrastructure, increased load on the national grid, safety and effectiveness of batteries, and EV performance in desert conditions. In this study online survey was conducted throw 698 drivers in Saudi Arabia. The hot weather condition is very specific and required attention from manufacturers. Similarly, the cast study in Sub-Sahara region by (Collett et al., 2021) showed some key issues in adoption EVs such as limited electricity supply, and the flooding of used car market in the region.

In India (K V et al., 2022) conducted online survey method using the snowball sampling technique is used to collect data from 172 respondents from specific

location using a quantitative methodology and identified several variables that affect the adoption of electric vehicles, including financial barriers, vehicle performance barriers, a lack of infrastructure for charging, environmental conservation, societal influences, and social awareness of electric vehicles. Other study collected expert opinion to evaluate the barriers to EVs adoption. (James et al., 2022) used hybrid structural model AHP (Analytic Hierarchy Process) and (Decision making trial and evaluation laboratory) DEMATEL to address barrier of EVs adoption in India. Other study in Brazil, related to the diffusion of electric vehicle in the market discovered the attractiveness, barriers and solutions. Semi structured interviews reveal essential EV attractions, but barriers include cost, charging infrastructure, and public policies. Solutions include increased emission consumer awareness, tax incentives, and technological advances in battery performance and charging station efficiency are the key for electric vehicle diffusion in Brazilian market(Ruoso & Ribeiro, 2022). Other study try to fine the relation between barrier based on (Patyal et al., 2021) these out of the studies could provide significant information for policy maker and automobile industry manufacturers building effective solution for better EVs adoption in the future.

The transition from ICEVs to EVs has a lot of challenges and required government intervention. The switch from internal combustion engines (ICEVs) to electric vehicles (EVs) is difficult because of economic and technological issues such high upfront costs, a short range, inadequate infrastructure for charging, and uncertainty on the calibre of the technology. However, as (S. Li et al., 2020) illustrate the role of government in promoting EVs adoption which emphasis on market potential. Governments in significant nations have set high targets for EV adoption and put these goals into practice through the implementation of legislation. These consist of

non-financial perks including subsidized power, parking, and road usage rights, as well as subsidies for EV buyers, subsidies for charging stations, and other benefits. In addition, supply-side regulations like the EV mandate and fuel economy standards seek to achieve the EV share targets set by automakers and boost fleet fuel efficiency. Most previous studies investigated all electric vehicle types and not specific on battery EV, Plug-in EV, or hybrid vehicles. Some directed their study on battery electric vehicle but not look in the vehicle types like motorcycle, tricycle, and car. Thus, in this study only examine on battery electric vehicles and seek more factor influence on vehicle types and comparing the effect.

Table II-1: Summary of Previous Studies

N	Topic	Method	Country	Reference
1	Identifying Factors Associated with Consumers' Adoption of e-Mobility—A Systematic Literature Review	Systematic Literature Review	Not Specified	(Stockkamp et al., 2021)
2	Can electric vehicles be good for Sub-Saharan Africa?	Context-specific approaches	Sub-Saharan Africa	(Collett et al., 2021)
3	Modeling barriers to the adoption of electric vehicles: An Indian perspective	ISM (Interpretive Structure Modeling) and MICMAC (Matrice d'Impacts Croisés Multiplication Appliqués à un Classement)	India	(Patyal et al., 2021)
4	Identification of Potential Barriers to Electric Vehicle Adoption in Oil-Producing Nations—The Case of Saudi Arabia	Mix qualitative and qualitative Online Q with 698 R	Saudi Arabia	(Alotaibi et al., 2022)
5	Evaluation of Barriers to Electric Vehicle Adoption in Indonesia through Grey Ordinal Priority Approach	Grey Ordinal Priority Approach	Indonesia	(Candra, 2022)
6	Identification and evaluation of barriers in the implementation of electric mobility in India	AHP-DEMATEL (Decision making trial and evaluation laboratory)	India	(James et al., 2022)
7	A Study on the Factors Influencing the Purchase of Electric Vehicles	online survey (100Respondents) + empirical analysis	Korea	(Kim & Kang, 2022)
8	Factors Influencing Battery Electric Vehicle Adoption in Thailand—Expanding the	partial least squares structural equation modeling (PLS-SEM	Thailand	(Manutworakit & Choocharukul

	Unified Theory of Acceptance and Use of Technology's Variables	with 403 participations		, 2022)
9	An assessment of barriers and solutions for the deployment of electric vehicles in the Brazilian market	Semi-structured interviews (Thirty-one interviews were conducted, each lasting around 30 min)	Brazil	(Ruoso & Ribeiro, 2022)
10	Identification and Analysis of Barriers Against Electric Vehicle Use	AHP	Nepal	(Adhikari et al., 2020)

II.2 Some Policies for EVs Adoption in Practice

The adoption of battery electric vehicles (BEVs) can be dramatically impacted by government action. Tax credits, subsidies, grants, and refunds are a few examples of incentives that can be used to lower the cost and increase customer interest in BEVs. Governments can invest in public charging stations and laws to incorporate EV charging infrastructure. Infrastructure development is essential for widespread BEV adoption. The market will become more competitive because of tougher pollution requirements and rules encouraging automakers to prioritize BEV manufacturing and marketing. Governments can set budget for research and development, which will result in improvements in technology and affordable price.

The most practice policy in lifting EV adoption is incentive. The BEV 'success' tale is Norway. The government offers the most extensive incentives in all of Europe to promote the use of BEVs. The tax break offered to customers who buy a BEV is a crucial part of these incentives. The advantages include a VAT exemption, additional car purchase or sales tax exemptions, and a 50% company car tax relief. BEVs are now fully price competitive with ICE vehicles because to non-tax incentives like free use of most toll highways, free battery charging at publicly sponsored charging

stations, and free parking in public lots according to European Commission-European Alternative Fuels Observatory-Norway[8].

In China, government inject huge purchase subsidy. The average subsidy from the central and local government about $7,000 per EV, or nearly 26% of retail price on average and it can reach as high as 73% of purchase price. The total subsidies from the central and local government are nearly 55 billion Yuan during the sample period for the 150 cities. The results suggest that consumer subsidies played an important role in promoting EV sales, explaining nearly 55% of the EV sales during the data period. From 2011 to 2019, the total consumer subsidies from both central and local governments nearly 50 billion US dollars, including subsidies to commercial vehicles. The effect of consumer subsidies is stronger in China due to the larger price sensitivity among Chinese consumers(S. Li et al., 2020).

Beside financial subsidy, the other privileged services are attracting consumer as well. A specific E-Number plate for electric vehicles was created in Norway, allowing local authorities to decide on incentives like free parking and bus lanes based on these number plates. This program contributes to raising public awareness of clean vehicles on the roads. Municipalities in Norway have been able to choose taxes and exemption categories since 2016, which has resulted in various local regulatory frameworks. Up until 2019, parking spaces and charging are free. Additionally, while electric vehicles are permitted unrestricted access to bus lanes, some bus paths regularly face traffic during rush hour. The Oslo municipality responded to this problem in 2017 by restricting access to the bus lane to only electric vehicles with two or more occupants. Regional toll roads are excluded from

[8] https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/norway/incentives-legislations

charging fees for electric vehicles. However, during peak hour, some bus lanes frequently face congestion. The Oslo municipality responded to this problem in 2017 by restricting access to the bus lane to only electric vehicles with two or more occupants. Regional toll roads do not require electric cars to pay, but starting in 2019, they will be required to pay a reduced rate. Since 2009, most ferries connecting sections of the national road network have allowed electric cars free access; local governments set tariffs for crossing non-national roads.

In China the green plate policy, implemented in three waves, aims to promote electric vehicles (EVs) with special license plates in green colour, a significant change from gasoline vehicle license plates. The policy has a robust and large effect on EV sales, with a preferred specification of ¥20,000 subsidies. The policy contributed to nearly 18% of EV sales during the sample period, highlighting the significant value it brings to consumers through multiple channels. Recent literature suggests that consumers demonstrate their environmental preferences by purchasing green products or seeking status through conspicuous conservation. Labelling can guide consumer purchasing decisions and encourage behavioural change toward sustainability. The policy's efficacy is substantial, and its impact on EV sales is substantial, despite the minimal cost(S. Li et al., 2020).j

III. Methodology

III.1 Analysis Hierarchy Process (AHP)

AHP is the method that applies mathematics and psychology to solve problems in structure format and it was developed by Thomas L. Saaty in the 70s. Rather than choosing yes or no, this method provides a better solution for decision-making with a contribution of mathematic application to show more evidence for your decision. It weighs the criteria to reach the goal; then, evaluates the options by comparing all the alternatives that offer. Criteria are not always equal in value since they depend on the judgment of experts. The common hierarchy structure consists of three levels. The top is problem structuring in which a goal or problem is set; next is the evaluation, in which criteria are built and employed to judge the solutions or choices available. The final level is alternations or choices to reach the goal or solve the problem. After the hierarchy has been constructed, the experts thoroughly assess each of its components by comparing them with one another two at a time in terms of how they will affect a component above them in the hierarchy. The experts can utilize specific data, skills, and experiences about the elements to make the comparisons, but they usually rely on their perceptions of the factors' relative significance and significance. The AHP's core principle is that evaluations can be conducted using personal judgment in addition to the underlying data. Later, these evaluations are converted to mathematical value and compared with entire choices or solutions.

The mathematics formulas to calculate the relative import and final evaluation are pairwise comparison matrix, Eigenvector, Consistency index, Consistency ratio,

priority vector, and final priority. A pairwise comparison matrix is designed to evaluate how important each criterion is in comparison to the others. Typically, the matrix is a square matrix with dimensions of n x n, where n is the total number of criteria. Thus, in this study, n is the number of factor categories in level 2, and n is the number of factors within each category in level 3. Comparison matric as shown below. (Benítez et al., 2011; Mu & Lee, 2017; R. W. SAATY, 1987)

Table III-1 Factor Comparison Matric

Factor	F1	F2	F3	F4
F1	1	2	4	5
F2	1/2	1	1/5	1/9
F3	1/4	5	1	3
F4	1/5	9.0	1/3	1

The relative weight of one criterion in relation to another is represented by each element in the matrix. Values between 1 and 9 are used to fill the matrix's elements. The matrix's eigenvalue is used to calculate the pairwise comparison matrix's eigenvector. The relative weight of each criterion in the hierarchy is represented by the eigenvector. The eigenvector's constituents are normalized, resulting in an element sum of 1. The consistency index, measuring the consistency of the pairwise comparison matrix, could obtain by the formula:

$$CI = (\lambda max - n) / (n - 1) \quad \text{.....(1)}$$

Where n is the number of factors and λmax is the largest eigenvalue of the matrix. The consistency ratio (CR) is the result of the consistency index (CI) divided by the average random index (ARI) with a matrix of the equivalent size and it measures the consistency level in the pairwise comparison.

$$CR = CI/ RI \quad \text{.....(2)}$$

The priority vector, the pairwise comparison matrix multiple by Eigenvector, indicates the last priority in the hierarchy of each criterion. The last step is the final priority of each criterion which is calculated by multiplying each priority vector with each criterion value. Then, the final priority's value of each criterion is compared and ranked. (R. W. SAATY, 1987)

Table III-2: Random Consistency Index (RI) Value

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Table III-3: Scale of evaluation (1-9)

Numerous Scale	Definition	Explanation
1	Equally Important	Factor A and Factor B are equally important
3	Moderately Important	Factor A is moderately important over Factor B
5	Strongly Important	Factor A is Strongly Important over Factor B
7	Very Strongly Important	Factor A is Very Strongly Important over Factor B
9	Extremely Important	Factor A is Extremely Important over Factor B
2,4,6	Intermediate Value	
Reciprocals	Inverse comparison Value	If Factor A got 3 values when it compared to Factor B, then Factor B got 1/3 value when compared to Factor A.

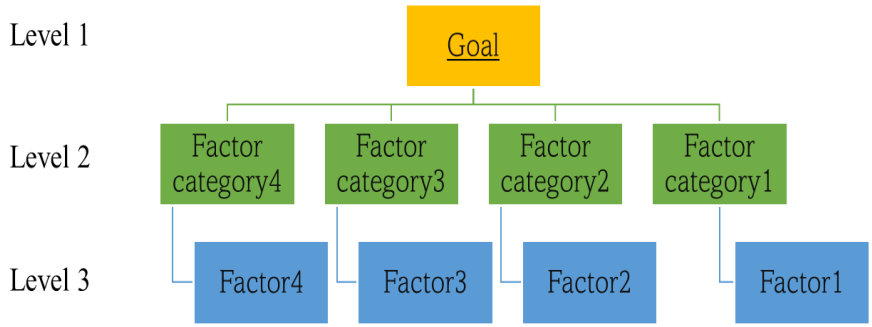

Figure III-1: Formation of Hierarchy Structure Model

III.2 The Analytic Hierarchy Process Framework

The Analytic Hierarchy Process (AHP) framework, which has six key parts, to analyze the adoption of Battery Electric Vehicles (BEVs) in Cambodia. First, we'll set a specific goal which is emphasis on BEV adoption in Cambodia. Secondly, as detailed in Chapter 2 all factors were selected based on previous studies. This study has classified the 22 different factors that affect the adoption of BEVs into six groups. Thirdly, we'll build the AHP model, which will act as the starting point for the choice-making procedure. To assess the factors' relative importance, we will create pairwise comparisons between them in the fourth step. To get weightings for pairwise comparisons, we will then run a survey and solicit expert input. Final step is combining all comparison matric from all experts by geometric mean (Adhikari et al., 2020; Krejčí & Stoklasa, 2018; Leroy, n.d.; Mu & Lee, 2017; Shameem et al., 2020). The detailed factors in this study were described in chapter II based on previous studies and figure below is AHP framework which consist of six steps.

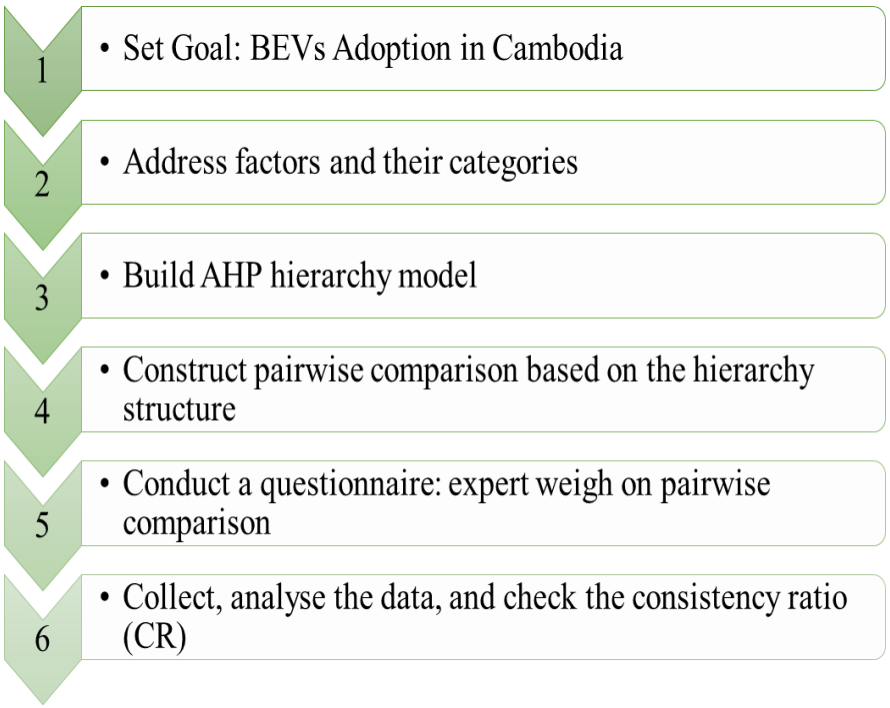

Figure III-2: AHP Framework

III.3 Factors Classification

The factor classification focuses on the importance of technology, economic factor, infrastructure, government support, reliable and environmental electricity supply, and consumer in driving BEV adoption. Technology advancements, battery charging, electric motor efficiency, and connected vehicle technologies are crucial factors for consumers when evaluating BEV options. Economic factors include the cost of BEV, total cost of ownership. Infrastructure is essential for ensuring adequate facilities. Government support, such as financial incentives, tax credits, subsidies, and regulations, promotes BEV adoption by reducing barriers, fostering market competition, and encouraging investment in industry. Reliable and environmental electricity supply is crucial for ensuring widespread BEV ecosystem. Understanding demographic difference in consumer helps manufacturers, policymakers, and stakeholders develop effective strategies to promote BEV effectively.

III.3.1 Technology

Vehicle performance and design are the key technology elements in automobile industry. BEV is the new vehicle technology compare to combustion vehicle but these elements are required to convince consumer. Unlike combustion vehicle, BEV performance is dependent on Battery. The capacity energy storage in battery affect to driving speed and range of vehicle. Moreover, charging time and battery life are criteria for selection high function battery. Model variety offers consumers a wide range of choices and caters to different lifestyles, preferences, and budgets, allowing consumers to find a vehicle that suits their lifestyle and style. By building good performance and more models EVs are more competitive to ICEV in the market.

There are several researches (K V et al., 2022), (Tarei et al., 2021), (Kim & Kang, 2022) (Manutworakit & Choocharukul, 2022) (Patyal et al., 2021) that stress these elements and their influence on the adoption of EV. The detail factors are derived from previous literatures as below.

1. Driving Range

The driving range of EVs is the optimal distance that a car could reach within a full charge. During this last decade, the driving range has improved significantly. In 2011, the EV driving range was from 68 to 94 miles which was a huge concern for consumers and could lead to range anxiety (Noel et al., 2019). The limited driving distance of EVs is the main obstacle to expend it market (Egbue & Long, 2012; Patyal et al., 2021). However, recently in 2020, BEV driving rage can reach beyond 400 km which expense BEV market for the potential consumer who needs long-distance driving (Knapp •, n.d.). For instance, the current on a single charge Tesla Model 3 offers an EPA estimated 353 miles, and model Y EPA estimated 326 miles. Hyundai's Kona is fully Electric and gets an EPA-estimated range of 258 miles(Doll, 2021). For E-motorcycles, the longest driving range available in 2023 is about 256 km, Energica Experia, from the Italian manufacturer (15 Best Electric Motorcycles Of 2023: Updated Ranking, n.d.).

2. Charing Time

The time period that takes for the discharge battery to fully charge[9] or the time driver spends on replacing the discharge battery to fully charge for electric vehicles (Chau, 2014). Thus, charging time varies by battery capacity and charging

[9] (Charging Time - an Overview | ScienceDirect Topics, n.d.)

technology. The bigger the battery capacity the longer time is needed to fill at a charging station while it takes minutes to change the battery within the swapping battery station (Ahmad et al., 2020). For example, BEV utilizes slow charging at home or at work which takes around 4–10 hours for a full charge for level 2 through 240V which could install at home, while 208V chargers are common at commercial buildings. Quick chargers could top up the battery for around 20–60 minutes with direct current (DC) and the typical location for it is at a public place[10]. In contrast, ICV takes about 5 minutes to fill the fuel tank. This difference leads to another challenge for BEV penetration in the market (Egbue & Long, 2012; Patyal et al., 2021).

3. Battery Life

The term "battery life" describes how long a battery-operated item may work before the battery needs to be recharged. The amount of time a battery may last before losing all its capacity is commonly represented in hours of use. A lot of variables, such as the device's kind, power consumption, battery type, temperature, and usage circumstances, might have an impact on the actual battery life. While the number of times a battery may be fully charged and then entirely depleted while still retaining a specific level of performance is defined as the life cycle. A battery life cycle is typically expressed as a percentage of the initial battery capacity, and it might differ based on the type of battery, the usage circumstances, and how the battery is charged and discharged. A lithium-ion battery, for instance, might have a life cycle of 500 to 1000 cycles, whereas a lead-acid battery might have a life cycle of 300 to 500 cycles. Lithium batteries are widely used in electronic devices including BEV. Compared to other battery types, they have high energy efficiency, high-temperature

[10] (Electric Vehicle Charging Speeds | US Department of Transportation, n.d.)

tolerance, low self-discharge, a high ratio of power to weight, and can recycle. Typically, the life span is around 8-10 years or 100,000 miles with energy consumption 14.7kWh/100km (EV Batteries and Recycling | Argonne National Laboratory, n.d.; Iclodean et al., 2017). One of the key elements influencing how well an electric car performs is its battery life since it is the primary source of energy for the electric motor that powers the car. Thus, battery life and life cycle could affect driving range due to battery capacity. The time needed to recharge the battery may grow longer and the power transfer from the battery to the motor may also degrade when the battery life cycle shortens. At the end of battery life, a new battery is needed which affects the cost of ownership of a vehicle (Han et al., 2019; Iclodean et al., 2017).

4. Model Varieties

On the road, BEV is not limited to only cars, there are other vehicles like e-bus, e-motorbike, and scooters that are already available on the market. Unlike last decade, more and more automobile manufacturers involving in producing BEVs. In 2021 the electric car models were beyond 450 models, and 15% more than what had in previous year according to IEA, Global EVs outlook 2022. There has been a noticeable increase in sales volumes across all markets as the number of EV car models available has increased. The electric car model growth rate was 34% from 2015 to 2021. This reflects the desire of manufacturers to gain market share for EVs by launching new products as soon as possible to appeal to a wider range of consumers.

III.3.2 Economic

Financial issue often the barrier for consumer to purchase BEV since the upfront cost is higher than ICEV (Egbue & Long, 2012; L. Li et al., 2020). However, other costs like fuel cost and repair cost are excluded. Consumers can make well-informed choices concerning the affordability of vehicles and long-term financial obligations by taking the overall cost of ownership into account (Hagman et al., 2016). The total cost of ownership of a vehicle may be higher over time even though it may have a lower initial cost. Consumers can compare various vehicle alternatives and select the one that best suits their budget and financial objectives by evaluating overall cost. In addition, government could provide better support for consumer to tackle this financial issue by understanding related important of each component in overall cost.

1. Purchase Cost

The previous study showed the negative impact of the higher price of BEVs (Egbue & Long, 2012; L. Li et al., 2020). When the market price of BEVs is still beyond the ICEVs, consumers still take it into consideration. However, the price of BEVs is based on the cost of the battery. In 2020 the price of batteries dropped around 89 percentage compared to the last ten years and this battery price is expected to decrease gradually(Berckmans et al., 2017). This dropping price of batter could provide a positive effect to BEVs adoption. The cost of vehicle drops down gradually as the battery price.

2. Operation Cost

BEVS fuel cost is related to electricity price and this price varies depending on location, type charging station, and models. The operation cost of ICEVs is volatile

based on the price of crude oil. According to Euro news in 2022, driving the same distance the cost for filling the petrol tank was 80% higher than the price to charge electric car. The most favorable benefits of BEVs for consumers are low fuel cost, less maintenance, and more energy efficient.

3. Maintenance Cost

Most brand-new vehicles are sold with a guarantee that covers any problems that arise within the first three years of ownership. Therefore, repair expenses should be minimal or nonexistent over the first three years. The owner must adhere to the vehicle specific service intervals for the warranty to be effective, nevertheless. Adding the manufacturer's projected service cost for the ownership period results in service charges. Due to their excellent regenerative braking, BEVs feature fewer moving components that do not require regular oil or filter replacement and have less brake pad wear. According to estimates, BEVs' maintenance and repair costs are less than those of ICEVs. For minimal maintaining parts like tire and the outside body of the vehicle are the same (Hagman et al., 2016). However, after 5 years up consumers start to fear about battery replacement cost. Since the battery degradation has been processed gradually, and the battery replacement cost is quite expensive.

4. Resale Value

Consumers always think about the vehicle deprivation rate when they purchase it. With the uncertainty about BEVs market consumers doubt the resale price. Only the long-range of BEVs have a similar residual price with ICEV after 3 years of purchasing. The deprivation rate of ICEVs is 39 percent after 3 years but BEVs could reach more than halve of the deprivation rate and it depend on battery

condition (Knapp,2021). This high deprivation rate also impacts consumers when they want to purchase a new vehicle.

III.3.3 Infrastructure

Infrastructure is crucial for facilitating the adoption and growth of electric vehicles. To establish ecosystem for electric vehicles, facilities are focused on both supply and demand side. For demand side consumer need sufficient equipment and services for their need. Specialized manufacturing facilities are needed by EV vendors to build different parts and systems for electric vehicles. To maintain environmental friendly benefit waste management should be taken in to account. In context of Cambodia four factors were selected and describe below.

1. Charging Station

The charging station is the main support to boost BEV market. With limited amount of it in public, the consumer could feel insure to purchase BEV(Broadbent et al., 2018; Candra, 2022; Egbue & Long, 2012). Charging stations are a dilemma among shareholders in EV market around the world. In Cambodia still not prepare for BEV market since there are few charging stations even in capital city. In this case consumers charge their vehicle mostly in their home. Thus, consumers who prefer long distance driving become more insure and loss courage to purchase.

2. Service Centre and Equipment

(Ghimire and Kim2018; Tarei et al.,2021) emphasis on the important of service centre. Adequate service centre and equipment is usual an issue for imported vehicles. The BEVs is new technology compared to ICEVs, so it requires different technician. Also, the equipment is not available sometime which needs more time

and money to spend on it. In Cambodia BEVs fix and repair techniques can be convoluted, and a couple of prepared mechanics are accessible to fix such issues when they emerge. Consumers fear that they could not find repair or maintenance services beside the place where they bought the BEV.

3. Battery Recycling Facility

Battery recycling ensures that used electric vehicle batteries are properly handled and recycled and offer environmental and sustainable waste management (Pražanová et al., 2022). As the demand for BEVs increases, so does the number of end-use batteries. Efficient recycling helps manage these batteries in an environmentally friendly manner, reducing the environmental impact of battery waste. Recycling promotes the idea of a circular economy by extending the life of battery products. Instead of being thrown away as waste, batteries can be recycled and reused in the manufacture of new batteries. This reduces the need to dispose of new raw materials, saves materials and reduces waste generation. Knowing that a reliable and effective system exists to manage battery expiration reassures potential customers about long-term sustainability and environmental impact posed by their choice of vehicle This could have a positive impact on BEV adoption by addressing battery drainage concerns.

4. Domestic Manufacturer

Battery electric vehicle adoption is influenced by domestic production since it lowers costs, fosters employment growth, and increases economic output. BEVs are more possible reasonably priced correlated to local production, which also removes import fees, transportation costs, and logistical charges. Additionally, being close to suppliers and component producers lowers production costs and improves supply

chain efficiency, which increases the appeal and accessibility of BEVs to a larger spectrum of consumers. As a result, adoption rises, and related businesses like software development, battery production, and infrastructure for charging thrive. Collaboration between automakers, suppliers, and research institutions fosters technological innovation and knowledge transfer within the nation and advances the technology of electric vehicles. The domestic manufacturer has influence on adoption of EVs (Adhikari et al., 2020).

III.3.4 Government Support

Governments can use policies, market-based regulations, or information-provision strategies to promote the use of electric vehicles. These policies, which might take the form of financial, direct subsidies, education campaigns, or regulatory changes, can help increase the share of EV sales and attract shareholders to invest more.

1. Financial Incentive

It is the incentive grand to the vehicle owner like an import tax reduction, road tax exception, and direct subsidy. The gape in purchase price between BEVs and ICEVs is huge so to decrease this gape is significant to up take EVs market. Government in some countries set up the incentive. For instance, Norway government is recognised the most generous and ambition in EVs adoption. Form 2021 BEVs registration fee is excepted, and the following year VAT is also included. Purchase subsidies also grand to vehicle owner. Not only support consumer, but subsidy is also imposed to supplier and charging station facility[11].

[11] (Incentives and Legislation | European Alternative Fuels Observatory, n.d.)

2. Convenience Incentive

It refers to privileged services that government could offer to vehicle owners such as parking, free charging, and special road land. Along with financial aid, privileged services like Norway's E-Number plate for electric cars and regional toll highways have drawn customers. These services help promote electric vehicles and increase public knowledge of clean transportation options.

3. Policy and Standard

A long-term strategy is required because the electric car sector is still in early stage and needs government policy support to expand. To entice people to purchase EVs, nations like China and the United States provide subsidies, tax breaks, and exemptions. Financial inducements like subsidies, favourable tax treatment, and free parking have a positive effect on the uptake of EVs by consumers. Moreover, the effective of the adoption is not drive from a single policy but the mix policy from the whole mechanism from supplier to consumer(Yong & Park, 2017)**.**

III.3.5 Reliable and Environmental Electricity Supply

Deployment of BEV result in more demand for electricity and the impact of increasing adoption on grid should be considered. The effectiveness of EV development for zero emissions is relies on the source of electricity generation. In case most of the energy mix are from fossil fuel or coal the emission continue. The generation from renewable energy sources is the catalyst to complete zero emissions plan. Meanwhile the availability of electricity supply is really a concern for developing countries. some developing countries still have low electrification rate.

Electricity distribution also the key component the create a quality electricity supply. The criteria for quality electricity supply and environmental are:

- ✧ Electricity generates from Renewable Energy Sources
- ✧ Adequate power generation to meet demand
- ✧ Stable electricity distribution

III.3.6 Consumer

The variable in demographic difference from consumer have influence on purchase intention (Huang & Ge, 2019). Due to their more expensive purchase prices compared to gasoline-powered vehicles, electric vehicles (EVs) play a key role in income when considering their adoption. Higher income and EV adoption have been found to be positively correlated in studies with higher earnings being associated with more willingness to pay. The adoption of EVs is also influenced by consumer education, with studies identifying low, moderate, and high educational levels. A high level of education effects EV purchases across all vehicle segments and raises consumers' willingness to pay for EVs (Stockkamp et al., 2021),. Battery Electric Vehicle (BEV) adoption is significantly influenced by product trust. The adoption rate of BEVs can be impacted by consumer confidence in the product and its ancillary features, reliability, and performance. The influence or perception of peer and social has possibly related to purchase decisions. Overall consumer really impacts to adoption and this study only focus four elements like: income, education, product trust, and social influence.

Table III-4 Factors Summery

Factor Category	Factor	Description
Technology	Driving Range	It is the optimal distance (km) that a car could reach within a full charge
	Charging Time	The time period that takes for the discharge battery to fully charge or the time driver spends on replacing the discharge battery to fully charge for electric vehicles
	Battery Life	It is the time of battery last before replacing a new battery.
	Model Varieties	The vehicle models are available in the market that provides options for the buyer to purchase based on their preferences.
Economic	Purchase Cost	It is the cost for own a vehicle or buying a vehicle.
	Operation Cost	It is the cost of materials like gasoline, diesel, and electricity to run a vehicle in km.
	Maintenance Cost	It is the expense of vehicle fixing and changing spare parts.
	Resale Value	The price of the vehicle is predicted in the market when the vehicle is sold again.
Infrastructure	Charging Station	It refers to amount public and private charging spots across the country.
	Service Centre & Equipment	The places provide vehicle maintenance services and spare parts.
	Battery cycling Facility	It refers to public or private companies that collected, store, and recycle the used battery.
	Domestic Manufacturer	It refers to the vehicle production that is located within the county.
Government Support	Financial Incentive	It is the direct incentive grand to the vehicle owner like an import tax reduction or road tax exception.
	Convenience Incentive	It refers to privileged services that government could offer to vehicle owners such as parking, free charging, and special road land.
	Policy and Standard	The support comes from the government through the creation of policies and standards in the BEV system.

Reliable and Environmental Electricity Supply	Enough Electricity Generation	There is an adequate amount of electricity generation to support demand across the county.
	Stable Electricity Distribution	Stable electricity distribution provides by both public and private companies.
	Renewable Energy Sources	Electricity generation comes from renewable energy sources.
Consumer	Product Trust	It refers to the faith and value that consumers have in products, especially in new technology products.
	Social Influence	It refers to the influence of social groups like friends, neighbours, or social media on individual decisions.
	Income	It is the amount of money that an individual could earn per month.
	Education	The level of general education that an individual acquired (Middle school, High school, Bachelor, Master, Ph.D. ...etc)

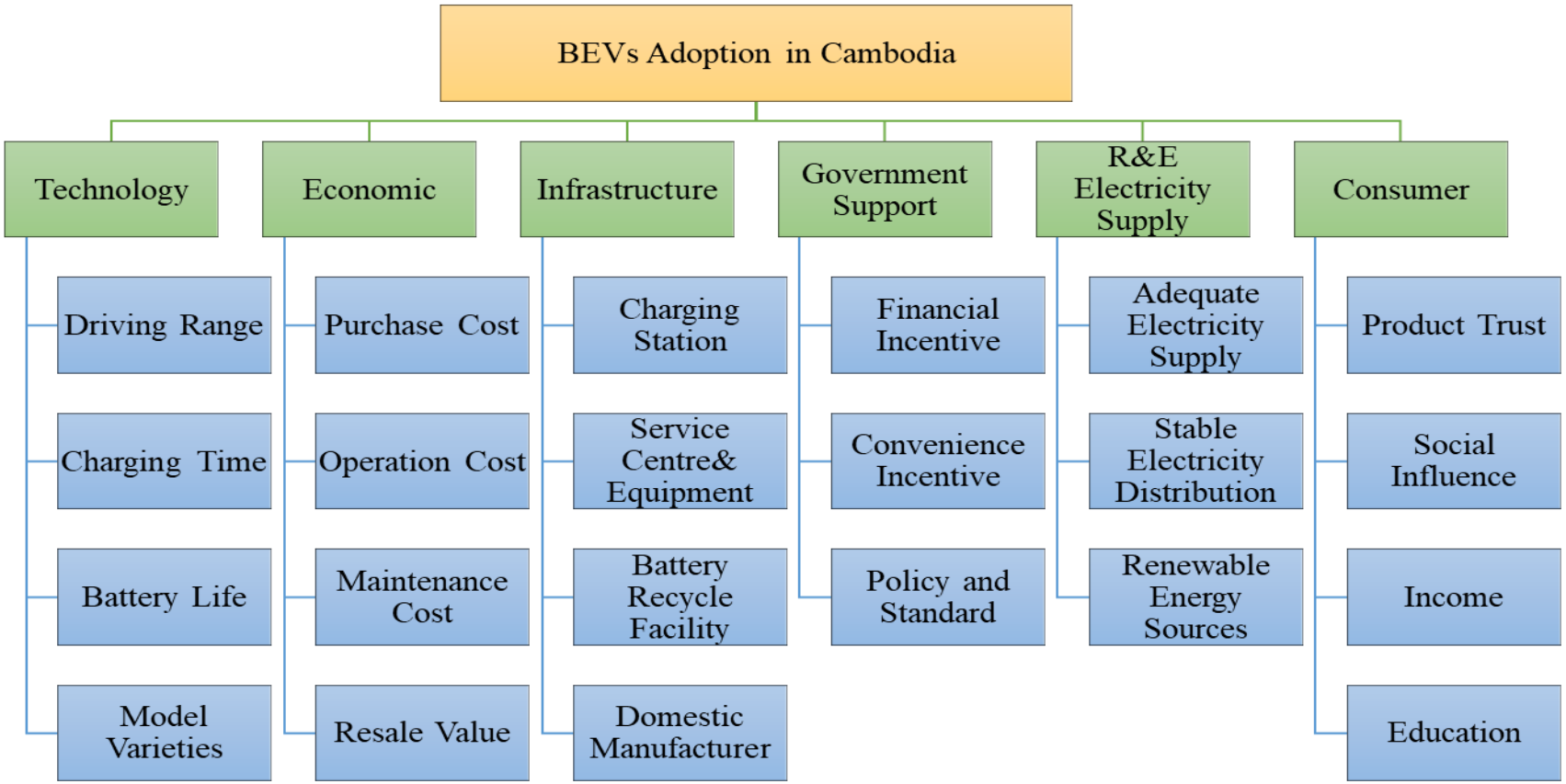

Figure III-3: AHP Hierarchy Structure of Factors Associated with BEVs Adoption

III.4 Questionnaire Design

This questionnaire explores expert judgment on ranking the factors that influence BEV adoption in Cambodia by factor pair-wise comparison. The questionnaire consists of three sections and the first section is for the general information of respondents. The second section is the pair-wise comparison for 4-wheel vehicles (passenger cars) and the third section is the pair-wise comparison for the 2-wheel and 3-wheel vehicles (motorcycles, scooters, and tricycles). In the second and third sections, the expert gives their judgment on factor as well as factor category. The exports are expected from the public sector, private sector, academia, and nonprofit organizations (NGOs). Through the questionnaire, data about the relative importance of factors and factor categories respected to the goal (BEV Adoption) is obtained by pair-wise comparison. This comparison is core data in AHP. In this study, the hierarchy of the model consists of three levels. The first level is the goal of this research which is BEV adoption in Cambodia. The second level is the factor category which has 6-factor categories, and the third level is the factor which accounts for 22 factors. The whole questionnaire is in the Appendix and the table below is an example of scaling in the questionnaire. The scale is nine points to the left and nine points to the right that indicates the level of relative importance of each pair. The detail verbal meaning and number scaling is describe in table III-3 above For example, in technology category the respondents need to give their judgement on driving range vs Model variety. If they thought that these two factors are equally important so they selected number (1). If respondents thought that Driving range is strongly important than Model varieties, they

selected number (5) on the left side. If they thought that Model varieties is strongly important than Driving range, they selected number (5) on the right side. The process is the same with other pairs.

Table III-5: Scaling in the questionnaire

With Respect to the Technology for the BEV adoption of a 4-wheel vehicle (passenger car)																	
Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Variety
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Variety

a. It indicates that Factor A (Driving Range) and Factor B (Model Variety) are equally important in the Technology category.

b. It indicates that Factor B (Model Variety) is Strongly important compared to Factor A (Driving Range) in the Technology category

III.5 Data Collection

In this study the survey was conducted by online and total respondents are 39. Respondents are experts from public institution, private company, non-government organization and academia. Respondents were divided in two groups: local expert and regional expert. The local experts are 25 experts from Cambodia while regional experts are 12 experts from Southeast Asian region. The majority of them got 4-10 years experiences. 51% of respondents are in public sector, 23% are from private sector, 18% are from academia and 8% are from non-government organization.

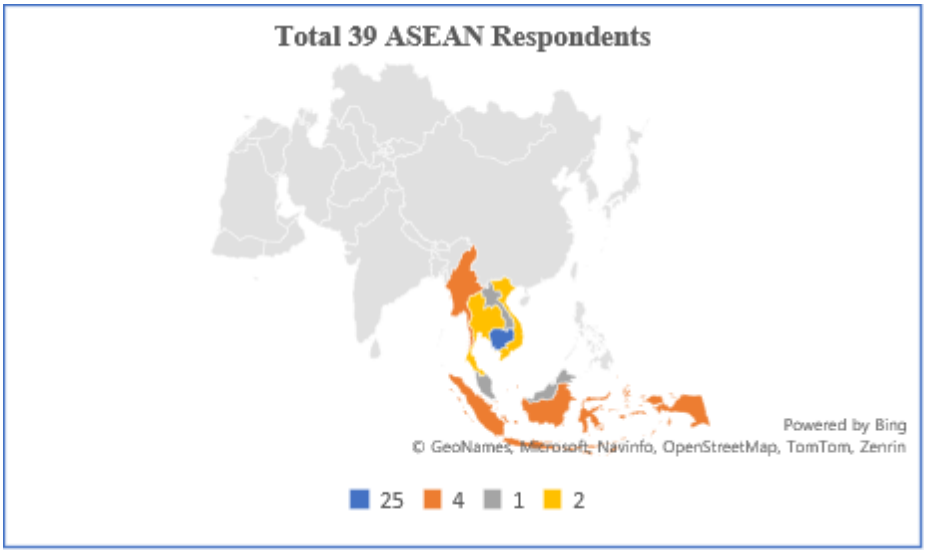

Figure III-4 Number of dependents and their countries

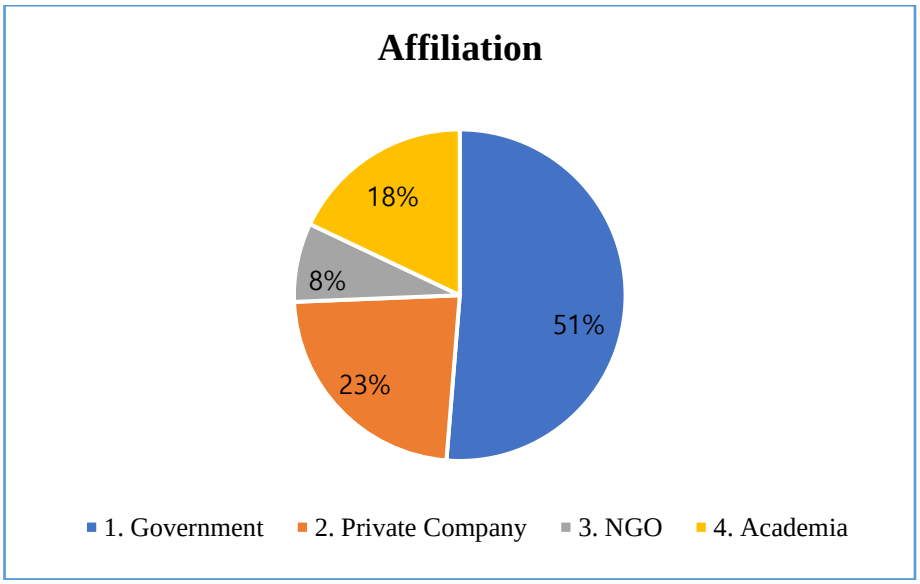

Figure III-5 Respondents affiliation

IV. Analysis, Results, and Discussion

This chapter describes the analysis process and results, and the steps taken to get conclusions from the data that were gathered. The empirical findings from the use of the AHP methodology are examined and presented.

IV.1 Result of 2- and 3-wheel BEV Adoption

IV.1.1 Result of Overall Aggregated Evaluation of Each Category

As shown in Table 1 and Figure 1, the category "Government Support" is given the highest priority, with a weight of 20.42%. With a weight of 18.21%, "Renewable and Energy Electricity Supply" is close behind. With a weight of 16.89%, "Infrastructure" is the third most weighted category. While "Economic" is given a weight of 14.80%, "Technology" is given a weight of 14.90%. Finally, the "Consumer" group has the lowest weight, with 14.78%. These percentages show how various categories are prioritized according to their relative value influencing BEV adoption for 2-and 3-wheel vehicles in Cambodia.

Table IV-1: Ranking of Factor Category Associated with BEV Adoption for 2- and 3-Wheel Vehicles

Category	Priority Weight	Priority Weight (%)	Rank
Technology	0.1490	14.90	4
Economic	0.1480	14.80	5
Infrastructure	0.1689	16.89	3

Government Support	0.2042	20.42	1
R&E Electricity Supply	0.1821	18.21	2
Consumer	0.1478	14.78	6

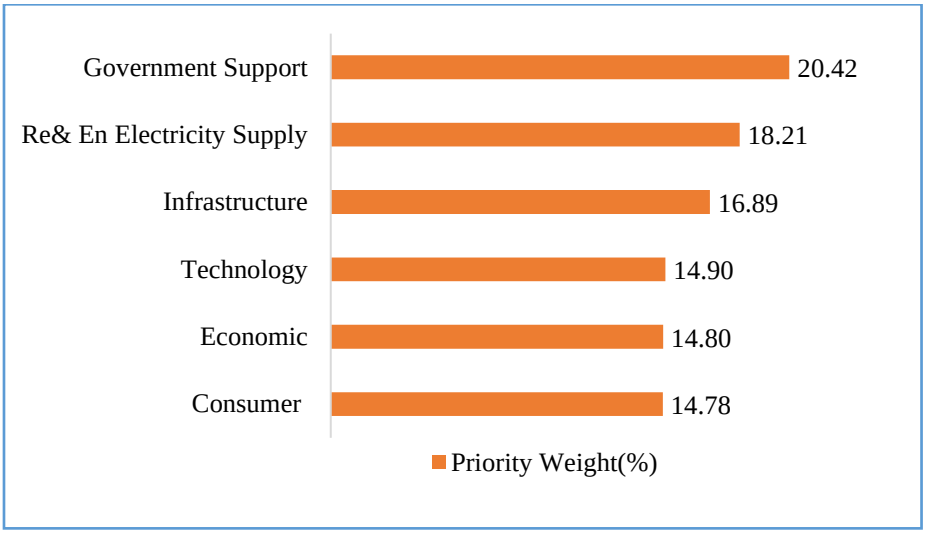

Figure IV-1: Factor Category Prioritization (2-and 3-wheel vehicles)

IV.1.2 Result of Priority Weight within Each Factor Category

All the Factors allocated to each category were weighted. For Technology Category, four factors were evaluated. Results in Table 2 and Figure 2 indicate "Battery Life" has the highest priority weight among the factors in the Technology category, with a weight of 35.75%. With a priority weight of 26.83%, "Charging Time" comes in second place, followed by "Driving Range" (19.80%), and "Model Varieties" (17.62%), which has the lowest priority weight.

Table IV-2 Ranking of Each Factor in the Technology Category (2-and 3-wheel vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Driving Range	0.1980	19.80	3
Charging Time	0.2683	26.83	2
Battery Life	0.3575	35.75	1
Model Varieties	0.1762	17.62	4

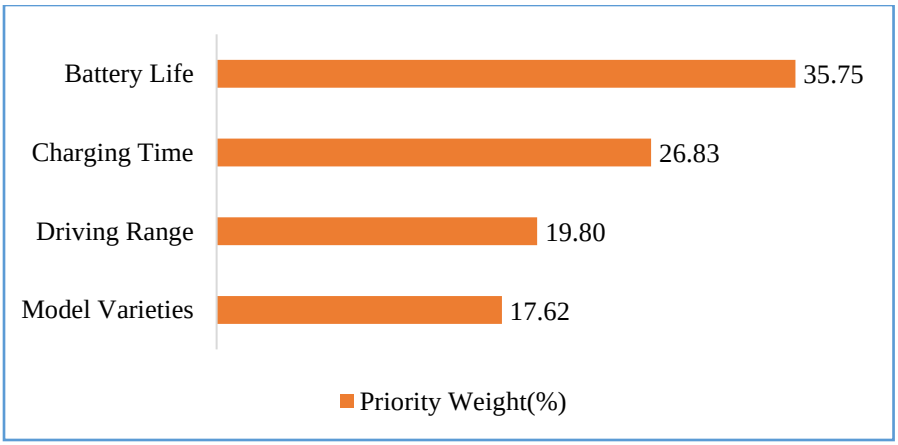

Figure IV-2: Factors' Priority Weight within the Technology Category (2-and 3-wheel vehicles)

In Economic Category, as shown in Table 3 and Figure 3 indicate that Purchase Cost has the top priority weight among four factors with a percentage (30.24%), followed by maintenance Cost (26.93%), Operation Cost (22.23%), and the less weight is Resale Value (20.60%).

Table IV-3: Ranking of Each Factor in the Economic Category (2-and 3-wheel vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Purchase Cost	0.3024	30.24	1
Charging Time	0.2223	22.23	3
Battery Life	0.2693	26.93	2
Model Varieties	0.2060	20.60	4

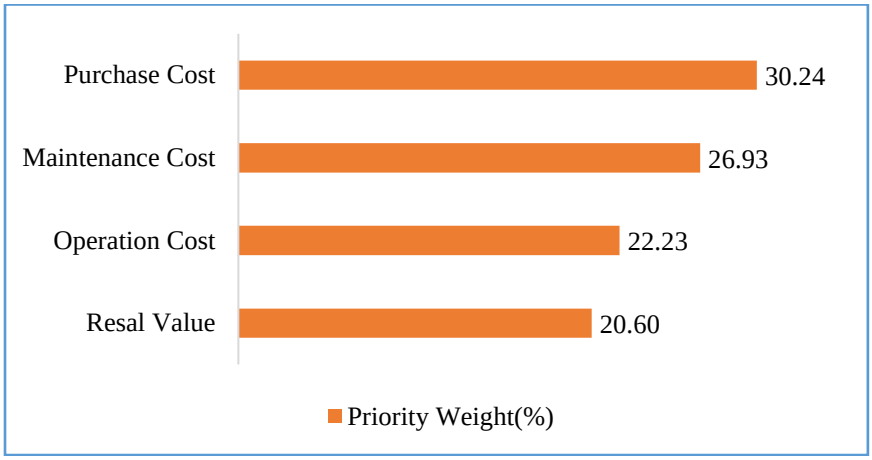

Figure IV-3: Factors' Priority Weight within the Economic Category (2-and 3-wheel vehicles)

Regarding the data shown in Table 4 and Figure 4, "Charging Station" has the highest priority weight in the infrastructure category at 29.24%. With a priority weight of 28.05%, "Domestic Manufacturer" is closely following. At 21.74%, "Battery Cycling Facility" is the factor with the third-highest priority weight. The final item has the lowest priority weight (20.97%), which is "Service Centre & Equipment".

Table IV-4: Ranking of Each Factor in the Infrastructure Category (2-and 3-wheel vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Charging Station	0.2924	29.24	1
Service Centre &Equipment	0.2097	20.97	4
Battery cycling Facility	0.2174	21.74	3
Domestic Manufacturer	0.2805	28.05	2

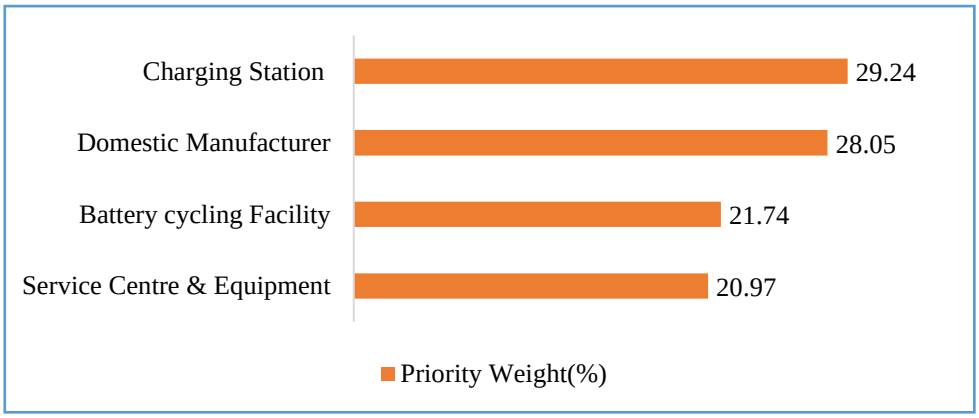

Figure IV-4: Factors' Priority Weight within the Infrastructure Category (2- and 3-wheel vehicles)

In the category of government support, according to the results in Table 5 and Figure 5, "Financial Incentive" has the highest priority weight (41.91%). With a priority weight of 32.20%, the factor "Policy & Standard" comes in second place. The "Convenient Incentive" factor has the lowest percentage weight, with a value of 25.89%.

Table IV-5: Ranking of Each Factor in the Government Support Category (2- and 3-wheel vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Financial Incentive	0.4191	41.91	1
Convenient Incentive	0.2589	25.89	3
Policy & Standard	0.3220	32.20	2

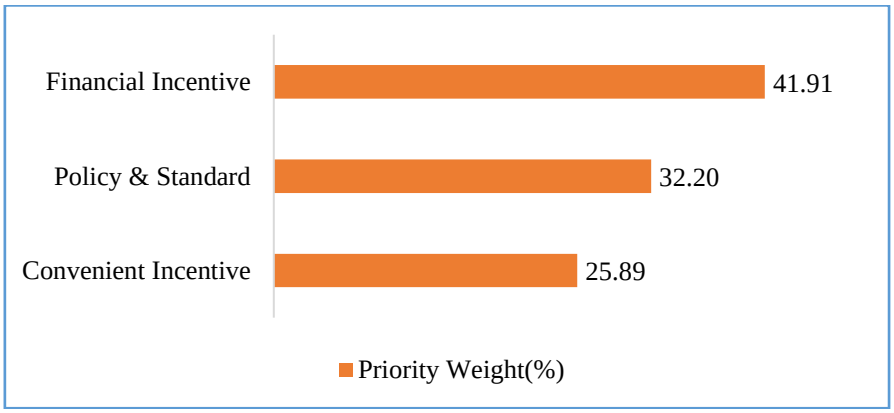

Figure IV-5: Factors' Priority Weight within the Infrastructure Category (2- and 3-wheel vehicles)

For the Reliable and Environmental Electricity Supply Category the data shown in Table 6 and Figure 6, "Adequate Electricity Generation" has the highest priority weight at 35.88%. With a priority weight of 33.75%, "Renewable Energy Sources" is narrowly following. The final item has the lowest priority weight (30.37%), which is "Stable Electricity Distribution"

Table IV-6: Ranking of Each Factor in the Reliable and Environmental Electricity Supply Category (2-and 3-wheel vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Adequate Electric Generation	0.3588	35.88	1
Stable Electricity Distribution	0.3037	30.37	3
Renewable Energy Sources	0.3375	33.75	2

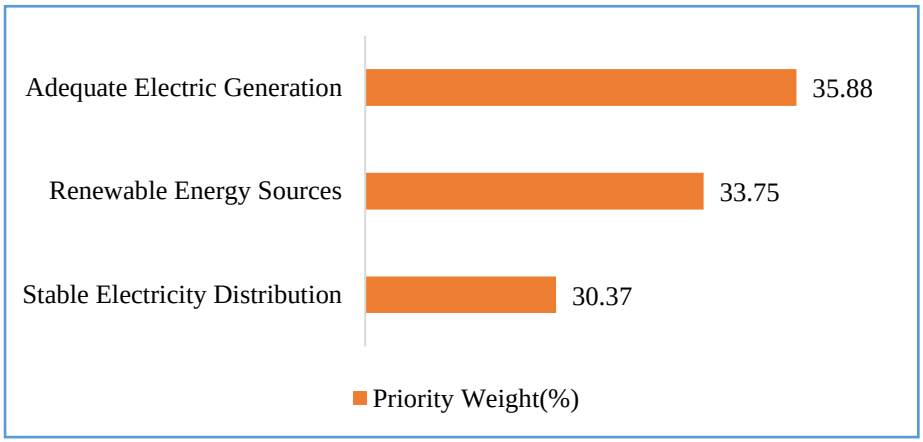

Figure IV-6: Factors' Priority Weight within Environmental Electricity Supply Category (2-and 3-wheel vehicles)

For the final Category is Consumer four factors are evaluated. As the data illustrated in Table 7 and Figure 7, the top priority factor is Income accounting for 35.17%, followed by Education at 27.01%, Product Trust at 24.32%, and the lowest one is Social Influence at 13.50%.

Table IV-7: Ranking of Each Factor in the Consumer Category (2-and 3-wheel vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Product Trust	0.2432	24.32	3
Social Influence	0.1350	13.50	4
Income	0.3517	35.17	1
Education	0.2701	27.01	2

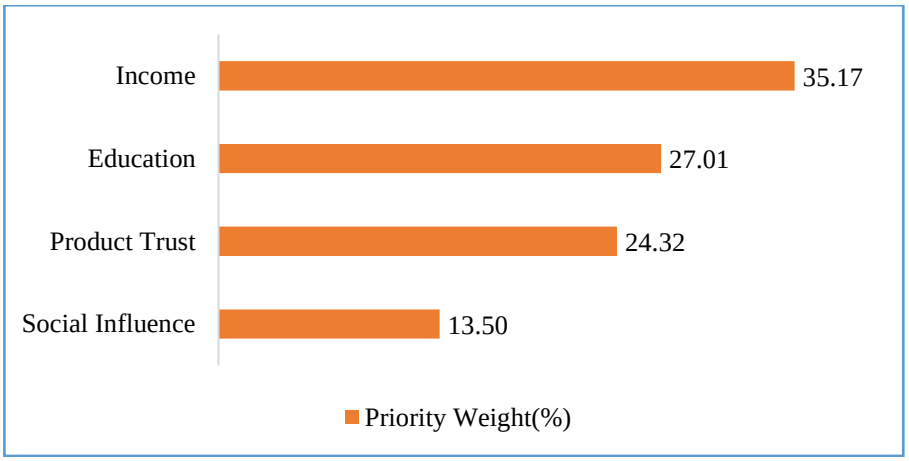

Figure IV-7: Factors' Priority Weight within Environmental Electricity Supply Category (2-and 3-wheel vehicles)

IV.1.3 Overall Factors Ranking

The overall ranking of Factors that are associated with BEV adoption for 2-and 3- wheel vehicles is based on the overall priority weight from each factor multiple with their Category weight. The results of the calculation based on Table 8 and Figure 8 indicate that the factor that has the highest priority on BEV adoption for 2-and 3- wheel vehicles in Cambodia is Financial Incentive (8.56%), followed by Policy and Standard (6.58%), Adequate Electricity Generation (6.53%), Renewable Energy sources (6.14%), and Stable Electricity Distribution (5.53%). These are the top 5 factors that weigh above (5%). Next, the factors that got weight between (4%-5.33%) are Battery Life (5.33%), Convenient Incentive (5.29%), Income (5.20%), Charging Station (4.94%), Domestic Manufacturer (4.74%), Purchase Cost (4.47%), and Charging Time (4.0%), in that order. These factors were classified in the rank from sixth to twelfth respectively. Then, the remaining factors were ranked from thirteenth to twenty seconds has a weight from 3.99% to 2%. The rankings of the factors were reviewed in each group of experts, but there were no significant variations in the results. Thus, the entire results are provided within these aggregated results. The rankings and weights of each factor are depicted in Figure 8.

Table IV-8: The Priority Weight and Ranking of Factors Associated with BEV Adoption for 2- and 3-wheel Vehicles

Factor Category	Priority Weight	Factor	Priority Weight	Overall, Weight	Overall, Weight%	Rank
Technology	0.1490	Driving Range	0.1980	0.0295	2.95	20
		Charging Time	0.2683	0.0400	4.00	12
		Battery Life	0.3575	0.0533	5.33	6
		Model Varieties	0.1762	0.0263	2.63	21
Economic	0.1480	Purchase Cost	0.3024	0.0447	4.47	11
		Operation Cost	0.2223	0.0329	3.29	18
		Maintenance Cost	0.2693	0.0398	3.98	14
		Resale Value	0.2060	0.0305	3.05	19
Infrastructure	0.1689	Charging Station	0.2924	0.0494	4.94	9
		Service Centre & Equipment	0.2097	0.0354	3.54	17
		Battery cycling Facility	0.2174	0.0367	3.67	15
		Domestic Manufacturer	0.2805	0.0474	4.74	10
Government support	0.2042	Financial Incentive	0.4191	0.0856	8.56	1
		Convenient Incentive	0.2589	0.0529	5.29	7
		Policy & Standard	0.3220	0.0658	6.58	2

Reliable and environmental electricity supply	0.1821	Adequate Electric Generation	0.3588	0.0653	6.53	3
		Stable Electricity Distribution	0.3037	0.0553	5.53	5
		Renewable Energy Sources	0.3375	0.0614	6.14	4
Consumer	0.1478	Product Trust	0.2432	0.0359	3.59	16
		Social Influence	0.1350	0.0200	2.00	22
		Income	0.3517	0.0520	5.20	8
		Education	0.2701	0.0399	3.99	13

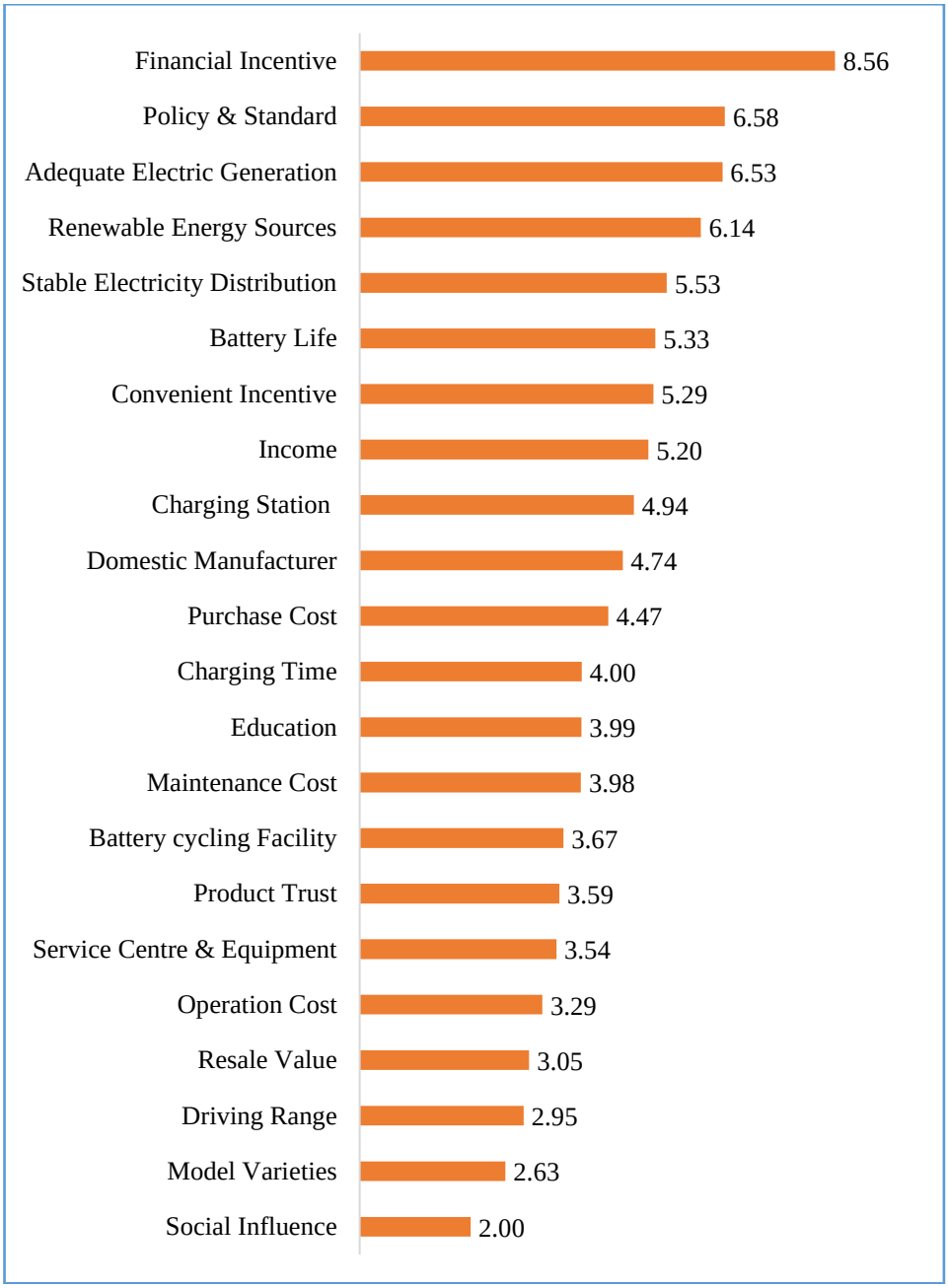

Figure IV-8: Overall Priority Weight of Each Factor (2-and 3-wheel vehicles)

IV.2 Result of 4-wheel Adoption

IV.2.1 Result of Overall Aggregated Evaluation of Factor Category

Six-factor categories were evaluated and based on the results shown in Table 9 and Figure 9 below, the categories are ranked according to the percentage of priority weight. The category with the highest priority weight percentage, 21.51%, is government support. The Economic category is closely followed, with a priority weight of 18.41%. The third greatest priority weight percentage, 17.94%, is held by the category of electricity supply. Infrastructure is next in line with a priority weight of 15.71%. With a priority weight percentage of 15.86%, the Technology category is ranked sixth in importance. The Consumer category has the lowest priority weight percentage (10.57%). These percentages show how these categories are prioritized according to their relative value influencing BEV adoption for 4-wheel vehicles in Cambodia.

Table IV-9: Ranking of Factor Category Associated with BEV Adoption for 4-Wheel Vehicles

Category	Priority Weight	Priority Weight (%)	Rank
Technology	0.1586	15.86	4
Economic	0.1841	18.41	2
Infrastructure	0.1571	15.71	5
Government Support	0.2151	21.51	1
R&E Electricity Supply	0.1794	17.94	3

Consumer	0.1057	10.57	6

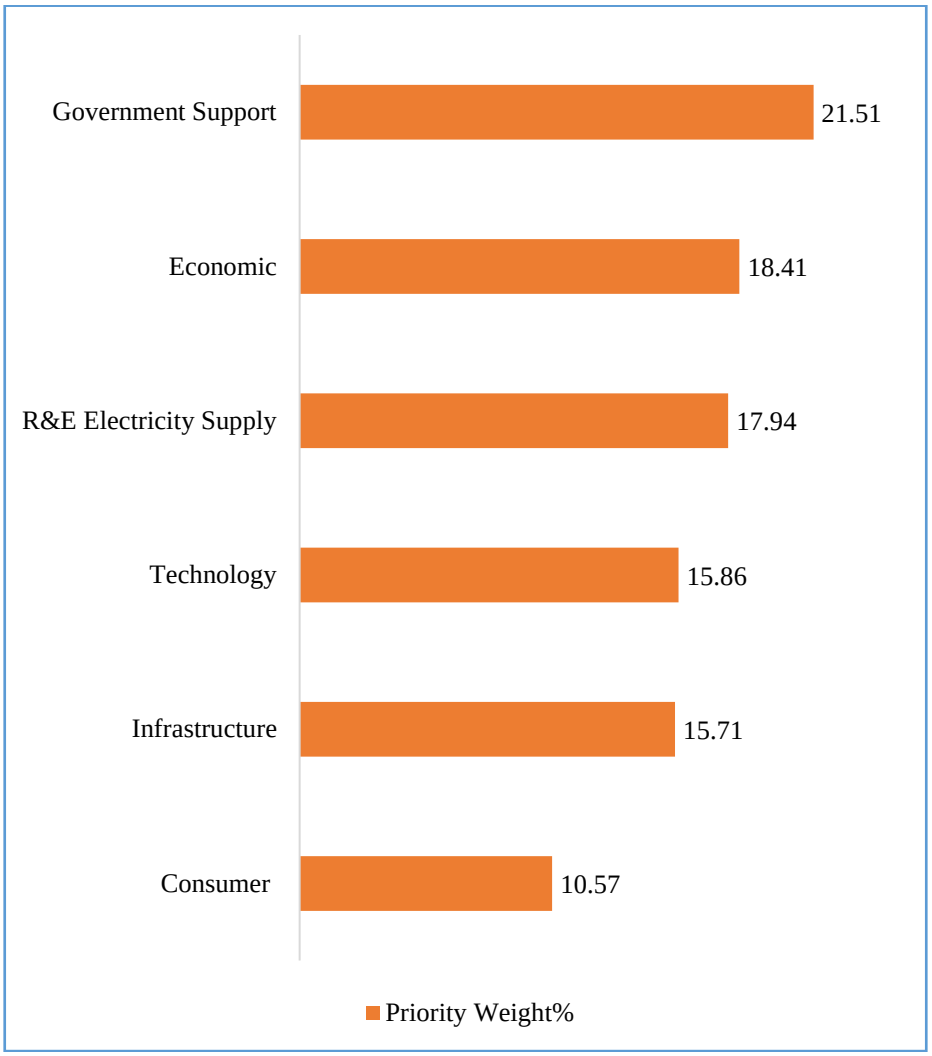

Figure IV-9: Factor Category Prioritization (4-wheel vehicles)

IV.2.2 Result of Priority Weight within Each Factor Category

All the Factors allocated to each category were weighted. For Technology Category, four factors were evaluated. Results in Table 10 and Figure 10 indicate "Battery Life" has the highest priority weight among the factors in the Technology category, with a weight of 32.35%. With a priority weight of 27.10%, "Charging Time" comes in second place, followed by "Driving Range" (24.41%), and "Model Varieties" (16.14%), which has the lowest priority weight.

Table IV-10: Ranking of Each Factor in the Technology Category (4-wheel vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Driving Range	0.2441	24.41	3
Charging Time	0.2710	27.10	2
Battery Life	0.3235	32.35	1
Model Varieties	0.1614	16.14	4

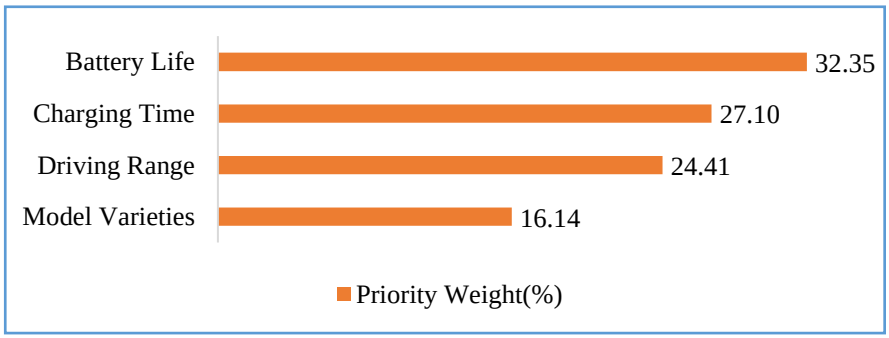

Figure IV-10: Factors' Priority Weight within the Technology Category (4-wheel Vehicles)

According to the data presented in Table 11 and Figure 11, the factors are ordered from highest to lowest priority weight percentage within the Economic category. "Maintenance Cost" has the greatest priority weight percentage of any factor, at 29.77%. The factor "Purchase Cost" comes in second place, with a priority weight percentage of 26.01%. "Operation Cost" is ranked third in priority weight percentage, with a value of 25.07%, while "Resale Value" is ranked last, with a value of 19.15%.

Table IV-11: Ranking of Each Factor in the Economic Category (4-wheel Vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Purchase Cost	0.2601	26.01	2
Charging Time	0.2507	25.07	3
Battery Life	0.2977	29.77	1
Model Varieties	0.1915	19.15	4

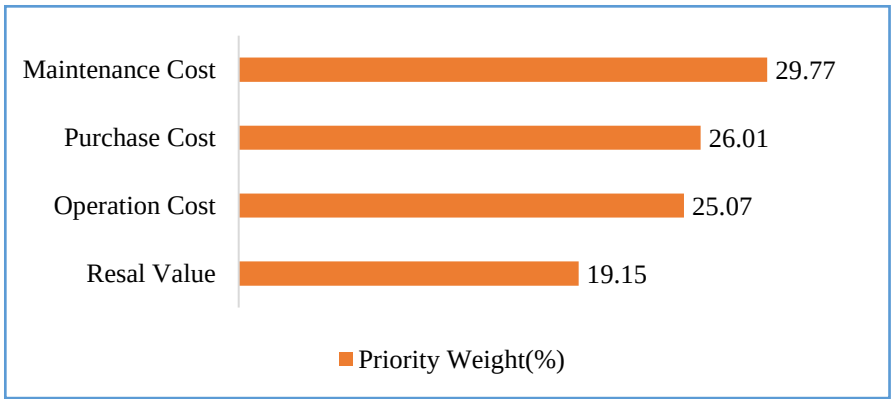

Figure IV-11: Factors' Priority Weight within the Economic Category (4-wheel Vehicles)

"Charging Station" has the highest priority weight in the infrastructure category at 36.12%. as shown in Table 12 and Figure 12. With a priority weight of 24.72%, "Domestic Manufacturer" is closely following. At 21.22%, "Service Centre & Equipment" is the factor with the third-highest priority weight. The final item has the lowest priority weight (17.94%), which is the "Battery Cycling Facility".

Table IV-12: Factors' Priority Weight within the Infrastructure Category (4-wheel Vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Charging Station	0.3612	36.12	1
Service Centre &Equipment	0.2122	21.22	3
Battery cycling Facility	0.1794	17.94	4
Domestic Manufacturer	0.2472	24.72	2

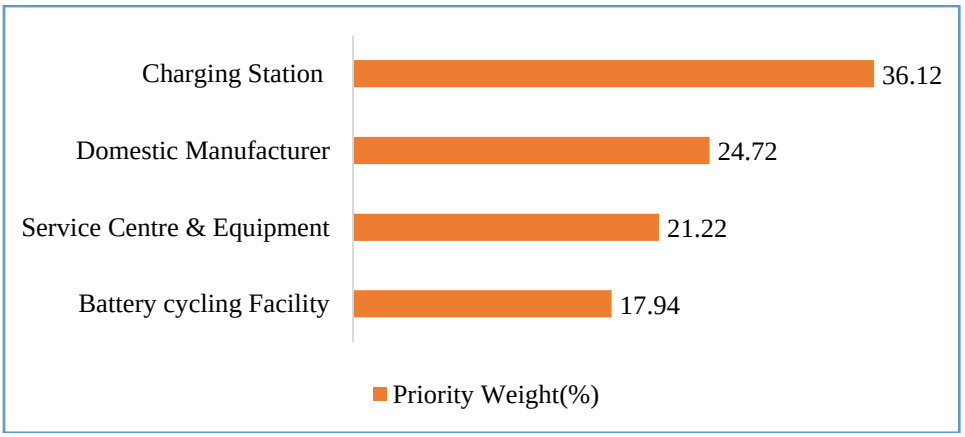

Figure IV-12: Factors' Priority Weight within Infrastructure Category (4-wheel Vehicles)

In the category of government support, "Financial Incentive" has the highest priority weight (41.70%). With a priority weight of 30.38%, the factor "Policy & Standard" comes in second place. The "Convenient Incentive" factor has the lowest percentage weight, with a value of 27.92%. Based on the results shown in Table 13 and Figure 13.

Table IV-13: Factors' Priority Weight Within Government Support Category (4-wheel Vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Financial Incentive	0.4170	41.70	1
Convenient Incentive	0.2792	27.92	3
Policy & Standard	0.3038	30.38	2

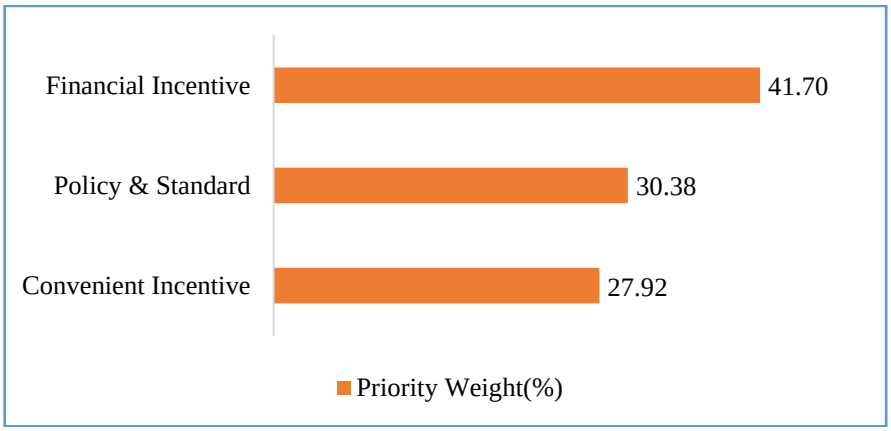

Figure IV-13: Factors' Priority Weight within Government Support Category (4-wheel Vehicles)

For the Reliable and Environmental Electricity Supply Category the data shown in Table 14 and Figure 14 below "Renewable Energy Sources" has the highest priority weight at 35.57%, followed closely by "Adequate Electricity Generation" with a priority weight of 34.32%. The final factor has the lowest priority weight (30.11%) which is "Stable Electricity Distribution."

Table IV-14: Factors' Priority Weight Within Reliable and Environmental Electricity Supply Category (4-wheel Vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Adequate Electric Generation	0.3432	34.32	2
Stable Electricity Distribution	0.3011	30.11	3
Renewable Energy Sources	0.3557	35.57	1

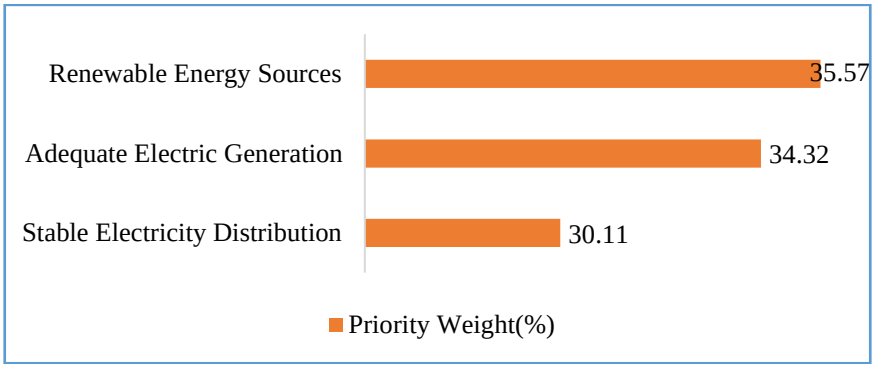

Figure IV-14: Factors' Priority Weight within Reliable and Environmental Electricity Supply Category (4-wheel Vehicles)

The final Category is Consumer, and four factors are evaluated. The top priority factor is Income accounting for 36.20%, followed by Product Trust at 26.40%, Education at 24.32%, and the lowest one is Social Influence at 14.35%. As the results are illustrated in Table 15 and Figure 15 below.

Table IV-15: Factors' Priority Weight Within Consumer Category (4-wheel Vehicles)

Factor	Priority Weight	Priority Weight (%)	Rank
Product Trust	0.2640	26.40	2
Social Influence	0.1435	14.35	4
Income	0.3620	36.20	1
Education	0.2305	23.05	3

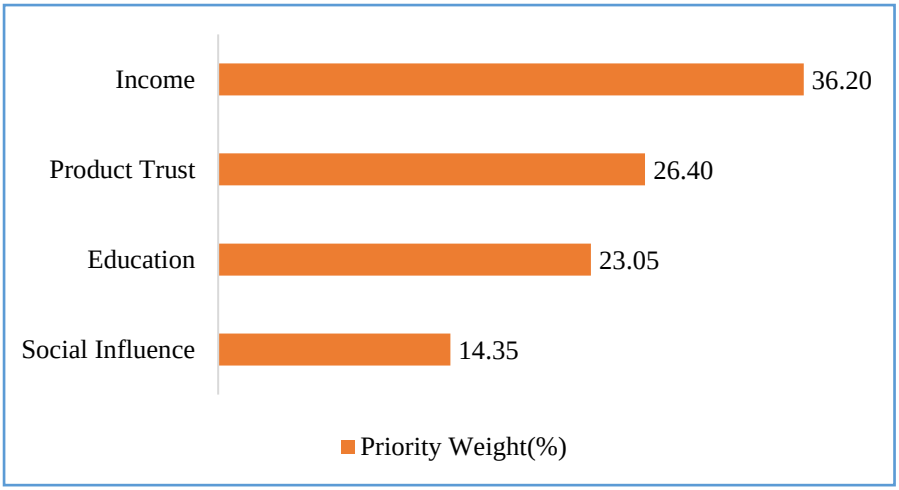

Figure IV-15: Factors' Priority Weight within Consumer Category (4-wheel Vehicles)

IV.2.3 Overall Factors Ranking

The overall priority weight of each factor was obtained by multiplication between the weight of the individual factor and its category weight. The overall ranking of Factors that are associated with BEV adoption for 4-wheel vehicles is based on the overall priority weight of each factor. Based on Table 16 and Figure 16 underneath shows that the factor that has the highest priority is Financial Incentive (8.97%), followed by Policy and Standard (6.53%), Renewable Energy sources (6.38%), Adequate Electricity Generation (6.16%), Convenient Incentive (6.0%), Charging Station (5.68%), and Maintenance Cost (5.48%). These factors are ranked first to seventh respectively with weights (8.97%-5.48%). Stable Electricity Distribution (5.40%), Battery Life (5.13%), Purchase Cost (4.79%), Operation Cost (4.62%), Charging Time (4.3%), Domestic Manufacturer (3.88%), Driving Range (3.87%), and Resale Value (3.53%) are the next factors that received weight between (5.40%-3.53%). These elements were ranked eighth through sixteenth, respectively. The remaining factors were ranked from 17th to 22nd with a weight between 3.33% to 1.52%. Each expert group examined the factor rankings, but there were no appreciable differences in the outcomes. As a result, these aggregated results provide the overall ranking.

Table IV-16: The Priority Weight and Ranking of Factors Associated with BEV Adoption for 4-Wheel Vehicles

Factor Category	Priority Weight	Factor	Priority Weight	Overall, Weight	Overall, Weight%	Rank
Technology	0.1586	Driving Range	0.2441	0.0387	3.87	14
		Charging Time	0.2710	0.0430	4.30	12
		Battery Life	0.3235	0.0513	5.13	9

		Model Varieties	0.1614	0.0256	2.56	20
Economic	0.1841	Purchase Cost	0.2601	0.0479	4.79	10
		Operation Cost	0.2507	0.0462	4.62	11
		Maintenance Cost	0.2977	0.0548	5.48	7
		Resale Value	0.1915	0.0353	3.53	16
Infrastructure	0.1571	Charging Station	0.3612	0.0568	5.68	6
		Service Centre & Equipment	0.2122	0.0333	3.33	17
		Battery cycling Facility	0.1794	0.0282	2.82	18
		Domestic Manufacturer	0.2472	0.0388	3.88	13
Government support	0.2151	Financial Incentive	0.4170	0.0897	8.97	1
		Convenient Incentive	0.2792	0.0600	6.00	5
		Policy & Standard	0.3038	0.0653	6.53	2
Reliable and environmental electricity supply	0.1794	Adequate Electric Generation	0.3432	0.0616	6.16	4
		Stable Electricity Distribution	0.3011	0.0540	5.40	8
		Renewable Energy Sources	0.3557	0.0638	6.38	3
Consumer	0.1057	Product Trust	0.2640	0.0279	2.79	19
		Social Influence	0.1435	0.0152	1.52	22
		Income	0.3620	0.0383	3.83	15
		Education	0.2305	0.0244	2.44	21

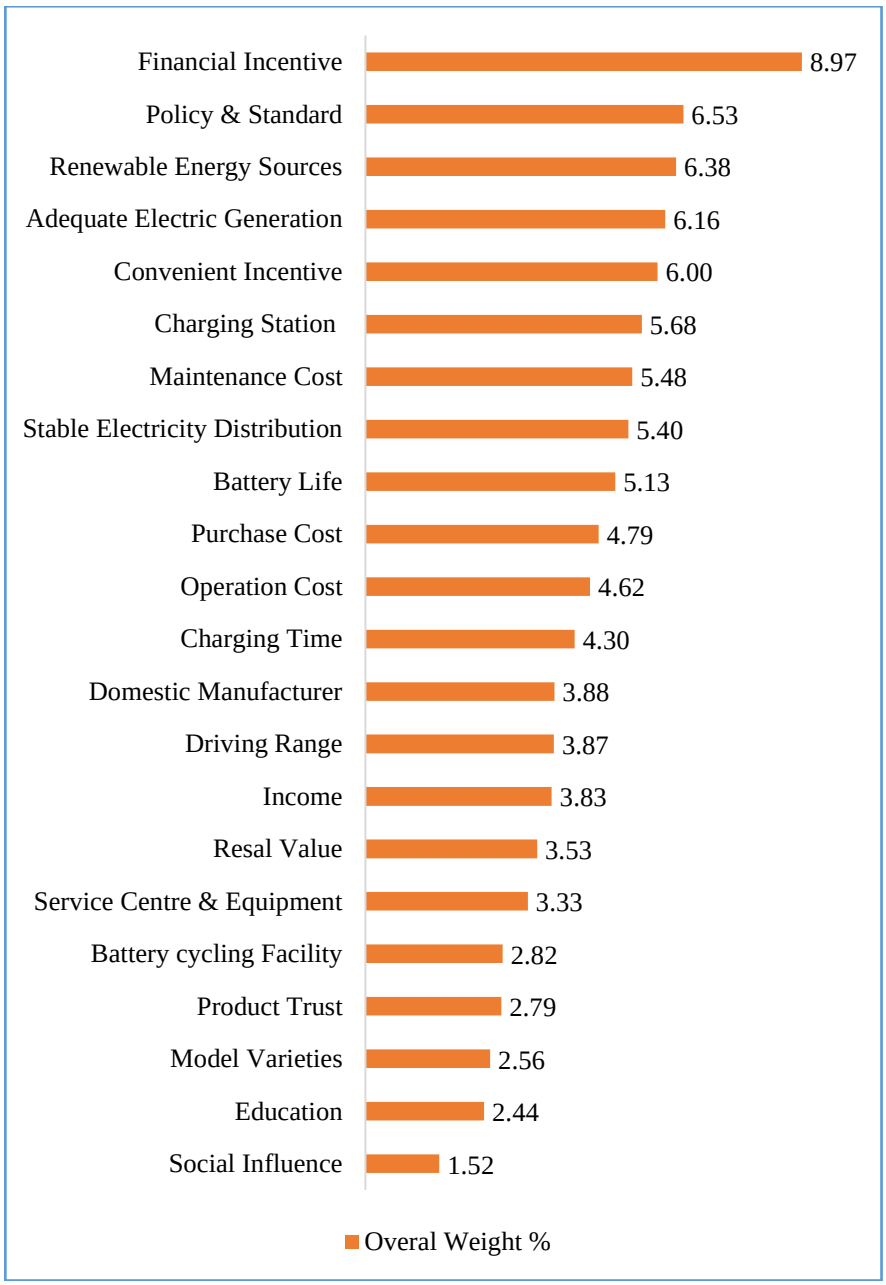

Figure IV-16: Overall Priority Weight of Each Factor (4-wheel vehicles)

IV.3 Comparison of Results Priority Weight between 4-wheel vehicles and 2-and 3-wheel vehicles

IV.3.1 Comparison Priority Weight of Factor Categories

Experts evaluated six-factor categories for both vehicle types. As the results in Table 17 and Figure 17 below indicate that three-factor categories stay in the same rank in both vehicle types. Government support got the highest priority with a percentage of 20.42% in 2- and 3-wheel and 21.53% in 4-wheel. The consumer got the lowest rank for both cases. Reliable and Environmental Electricity Supply is also ranked highly in both cases, coming in at second and third place for 2- wheel and 4-wheel vehicles, with weight of 18.21% and 17.90%, respectively. While, Between the two types of automobiles, there are different rankings. Infrastructure comes in third for 2-and 3-wheels but drops to fifth for 4-wheels. Economic comes in sixth for 2- and 3-wheel yet moves up to second for 4-wheel vehicles.

Table IV-17: Comparison of Ranking Results of Factor Categories

Category	**2-3-wheel**		**4-wheel**	
	Priority Weight (%)	Rank	Priority Weight (%)	Rank
Technology	14.90	4	15.98	4
Economic	1.80	5	18.43	2
Infrastructure	16.89	3	15.61	5
Government Support	20.42	1	21.53	1
R&E Electricity Supply	18.21	2	17.90	3
Consumer	14.78	6	10.55	6

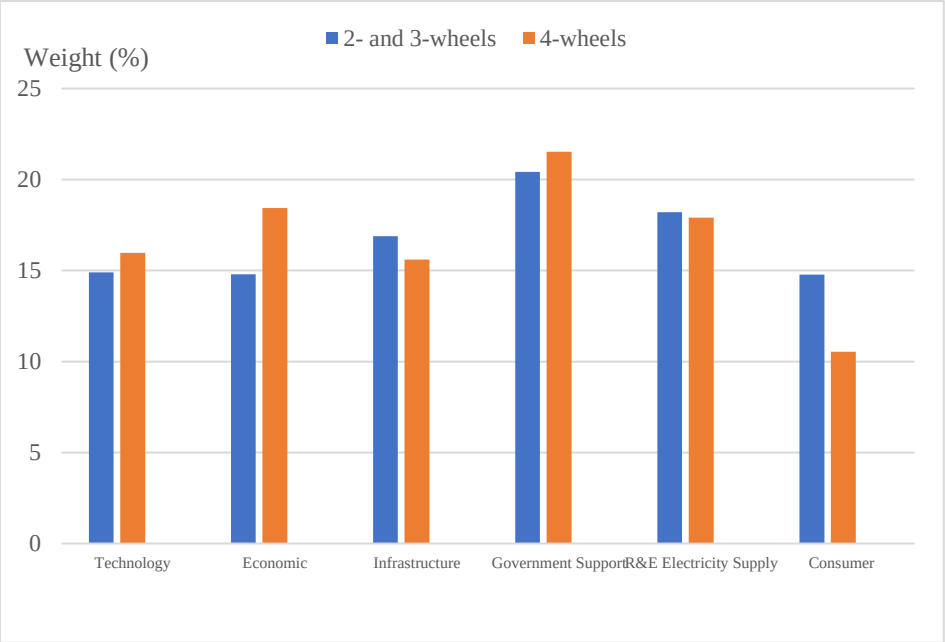

Figure IV-17: Comparison of Ranking Results of Factor Categories

IV.3.2 Comparison of Ranking Results within Each Category

Each factor within each category was examined for its differences between the two vehicle groups but there is no significant difference within these 5 categories (Technology, Infrastructure, Government Support, R&E Electricity Supply, and Consumer). However, noticeable differences appear within Economic Category as shown in Table 19 and Figure 19 below. For Economic Category only two factors got the same position, which is Operation Cost, third rank with 22.23% in 2-and 3-wheels and 24.31% in 4-wheels and resale value got the lowest rank in both cases. Purchase Cost got the first rank (30.24%) in 2-and 3-wheels yet it moves to the second position (20.66%) in 4-wheels. Maintenance Cost is the highest influence for 4-wheel vehicle with 29.77% and come to second factor for

motorcycle and tricycle. The comparison results of the overall ranking of each factor illustrate in Table 19.

Table IV-18: Comparison of Ranking within the Economic Category

Factor	2-and 3-wheel		4-wheel	
	Priority Weight (%)	**Rank**	**Priority Weight (%)**	**Rank**
Purchase Cost	30.24	1	26.01	2
Operation Cost	22.23	3	25.07	3
Maintenance Cost	26.93	2	29.77	1
Resale Value	20.60	4	19.15	4

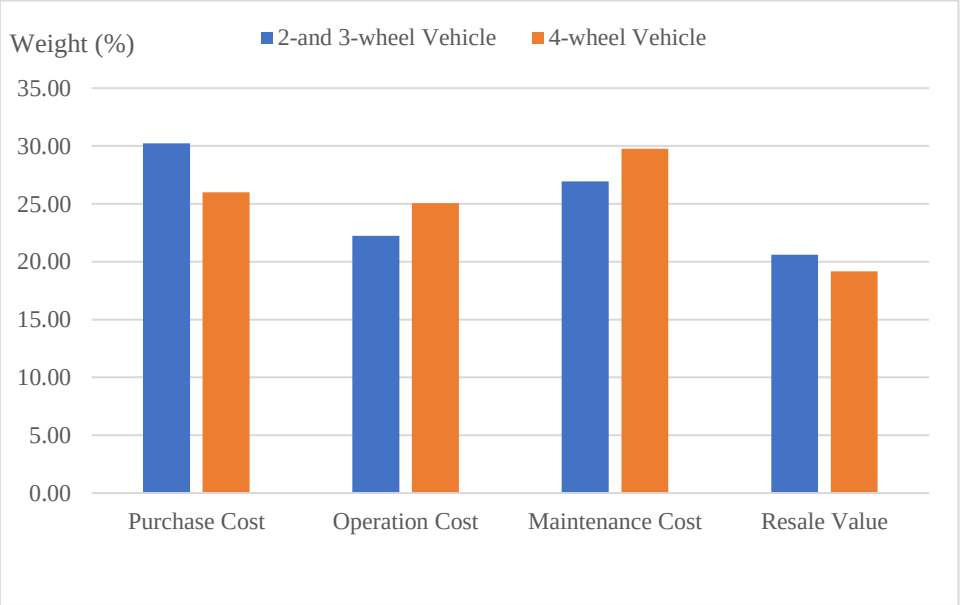

Figure IV-18: Comparison of Ranking within the Economic Category

Table IV-19: The comparison results of the overall ranking

Factor	2-and 3-wheel		4-wheel	
	Priority Weight (%)	Rank	Priority Weight (%)	Rank
Driving Range	2.95	20	3.87	14
Charging Time	4.00	12	4.30	12
Battery Life	5.33	6	5.13	9
Model Varieties	2.63	21	2.56	20
Purchase Cost	4.47	11	4.79	10
Operation Cost	3.29	18	4.62	11
Maintenance Cost	3.98	14	5.48	7
Resale Value	3.05	19	3.53	16
Charging Station	4.94	9	5.68	6
Service Centre & Equipment	3.54	17	3.33	17
Battery cycling Facility	3.67	15	2.82	18
Domestic Manufacturer	4.74	10	3.88	13
Financial Incentive	8.56	1	8.97	1
Convenient Incentive	5.29	7	6.00	5
Policy & Standard	6.58	2	6.53	2
Adequate Electric Generation	6.53	3	6.16	4

Stable Electricity Distribution	5.53	5	5.40	8
Renewable Energy Sources	6.14	4	6.38	3
Product Trust	3.59	16	2.79	19
Social Influence	2.00	22	1.52	22
Income	5.20	8	3.83	15

IV.4 Discussion

The result of this study showed that government support have a strong influence on BEV adoption in Cambodia for both vehicle types and financial incentive is top spot from overall ranking. Similarly, fiscal incentives have significantly accelerated the adoption of electric light-duty vehicles (LDVs) and boosted the scale of EV manufacturing and battery industries. These measures, such as purchase subsidies and vehicle registration tax rebates, were implemented in the in Norway, the US, China and Korea[12]. For instance, Norway introduced tax incentives to encourage the purchase of electric vehicles (EVs), including exemptions from registration, VAT, and motor fuel taxes according to OECD.org. Also, in China employ substantial subsidies, and the purchase subsidies could range from 26%-73% of retail price(S. Li et al., 2020). Korea implemented their ecofriendly vehicle policy which provide purchase incentive up to 50% [13] Developed countries like Europe have implement their policy to expend more zero emission vehicle (ZEV) deployment[14] by ensuring adequate infrastructure.

As Cambodia is developing countries and BEV is a new technology compared to combustion vehicles so many challenges in adoption it without initiative from governments the market for this new technology hardly to emerge. Government intervention could provide suitable ecosystem for both producers and consumers. Policy could attract more shareholders to involve and invest; also, with assist from government consumer are confident to utilize the new technology as mentioned in IEA Global EV Outlook 2023. Similarly, a case study in Thailand

also indicated the positive relation between BEV purchase intention and policy (Manutworakit & Choocharukul, 2022). Within this category, financial incentives come in the first rank, followed by policy and standard. The top three overall ranking are Finical incentive, policy and standard, and adequate electricity generation. For consumer, the most favourable policy is financial incentives. Financial incentives can reduce the cost of electric vehicles and make them more affordable for consumers. They can also influence consumer decision-making and positively impact electric vehicle adoption rates. Additionally, financial incentives can send a strong signal to consumers that the government supports the adoption of electric vehicles, raising awareness about the benefits of electric mobility and shifting consumer perceptions toward considering electric vehicles as viable alternatives. Finally, financial incentives can help kickstart the electric vehicle market and stimulate demand, attracting automakers to produce more and accelerating the development of electric vehicle technologies. As for best practices of BEV adoption in Norway which apply generous financial incentive policies (Bjerkan et al., 2016; Mersky et al., 2016). Beside financial incentives, green plant policy have shown significant impact on adoption in China based on (S. Li et al., 2020). It is emphasizing the considerable value it offers to customers through a variety of channels. Customers express their environmental views via buying eco-friendly products or by gaining status through outward conservation. Labelling can direct consumer spending and promote sustainable products. Despite the little cost, the strategy has a significant impact on EV sales and is highly effective.

Reliable and environmental electricity supply is the second important factor's category for 2-and 3-wheel vehicles with (16.89%). Followed by infrastructure and the broad adoption of electric vehicles depends on the availability and adequacy of the electricity supply. The availability of a dependable charging for EV owners is guaranteed by a strong and stable electrical grid and adequate power generation. Reliable electrical supply system is necessary to meet EV owners' charging requirements. The main advantage of BEV adoption is the reduction CO2 emission compared to conventional vehicles, and it could achieve its benefit only when the electricity generation is not come from fossil fuel. In contrast, inadequate electricity supply or unstable distribution would give negative impact on EV adoption rates. In Cambodia the electricity generation has clean energy share more than half in 2022; however, the quality of electricity supply seems not sufficient during summertime and blackout usually occur due to high demand energy for cooling spaces and limited generation from hydro power plant according to power outage schedule releasing from EDC and Khmer time news[15].

In addition, similar to many studies that emphasis impact of infrastructure for adoption of EVs (K V et al., 2022; Kim & Kang, 2022; Manjula. B. C et al., 2022; Manutworakit & Choocharukul, 2022; Patyal et al., 2021; Ruoso & Ribeiro, 2022; Tarei et al., 2021). Within infrastructure category, charging station and domestic manufacturers are ranked as key factors for BEV adoption in Cambodia. For BEV owners' convenience and accessibility are provided through public charging stations, office charging, and residential charging alternatives. The availability of public charging station effects consumers purchase decision

based on (Sierzchula et al., 2014). Domestic manufacturers could support national economic growth and job creation, supply chain integration and localization, and policy support and incentives. Local production of key components and parts for BEVs reduces dependency on imports, strengthens the domestic supply chain, and enhances the overall competitiveness of the electric vehicle industry. Up to now Cambodia only have assemble plant for combustion vehicle only. Thus, the domestic manufacture is crucial for the expansion of BEV adoption. The other categories like technology, economic, and consumer have less influence compared to above mention and were ranked as fourth, fifth, and sixth respectively.

The overall factor influences are organized in three degrees (strong, moderate, and less) of influences on the BEV adoption. The strong influenced factors classify by the overall weight is greater than 5%. Based on this criterion eight factors were grouped in strong influences factors. Similarly, the moderate influenced factors had overall weight from 3.5%-5%. There are nine factors that classify in this group. The less influent factors got weight lover than 3.5%. The detail factor influences for 2-and 3-wheel vehicles is shown in table below.

Table IV-20: Degree of Factors Influence on for 2-and 3-Wheel Vehicles

Strong	Moderate	Less
Financial Incentive	Domestic Manufacturer	Operation Cost
Policy & Standard	Purchase Cost	Resale Value
Adequate Electric Generation	Charging Time	Driving Range
Renewable Energy Sources	Education	Model Varieties
Stable Electricity Distribution	Maintenance Cost	Social Influence
Battery Life	Battery cycling Facility	
Convenient Incentive	Product Trust	
Income	Service Centre & Equipment	
Charging Station		

For 4-wheel vehicles, economic is considered as second important category, followed by reliable and environmental electricity supply and infrastructure. In the category of economic, maintenance cost is the highest rank followed by purchase cost. For consumer, the maintenance for BEV that concerned them the most is battery replacement cost. The more drive the more charge led to more degradation of battery. The state of degradation is also dependent on the battery model and manufacturers and the average of live span is from five to ten years. Battery degradation could affect the performance of vehicle when it reaches life span (Cluzel, C., & Douglas, C., 2012; Han et al., 2019). The limited availability of battery in the country could add extra fee to battery replacement cost. This issue would be less bothered for consumer in case manufacturer claim their battery insurant on specific period of time. In addition, purchase cost of BEV is higher compared to conventional car and it usually barrier for BEV

purchases intention (Candra, 2022; Ruoso & Ribeiro, 2022; Tarei et al., 2021). However, consumer should value the total cost of ownership of their choice of vehicles rather than only in purchase cost. Based on (Hagman et al., 2016) the comparison of internal combustion car(, PHEV, and BEV indicated that the total of owner of these BEV is the lowest while its purchase cost is the highest. To reduce the gap between purchase of BEV and ICEV, government intervention is needed. Financial incentives and other policies could be the practical solution as example of Norway and China (S. Li et al., 2020; Sierzchula et al., 2014; Zhang et al., 2011). For the categories of reliable and environmental electricity supply and infrastructure are required the same amount of attention and significance influence for both 4-wheel and 2-and 3-wheel vehicles. Among all six categories consumer is the less important and rank last for both vehicle types. Income is the strongest influence factor in this category in which indicated the affordability. Cambodia is developing country with low-middle income status according to World Bank, 2021. The economic growth rate is around 7% for the last decade so this a positive sign for government to introduce BEV to automobile market.

The overall factors are organized in three degrees of influences on the BEV adoption: strong, moderate, and less important. The detail factor influences 4-wheel vehicles is shown in table below. The strong influenced factors classify by the overall weight is greater than 5%. Based on this condition, nine factors are gathered in strong influences factors. Similarly, the moderate influenced factors have overall weight from 3.5%-5%. There are nine factors that classify in this group. The less influent factors got weight lover than 3.5%. The detail factor influences for 4-wheel vehicles is shown in table below.

Table IV-21: Degree of Factors Influence on for 4-Wheel Vehicles

Strong	Moderate	Less
Financial Incentive	Purchase Cost	Service Centre & Equipment
Policy & Standard	Operation Cost	Battery Recycling Facility
Renewable Energy Sources	Charging Time	Product Trust
Adequate Electric Generation	Domestic Manufacturer	Model Varieties
Convenient Incentive	Driving Range	Education
Charging Station	Income	Social Influence
Maintenance Cost	Resale Value	
Stable Electricity Distribution		
Battery Life		

Six-factor categories for both vehicle types were reviewed by experts. The three-factor categories were ranked in the same order for both vehicle types, as shown by the results in Table 17 and Figure 17 above. Government support received the highest priority with financial incentive as highest influence factor for the BEV adoption in Cambodia all vehicle types. Technology was ranked fourth in both cases while consumer received the lowest ranking. Reliable and Environmental Electricity Supply has similar significance on adoption for both cased since adequate electricity supply is crucial to satisfy the demand of consumers. With adequate and stable electricity supply consumer are confident in charging their vehicles. With clean and renewable energy resources the aim of reducing GHG emission from transportation sector by employ BEV is achieved. Infrastructure is moderately important compared to above categories. Yet, both vehicle types insist on charging station and domestic manufacturer for convenient ecosystem and availability of products and services. In Economic

category, maintenance cost is the first rank for 4-wheel vehicles. This show the concern about battery replacement cost in the car since battery degradation is natural phenomenon and battery replacement cost for car is more expensive. While for motorcycle and tricycle purchase cost is the strongest influence. Financial incentive could cut down the gap of purchase price between BEV and ICEV. However, it could not deal with the fear of battery replacement cost that consumer had. The government and other stakeholders especially manufacture, or importer should consider this issue.

V. Conclusion

V.1 Key Findings

The results in Chapter IV indicate that government support is the most influential factor in promoting BEV adoption in Cambodia, as it provides a suitable ecosystem for producers and consumers. This can attract more investors and consumers. Financial incentives are the most favorable policy, as they can reduce the cost of electric vehicles and make them more affordable. Financial incentives can raise awareness about the benefits of electric mobility and shift consumer perceptions toward considering electric vehicles as viable alternatives. Other policies also have a significant impact on adoption. Reliable and environmental electricity supply is the second important factor for BEV adoption, with 16.89% of the factors being ranked.

Infrastructure is crucial for the broad adoption of electric vehicles, with a strong and stable electrical grid and adequate power generation. Infrastructure, including charging stations and domestic manufacturers, is also key to BEV adoption in Cambodia. Public charging stations, office charging, and residential charging alternatives are provided for BEV owners' convenience and accessibility. Domestic manufacturers can support national economic growth, job creation, supply chain integration, localization, policy support, and incentives. Other factors like technology, economics, and consumption have less influence on BEV adoption, ranking fourth, fifth, and sixth, respectively.

Economic considerations are most important for 4-wheeled vehicles, followed by infrastructure and environmentally friendly electrical supply. The highest costs are for maintenance, then purchases. Consumers are particularly concerned about battery replacement costs since they can impact a vehicle's performance and lifespan. Limited battery supply in certain countries may result in higher battery replacement costs, although buyers will be less bothered with this problem if manufacturers claim their battery guarantee. BEV purchases may be affected by its high initial cost compared to conventional vehicles. Instead of merely considering the purchase price, consumers should consider the overall cost of ownership. The difference between the purchase of BEVs and ICEVs can be narrowed with the help of government action, financial incentives, and regulations.

Overall, this study indicates a slightly different weight difference between 2-wheel, 3-wheel, and 4-wheel. The top three main factors for 2-wheel and 3-wheel are government support, reliable and environmental electricity supply, and infrastructure. While in 4-wheel adoption, the top three main factors are government support, economic, and reliable and environmental electricity supply.

V.2 Policy Implementation

BEVs adoption is in the early stage in Cambodia, and the demand in the market is limited. Based on the key findings, government support is the top priority for better adoption in Cambodia. Government intervention has a significant impact, and it is the key to pushing the adoption rate in the country. Providing incentives is one of the effective policy tools to uptake BEVs. Incentive substantially

impacts EV adoption, so fiscal policy is a key element for better function. The incentive should be grand to both consumers and suppliers. Financial incentives could cut down the upfront cost of electric vehicles, making them more competitive with conventional vehicles. This encourages consumers to purchase EVs. In addition, the charging station network is mostly the main barrier for EVs. Incentives for EVs supplier and infrastructure are an efficient tool for building an excellent EV ecosystem. Other policy tools like green plants and prevailed services also exhibit considerable effectiveness.

Government should be cautious about planning long-term strategies for EV adoption. This strategy plan should provide a clear vision and direction and be more stable and consistent for government to reach the goal. The clear intention from the government could show the positive condition for private shareholders to come in. Also, the different government institutions could collaborate more effectively. With clear planning, the government can distribute resources more effectively.

Governments should focus on electricity supply with reliable and environmental sources to ensure the widespread BEVs adoption. This entails making investments in grid infrastructure upgrades. Growing the networks of charging infrastructure will impact the power grid. It is essential to work with utility companies to handle any potential issues brought on by the rise in electricity demand from the transportation sector. Also, the energy mix should be more from clean energy sources. The government needs to inject more investment into clean energy infrastructure. Achieving a better adoption rate of EVs requires a holistic approach from all shareholders. The government is the kickstart of the journey.

V.3 Research Limitation and Further Research

The AHP technique was used in this study to rank factor that influences BEV adoption in Cambodia. All the comparative information that was used was gathered from experts from government officials, private companies, NGOs, and academic sectors. Naturally, there is a chance that the respondents' opinions in this study were biased. All the factors were selected according to previous studies, then ranked in order of importance using the experts' opinions. This issue was resolved using various multi-criteria decision-making techniques, and the outcomes were contrasted.

Finally, only the demand side was included in the survey's respondent pool, and the factors are more related to the demand side than the supplier side. As a result, supplier-side experts may be included in future studies, and more aspects related to the supplier side should include.

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Appendices

AHP Expert Questionnaire Form

Survey on "Evaluation of Factors Associated with BEV Adoption-Cambodia Case"

This research is conducted by Sotha Keo, a master's candidate, under the supervision of Professor Yeonbae Kim, in the International Energy Policy Program (IEPP), Department of Technology Management Economic and Policy, Seoul National University. This study will investigate the main factors that influence BEV adoption in Cambodia from experts' perspectives by using the Analytic Hierarchy Process (AHP).

This questionnaire explores expert judgment on ranking the factors that influence BEV adoption in Cambodia by factor pair-wise comparison. The questionnaire consists of three sections and the first section is for the general information of respondents. The second section is the pair-wise comparison for 4-wheel vehicles (passenger cars) and the third section is the pair-wise comparison for the 2-wheel and 3-wheel vehicles (motorcycles, scooters, and tricycles). In the second and third sections, the expert gives their judgment on factor as well as factor category. The exports are expected from the public sector, private sector, academia, and nonprofit organizations (NGOs). All your information in this survey will be used for this research purpose only and it will be confidential. All the responses are used as statistical data in writing the master thesis only and will not be disclosed.

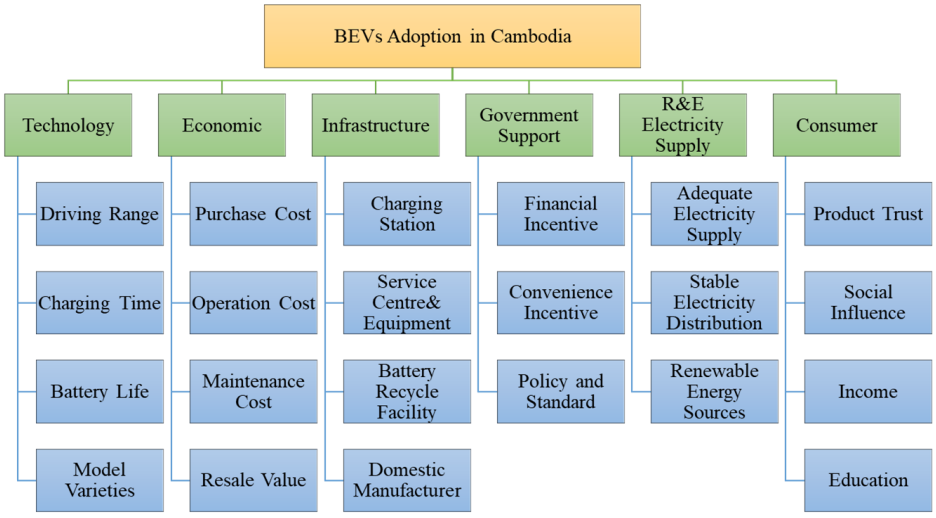
For more information, comments, and requests, please contact us via e-mail at sothakeo.kia@gmail.com or 2021-20081@snu.ac.kr

In this survey, 6-factor categories with 22 factors are selected for evaluation through experts' opinions and views. For complex decision-making and weighing all the factors, Analytic Hierarchy Process (AHP) is used. Through the questionnaire, data about the relative importance of factors and factor categories respected to the goal (BEV Adoption) is obtained by pair-wise comparison. This comparison is core data in AHP. In this study, the hierarchy of the model consists of three levels. The first level is the goal of this research which is BEV adoption in Cambodia. The second level is the factor category which has 6-factor categories, and the third level is the factor which accounts for 22 factors.

The top level of the hierarchy structure is the goal. To achieve the goal, two more levels are constructed which function as criteria and sub-criteria. The second level (Factor Category) is represented as criteria that are the components to support the goal. The third level (Factor) is the sub-criteria which is more specific and detailed than the criteria. It is the key important to fulfilling each criterion. With this structure, two steps evaluation is needed. The first step is to evaluate the factor categories by comparing their importance. This step allows us to understand the weight of each factor category that influences the goal. The second step is to evaluate each factor within each category. The degree of factor influence is indicated in this step. Finally, all factors are ranked by their degree of influence. The details of all factors are presented in the table below.

Factor Category	Factor	Description
Technology	Driving Range	It is the optimal distance (km) that a car could reach within a full charge
	Charging Time	The time period that takes for the discharge battery to fully charge or the time driver spends on replacing the discharge battery to fully charge for electric vehicles
	Battery Life	It is the time of battery last before replacing a new battery.
	Model Varieties	The vehicle models are available in the market that provides options for the buyer to purchase based on their preferences.
Economic	Purchase Cost	It is the cost for own a vehicle or buying a vehicle.
	Operation Cost	It is the cost of materials like gasoline, diesel, and electricity to run a vehicle in km.
	Maintenance Cost	It is the expense of vehicle fixing and changing spare parts.
	Resale Value	The price of the vehicle is predicted in the market when the vehicle is sold again.
Infrastructure	Charging Station	It refers to amount public and private charging spots across the country.
	Service Centre & Equipment	The places provide vehicle maintenance services and spare parts.
	Battery cycling Facility	It refers to public or private companies that collected, store, and recycle the used battery.
	Domestic Manufacturer	It refers to the vehicle production that is located within the county.

Government Support	Financial Incentive	It is the direct incentive grand to the vehicle owner like an import tax reduction or road tax exception.
	Convenience Incentive	It refers to privileged services that government could offer to vehicle owners such as parking, free charging, and special road land.
	Policy and Standard	The support comes from the government through the creation of policies and standards in the BEV system.
Reliable and Environmental Electricity Supply	Enough Electricity Generation	There is an adequate amount of electricity generation to support demand across the county.
	Stable Electricity Distribution	Stable electricity distribution provides by both public and private companies.
	Renewable Energy Sources	Electricity generation comes from renewable energy sources.
Consumer	Product Trust	It refers to the faith and value that consumers have in products, especially in new technology products.
	Social Influence	It refers to the influence of social groups like friends, neighbors, or social media on individual decisions.
	Income	It is the amount of money that an individual could earn per month.
	Education	The level of general education that an individual acquired (Middle school, High school, Bachelor, Master, Ph.D ...etc)



Instruction:

Please choose one of the scales to indicate, in your opinion, which pair of components or variables is more crucial. The component on the left is deemed to be more essential than the component on the right if the chosen scale is on the left side of 1, and vice versa.

AHP Scale:

Numerous Scale	**Definition**	**Explanation**
1	Equally Important	Factor A and Factor B are equally important
3	Moderately Important	Factor A is moderately important over Factor B
5	Strongly Important	Factor A is Strongly Important over Factor B

7	Very Strongly Important	Factor A is Very Strongly Important over Factor B
9	Extremely Important	Factor A is Extremely Important over Factor B
2,4,6	Intermediate Value	

Example:

With Respect to the Technology for the BEV adoption of a 4-wheel vehicle (passenger car)																	
Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Driving Range	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Model Variety
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	**5**	6	7	8	9	Model Variety

a. It indicates that Factor A (Driving Range) and Factor B (Model Variety) are equally important in the Technology category.

b. It indicates that Factor B (Model Variety) is Strongly important compared to Factor A (Driving Range) in the Technology category

a. It indicates that Factor A (Driving Range) and Factor B (Model Variety) are equally important in the Technology category.

b. It indicates that Factor B (Model Variety) is Strongly important compared to Factor A (Driving Range) in the Technology category

I. Section: DEMOGRAPHIC DETAILS OF THE RESPONDENTS

1. Name:
2. Country
3. Affiliation
4. Current Position
5. Education
6. Age
7. Income
8. How many vehicles do you have? 4wheel, 2wheel? BEV?

II. Factor Evaluation "For 4-wheel BEV (passenger cars)"

1. Prioritize Factor Category – 1st level in the hierarchy structure

With Respect to the **Goal** for the BEV adoption of a 4-wheel vehicle (passenger car) which factor category is more important?																		
Factor Category A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor Category B**
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Economic
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Infrastructure
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government Support
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Infrastructure
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government Support
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government Support
Infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Government Support	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Government Support	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Reliable and Environmental Electricity Supply	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer

2. Prioritize Factors within Each Factor Category - 2nd level in the hierarchy structure.

2.1 With Respect to the **Technology factor** for the BEV adoption of a 4-wheel vehicle (passenger car) which factor is more important?

Factor A	Extremely		Very Strongly		Strongly		Moderately		Equally		Moderately		Strongly		Very Strongly		Extremely	Factor B
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Charging Time
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Battery Life
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Varieties
Charging Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Battery Life
Charging Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Varieties
Battery Life	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Varieties

2.2 With Respect to the **Economic factor** for the BEV adoption of a 4-wheel vehicle (passenger car) which factor is more important?

Factor A	Extremely		Very Strongly		Strongly		Moderately		Equally		Moderately		Strongly		Very Strongly		Extremely	Factor B
Purchase Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Operation Cost
Purchase Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Maintenance Cost
Purchase Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Resale Value
Operation Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Maintenance Cost
Operation Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Resale Value
Maintenance Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Resale Value

2.3 With Respect to the **Infrastructure factor** for the BEV adoption of a 4-wheel vehicle (passenger car) which factor is more important?

Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Charging Station	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Service Centre & Equipment
Charging Station	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Battery Recycling Facility
Charging Station	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Domestic Manufacturer
Repair & Service Centre	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Battery Recycling Facility
Repair & Service Centre	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Domestic Manufacture
Battery Recycling Facility	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Domestic Manufacture

2.4 With Respect to the **Government Support factor** for the BEV adoption of a 4-wheel vehicle (passenger car) which factor is more important?

Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Financial Incentive	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Convenience Incentive
Financial Incentive	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Policy and Standard
Convenience Incentive	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	Policy and Standard

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2.5 With Respect to the **Reliable Electricity Supply factor** for the BEV adoption of a 4-wheel vehicle (passenger car) which factor is more important?

Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Enough Electricity Generation																		Stable Electricity Distribution
Enough Electricity Generation																		Renewable Energy Sources
Stable Electricity Distribution																		Renewable Energy Sources

2.6 With Respect to the **Consumer factor** for the BEV adoption of a 4-wheel vehicle (passenger car) which factor is more important?

Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Product Trust																		Social Influence
Product Trust																		Income
Product Trust																		Education
Social Influence																		Income
Social Influence																		Education
Income																		Education

III.Factor Evaluation For "2and 3-wheel BEVs (motorcycles, scooters, and tricycles)".

1. Prioritize Factor Category – 1st level in the hierarchy structure

With Respect to the **Goal** for the BEV adoption of 2and 3-wheel vehicles (motorcycles, scooters, and tricycles) which factor category is more important?																	
Factor Category A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor Category B**
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Economic
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Infrastructure
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government Support
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Technology	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Infrastructure
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government Support
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Economic	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government Support
Infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Government Support	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliable and Environmental Electricity Supply
Government Support	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer
Reliable and Environmental Electricity Supply	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Consumer

2. Prioritize Factors within Each Factor Category - 2nd level in the hierarchy structure

2.1 With Respect to the **Technology factor** for the BEV adoption of 2and 3-wheel vehicles (motorcycles, scooters, and tricycles) which factor is more important?

Factor A	Extremely		Very Strongly		Strongly		Moderately		Equally		Moderately		Strongly		Very Strongly		Extremely	Factor B
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Charging Time
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Battery Life
Driving Range	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Varieties
Charging Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Battery Life
Charging Time	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Varieties
Battery Life	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Model Varieties

2.2 With Respect to the **Economic factor** for the BEV adoption of 2and 3-wheel vehicles (motorcycles, scooters, and tricycles) which factor is more important?

Factor A	Extremely		Very Strongly		Strongly		Moderately		Equally		Moderately		Strongly		Very Strongly		Extremely	Factor B
Purchase Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Operation Cost
Purchase Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Maintenance Cost
Purchase Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Resale Value
Operation Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Maintenance Cost
Operation Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Resale Value
Maintenance Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Resale Value

2.3 With Respect to the **Infrastructure factor** for the BEV adoption of 2and 3-wheel vehicles (motorcycles, scooters, and tricycles) which factor is more important?

Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Charging Station	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Service Centre & Equipment
Charging Station	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Battery Recycling Facility
Charging Station	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domestic Manufacturer
Service Centre & Equipment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Battery Recycling Facility
Service Centre & Equipment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domestic Manufacture
Battery Recycling Facility	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domestic Manufacture

2.4 With Respect to the **Government Support factor** for the BEV adoption of 2and 3-wheel vehicles (motorcycles, scooters, and tricycles) which factor is more important?

Factor A	**Extremely**		**Very Strongly**		**Strongly**		**Moderately**		**Equally**		**Moderately**		**Strongly**		**Very Strongly**		**Extremely**	**Factor B**
Financial Incentive	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Convenience Incentive
Financial Incentive	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Policy and Standard
Convenience Incentive	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Policy and Standard

2.5 With Respect to the **Reliable Electricity Supply factor** for the BEV adoption of 2and 3-wheel vehicles (motorcycles, scooters, and tricycles) which factor is more important?

Factor A	Extremely		Very Strongly		Strongly		Moderately		Equally		Moderately		Strongly		Very Strongly		Extremely	Factor B
Enough Electricity Generation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Stable Electricity Distribution
Enough Electricity Generation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Renewable Energy Sources
Stable Electricity Distribution	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Renewable Energy Sources

2.6 With Respect to the **Consumer factor** for the BEV adoption of 2and 3-wheel vehicles (motorcycles, scooters, and tricycles) which factor is more important?

Factor A	Extremely		Very Strongly		Strongly		Moderately		Equally		Moderately		Strongly		Very Strongly		Extremely	Factor B
Product Trust	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Social Influence
Product Trust	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Income
Product Trust	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Education
Social Influence	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Income
Social Influence	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Education
Income	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Education

This is the end of our questionnaire and thank you so much for your contribution.

Abstract in Korean

기후 변화는 심각한 세계적인 문제가 되었다. 파리 협정은 지구의 기온 상승을 섭씨 2 도 이하로 제한하는 것을 목표로 하고 있기 때문에 많은 나라들이 그들의 배출을 줄이려고 계획하고 있다. 캄보디아의 경우 CO_2 배출의 두 가지 주요한 부문은 발전과 수송이다. 발전 에서 는 에너지의 청정화가 잘 진행되고 있다. 2022 년 61.06%를 청정에너지가 차지하고 있다. 그러나 운송 부문은 전체 에너지 소비량의 46%를 차지하면서도 아직도 대부분 석유 제품 을 에너지로 사용하고 있다. 결과적으로, 캄보디아의 수송 부문이 CO_2 배출의 가장 큰 기여자이다. 캄보디아는 2030 년까지 탄소배출량의 41.7%를 감축할 계획을 가지고 있다. 이를 실현하기 위해 운송부문에 적용하려고 하는 주요한 정책수단은 전기차의 보급확대이다., 그럼에도 불구하고, 캄보디아에서 전기차 보급은 아직 초기 단계이다. . 시장 잠재력은 크지만 보급 속도는 느리고 전기차에 대한 기본정보도 여전히 제한적이다. 따라서, 캄보디아 전기차의 보급확대와 관련된 예상 요인을 식별하고 상대적 중요성을 파악하는 것은 전기차 보급확대 정책 수립에 매우 중요하다. 본 연구는 캄보디아의 4 륜 그리고 2 륜 및 3 륜 전기차량의 도입에 영향을 미치는 잠재적 요인을 분석적 위계 절차방법을 (AHP) 이용하여 분석하였다. 전기차 관련 전문가의 관점을 기반으로 하여 선정된 22 개 요인의 상대적

중요성을 분석하였다. 분석결과는 2-3 륜차의 경우 '정부지원', '안정적 전력공급', '인프라' 관련 요인이 가장 중요한 요인이고 4 륜차의 경우에는 '정부지원', '경제성(비용)', '안정적 전력공급'이 가장 중요한 요인임을 보여 주었다.

이 발견은 더 나은 BEV 채택 계획을 위한 정책 및 주주들에게 통찰력 있는 정보를 제공할 수 있다.