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EXPLORING THE FACTORS INFLUENCING ELECTRIC VEHICLE ADOPTION: A CASE STUDY OF THE PUBLIC SECTOR IN HUNAN, CHINA

ZHAO BINLIANG

Universiti Utara Malaysia

DOCTOR OF PHILOSOPHY
UNIVERSITI UTARA MALAYSIA
2025

EXPLORING THE FACTORS INFLUENCING ELECTRIC VEHICLE ADOPTION: A CASE STUDY OF THE PUBLIC SECTOR IN HUNAN, CHINA

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A thesis submitted to the Ghazali Shafie Graduate School of Government in fulfilment of the requirement for the Doctor of Philosophy Universiti Utara Malaysia

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ABSTRACT

The adoption of electric vehicles (EVs) in the public sector of Hunan, China, remains low despite national commitments to carbon neutrality and urban sustainability. This study addressed the pressing issue of limited EV penetration in Hunan's public sector, where challenges include inadequate charging infrastructure, high vehicle and facility costs, suboptimal EV performance, insufficient technical knowledge, and fragmented governance mechanisms. The research objectives were to examine the direct and indirect effects of technical and economic factors on EV adoption, and to assess the mediating role of infrastructure governance in shaping adoption outcomes. A quantitative research design was employed, using structured questionnaires distributed through systematic sampling to government agencies, public institutions, and corporate fleets engaged in urban transportation. A total of 459 questionnaires were distributed, with 166 valid responses collected from executives, managers, and transportation officials across Hunan. Data analysis was conducted using Partial Least Squares-Structural Equation Modeling (PLS-SEM) via SmartPLS. The findings revealed that charging infrastructure, charging facility cost, economic benefits, and infrastructure governance significantly and positively influence EV adoption. In contrast, vehicle cost, EV performance, and technical knowledge showed no direct significance. However, governance mechanisms mediate the effects of vehicle cost, economic benefits, and EV performance on adoption. The model explained 52% of the variance in EV adoption ($R^2 = 0.52$). These results underscored the central role of infrastructure governance in overcoming technical and economic barriers. Theoretically, this study contributed to the use of Extension of Technology Acceptance Model (TAM2) and Social Technical System Theory in studying the context of technical and economic factors at improving EV adoption in the public sector of Hunan. From a practical point of view, this study revealed that the integrated policy coordination, strategic infrastructure investment, and targeted economic incentives are essential for accelerating EV adoption in Hunan's public sector.

Keywords: Electrical vehicle adoption, infrastructure governance mechanisms, technical factors, economic factors, Hunan's public sector.

ABSTRAK

Penggunaan kenderaan elektrik (EV) dalam sektor awam Hunan, China, masih rendah walaupun terdapat komitmen nasional terhadap karbon neutraliti dan kelestarian bandar. Kajian ini meneliti isu mendesak berkaitan kadar penembusan EV yang terhad dalam sektor awam Hunan, yang mana cabaran utama termasuk kekurangan infrastruktur pengecasan, kos kenderaan dan fasiliti yang tinggi, prestasi EV yang kurang memuaskan, pengetahuan teknikal yang terhad, serta mekanisme tadbir urus yang berpecah-belah. Objektif kajian adalah untuk menilai kesan langsung dan tidak langsung faktor teknikal dan ekonomi terhadap penggunaan EV, serta meneliti peranan pengantaraan mekanisme tadbir urus infrastruktur dalam mempengaruhi hasil penggunaan. Reka bentuk penyelidikan kuantitatif digunakan melalui soal selidik berstruktur yang diedarkan secara pensampelan sistematik kepada agensi kerajaan, institusi awam, dan armada korporat yang terlibat dalam pengangkutan bandar. Sebanyak 459 soal selidik diedarkan, dengan 166 respons sah diterima daripada eksekutif, pengurus, dan pegawai pengangkutan di seluruh Hunan. Analisis data dijalankan menggunakan Pemodelan Persamaan Berstruktur PLS (PLS-SEM) melalui SmartPLS. Dapatan kajian menunjukkan bahawa infrastruktur pengecasan, kos fasiliti pengecasan, manfaat ekonomi, dan mekanisme tadbir urus memberi pengaruh positif serta signifikan terhadap penggunaan EV. Sebaliknya, kos kenderaan, prestasi EV, dan pengetahuan teknikal tidak menunjukkan pengaruh langsung yang signifikan. Namun, mekanisme tadbir urus berfungsi sebagai pengantara antara kos kenderaan, manfaat ekonomi, dan prestasi EV terhadap penggunaan. Model ini menerangkan 52% varians penggunaan EV ($R^2 = 0.52$). Keputusan ini menggariskan peranan utama tadbir urus infrastruktur dalam mengatasi halangan teknikal dan ekonomi. Secara teorinya, kajian ini menyumbang kepada penggunaan Pengembangan Model Penerimaan Teknologi (TAM2) dan Teori Sistem Sosio-Teknikal dalam mengkaji konteks faktor teknikal dan ekonomi dalam meningkatkan penggunaan EV dalam sektor awam Hunan. Dari sudut praktikal, kajian ini mendedahkan bahawa penyelarasan dasar bersepadu, pelaburan infrastruktur strategik, dan insentif ekonomi yang disasarkan adalah penting untuk mempercepatkan penggunaan EV dalam sektor awam Hunan.

Kata kunci: Penggunaan kenderaan elektrik, mekanisme tadbir urus infrastruktur, faktor teknikal, faktor ekonomi, sektor awam Hunan.

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ACKNOWLEDGEMENT

I am deeply grateful to ASSOC.PROF.PMgr.SR.DR.MOHAMAD SUKERI BIN KHALID, my primary supervisor, for his unwavering dedication and meticulous guidance throughout the doctoral journey. His profound knowledge, keen insights,and patient mentorship have been instrumental in shaping the trajectory of this research. His readiness to answer every query, no matter how trivial it seemed, and his timely, thorough responses have been a beacon of support. His kindness and sincerity have not only made him a revered academic figure but also a cherished friend.

I extend my heartfelt appreciation to my secondary supervisor, SR.DR.FARAHIYAH BINTI FADZIL, for her invaluable contributions. Her careful review of the thesis content and presentation slides, coupled with her encouraging words and positive feedback, have significantly bolstered my confidence and refined the quality of my work.

The unwavering support from my beloved wife, Ms.Bu Wenna, has been the cornerstone of my academic pursuit. Her steadfast encouragement and belief in my abilities have been a constant source of strength. The sacrifices made by my father-in-law, Mr.Bu Jianhua, and mother-in-law, Ms.Bu Yanmin, who relocated to Malaysia with us and took on the responsibility of caring for my daily needs,have been immeasurable. Their presence and support have enabled me to surmount numerous challenges and focus wholeheartedly on my research.

I am also immensely thankful to my dear friend, Mr.Li Ruiming, for his invaluable suggestions on the survey design for my thesis. His input has been crucial in enhancing the validity and effectiveness of my research methodology.

I am profoundly indebted to all these individuals who have played a pivotal role in the successful completion of this doctoral thesis. Their collective support has not only enriched the academic aspect of my life but has also left an indelible mark on my personal growth.

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LIST OF ABBREVIATIONS

EV	Electrical Vehicle
STS	Social Technical System Theory
TAM2	Extension of Technology Acceptance Model
PLS-SEM	Partial Least Squares-Structural Equation Modeling

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CHAPTER ONE

INTRODUCTION

1.1 Background

The adoption of electric vehicles (EVs) in private and public sector transportation has gained global traction as a response to the urgent need to mitigate climate change by decreasing dependence on fossil fuels, reduce urban pollution and enhance urban sustainability (Harahap, Mohammed, Henrysson, Franco, & Jenelius, 2023; Bhat,Verma, & Verma, 2022; Achıaw & Kanol, 2021; Carvalho, Delafave, & Balestieri, 2021; Haustein, Jensen, & Cherchi, 2021; Grandi, 2020; Reiner, Beard, Park, & Kinnear, 2020; Anastasiou, Fuehres, & Sousa-Zomer, 2018; Egnér & Trosvik, 2018; Huang, Tian, Lu, & Li, 2017; An, Ouyang, Liu, Li, Fu, & Li, 2016; Shah, Farias, & Lee, 2016; Aasness, & Odeck, 2015; Albino, Berardi & Dangelico, 2015). Globally, governments, industries, and urban planners increasingly recognize the significance of transitioning from internal combustion engine (ICE) vehicles to EVs, particularly in densely populated urban environments to reduce urban emissions and achieve low-carbon development goals (Jing, Yuan, Rezaei, Qian, & Zhang, 2020; Kawamoto, Mochizuki, Moriguchi, Nakano, Motohashi, Sakai, & Inaba, 2019).

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The global context of EV adoption is driven by multitude of environmental, economic, and technological factors, with various countries striving to achieve the targets set under international frameworks, such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs) (Fournel, 2022; Liu, Wu, Qian, Wu, & Wang, 2021; Hao & Lei, 2021).

Furthermore, the transportation sector accounts for approximately 24% of direct CO2 emissions from fuel combustion, with private and public sector transportation being a major contributor (International Energy Agency [IEA], 2022). As urban areas are often the epicenters of transportation-related pollution, the shift towards EVs is pivotal for reducing greenhouse gas emissions. Several regions globally have taken aggressive policy measures to promote EV adoption. For instance, the European Union aims to phase out the sale of new ICE vehicles by 2035 (European Environment Agency [EEA], 2024), while The United States, under its Inflation Reduction Act of 2022, has also introduced significant financial incentives to accelerate the transition to EVs (Jing et al., 2020; Chen, Wang, & Liu, 2018). Norway has been a global leader in EV adoption, due to government incentives such as tax exemptions, free tolls, access to bus lanes, and free parking. Aasness & Odeck (2015) explore how these incentives have significantly boosted EV sales, making Norway one of the top countries in terms of EV market share. Anastasiou, Fuehres, & Sousa-Zomer (2018) argued that Norway, with extensive government incentives and a well-established network of fast-charging stations, has achieved rapid EV adoption. In contrast, the Netherlands focuses more on a dense network of regular charging points and urban planning, leading to steady EV uptake. In the Asia region, using survey data from Indian consumers, Bhat, Verma, & Verma (2022), identifies key factors such as purchase cost, driving range, charging

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infrastructure, environmental concerns, and government incentives as significant determinants of EV adoption. They suggest that targeted policy interventions, such as subsidies and infrastructure development, are crucial to accelerating EV adoption in India.

Finally, in South American Latin region, Carvalho, Delafave, & Balestieri (2021) through their findings suggest that without significant government support, such as subsidies and investments in charging infrastructure, EV adoption in Brazil will remain slow. The study emphasizes the importance of targeted policy interventions to overcome financial and infrastructural barriers and accelerate the transition to cleaner private and public sector urban transportation in Brazil.

In addition, from a technological perspective, advances in battery technology, charging infrastructure, and vehicle-to-grid (V2G) integration have bolstered the feasibility of EVs as a sustainable alternative to ICE vehicles. The decreasing cost of lithium-ion batteries, which fell by nearly 90% between 2010 and 2020 (International Energy Agency [IEA], 2022), has significantly lowered the price barrier for EVs. Moreover, the expansion of charging networks is reducing range anxiety, a key consumer concern, particularly in urban areas (Fournel, 2022; Di Foggia, 2021; Degirmenci & Breitner, 2017).

As for China in the context of EV adoption, China is the world's largest carbon emitter (China Meteorological Administration (CMA), 2023). Vehicle exhaust accounts for 15% of CO2 emissions. At the 75th session of the United Nations General Assembly held on September 22, 2020, China pledged to the world to achieve carbon peak by

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2030 and carbon neutrality by 2060. The automotive industry's dependence on fossil fuels has led to far-reaching environmental problems, such as vehicle emissions and climate change, affecting ecological balance, living conditions, and human health (Hildemann et al., 2015). Moreover, 90% of the world's energy supply is made up of coal, oil and natural gas, traditional energy sources are non-renewable, and China is more than 60% dependent on imported crude oil. 70% of imported crude oil is used in vehicles. At the same time, if oil imports are stopped, China's crude oil reserves will be depleted within 50 days. As of 2022, China's hydropower accounts for 29% of the world's total, photovoltaic power generation accounts for 32%, wind power generation accounts for 51%, and rare earth reserves account for 42% of the world's total (China Meteorological Administration (CMA), 2023).

Based on the above narration of the status quo of China heavily -dependence on fossil fuel, thus, the development of electric vehicles is a strategic decision for China to reshape its own position in the international energy landscape. Electric vehicles are critical to achieving environmental sustainability by reducing carbon emissions and dependence on fossil fuels, and China has made significant progress in adopting electric vehicles (CAAM, 2021). China, the world’s largest automotive market, has introduced stringent regulations and incentives to push the development and adoption of EVs (Lu, 2022; Chen, Zeng, & Tan, 2021; He, Wu, & Li, 2020; Liu, Chen, Liu, & Yan, 2020; Liu, Tang, & Sun, 2020). In the transportation sector, there are generally two approaches to addressing this issue: improving the energy efficiency of internal combustion engines and increasing the use of alternative energy sources (Li, Gu, & Ma, 2017). Electric vehicles (EVs), which are highly energy-efficient, are being deployed on a large scale to tackle current energy and environmental challenges

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(Kawamoto, Mochizuki, Moriguchi, Nakano, Motohashi, Sakai, & Inaba, 2019). Promoting and applying EVs is seen as one of the most effective methods to reduce carbon emissions from urban transportation (Li, Xiong, & Wang, 2020).

As the world's largest automobile market and a major emitter of greenhouse gases, China faces unique challenges and opportunities in developing sustainable and low-carbon cities (Jing, Yuan, Rezaei, Qian, & Zhang, 2020). Recognizing the importance of electric vehicles, the Chinese government has implemented various policies and initiatives to promote their adoption (Li, Xiong, & Wang, 2020; Li, Wang, Zhang, & Chen, 2018; Li et al., 2017; Li et al., 2016). According to the China Association of Automobile Manufacturers, in 2023, China's electric vehicle sales reached 9.495 million units, accounting for about 69% of global electric vehicle sales (13.689 million units) (China Association of Automobile Manufacturers (CAAM), 2024). As of December 2023, there were 20.41 million electric vehicles in China, making up approximately 48.6% of global electric vehicle ownership (42 million). These figures underscore the significant progress China has made in the EV sector (CAAM, 2024). China's automobile production and sales have ranked first in the world for 15 consecutive years. However, many cities face energy consumption and air pollution challenges due to the increase in cars. Currently, China holds the largest market segment (almost 50%) of EVs, with government policy being the main driver of this market (CAAM, 2024).

In another context, as providers of urban infrastructure and services, the green transformation of urban public sector transportation fleets serves as a model and catalyst for the low-carbon development of entire cities (Li, Chen, & Hong, 2016).

The adoption of urban public sector transportation using electric vehicles (EVs) can significantly help cities in China such as Hunan to address energy consumption and air pollution challenges resulting from the increase in cars (Huang et al., 2017). By replacing conventional urban public sector transportation fleets with electric buses and other EVs, cities can drastically reduce their carbon footprint (Hunan Provincial Electric Vehicle Industry Association 2021; Zhou, Wu, Wu, & Wang, 2020).

This aligns with China's goals for low-carbon city development and its commitments to the Paris Agreement on climate change (Liu et al., 2021; Hao & Lei, 2021). Conventional vehicles emit pollutants such as nitrogen oxides (NOx) and particulate matter (PM), which degrade air quality. Electric public transportation vehicles help mitigate this issue by eliminating these harmful emissions, leading to cleaner air, and improved public health (Zhang, Chen, & Tan, 2020). China is heavily investing in renewable energy sources such as wind, solar, and hydroelectric power (Zhou et al., 2020). By integrating EV charging infrastructure with renewable energy grids, cities can ensure that the electricity used by urban public sector transportation is clean and sustainable (Zhang, Wang, Wang, & Bi, 2016). This reduces the environmental impact of energy production and supports the transition to a renewable energy future (Wu, Guo, Zhang, & Zeng, 2018).

Notwithstanding, the shift to electric urban public sector transportation necessitates the development of extensive charging infrastructure (Liu, Ma, Liu, & Shen, 2019). This includes the installation of fast-charging stations and the integration of smart grid technologies (Zhou, Jiang, & Xu, 2021). Such developments not only support the EV ecosystem but also contribute to modernizing urban infrastructure, making cities like

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Hunan more resilient and adaptable to future technological advancements (Liu, Chen, Liu, & Yan, 2020). In addition, investing in electric public transportation can stimulate economic growth by creating jobs in the manufacturing, installation, and maintenance of EVs and their infrastructure (Liu, Li, Zhang, Li, & Li, 2019).

Additionally, it can reduce the economic costs associated with health care for pollution-related illnesses and environmental degradation (Liu, Wang, Zhang, & Wang, 2018). In a nutshell, the adoption of electric vehicles in urban public sector transportation offers a comprehensive approach to tackling the dual challenges of energy consumption and air pollution in China's rapidly growing cities like Hunan. By reducing emissions, improving energy efficiency, leveraging renewable energy, and fostering economic and infrastructural development, EVs can play a pivotal role in creating sustainable, livable urban environments in Hunan (Wang, Huang, Yu, Wang, & Li, 2019).

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However, through extant literature, this study found out that promoting electric vehicles fleet in the urban public sector transportation requires addressing not only technical and economic factors challenges (Liu, Sun, & Chen, 2020) as mentioned above but also ensuring support from effective urban infrastructure governance mechanisms (Zhang, Li, & Wang, 2021; Wang, Jin, Wang, & Liu, 2018; Li, Dong, & Yu, 2017). This includes policy incentives, subsidies, the construction of charging infrastructure, and cross-sectoral cooperation (Liang, Zhang, & Huang, 2021). A key aspect is the development of effective urban infrastructure governance mechanisms, including charging infrastructure planning, financing models, stakeholder coordination, and policy implementation (Luo, Li, Xu, & Zhang, 2018; Wu, Zhang, Zhang, & Du, 2017). Scholars and researchers are increasingly emphasizing the

importance of governance mechanisms in facilitating the integration of electric vehicles into urban transport systems (Zhang, Li, & Wang, 2021, Wang, Liu, & Zhang, 2020).

Although the rise of electric vehicles is to maintain and protect the environment while reducing oil use, the share of new energy vehicles in China is about 31% and still needs to continue to increase (the total sales of vehicles in the Chinese market in 2023 will be 30.094 million units, of which 9.495 million new energy vehicles will be sold) (China Association of Automobile Manufacturers (CAAM), 2024). In particular, the adoption rate of EVs in the urban public sector transportation is low, at only 10%, so it is important to consider understanding the effectiveness of policy incentives for EV adoption in China as the subject of more research (Ramasamy, Qian, Zhai, & Liu, 2021; Zhang et al., 2021). Studying the impact of urban infrastructure governance mechanisms on the adoption of electric vehicles, particularly in the urban public sector transportation (Ramasamy et al., 2021; Lim, Ignatius, Miguel, Wong, & Juang, 2017) is therefore of great significance; this can inform the development of effective policies and measures to promote the widespread adoption of electric vehicles in the context of urban public sector transportation (Wang, Liu, & Zhang, 2020; Li, Jiang, Shao, Zhao, & Luo, 2019). As shown in the Table 1.1, the differences and advantages of electric vehicles and traditional fuel vehicles are compared from five aspects.

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Table 1.1
Comparison of electric vehicles and traditional fuel vehicles

Aspects	Fuel vehicle	Electric Vehicle
Handling Performance	The engine is noisy, the NVH performance is poor, and the multi-gear drivability is poor	Good drivability, simple operation, strong power, lower noise ，China can develop all the key components for its own electric vehicles.
Environmental protection	Environmental pollution, limited use in some areas, 18 tons of fuel sweeper annual carbon emissions of 50 tons	Zero emission and no pollution, policy-oriented, 18 tons of electric sweeper annual carbon emissions of 21 tons ~ 0 tons
Maintenance	The number of engine and transmission parts is more than 3,000, and the maintenance cost is high, with an average annual value of 25,000 RMB for 18-ton fuel vehicles	There are only 120 drive system parts, the structure is simple, the motor is maintenance-free, and the annual maintenance cost of the whole vehicle is a quarter of that of the fuel vehicle
Energy consumption costs	The cost of fuel remains high, and the cost of 18 tons of sweepers is 6 yuan per kilometer.	The cost of electricity is one-third of that of oil
Economic benefits	The total operating cost of the 18-ton fuel sweeper for 5 years is 1.46 million RMB	The total operating cost of the 18-ton electric sweeper is 380,000 RMB in 5 years, and the total expenditure in 5 years is 700,000 RMB

Source: Cheng, Ma, Zhang, Liu, Liu, & Yang (2020). Comparative analysis of environmental performance between electric vehicles and conventional vehicles in China.

1.2 Problem Statement

Starting in 2022, the emphasis shifted towards promoting electric vehicles in the public sector. However, many Chinese cities are still lagging in EV adoption due to three fundamental challenges: (i) technical limitations, (ii) economic barriers, and (iii) infrastructure governance issues. Current adoption rates of electric vehicles in the public sector remain low (MIIT, 2022). Additionally, the development of charging infrastructure is uneven and incomplete, and the initial ownership costs of EVs remain high. As depicted in Figure 1.1 (next page), the overall penetration rate of electric

vehicles in China's public sector stands at just 10%, with significant variations across different provinces and cities (MIIT, 2022).

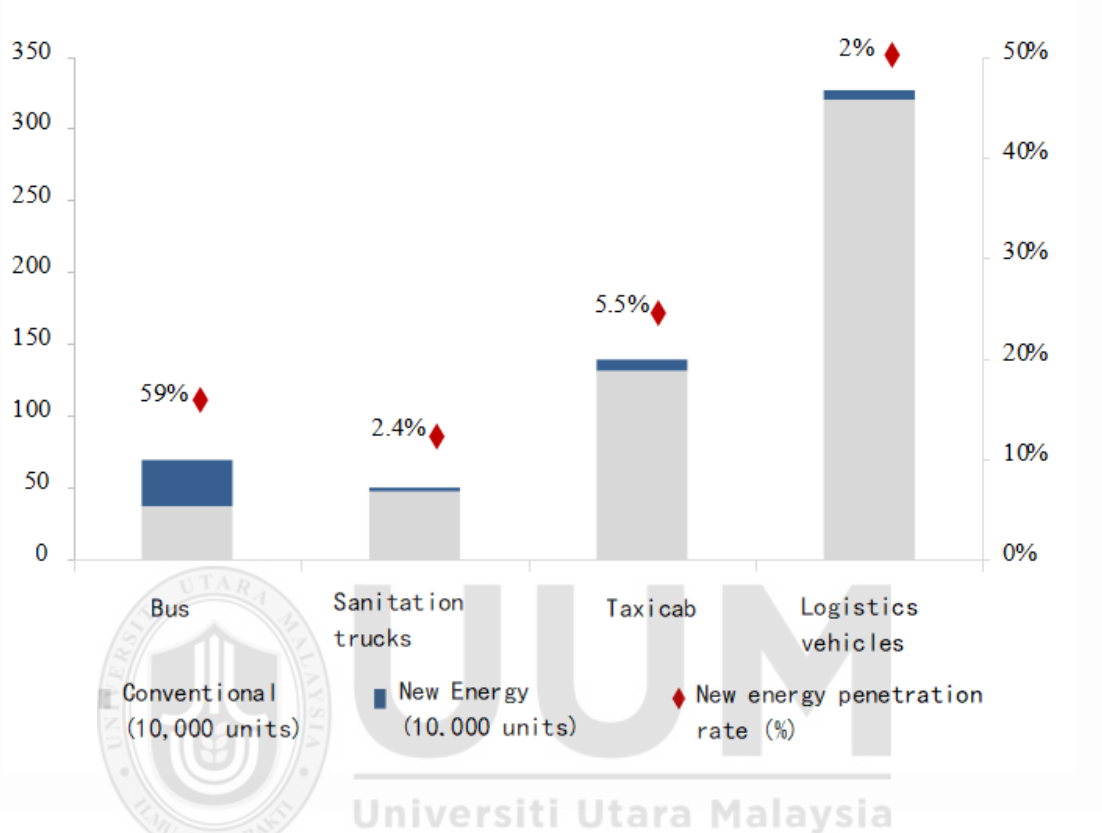

Figure 1.1 New Energy Vehicle Industry Development Plan (2021-2035)
Source: Ministry of Industry and Information Technology (MIIT) (2022)

As illustrated in Figure 1.2, China's cities that have seen significant development of new energy vehicles are primarily economically advanced first-tier cities, while many second-tier and third-tier cities have shown limited success in promoting these vehicles (MIIT, 2022). Despite the large number of electric vehicles, their overall market share remains relatively low. Therefore, further study is necessary to assess the effectiveness of infrastructure governance mechanisms in promoting the adoption of electric vehicles, particularly within Hunan Province's public sector (Kawando et al., 2019; Li, Dong, & Yu, 2017; Huang et al., 2017; Aasness & Odeck, 2015), as many of the existing research in China had focused on private consumer EV adoption (Yang et al.,

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2021; Guo et al., 2021; Liu et al., 2021; Wang et al., 2020; Liu et al., 2020; He et al., 2019; Xu et al., 2019; Wang et al., 2018; Li et al., 2017; Chen et al., 2016).

Thus, there is a significant gap to assess the adoption of EV in public sector, notably in Hunan as Tier 2 city (MIIT, 2022). The adoption of electric vehicles (EVs) in China's public sector remains uneven, with high penetration rates in Tier 1 cities such as Beijing, Shanghai, and Shenzhen, but considerably slower uptake in second and third-tier regions. Hunan Province exemplifies this disparity, as despite significant policy support and fiscal input, adoption rates within its public transportation sector remain low. Technical limitations such as insufficient charging infrastructure, vehicle performance constraints, and knowledge gaps among stakeholders are compounded by high initial ownership costs and governance inefficiencies. These factors have collectively hindered the effective transition to EVs, highlighting a crucial gap between national policy ambitions and local-level implementation. Understanding this gap is particularly important, as China aims for full electrification of public vehicles by 2035.

Hunan was selected as the case study for this study precisely because it embodies the tensions between strong institutional commitment and weak market outcomes. On the one hand, Hunan benefits from a comprehensive public system, where government-controlled transportation and centralized decision-making provide a solid institutional foundation for EV adoption. The province also enjoys sufficient fiscal capacity to absorb the high upfront costs of EV infrastructure. On the other hand, as a designated key province for national new energy vehicle promotion, it continues to experience institutional bottlenecks: while policy inputs are substantial, the market conversion

rate is low, with limited EV ownership and uneven charging infrastructure development.

Additionally, Hunan holds strong regional representativeness. Situated in central China and serving as a transportation hub, it reflects the policy implementation realities of "non–first-tier, resource-limited" cities, offering a useful contrast to wealthier coastal regions. This makes Hunan particularly suitable for testing the effectiveness of policies across varying economic contexts. The province also has a supportive industrial base, with new energy vehicle manufacturers such as BYD and Jiangling, alongside universities that contribute to research and technology transfer. Nonetheless, inefficiencies in resource utilization underscore the importance of governance mechanisms and institutional incentives. For these reasons, its policy representativeness, governance challenges, industrial foundation, and practical operability, Hunan provides a compelling and strategically significant context for examining the factors that influence EV adoption in China's public sector.

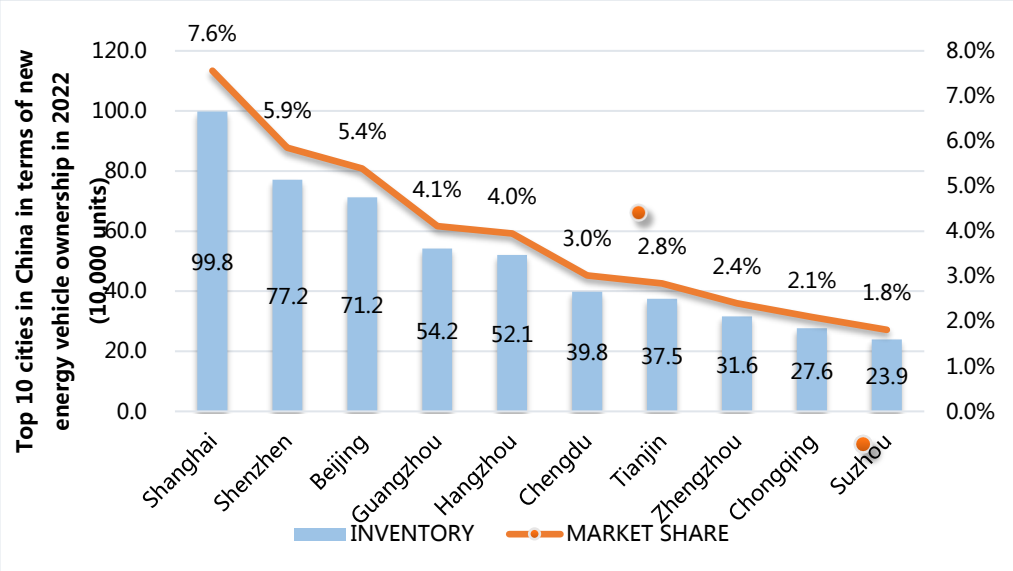

Figure 1.2 China's cities & new energy vehicles adoption
Source: China Association of Automobile Manufacturers (CAAM) (2024)

In 2009, the Chinese government introduced the "Automobile Industry Adjustment and Revitalization Plan" to initiate the national energy-saving and new energy vehicle demonstration project that led to sustainable urban development. That same year, the Ministry of Finance issued the "Notice on Carrying Out the Pilot Work of Energy-saving and New Energy Vehicle Demonstration and Promotion," which provided subsidies for the purchase of new energy vehicles in the public service sectors of pilot cities. This marked the beginning of the new energy vehicle subsidy era. From 2009 to 2012, the government launched the "10 Cities, 1,000 Vehicles" project, selecting 10 cities annually to deploy 1,000 new energy vehicles for demonstration purposes, focusing on buses, taxis, government vehicles, municipal fleet vehicles, and postal services that will eventually lead to sustainable urban development. In 2017, a more detailed subsidy policy was introduced, aiming to encourage technological advancement in new energy vehicles.

By the end of 2019, after a decade of subsidies amounting to over 100-billion-yuan, China had successfully grown its new energy vehicle fleet from zero to 3.8 million, making it the global leader in both production and sales. In 2020, the Ministry of Industry and Information Technology (MIIT) issued the "New Energy Vehicle Industry Development Plan (2021-2035)", setting ambitious targets to make electric vehicles the dominant form of new sales, fully electrify public transport, and commercialize fuel cell vehicles by 2035. This plan is intended to support energy conservation, emission reduction, and enhanced operational efficiency.

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In alignment with the research questions and research objectives of this study, the low adoption rate of electric vehicles (EVs) in Hunan Province is attributed to a combination of factors, including inadequate charging infrastructure, subpar vehicle performance, and a lack of technical knowledge among key stakeholders such as fleet drivers (Di Foggia, 2021; Hunan Provincial Economic and Information Technology Commission, 2018). These technical factors pose substantial barriers to the smooth integration of EVs into the public transportation system. The slow pace of EV adoption in Hunan is the result of interconnected challenges that hinder the region's public transportation system from effectively embracing electric mobility (Hunan Provincial Electric Vehicle Industry Association, 2021). First and foremost, inadequate charging infrastructure is a critical impediment (Chen, Yao, Huang, Chen, & Hu, 2021; Liu, Ma, Liu, & Shen, 2019). The insufficient number of charging stations, coupled with their uneven distribution across the province, creates significant accessibility challenges, particularly in less densely populated and economically disadvantaged areas (Hunan Provincial Electric Vehicle Industry Association, 2021; Huang, Zhang, Zuo, Wang, & Li, 2021). The absence of comprehensive infrastructure coverage not only undermines the feasibility of EV operations but also intensifies range anxiety, thereby discouraging potential users from adopting electric vehicles (Liu et al., 2019; Chen, Huang, Zhang, & Hu, 2017; Chou, Wang, & Chen, 2016). Furthermore, the existing infrastructure often lacks the capacity to support rapid charging requirements for public transportation fleets, resulting in extended downtimes and decreased operational efficiency (Liu et al., 2019).

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In addition, the suboptimal performance of electric vehicles further constrains their adoption. Public transportation systems demand vehicles that exhibit consistent reliability in key performance areas such as range, power, and durability under varying operational conditions. However, the current fleet of EVs in Hunan often fails to meet these demanding standards, particularly in terms of battery life and performance under extreme weather conditions (Liu et al., 2019; Hunan Provincial Economic and Information Technology Commission, 2018). This inconsistency raises concerns among operators regarding the reliability and cost-effectiveness of transitioning to EVs, reinforcing a preference for traditional internal combustion engine vehicles that are perceived as more dependable (Li, Song, Liu, & Xie, 2019). Moreover, a significant barrier stems from the limited technical knowledge among key stakeholders (Featherman, Jia, Califf, & Hajli, 2021). Successfully integrating EV technology into public transportation systems requires a thorough understanding of vehicle maintenance, charging infrastructure, and operational integration. In Hunan, there is a notable knowledge gap among municipal planners, transportation authorities, and fleet operators regarding these technical aspects (Hunan Provincial Electric Vehicle Industry Association, 2021). This knowledge deficit impairs decision-making and fosters a reliance on conventional technologies, as stakeholders may be reluctant to adopt systems they do not fully understand or are not equipped to manage effectively (Hunan Provincial Electric Vehicle Industry Association, 2021; Hao & Lei, 2021).

Addressing these technical barriers, insufficient charging infrastructure, suboptimal vehicle performance, and a deficit in technical knowledge, requires a coordinated approach to enhance infrastructure, improve vehicle technology, and build stakeholder capacity. Additionally, economic factors, such as the high initial cost of vehicle ownership, high tariffs associated with charging facilities, and concerns over the long-

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term economic benefits of EVs, further complicate adoption. The substantial upfront investment required for EVs, coupled with high operating costs due to elevated tariffs, dissuades public transportation operators from transitioning to electric fleets (Chen, Wang, & Liu, 2018; Haustein, Jensen, & Cherchi, 2021). Beyond technical and economic challenges, deficiencies in China's infrastructure governance mechanisms also hinder the widespread adoption of EVs (Liu & Zhang, 2021; Li, Wang, Zhang, & Chen, 2018). Fragmented institutional responsibilities, inadequate coordination between national and local authorities, and weak regulatory frameworks contribute to inefficiencies in infrastructure development and quality, particularly in Hunan. The lack of comprehensive governance has resulted in uneven infrastructure development, further delaying the adoption of EVs (He, Wang, & Liu, 2019; Li et al., 2018).

To better understand this phenomenon, two theoretical perspectives, Technology Acceptance Model 2 (TAM2) and Socio-Technical Systems (STS) Theory, offer critical insights. From the TAM2 perspective, adoption of EVs in the public sector depends on how stakeholders such as government officials, fleet managers, and operators perceive the usefulness (e.g., operational efficiency, cost savings, environmental compliance) and ease of use (e.g., integration into existing transport systems, maintenance requirements) of EVs. Furthermore, TAM2 highlights the role of social influence and subjective norms, which are especially relevant in China’s public sector where adoption decisions are strongly shaped by government policy directives and reputational pressures to align with carbon neutrality goals. If EVs are not perceived as both useful and easy to implement, public sector actors are likely to default to conventional vehicles despite policy incentives.

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At the same time, TAM2 alone cannot capture the systemic complexity of EV adoption in Hunan. Here, STS theory provides a complementary lens, emphasizing that successful technological adoption requires alignment between the technical subsystem (vehicle performance, charging networks, and technical expertise) and the social subsystem (policy coordination, institutional capacity, and stakeholder collaboration). In Hunan, fragmented governance structures and weak institutional coordination illustrate how misalignment between social and technical systems undermines adoption, even when national policies and technical solutions exist.

Thus, the persistent low adoption rate of EVs in Hunan's public sector is not only a result of technical and economic challenges but also of inadequate socio-technical alignment and weak institutional mechanisms. By integrating TAM2 and STS perspectives, this study addresses both the micro-level perceptions of usefulness and ease of use (TAM2) and the macro-level systemic interactions between social and technical infrastructures (STS). This theoretical integration provides a robust foundation for examining how technical and economic factors, mediated by governance mechanisms, influence the adoption of EVs in Hunan's public sector, an essential step toward achieving China's goal of full electrification of public vehicles by 2035.

In conclusion, the low adoption rate of electric vehicles in Hunan Province is the result of multifaceted barriers involving technical, economic, and governance-related factors. Overcoming these challenges will require targeted policy interventions, infrastructure improvements, and enhanced stakeholder engagement to foster the successful integration of EVs into the region's public transportation system. This study explores the factors influencing EV adoption in Hunan, focusing on the mediation role of

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infrastructure governance mechanisms, particularly as public sector electrification gains momentum, with full electrification of public vehicles expected by 2035 (MIIT, 2020).

1.3 Research Gap

Despite China's ambitious targets of peaking carbon emissions by 2030 and achieving carbon neutrality by 2060, the widespread adoption of electric vehicles (EVs) continues to face persistent challenges, particularly in less economically developed provinces such as Hunan. Existing research has predominantly examined EV adoption in first-tier cities and among private consumers, while far less scholarly attention has been given to the public sector in second- and third-tier regions, despite its pivotal role in reducing emissions through buses, taxis, sanitation, and municipal fleets. Although previous studies have established that technical and economic barriers, such as inadequate charging infrastructure, high upfront costs, and limited technical knowledge, constrain EV adoption, the literature has not sufficiently addressed how decision-making perceptions (perceived usefulness and perceived ease of use, TAM2) interact with socio-technical governance structures (STS) in shaping adoption outcomes within the public sector. This represents a crucial theoretical gap, as existing research often isolates user acceptance factors (technology-focused) from governance mechanisms (institution-focused), without integrating them into a coherent explanatory framework.

Furthermore, national initiatives such as the "10 Cities, 1,000 Vehicles" program have accelerated adoption overall, but their uneven success across regions underscores the importance of local socio-technical alignment. In Hunan, where adoption remains limited despite strong policy inputs, the absence of research on how governance

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mechanisms mediate the relationship between technical/economic constraints and public sector adoption decisions represents a missed opportunity to advance theoretical understanding. Accordingly, this study addresses these gaps by integrating TAM2 and STS to develop a multidimensional framework for understanding EV adoption in Hunan's public sector. This integration allows the research to move beyond a purely geographical contribution by offering a novel conceptual approach: linking individual and organizational perceptions of usefulness and ease of use with the broader socio-technical governance mechanisms that condition adoption outcomes. By doing so, the study not only enriches the literature on sustainable transportation but also contributes to the refinement of technology adoption theory in the context of public sector electrification.

Thus, the novelty of this study lies not only in focusing on Hunan as a representative case but also in operationalizing TAM2 constructs (PU, PEOU) and socio-technical governance within a public sector EV adoption context, which is a domain underexplored in prior research.

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1.4 Research Framework

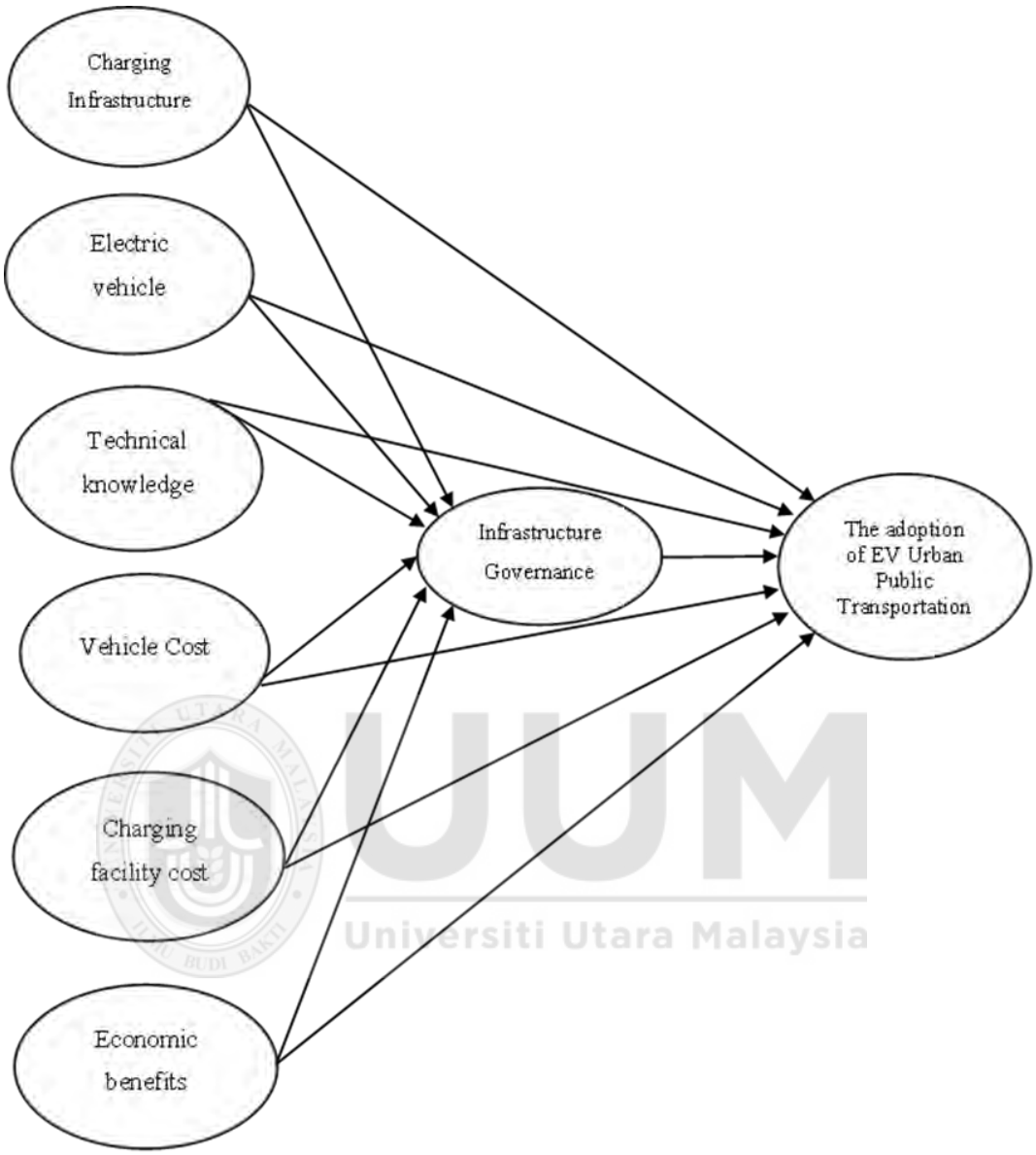

Figure 1.3 Research Framework & its Proposed Relationships

1.5 Research Questions

In line with the problem statement, this study developed five (5) research questions and they are:

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1. How do technical factors (charging infrastructure, EV performance, and technical knowledge) influence on the adoption of EV in the public sector of Hunan, China?

2. How do economic factors (vehicle cost, charging facilities cost, and economic benefits) influence the adoption of EV in the public sector of Hunan, China?

3. To what extent do technical factors indirectly influence EV adoption in the public sector through infrastructure governance mechanisms in Hunan, China?

4. To what extent do economic factors indirectly influence EV adoption in the public sector through infrastructure governance mechanisms in Hunan, China?

5. What is the influence of infrastructure governance mechanisms in EV adoption in the public sector of Hunan, China?

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1.6 Research Objectives

In line with the problem statement, this study developed five research objectives and collectively aims to provide a comprehensive understanding of the factors affecting the adoption of electrical vehicle in public sector in Hunan, and they are:

1. To examine the direct influence of technical factors (charging infrastructure, EV performance, and technical knowledge) on the adoption of EV in the public sector of Hunan, China.

2. To analyze the direct influence of economic factors (vehicle cost, charging facilities cost, and economic benefits) on the adoption of EV in the public sector of Hunan, China,

3. To explore the indirect effects of technical factors charging infrastructure, electric vehicle performance, and technical knowledge) on the adoption of EV in the public sector of Hunan, China, mediated by infrastructure governance mechanisms,

4. To assess the indirect effects of economic factors (vehicle cost, charging facilities cost, and economic benefits) on the adoption of EV in the public sector of Hunan, China, mediated by infrastructure governance mechanisms, and;

5. To investigate the role of infrastructure governance mechanisms in facilitating EV adoption in the public sector of Hunan, China.

1.7 Scope of Study

This study seeks to provide a comprehensive understanding of how technical and economic factors interact with infrastructure governance mechanisms in shaping the adoption of electric vehicles (EVs) within urban public transportation. By concentrating on Hunan Province, the research offers valuable insights that can guide policy-making and implementation strategies, thereby supporting China's broader objectives of carbon reduction and sustainable urban development.

Geographically, the study is confined to Hunan Province, with a particular focus on the adoption of EVs in the public sector. Hunan is representative of second-tier regions in China, making it an appropriate case for exploring adoption dynamics in areas with different economic profiles than first-tier cities. Sectorally, the research concentrates on urban public transportation, encompassing buses, taxis, and municipal fleets. This sector was chosen due to its high potential for carbon reduction and its distinct operational challenges compared to private transportation. Temporally, the study covers the period from 2009, when the government first initiated significant new

energy vehicle programs, through to the present, while also considering projected developments and policy impacts up to 2035.

The research examines three sets of factors. Technical factors include charging infrastructure, EV performance, and the technical knowledge of operators and maintenance personnel. Economic factors cover vehicle cost, charging facility cost, and the broader economic benefits of EV adoption, including cost savings and government incentives. Governance mechanisms encompass policy frameworks, regulatory environments, and institutional support systems that facilitate or hinder adoption.

Methodologically, the study employs a quantitative approach, using surveys and statistical analysis to evaluate the influence of these factors on EV adoption. Quantitative methods are appropriate here due to their ability to provide objective measurements, ensure statistical rigor, and generate findings that are both reliable and generalizable. Data will be collected through systematic sampling, with 459 questionnaires distributed to respondents across three main categories: government agencies, public institutions, and corporate fleets involved in urban transportation. The respondents, ranging from executives to top managers, represent stakeholders with direct relevance to EV adoption. Based on typical response rates in China (20–30%), approximately 150 valid responses are expected, which is sufficient for analysis using SPSS and Smart PLS.

Through this design, the study not only tests the direct relationships among technical and economic factors but also explores the mediating role of infrastructure governance

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mechanisms, offering a robust framework to understand EV adoption in Hunan's public sector.

1.8 Significance of Study

The significance of this study lies in its comprehensive approach to examining the multifaceted factors influencing the adoption of electric vehicles (EVs) in urban public transportation, with Hunan Province serving as a strategically chosen case. Unlike first-tier cities such as Beijing, Shanghai, and Shenzhen, where EV adoption has been accelerated by advanced infrastructure, stronger fiscal capacity, and concentrated technology development, Hunan represents the conditions of second-tier regions where policy ambitions often outpace local implementation outcomes. This makes Hunan an analytically valuable context for assessing how China's national EV adoption policies translate into practice across diverse economic and infrastructural landscapes. By situating the study in Hunan, the research directly links provincial realities with national policy objectives. As a transportation hub in central China, Hunan is a designated province for new energy vehicle promotion under the New Energy Vehicle Industry Development Plan (2021–2035). However, its relatively modest technological advancement, uneven charging infrastructure, and governance bottlenecks contrast sharply with the successes of more advanced provinces. This provincial disparity exemplifies the national challenge: while China has achieved global leadership in EV sales, adoption in second- and third-tier regions lags significantly, threatening the achievement of the 2035 target of full electrification of public vehicles.

From an environmental perspective, the study speaks directly to China's broader carbon-reduction agenda. With vehicle exhaust accounting for nearly 15% of national

CO_2 emissions, the electrification of public transportation in provinces like Hunan is critical for reaching carbon peak by 2030 and neutrality by 2060. From a policy perspective, this research clarifies how technical and economic barriers, when mediated through infrastructure governance mechanisms, affect adoption outcomes, thereby guiding policymakers in designing more differentiated and regionally responsive interventions. Economically, the study highlights the cost-saving potential of EV fleets through reduced fuel consumption, lower maintenance, and long-term operational benefits. It also underscores the specific financial barriers faced in Hunan, such as high upfront vehicle and charging facility costs, illustrating how tailored subsidies and investment models could bridge the gap between central policy intentions and local adoption realities. Technologically, the study evaluates EV performance and the technical knowledge of operators in Hunan, offering insights that can inform manufacturers and service providers on how to adapt vehicles for diverse operational contexts beyond first-tier cities.

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Socially and regionally, the study contributes by illuminating how second-tier provinces can overcome adoption inertia to support national sustainability goals. Cleaner and more sustainable transportation in Hunan not only enhances air quality and public health but also provides a model for other resource-constrained provinces. In this way, the study enriches the academic discourse on EV adoption by linking national policy frameworks with provincial implementation realities, thereby promoting more inclusive and equitable pathways toward China's low-carbon urban mobility transition.

1.8.1 Theoretical Significance

The theoretical significance of this study lies in its attempt to address the limited conceptual integration between technology acceptance and socio-technical governance in the study of electric vehicle (EV) adoption. While existing scholarship has recognized technical and economic constraints, it often treats adoption as either a matter of individual perceptions or as a structural policy challenge, without bridging the two. By embedding Technology Acceptance Model 2 (TAM2) and Socio-Technical Systems (STS) Theory into the research framework, this study develops a multidimensional perspective that directly links the research problem, low EV adoption in Hunan's public sector despite strong policy incentives, with the theoretical mechanisms that can explain it.

Specifically, this research extends TAM2 by applying it to the public sector, where adoption decisions are not purely consumer-driven but shaped by institutional mandates, organizational priorities, and stakeholder expectations. In this setting, perceived usefulness (PU) (e.g., operational efficiency, cost savings, compliance with environmental mandates) and perceived ease of use (PEOU) (e.g., ease of fleet integration, maintenance requirements, charging convenience) become decisive in shaping whether transport authorities, managers, and fleet operators support or resist adoption. TAM2 also highlights the role of subjective norms and image, which are particularly salient in China's public sector, where conformity to central policy directives and the reputational benefits of aligning with sustainability goals influence adoption intentions.

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At the same time, the study contributes to STS theory by demonstrating that perceptions of usefulness and ease of use cannot be separated from the broader socio-technical environment. In Hunan, fragmented governance structures, uneven infrastructure, and gaps in technical knowledge illustrate how misalignment between the technical subsystem (charging networks, vehicle performance, expertise) and the social subsystem (policies, institutional capacity, stakeholder collaboration) hinders adoption, even when EVs are technologically viable and supported by national policy. By applying STS, the study explains why purely technological or economic improvements cannot guarantee adoption unless governance mechanisms and institutional incentives evolve in parallel.

Taken together, the integration of TAM2 and STS advances theoretical understanding by bridging micro-level acceptance factors (PU, PEOU, social influence) with macro-level socio-technical alignment (infrastructure, policy, governance). This holistic framework not only clarifies the factors shaping EV adoption in Hunan's public sector but also contributes to refining technology adoption theory in contexts where organizational decision-making, governance mechanisms, and socio-technical systems converge.

1.8.2 Practical Significance

The practical significance of this thesis lies in its capacity to generate tangible improvements in the adoption of electric vehicles (EVs) within urban public transportation systems. By systematically analyzing the technical, economic, and governance factors that influence adoption, the study provides a structured roadmap for policymakers, public transportation agencies, investors, manufacturers, and other stakeholders. Its findings can be translated into more effective policies, improved

infrastructure planning, targeted investment decisions, stronger public–private partnerships, and, ultimately, environmental, and public health benefits.

For policymakers, the study offers actionable insights by clarifying how technical and economic factors, mediated by governance mechanisms, shape adoption outcomes. Such evidence can inform the design of incentives, subsidies, and regulatory frameworks that directly address barriers to adoption. Similarly, the research underscores the centrality of infrastructure planning, highlighting the need for strategically located charging stations to reduce feasibility constraints in operating electric buses, taxis, and municipal vehicles. Investors and industry stakeholders can also benefit from the study's assessment of cost–benefit dynamics, which provides guidance for allocating resources to charging infrastructure, manufacturing, and related technologies.

Public transportation agencies stand to gain by using the findings to plan fleet upgrades, implement training programs, and refine maintenance operations, ensuring a smoother transition to electric mobility. At the same time, the study offers valuable direction for manufacturers and technology providers, who can tailor vehicle designs to the operational requirements of public fleets, thus driving technological innovation. The importance of governance and collaboration highlighted in this research further reinforces the role of public–private partnerships in accelerating adoption, pooling resources for infrastructure development, and aligning policy and industry goals.

On a broader scale, the adoption of EVs in public transportation has the potential to significantly reduce air pollution and greenhouse gas emissions, directly contributing to public health and environmental sustainability. By focusing on Hunan Province, a

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second-tier region, the study also addresses regional disparities in adoption, providing context-specific insights that can be extended to other less economically developed areas in China. Finally, the emphasis on technical knowledge underscores the need for capacity building through targeted education and vocational training programs, equipping public transportation staff with the skills to operate and maintain EV fleets effectively. Collectively, these contributions ensure that the study delivers not only theoretical value but also practical solutions for advancing sustainable mobility.

1.9 Operational Definitions & Mapping

Operational definitions delineate the precise methodologies or techniques utilized to gauge or alter a variable within a research inquiry. They offer a meticulous and lucid explanation of how a particular variable is observed, measured, or manipulated within the specific context of the study (Hair, Black, Babin & Anderson, 2010). These definitions establish and elucidate the variables or concepts under scrutiny in a particular and quantifiable manner (Sekaran & Bougie, 2013). They are indispensable for ensuring the accuracy, reproducibility, and validity of the research (Saunders, Lewis & Thornhill, 2009). For this study, all operational definitions are drawn from and adjusted based on previous empirical research instruments, with corresponding references provided. The key terms from each instrument are integrated into the operational definitions for all dependent and independent variables. In addition, all operational definitions are mapped with the underpinning theory (conceptual definitions), notably Technological acceptance Model 2 (TAM2), so that the underpinning theories serve as actual analytical framework in this study.

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1. **Charging infrastructure** refers to the network of charging stations and related facilities required to support electric vehicles. In this study, it is measured by the availability, accessibility, and geographic distribution of public charging stations in urban areas of Hunan Province. The density of charging stations and their operational efficiency are key indicators (Bakker & Trip, 2013). In term of mapping with Charging infrastructure mapped to PEOU (Perceived Ease of Use) under TAM2, since well-developed charging networks reduce user effort and complexity, making EV adoption easier for operators.

2. **Electric vehicle performance** encompasses the functional capabilities and reliability of EVs used in urban public transportation. This includes metrics such as range per charge, energy efficiency, reliability (frequency of breakdowns), and user satisfaction (Wang et al., 2018). Performance data can be gathered from transportation agencies and user feedback surveys. Electric vehicle performance mapped to PU (Perceived Usefulness), as higher performance (reliability, range, efficiency) enhances the perceived operational value and benefits of EVs.

3. **Technical knowledge** refers to the level of expertise and understanding among transportation operators, maintenance staff, and policymakers regarding EV technologies. This is measured through surveys assessing knowledge of EV maintenance, operation, troubleshooting, and overall familiarity with EV technology (Zhou et al., 2020). Training records and certification programs also serve as indicators. Technical knowledge mapped to PEOU, since adequate knowledge and training lower the cognitive and operational barriers to adoption by increasing ease of integration into daily use.

4. **Vehicle cost** includes the initial purchase price of electric vehicles, as well as ongoing maintenance and operational costs. This study measures vehicle cost by comparing the total cost of ownership (TCO) of electric buses and taxis with their internal combustion engine counterparts. TCO includes purchase price, maintenance costs, fuel/charging costs, and depreciation (Hawkins et al., 2013). Vehicle cost mapped to PU, because affordability directly influences the perceived usefulness in terms of financial feasibility and returns on investment.

5. **Charging facilities cost** refers to the physical spaces and infrastructure where EVs are charged, including the types of chargers available (e.g., fast chargers, standard chargers), their power output, and the waiting time for charging. This is measured by the number, type, and utilization rate of charging facilities cost in public transportation hubs (Li et al., 2019). Charging facilities (Availability & Affordability) mapped to PEOU, as accessible and affordable charging reduces operational inconvenience and makes EV adoption easier.

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6. **Economic benefits** pertain to the financial advantages of using electric vehicles over conventional vehicles. These include savings on fuel costs, reduced maintenance expenses, and potential government subsidies or incentives. Economic benefits are quantified through cost-benefit analysis and financial performance reports of public transportation fleets (Egbue & Long, 2012). Economic Benefits mapped to PU, since the recognition of financial benefits strengthens perceptions of usefulness in meeting organizational and policy objectives.

7. **Infrastructure governance mechanisms** are the policies, regulations, and institutional frameworks that govern the development and management of EV

infrastructure. This includes government policies on EV incentives, regulations for charging station installations, and public-private partnerships. Governance effectiveness is measured by the comprehensiveness and enforcement of these policies and the level of coordination between different governmental and non-governmental stakeholders (Geels, 2014). Strong governance alignment enhances both perceived usefulness and perceived ease of use by ensuring infrastructure availability, cost-efficiency, and systemic reliability.

8. **Adoption of electric vehicle** refers to the process by which public transportation systems in Hunan, China, integrate electric vehicles into their fleets and the extent to which these vehicles are utilized in daily operations (Bakker & Trip, 2013). Adoption is conceptualized as the outcome of the interaction between TAM2 perceptions (PU and PEOU) and STS-driven governance alignment.

9. P**ublic sector** refers to government-owned, government-managed, or state-supervised organizations and institutions that provide services, manage resources, and implement policies in line with national and provincial development goals. It includes state administrative bodies, municipal governments, public institutions (such as schools, hospitals, and postal services), as well as state-owned enterprises (SOEs) that operate in strategic industries, including energy, transportation, and infrastructure. In urban transportation, the public sector typically covers government-operated bus systems, municipal taxi fleets, sanitation and logistics vehicles, and other transport services that are funded or regulated by local authorities. To conclude, Table 1.2 (next page) shows the construct–theory link (PU, PEOU, or STS), provides clear indicators that can be measured via questionnaire/survey and anchors each in recognized sources.

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Table 1.2
Construct–Theory Link

Construct	Theoretical Mapping (TAM2 / STS)	Measurement Indicators	Source(s)
Charging Infrastructure	PEOU (TAM2)	Availability of charging stations; accessibility across routes; ease of integration into operations	Adapted from Davis (1989); Venkatesh & Davis (2000); STS applications in mobility (Trist, 1981)
EV Performance	PU (TAM2)	Reliability; driving range; energy efficiency; maintenance requirements	Davis (1989); Venkatesh & Davis (2000)
Technical Knowledge	PEOU (TAM2)	Operator training; knowledge of EV operation; ability to troubleshoot and maintain vehicles	Venkatesh & Davis (2000); STS alignment studies
Vehicle Cost	PU (TAM2)	Purchase cost; lifecycle costs; affordability relative to budget	Davis (1989); TAM2 adoption studies
Charging Facilities	PEOU (TAM2)	Affordability of charging; convenience of payment and usage; availability during operation	Venkatesh & Davis (2000); EV adoption literature
Economic Benefits	PU (TAM2)	Fuel cost savings; reduced maintenance costs; long-term financial efficiency	Davis (1989); EV policy adoption research
Infrastructure Governance Mechanisms	STS (social subsystem mediation)	Policy support; regulatory enforcement; institutional coordination; stakeholder collaboration	Trist (1981); socio-technical governance literature
EV Adoption (Public Sector)	TAM2 (PU & PEOU) + STS alignment	Degree of fleet electrification; intention to expand EV use; compliance with policy mandates	Adapted from TAM2; STS applications in public sector transitions

1.10 Organization of the Dissertation

This study consists of five chapters. Chapter One highlighted the background to the study, the statement of the problem, and the research questions. These were followed by research objectives, the significance of the research, the scope of the study covered, and how the study was organized.

Chapter Two reviewed the underpinning theories of Extension of TAM & Social-Technical System Theory to arrive at the hypothetical model for this study. An in-depth review of the literatures on the dependent and independent variables of this dissertation will be conducted. The literature review focused on definitions, development, dimensions, models, and the relationship technical & economics factors in the adoption of electric vehicles through the mediation of infrastructure governance mechanisms in Hunan's urban public transportation, China.

Chapter Three focused on research methodology. It comprised of research framework, hypotheses development and research design of action research. It also contained measurement and instrument of variables and explanation of the data collection procedures. After that, a description on the population, sampling frame, sample of the study, unit of analysis, variable validity and variable reliability were presented. Finally, techniques of data analysis were briefly discussed in this chapter.

Chapter Four briefly restate the research questions or hypotheses and outline the structure of the chapter. Follows by demographic details of the study participants, and information on the sample size and any relevant characteristics (e.g., age, gender, occupation). Recap of how data was collected (methods, tools used) and mention any issues encountered during data collection. As for the presentation of results of

quantitative data, tabular format for descriptive statistics (mean, median, mode, standard deviation), inferential statistics (t-tests, ANOVA, regression analysis) as well as visual representations (graphs, tables, charts). Lastly, interpretation of the results in relation to the research questions or hypotheses, discussion of patterns, trends, and relationships found in the data and comparison of findings with existing literature or theoretical frameworks. This structure ensures that Chapter Four presents the research findings clearly and systematically, setting the stage for the subsequent discussion and conclusion chapters.

Chapter Five typically focuses on discussing the findings, drawing conclusions, and making recommendations based on the research conducted. Discussion of findings through the interpretation of results and answer the research questions or support/reject the hypotheses. Explain the significance of the findings in the context of existing literature. Explore the theoretical implications and consider the practical implications for the field of study, industry, or society. Comparison with literature, highlight any similarities, differences, or unexpected results and acknowledge any limitations in the research design, methodology, or data collection. Summarize the key findings of the study and state the overall conclusions that can be drawn from the research. Provide recommendations for professionals, policymakers, or other stakeholders.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Chapter Two reviews the literature underpinning this study. The discussion begins with the dependent variable, public sector electric vehicle (EV) adoption, before examining the independent variables, namely technical factors (charging infrastructure, EV performance, and technical knowledge) and economic factors (vehicle cost, charging facilities, and economic benefits). The mediating role of infrastructure governance mechanisms is also explored to highlight how governance shapes the adoption process. For each construct, the review considers definitions, conceptual foundations, and prior empirical findings, while also identifying key methodological approaches and gaps. Particular attention is given to the limited integration of technology acceptance perspectives with socio-technical governance in explaining public sector EV adoption. The chapter concludes by outlining the theoretical foundation of the study, linking Technology Acceptance Model 2 (TAM2) and Socio-Technical Systems (STS) Theory to the variables, thereby providing the conceptual base for the research framework.

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2.2 Overview of Global Electrical Vehicle (EV) Industry

The worldwide trend of electric vehicles (EVs) is characterized by rapid growth, driven by technological advancements, environmental concerns, government policies, and consumer demand (Zou, Khairul, Liu, & Zhang, 2024; Hao & Lei, 2021; Xiaojiang, 2021; Graham, 2021). Almost 14 million new electric cars were registered globally in 2023, bringing their total number on the roads to 40 million; registered by Global EV Outlook Report 2023 (International Energy Agency, 2023). These vehicles include hybrid electric vehicles, plug-in electric vehicles, and hydrogen-powered vehicles, all of which use one or more traction engines or electric engines for propulsion (Zhu, Wu, & Gaidai, 2024). EV sales have been growing exponentially. This number has continued to rise, with significant year-over-year increases. Countries like China, the United States, and various European nations (Norway, Germany, the Netherlands) are leading in EV adoption. China is the largest market, accounting for a substantial share of global EV sales (International Energy Agency, 2023; Hao & Lei, 2021)

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Improvements in battery technology, such as increased energy density, reduced costs, and faster charging times, have been crucial (Veza, Syaifuddin, Idris, Herawan, Abdulfatah, & Fattah, 2024; Yujie, 2021). Lithium-ion batteries dominate the market, but research into solid-state batteries and other advanced technologies continues (Yujie, 2021). The expansion of charging infrastructure is vital for EV adoption. There has been significant growth in the number of public charging stations, including fast chargers, which reduce charging times considerably. EVs are seen as a solution to reduce greenhouse gas emissions from the transport sector, which accounts for a significant portion of global emissions (Veza et al., 2024; Xiaojiang, 2021). They help in achieving air quality improvements, particularly in urban areas. Many governments

have introduced policies to promote EV adoption, including subsidies, tax incentives, and stricter emissions regulations for internal combustion engine vehicles (Zou et al., 2024; Hao & Lei, 2021), for example, the European Union has set ambitious CO2 reduction targets for new cars.

The cost of EVs is approaching parity with internal combustion engine vehicles due to declining battery costs and economies of scale. Total cost of ownership, including lower fuel and maintenance costs, is becoming more favorable for EVs (Xiaojiang, 2021). Major automakers are committing to electric mobility, with substantial investments in EV development. Companies like Tesla, Nissan, and Chevrolet have been at the forefront, while traditional manufacturers like Volkswagen, General Motors, and Ford are rapidly expanding their EV portfolios (Veza et al., 2024).

Increasing consumer awareness about climate change and sustainability is driving demand for EVs (Zhao, Furuoka, Rajah, & Shen, 2024). The variety of models available, including luxury, mid-range, and budget options, caters to a wider audience. EVs offer benefits such as instant torque, quiet operation, and low maintenance. Advancements in autonomous driving and connectivity features are also enhancing their appeal (Li, Long, Chen, Dou, Chen, Zheng, & He, 2020; Zhao et al., 2024). Despite improvements, range anxiety (fear of running out of battery) and long charging times remain concerns for some consumers. Continued investment in charging infrastructure and battery technology is essential. The integration of EVs into the grid presents challenges and opportunities (Li et al., 2020). Managed charging and vehicle-to-grid technologies can help balance demand and support renewable energy integration (Zhu, Wu, & Gaidai, 2024; Wenjun, 2018).

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Global initiatives like the Paris Agreement and collaborations between countries and organizations are promoting EV adoption. Partnerships between governments, industries, and research institutions are fostering innovation and infrastructure development. EVs are integral to the development of smart cities, with initiatives focusing on sustainable urban mobility. Integration with public transport, shared mobility solutions, and smart grids are key aspects (Shaoling, Zhe, Haibo, Chao, & Tao, 2021). The transportation sector's reliance on fossil fuels leads to severe environmental issues, including vehicle emissions and climate change, which affect ecological balance, living conditions, and human health (Rafiq, Parthiban, Rajkumari, Adil, Nasir, & Dogra, 2024; Hildemann et al., 2015). While energy-efficient substations have improved air quality, climate change remains a pressing issue. With 24% of greenhouse gas emissions originating from the transport sector, and 72% of that from ground transport, increased stakeholder engagement and efforts are essential for a green transport transition (Graham, 2021).

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Electric vehicles emerged as a strategic solution to meet the goals of decarbonization, ecological balance, commercialization, and technological innovation in transportation (Jing et al., 2020). Their integration is expected to pave the way for green mobility with zero carbon emissions. The global focus on electric vehicles brings both opportunities and challenges to the existing energy system (Karpenko et al., 2018). Recent research trends show a growing interest in the adoption of electric vehicles in smart cities, leading to reduced urban CO2 emissions. However, few studies have successfully facilitated the mainstream integration of electric vehicles in a flexible and efficient manner. Anthony's (2020) study uses an enterprise architecture approach to advance the digital transformation of electric vehicles towards sustainable mobility.

E-mobility is increasingly seen to enhance the sustainability of transportation systems, especially when vehicles are powered by renewable energy, potentially reducing the load on high-power-density grids (Shaoling ete al., 2021). The environmental benefits of these vehicles include a cleaner environment, reduced exposure to noise and pollutants, and economic advantages such as lower fuel and maintenance costs, free parking, no congestion charges, tax and financial benefits, and functional benefits like home charging and better technical performance (Bi-Hai, Chao-Chung, Nai-Wei, & Chun-Cheng, 2024). Some countries are implementing long-term policies to encourage the transition to electric mobility and promote citizen acceptance (Black & Nakanishi, 2024). These policies include building extensive charging infrastructure, issuing regulations for technical charging infrastructure and technology charging standards, and supporting citizen and business adoption through subsidies (Majihi, 2021).

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2.3 Extant Corpus on Global EV adoption

The study by Asati, Raghuwanshi, Vashisht, Muley, & Khare (2024) explores the growing global interest in sustainable transportation and the role of BEVs in reducing carbon emissions. Given the increasing demand for green energy solutions, it focuses on understanding what drives or hinders the adoption of BEVs in Madhya Pradesh, a region with specific economic, infrastructural, and cultural contexts that influence consumer behavior towards electric vehicles. The study reveals that economic considerations, particularly high upfront costs, and limited charging infrastructure, are major barriers to BEV adoption. Environmental awareness plays a positive role, but it is insufficient to drive adoption without stronger economic incentives and supportive infrastructure.

Arora, Sharma, and Singh (2023), published in Environmental Science and Pollution Research, investigates the future of mobility in India through the lens of the Diffusion of Innovation (DOI) theory, incorporating attitudinal factors to assess how new mobility technologies and models might be adopted. The study finds that consumer attitudes towards environmental sustainability and trust in new technologies play a significant role in shaping the adoption of new mobility models in India. Relative advantage and trialability (the ability to test or experiment with new technologies) were found to be crucial factors that influence the speed of adoption, especially for EVs and shared mobility solutions. Compatibility with existing infrastructure (such as charging stations for EVs or road readiness for autonomous vehicles) is highlighted as a key challenge for mobility innovations in the Indian market. The perceived cost of adopting new technologies (like EVs) is a major barrier, despite the long-term savings they may offer. Arora et al (2023) suggest that government intervention is necessary to facilitate the adoption of mobility innovations, particularly through the development of supporting infrastructure (charging stations, better road networks) and financial incentives (subsidies, tax breaks for EVs). They also recommend public awareness campaigns to improve consumer trust and environmental consciousness. Finally, the study predicts that while shared mobility models and EVs are likely to see significant growth in India, the adoption of more advanced technologies, such as autonomous vehicles, will take longer due to infrastructural and attitudinal barriers. However, with favorable government policies and improvements in infrastructure, the market is poised for substantial transformation.

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Boubker, Lakhal, Youssef, and Lotfi (2024), published in the World Electric Vehicle Journal, explores the factors influencing the intention to adopt electric vehicles (EVs) in Morocco. The study is situated in the context of Morocco's increasing focus on sustainability, aiming to transition towards greener transportation solutions to address environmental concerns. The findings revealed that firstly, environmental awareness emerged as a strong predictor of EV adoption intention, indicating that consumers with higher awareness of environmental issues were more likely to consider purchasing electric cars. Secondly, economic factors, particularly the high initial cost of electric vehicles, were found to be significant barriers to adoption. However, perceptions of long-term savings and financial incentives could mitigate these concerns. Thirdly, technological advancements were seen as both a motivator and a challenge. While consumers recognized the benefits of EV technology, concerns about the availability of charging infrastructure and battery performance remained prevalent. Fourthly, social influence and government policy were also important drivers, with the study suggesting that government interventions (such as providing subsidies and developing infrastructure) and societal pressure (from peers or environmental advocates) could positively impact EV adoption. The researchers conclude that while Morocco has made progress in promoting sustainable transport, the widespread adoption of electric vehicles is still hindered by economic and infrastructural challenges. However, with increased government support, improved technology, and greater environmental awareness, Morocco has the potential to significantly increase the uptake of electric vehicles, contributing to its sustainability goals.

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Buenavista, Ardvin Kester, and Servas (2024) examines the factors influencing the acceptance and adoption of electric public transportation (EPT) in the Philippines. The study is motivated by the need to understand public perceptions and behaviors related to sustainability as the Philippines transitions towards cleaner and greener transportation solutions. Environmental Awareness: The study finds that individuals with higher environmental awareness are more likely to support and accept EPT. However, the awareness alone is not sufficient to drive behavior change unless coupled with perceived personal benefits, such as cost savings or convenience. The researcher found that the accessibility and reliability of the EPT infrastructure play a crucial role in influencing adoption. Limited charging infrastructure, insufficient public knowledge, and concerns about reliability are significant barriers that hinder widespread acceptance. As for the economic benefits, such as lower fares and long-term savings due to reduced fuel dependency, were found to be important factors that encourage public acceptance of EPT. The affordability and perceived ease of use of electric public transport are key drivers for its adoption. Peer pressure, societal norms, and recommendations from trusted individuals also emerged as important determinants of EPT adoption. Individuals are more likely to accept and support EPT when they perceive that their peers or community members value it. Finally, government policies, incentives, and infrastructure development (charging stations, dedicated lanes, and road systems) were found to be essential in facilitating the transition to electric public transport. Without adequate support from the government and infrastructure improvements, public willingness to adopt EPT remains low. The researchers recommend that the Philippine government take active steps to improve the infrastructure necessary for EPT adoption, such as increasing the number of charging stations and providing financial incentives or subsidies to transport operators.

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They also advocate for public awareness campaigns to promote the environmental and economic benefits of EPT, aiming to improve public perception and drive behavioral change. Collaboration between the public and private sectors is highlighted as a crucial strategy for overcoming the challenges identified.

Black and Nakanishi (2024), published in Sustainability, provides an evaluation of policies implemented in Canberra, Australia aimed at reducing emissions from urban public transport. The study explores how well these policies have performed in practice and offers insights into the steps needed to achieve net-zero emissions in the city's transport sector. The study focuses on several key policies implemented in Canberra to reduce urban transport emissions: (i) Public Transport Investment: Investments in light rail and bus networks aimed at encouraging people to shift from private car use to public transport. (ii) Electric Vehicle (EV) Promotion: Incentives and subsidies for EV purchases, as well as the installation of charging infrastructure to support the transition to electric mobility. (iii) Active Transport Initiatives: Development of cycling and pedestrian-friendly infrastructure to encourage more sustainable, non-motorized forms of transport. (iv) Low-Emission Zones: Introduction of low-emission zones to restrict the use of high-emission vehicles in certain parts of the city. (v) Transport Demand Management (TDM): Policies aimed at reducing travel demand, such as congestion pricing and work-from-home incentives. The ex-post evaluation reveals several key findings: 1. Positive Impacts of Public Transport Investments: Investments in Canberra's public transport system, particularly the development of the light rail, have led to a modest reduction in private vehicle use and a corresponding decrease in transport emissions. However, the shift to public transport has not been as large as expected due to convenience and affordability concerns. 2. Limited Uptake of Electric Vehicles: Despite financial incentives and the expansion

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of EV charging infrastructure, the adoption of electric vehicles in Canberra remains slow. The high upfront cost of EVs and limited public knowledge about their benefits are identified as significant barriers to wider adoption. 3. Active Transport Infrastructure Underutilized: While Canberra has made progress in developing cycling and pedestrian infrastructure, usage remains low. Cultural attitudes favoring car ownership, combined with the city's urban sprawl, have limited the impact of these initiatives. 4. Challenges with Transport Demand Management: Policies aimed at reducing overall travel demand, such as congestion pricing and remote working incentives, have had limited success in shifting travel patterns. Many residents continue to rely heavily on private vehicles for daily commuting. Although the study focuses on Canberra, its findings are relevant to cities worldwide that are striving to reduce transport emissions and achieve net-zero targets. The challenges identified, such as cultural resistance to public transport, infrastructure gaps, and financial barriers, are common across many urban areas, and the policy recommendations offered by the authors have broader applicability in promoting sustainable urban transport globally.

Chonsalasin, Champahom, Jomnonkwao, Karoonsoontawong, Runkawee, & Ratanavaraha (2024) provides an empirical analysis of the role that perceptions of government policies play in influencing electric vehicle (EV) adoption in Thailand. The study explores the direct and indirect effects of policy perceptions on EV adoption by utilizing a measurement model and offering a detailed empirical examination of key factors. The researchers employ a measurement model grounded in the Diffusion of Innovation Theory and Technology Acceptance Model (TAM), supplemented with government policy perception variables. The framework assesses how factors such as perceived government support, trust in government policies, awareness of policy

incentives, and perceptions of policy effectiveness impact consumers' intention to adopt electric vehicles. The study's empirical analysis revealed several significant findings: 1. Positive Influence of Perceived Government Support: The perception that the government is providing strong support for EV adoption, through subsidies and tax incentives, positively influences the intention to adopt EVs. Consumers who view government support as substantial are more likely to consider purchasing an electric vehicle. 2. Trust in Government Policy: Trust in the government's long-term commitment to EV-related policies plays a crucial role in shaping adoption intentions. Consumers who trust that the government will maintain and expand EV policies over time are more willing to transition to electric vehicles. 3. Policy Awareness and Effectiveness: Awareness of government policies is positively correlated with EV adoption, but many respondents reported limited knowledge of specific incentives. This indicates that while policy awareness is critical, there is a gap in the public's understanding of available benefits. Moreover, perceptions of policy effectiveness also impact EV adoption, with respondents expressing doubts about the long-term impact and consistency of government initiatives. 4. Infrastructure Concerns: Although government policy perceptions are influential, concerns over the availability and accessibility of EV charging infrastructure remain a significant barrier. The study highlights the importance of expanding charging networks to increase consumer confidence in the practicality of owning an electric vehicle. The researchers identify several barriers to electric vehicle adoption in Thailand that are related to government policy perceptions: (i) Inconsistent Policy Messaging: Respondents expressed concerns over inconsistencies in policy implementation and messaging, which created uncertainty about the future of EV adoption in Thailand. (ii) Limited Public Awareness Campaigns: There was a general lack of awareness of the specific incentives and

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subsidies available for EV buyers, which limited the perceived attractiveness of electric vehicles as a viable alternative to traditional vehicles. (iii) Infrastructure Gaps: Despite government efforts to promote EV adoption, the limited availability of charging infrastructure, particularly in rural areas, continues to deter potential buyers. The study provides valuable insights for policymakers in Thailand and other emerging markets seeking to promote electric vehicle adoption. The findings suggest that while government policies are crucial, their success depends heavily on how they are perceived by the public. Policy effectiveness is not just about the introduction of incentives but also about building public trust and awareness. By improving the visibility and consistency of EV-related policies, governments can better support the transition to electric mobility.

Chonsalasin et al. (2024) conclude that government policy perceptions play a crucial role in shaping the adoption of electric vehicles in Thailand. The findings suggest that policymakers need to focus not only on designing policies but also on ensuring that these policies are effectively communicated to the public and are perceived as reliable and effective. Addressing barriers such as inconsistent messaging, infrastructure gaps, and limited public awareness will be essential for accelerating EV adoption in Thailand and achieving broader sustainability goals. Lanzini (2024) offers a comprehensive analysis of Italian consumer readiness for electric vehicle (EV) adoption through a survey-based study. The research focuses on understanding key factors that influence consumer attitudes and behaviors towards EVs in Italy, particularly in the context of urban sustainability and the nation's goals for reducing carbon emissions. The study's results reveal several important insights regarding Italian consumers' readiness to adopt electric vehicles: 1. Environmental awareness as a Key Driver: A strong positive correlation was found between environmental awareness and the willingness to adopt

EVs. Consumers who expressed higher levels of concern for environmental issues were significantly more likely to consider purchasing an electric vehicle. 2. Economic Barriers: Despite positive attitudes towards EVs, many respondents cited the high initial purchase cost as a barrier to adoption. This indicates that while long-term cost savings and lower operational costs are attractive to consumers, the upfront price remains a deterrent. 3. Infrastructure Concerns: One of the most significant barriers to EV adoption identified in the study was the lack of sufficient charging infrastructure, especially in rural areas. Consumers expressed concerns about the availability of charging stations, which diminishes their confidence in switching to an electric vehicle. 4. Influence of Government Policies: Awareness of government subsidies and tax incentives was found to be low among respondents, indicating a need for better communication and visibility of policy initiatives. Those who were aware of the incentives were more likely to consider adopting an EV, suggesting that improving public knowledge of available benefits could positively impact adoption rates. 5. Regional Variations: The study also found differences in readiness for EV adoption based on geographic location, with urban residents showing a higher likelihood of adoption compared to those in rural areas. This can be attributed to better infrastructure and higher levels of environmental awareness in urban settings. Based on the findings, the study offers several policy recommendations: (i) Enhanced awareness campaigns: The Italian government should invest in public awareness campaigns to better inform citizens about the benefits of EVs and the financial incentives available for purchasing them. This could involve targeted advertisements, collaborations with car manufacturers, and educational initiatives. (ii) Infrastructure development: Expanding the network of EV charging stations, particularly in rural and suburban areas, is critical to addressing consumer concerns about infrastructure. Public-private partnerships

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could be leveraged to accelerate the development of charging networks. (iii) Subsidy expansion: The government may need to consider increasing subsidies or offering more significant financial incentives to reduce the initial purchase cost barrier, especially for low- and middle-income consumers. (iv) Support for used EV markets: Encouraging the growth of a second-hand EV market could help make electric vehicles more affordable and accessible to a wider range of consumers.

This study by Lanzini (2024) provides useful insights for policymakers and industry stakeholders looking to promote electric vehicle adoption in Italy. The findings suggest that while consumers are generally positive about the environmental benefits of EVs, there are still significant economic and infrastructural barriers that need to be addressed. Improving the visibility of government policies and ensuring that charging infrastructure is widespread and reliable will be critical in driving future adoption.

Yeğin and Ikram (2022) provides a detailed examination of factors influencing consumer intentions to purchase electric vehicles (EVs) in Turkey by expanding the Theory of Planned Behavior (TPB). The study presents several significant findings: 1. Attitude toward EVs: A positive attitude toward electric vehicles is strongly associated with higher purchase intentions. Consumers who view EVs favorably are more likely to consider purchasing one. 2. Subjective Norms: Social influences, such as recommendations from friends and family or societal trends, play a significant role in shaping consumer intentions. If peers or family members advocate for EVs, individuals are more likely to follow suit. 3. Perceived Behavioral Control: Consumers' confidence in their ability to purchase and maintain an EV significantly impacts their intentions. Concerns about the availability of charging infrastructure and the overall usability of EVs can hinder purchase intentions. 4. Environmental Concerns: A

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growing awareness of environmental issues is linked to positive attitudes toward EVs. Consumers who prioritize sustainability are more inclined to adopt electric vehicles. 5. Perceived Benefits: The study found that perceived economic benefits (such as lower operating costs) and technological advancements (such as improved battery life and performance) also enhance purchase intentions. Yeğin & Ikram (2022) offers valuable insights into the determinants of electric vehicle purchase intentions among consumers in Turkey. By expanding the traditional Theory of Planned Behavior, the authors identify critical factors that influence consumer decisions and provide actionable recommendations for policymakers and industry stakeholders. The study highlights the importance of fostering positive attitudes, enhancing social norms, and improving perceived behavioral control to promote electric vehicle adoption effectively.

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2.4 Overview of Electrical Vehicle (EV) Industry in Hunan

In recent years, Hunan has made significant progress in developing electric vehicle infrastructure. Statistics from the Hunan Electric Vehicle Industry Association show that the number of public electric vehicle charging stations has grown significantly. From 512 charging stations in 2013, this number surged to 2,158 in 2021 (Hunan Electric Vehicle Industry Association, 2021). This expansion demonstrates the commitment and progress of stakeholders in creating an enabling environment for EV adoption. However, the challenge of ensuring equitable access to charging services must be addressed. Li et al. (2018) highlighted the importance of establishing charging stations with a balanced distribution between urban and rural areas to ensure that all residents have easy access to charging infrastructure.

Hunan has established a comprehensive policy and regulatory framework to support the development of electric vehicle infrastructure. The Hunan Electric Vehicle Industry Development Plan (2016-2020) determines the strategic direction to promote the application and infrastructure deployment of electric vehicles in the province. It outlines the goals and objectives of expanding the charging network, building charging stations and battery swapping facilities, and integrating EV charging infrastructure into public parking facilities (Hunan Provincial Development and Reform Commission, 2016). Complementing the plan, the Hunan Provincial Guidelines for the Construction of Charging Infrastructure provide specific technical standards, operational management requirements, and safety regulations for EV charging facilities (Hunan Provincial Commission of Economy and Information Technology, 2018). These guidelines ensure consistency, reliability, and safety of charging infrastructure across the region.

The statistics provide valuable insights into the progress of electric vehicle adoption in Hunan over the past decade. According to the Hunan Electric Vehicle Industry Association, Hunan has seen a significant increase in the number of electric vehicle registrations. From 602 registered EVs in 2013, this number rose to 77,294 by the end of 2020 (Hunan Electric Vehicle Industry Association, 2021). By the end of 2023, the number of new energy vehicles in Hunan Province has soared to 540,000. This upward trend shows that Hunan consumers are increasingly accepting and popular with electric vehicles.

2.4.1 EV adoption rates in Hunan and the rest of China

To gain a broader perspective, it is necessary to compare the EV adoption rate in Hunan with the rest of China. The study by Zhang et al. (2018) shows that Hunan is at

the forefront of EV adoption. In their study analyzing the construction of EV charging infrastructure, they found that Hunan is one of the regions with a high growth rate in EV registrations, suggesting that Hunan offers a favorable environment for EV adoption compared to many other regions in China. This highlights the importance of Hunan's efforts to promote and promote the adoption of electric vehicles. By the end of 2023, the number of new energy vehicles in China has reached 20.41 million, and the ranking of Chinese provinces is shown in the figure 2.1 below.

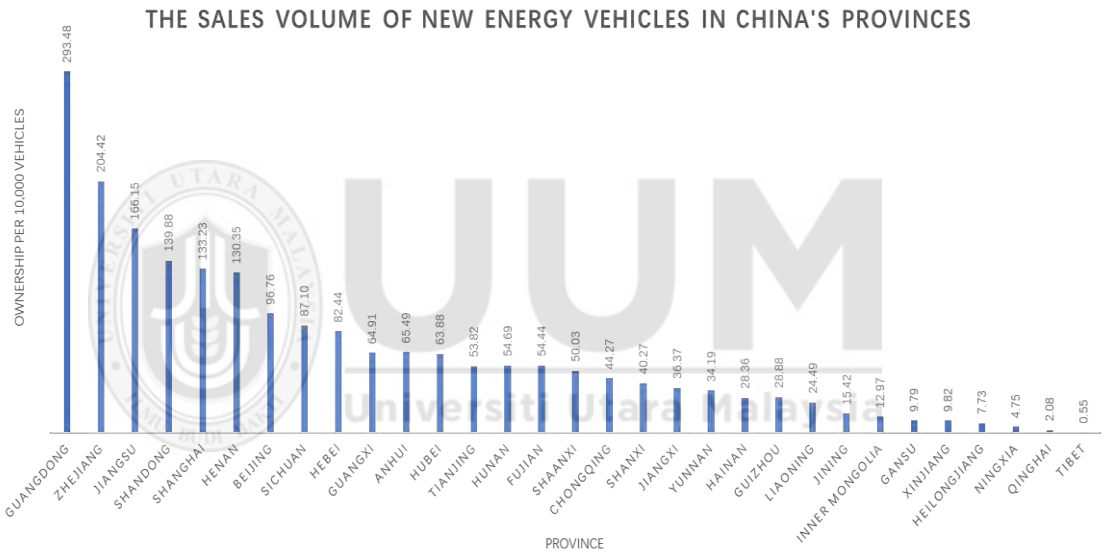

Figure 2.1 Factors influencing the growth of electric vehicle penetration in Hunan are identified

There are several factors contributing to the growth in the penetration of electric vehicles in Hunan. Government’s infrastructure governance mechanism plays a key role in stimulating consumer interest. For example, Li et al. (2018) discussed the impact of government subsidies and tax incentives on the Hunan EV market. These measures make EVs more financially viable for consumers and are an important driver of EV adoption. In addition, the development of charging infrastructure is essential to

alleviate range anxiety and improve convenience for EV owners. Wang et al. (2019) highlighted the importance of expanding and improving the EV charging network to support the growth of EV penetration in Hunan. In addition, public awareness and awareness of electric vehicles can also affect the adoption rate. A study by Zhao et al. (2020) highlighted the role of educational and promotional activities in increasing public awareness and acceptance of electric vehicles in Hunan. By dispelling misconceptions and emphasizing the environmental and economic benefits of electric vehicles, these initiatives help increase consumer confidence and adoption.

Socio-cultural factors also have a significant impact on the adoption of electric vehicles (Li, Fan, & Wang, 2017). With the increasing global awareness of climate change and environmental protection, the public acceptance of electric vehicles is gradually increasing. This cultural expectation is driving more people to consider adopting electric vehicles to reduce their environmental impact. In some societies and cultures, the adoption of electric vehicles is seen as a socially responsible and environmentally friendly act (Ramasamy, Qian, Zhai, & Liu, 2021). This norm can put pressure on individuals' adoption decisions, pushing them to follow the trend and adopt electric vehicles (Yeğin & Ikram, 2022). Institutional pressures are pressures from laws, policies, and industry standards that can promote or inhibit the adoption of electric vehicles. Governments indirectly drive the adoption of electric vehicles by legislating to restrict the use of internal combustion engine vehicles, or by setting emission standards (Lanzini, 2024; Ramasamy et al., 2021). Standards and specifications in the automotive industry can also affect the design, production, and sales of electric vehicles, such as uniform standards for charging interfaces, which can help improve the convenience and market acceptance of electric vehicles (Liu, Tang, & Sun, 2020).

In addition, the study by Vilchez et al. (2019) highlights the importance of EV purchase price as a determinant of European consumer choices and perceptions of incentives. Public policy initiatives aimed at addressing the price issue can help overcome barriers to adoption and accelerate the adoption of electric vehicles. In addition, Yang et al. (2020) highlighted the importance of brand trust, perceived benefits, attitudes, and purchase intentions in shaping consumers' behavior towards electric vehicles. By integrating the results of studies such as Helveston et al., (2015) Vilchez et al., (2019) and Yang et al., 2020, one could delve into the subtle interplay of government policies, consumer preferences, and economic influences in driving EV adoption in China. Analyzing the impact of subsidies, pricing models, and consumer perceptions of EV adoption can provide valuable insights for policymakers and industry stakeholders with the aim of promoting sustainable mobility practices and improving the economic viability of EV adoption in China.

To better achieve the promotion goal of electric vehicles, Wenbo Li et al (2020) conducted a large sample survey (N = 1039). Based on the joint analysis method, the Chinese public's preference for various incentive policies was investigated by using the method of joint analysis. The results show that less than one-third of consumers have a better understanding of incentives, while more than half of consumers have little knowledge of these policies. For consumers, the relative importance of different policy categories is ranked as follows: charging incentives, driving incentives, vehicle registration incentives, and purchase incentives. Among different social and demographic groups, consumers aged 26-30, with a monthly income of more than 20,000-yuan, high school, special middle, and master's degree (and above) believe that the relative importance of driving incentive policies is the highest Consumers in two-person households ranked purchase incentives first; Consumers with a monthly

income of 15,000 to 20,000 yuan and a family of three are given priority to register preferential policies.

Moreover, technological advancements and the availability of various EV models affect the adoption rate. The introduction of more affordable, longer-range EV models, coupled with improvements in charging infrastructure, addresses two key barriers to adoption, price, and range anxiety (Li et al., 2018). This broader selection appeals to a wider consumer base and contributes to the growth of electric vehicle applications in Hunan.

An analysis of the EV adoption rate in Hunan reveals a positive trajectory, with significant growth observed over the years. Comparisons with the rest of China highlight the favorable environment for the adoption of electric vehicles in Hunan. The key factors influencing the growth of electric vehicle penetration in Hunan include supportive government policies, incentives, development of charging infrastructure, vehicle pricing models, public awareness campaigns, and technological advancements. By addressing these factors, stakeholders can further drive the adoption of electric vehicles in Hunan and contribute to the development of a sustainable low-carbon city as EVs are integral to the development of smart cities, with initiatives focusing on sustainable urban mobility; integration with public transport, shared mobility solutions, and smart grids are key aspects.

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2.4.2 The Adoption of EV in Public Sector, Hunan

The Chinese government has taken decisive steps to accelerate the electrification of public sector vehicles through the issuance of policy directives, most notably the *Notice on Launching the First Batch of Pilots for the Full Electrification of Public*

Sector Vehicles (China Ministry of Industry and Information Technology [MIIT], 2020). This initiative forms a critical component of China's broader strategy to advance sustainable urban transportation, mitigate greenhouse gas emissions, and address the pressing issue of air pollution. The policy is underpinned by three interrelated objectives. First, it seeks to promote green transportation by reducing dependence on fossil fuels, thereby contributing to cleaner urban environments, and reinforcing China's commitment to carbon neutrality. Second, it aims to stimulate technological innovation by encouraging the development and application of advanced EV technologies, particularly in the areas of manufacturing and infrastructure. Third, the policy is designed to set a precedent for the private sector by demonstrating the feasibility and advantages of EV adoption in public transportation systems, with the expectation that public sector leadership will generate economies of scale and drive down overall costs.

The policy is operationalized through several key components. It specifically targets public sector fleets such as buses, taxis, government service vehicles, and municipal transportation units, establishing pilot programs in selected regions to evaluate both the opportunities and challenges of full electrification. These pilots are structured around defined timelines and milestones to ensure accountability and steady progress toward national targets. To support implementation, the government provides financial incentives, including subsidies, tax breaks, and low-interest loans, alongside substantial investment in the development of charging infrastructure and smart grid technologies. The notice also emphasizes the establishment of technical standards and regulations to ensure vehicle safety, infrastructure interoperability, and the phased elimination of high-polluting vehicles. Furthermore, a system of monitoring and evaluation is embedded within the policy framework to collect empirical data on

emissions reduction, cost savings, and operational efficiency, which will inform future decision-making.

The expected outcomes of this policy extend beyond environmental benefits. While significant reductions in air pollution and greenhouse gas emissions are anticipated, the initiative is also expected to yield economic savings in the long term through reduced fuel and maintenance costs, as well as to stimulate job creation in EV manufacturing and infrastructure sectors. Additionally, it is projected to catalyze technological advancements by accelerating innovation and fostering a comprehensive EV ecosystem encompassing production, services, and infrastructure. On the social front, the policy is expected to improve public perception and acceptance of EVs, thereby normalizing green transportation as part of everyday life and contributing to global efforts against climate change.

Nevertheless, several challenges and considerations accompany this ambitious initiative. The high initial investment required for vehicle procurement and infrastructure development poses financial constraints, making sustained government support essential. Technical barriers such as battery performance, charging times, and vehicle reliability also need to be addressed to ensure the operational feasibility of EVs in large-scale public service applications. Infrastructure development represents another significant hurdle, requiring coordinated planning to integrate charging networks with existing power grids while ensuring stable energy supply. Moreover, the transition depends on behavioral adaptation, as both public sector employees and the broader citizenry must become accustomed to new technologies and practices.

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In summary, the *Notice on Launching the First Batch of Pilots for the Full Electrification of Public Sector Vehicles* constitutes a landmark policy in China's sustainable transport agenda (MIIT, 2020). By articulating clear goals, offering financial and infrastructural support, and embedding mechanisms for monitoring and evaluation, the policy positions the public sector as a leader in the shift toward electrified mobility. Beyond its immediate environmental and economic impacts, the policy fosters technological innovation, signals China's global leadership in sustainable transport transitions, and creates a foundation for broader adoption of EVs across both public and private sectors.

2.4.3 Case studies of successful public transport infrastructure governance for electric vehicles

Several recent studies have highlighted Hunan's successful EV infrastructure governance mechanisms. For example, Liu and Zhang (2021) discuss the case of Yueyang, where the local government has implemented a comprehensive plan to develop EV charging infrastructure, including public and private charging facilities. The study highlights successful collaboration between governments, power utilities and charging service providers to ensure the availability and accessibility of charging stations. Another example is the city of Changde, where Chen et al. (2021) highlighted the successful integration of renewable energy sources such as solar into charging infrastructure networks to facilitate sustainable low-carbon EV charging.

Successful case studies in Hunan demonstrate various strategies and approaches to promote the adoption of electric vehicles and strengthen the public transport governance of infrastructure. Liu and Zhang (2021) highlighted the importance of government support and coordination to establish and improve the charging

infrastructure network. They also highlighted the role of public engagement and user feedback in improving the design and operation of charging facilities. Chen et al. (2021) highlighted the importance of using renewable energy to power EV charging stations, reduce environmental impact, and promote sustainable transportation solutions.

These recent case studies provide valuable lessons and best practices for effective public transport infrastructure governance for electric vehicles in Hunan. A key lesson is the importance of multi-stakeholder collaboration and coordination, including government agencies, utility companies, charging service providers, and EV owners, to ensure the successful implementation and operation of charging infrastructure (Liu & Zhang, 2021). In addition, integrating renewable energy into charging networks can contribute to a greener and more sustainable transportation system (Chen et al., 2021). With the support of Liu and Zhang (2021) and Chen et al. (2021), a recent case study on the governance mechanism of electric vehicle urban infrastructure in specific cities or regions in Hunan Province was studied. (2021) highlights strategies and approaches to promote EV adoption and develop sustainable infrastructure governance. Lessons learned and best practices highlight the importance of collaboration, government support, public participation, and renewable energy integration to create an enabling environment for Hunan's successful EV city infrastructure.

2.4.4 Environmental impact assessment of electric vehicle application in Hunan

The environmental impact assessment of electric vehicle (EV) adoption in Hunan is critical for evaluating the extent to which electrification can contribute to emission reduction and sustainability goals. Existing international and domestic studies provide a foundation for understanding how EVs affect multiple environmental dimensions. This section structures the discussion around four key areas: greenhouse gas emissions,

air quality, energy consumption, and broader ecological effects, offering lessons relevant to the regional context of Hunan.

A substantial body of research has highlighted the greenhouse gas (GHG) reduction potential of EV adoption. Zhong et al. (2018) conducted a life cycle assessment (LCA) of EVs in China, including Hunan Province, demonstrating that transitioning from internal combustion engine vehicles to EVs can significantly lower GHG emissions. Similarly, Hawkins et al. (2013, 2020) showed that the net benefits of EV adoption are contingent on the energy mix used in power generation, with greater reductions realized when renewable sources dominate the grid. Zhang et al. (2016) provided further evidence from Shanghai, illustrating that EVs charged with low-carbon electricity substantially reduce life-cycle emissions. Comparative research from Europe and the Netherlands (Sierzchula et al., 2014) reinforces that energy efficiency and charging infrastructure are decisive in maximizing GHG benefits. Collectively, these findings suggest that for Hunan, where the electricity grid is gradually diversifying, EV adoption has strong potential to support China's national carbon neutrality targets.

Air quality is another dimension where EV adoption can yield significant gains. Zhang et al. (2018) modeled reductions in pollutants such as nitrogen oxides (NOx) and particulate matter (PM) following EV deployment in Chinese cities, finding marked improvements in urban environments with high vehicle density. International studies echo these results: An et al. (2016) in North America and Wang et al. (2019) in Europe both documented declines in pollutants including CO, VOCs, and PM, translating into measurable public health benefits. Cherry et al. (2016) and Zhang et al. (2015) further highlighted that metropolitan areas with concentrated traffic experience the largest

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improvements when EV penetration is scaled up. These findings are particularly relevant for Hunan's urban centers, where traffic congestion contributes heavily to localized air pollution.

Beyond emissions, EV adoption also reshapes patterns of energy consumption. Hawkins et al. (2020) emphasized that EVs can reduce overall fossil fuel dependence when paired with cleaner electricity generation, though the environmental benefits are diminished if coal remains the dominant source. Sierzchula et al. (2014) further noted that charging infrastructure efficiency influences net energy savings. For Hunan, where energy infrastructure is still developing, investment in renewable power and smart grid technologies will be essential to ensure that EV adoption translates into tangible energy efficiency gains rather than shifts in pollution sources.

The ecological implications of EV adoption extend beyond air and climate. Studies such as Bryła, Chatterjee, and Ciabiada-Bryła (2023) suggest that reduced emissions not only benefit human health but also contribute to protecting biological ecosystems by lowering atmospheric pollutants that harm biodiversity. Additionally, life cycle assessments (e.g., Hawkins et al., 2013) have noted that while EVs reduce tailpipe emissions, the manufacturing process, particularly battery production, carries implications for water quality and resource use. Addressing these upstream impacts through technological innovation and regulatory oversight is vital to ensuring that EV adoption delivers holistic sustainability benefits in regions like Hunan.

Together, these studies highlight that EV adoption offers a multidimensional set of environmental benefits, ranging from greenhouse gas reductions and improved urban

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air quality to more sustainable patterns of energy use and ecosystem protection. However, these benefits are conditional on systemic factors such as energy mix, infrastructure efficiency, and technological advancements in manufacturing. For Hunan, a region grappling with both industrial growth and environmental pressures, a region-specific environmental assessment is necessary to quantify local impacts and guide policymakers in designing interventions that maximize the ecological value of electrification.

2.5 Technical Factors and Electric Vehicle Adoption

In this study, technical factors are those elements related to the technology and infrastructure necessary for the successful deployment and operation of EVs. It has been operationalized as charging infrastructure, electric vehicle performance, and technical knowledge which are the first set of independent variables. These factors are critical in determining the feasibility, efficiency, and effectiveness of EV adoption. Firstly, charging infrastructure refers to the network of charging stations and related facilities required to support electric vehicles (Chawla, Mohnot, Mishra, Harsh, & Singh, 2023). In this study, it is measured by the availability, accessibility, and geographic distribution of public charging stations in urban areas of Hunan Province. The density of charging stations and their operational efficiency are key indicators (Han & Sun, 2024). Secondly, electric vehicle performance encompasses the functional capabilities and reliability of EVs used in urban public transportation. This includes metrics such as range per charge, energy efficiency, reliability (frequency of breakdowns), and user satisfaction (Wang et al., 2018). Performance data can be gathered from transportation agencies and user feedback surveys. Thirdly technical knowledge refers to the level of expertise and understanding among transportation operators, maintenance staff, and policymakers regarding EV technologies

(Kethareswaran & Moulik, 2023). This is measured through surveys assessing knowledge of EV maintenance, operation, troubleshooting, and overall familiarity with EV technology (Zhou et al., 2020). Training records and certification programs also serve as indicators.

In the process of promoting and popularizing electric vehicles (EVs), the construction of charging infrastructure is a key factor that cannot be ignored (Zink, Valdes & Wuth, 2020). It not only directly affects the ease of use and practicality of electric vehicles, but also has an important impact on consumers' purchasing decisions. In recent years, the development of fast charging technology has provided strong support for the popularization of electric vehicles (Pang, Ye, & Zhang, 2023). Compared with traditional slow charging, fast charging technology can charge a large amount of electric energy into an electric vehicle in a short period of time, significantly improving the charging efficiency. For example, some fast-charging stations can charge an electric vehicle by 80% in 30 minutes, significantly reducing the waiting time for users. In addition, with the continuous advancement of technology, a new generation of super-fast charging technology is being developed, which is expected to further improve the charging speed and provide a more convenient charging experience for electric vehicle users (Rafiq, Parthiban, Rajkumari, Adil, Nasir, & Dogra, 2024; Zhao, Zheng, Deng, Yin, & Chen, 2018).

Wireless charging technology is another important technological advancement. Through magnetic resonance or electromagnetic induction, wireless charging technology can realize contactless charging of electric vehicles, providing users with a more convenient and safe charging method (Veza et al., 2024). Currently, wireless charging technology has been used in some public transportation and commercial

fleets, and it is expected to be more widely used in the field of private electric vehicles in the future as the technology matures and the cost decreases (Veza et al., 2024; Techa-Erawan, Ratisukpimol, & Bunditsakulchai, 2024).

A study conducted by Zhang et al. (2018) to examine the relationship between infrastructure development and electric vehicle sales in Hunan. The study collected data on the number of charging stations, the spacing between charging stations, and the sales of electric vehicles in different regions of Hunan. Statistical analysis shows that the availability and proximity of charging infrastructure is positively correlated with EV sales (Tuladharr, Yuangyai, Pengsakul, & Gyawali, 2023). The results of the study show that a well-developed charging infrastructure network is essential to promote the popularization of electric vehicles in Hunan. Similarly, Li et al. (2021) conducted a statistical analysis of EV sales data and charging infrastructure availability in different cities in Hunan. The study examined the relationship between the number of charging stations, the urban population, and electric vehicle sales. Statistical analysis shows that cities with a higher number of charging stations and larger populations have higher EV sales, indicating the importance of charging infrastructure in driving EV adoption (Worasatepongsa & Prakthayanon, 2022).

Wang et al. (2019) conducted a statistical analysis to evaluate the impact of charging infrastructure availability on EV adoption in Hunan. The study collected data on the number of public and private charging stations and electric vehicle sales in different cities in Hunan. Statistical analysis shows a positive correlation between charging infrastructure availability and EV adoption. The findings highlight the importance of a robust charging infrastructure network in boosting EV adoption. Huang et al. (2017) performed a statistical analysis of data from charging station construction and EV

charging infrastructure projects in Hunan. The study assesses the progress of infrastructure development and identifies potential gaps or challenges. Statistical analysis provides valuable insights into the current state of infrastructure development and the need for further investment and expansion.

Pandak, Piaralal, and Rethina (2024) reported that availability of charging stations plays a vital role on the intention to adopt EVs. Harahap et al. (2023) found that charging infrastructure such as special electricity tariffs, more robust batteries, faster or free charging, and higher storage density can effectively promote EV. Reiner, Beard, Park, and Kinnear (2020) established that charging infrastructure is a critical in EV adoption, as consumers need access to charging at very near, even at work, or availability of nationwide public charging infrastructure to enable long journeys. However, Bhat, Verma, and Verma (2022) and Imran and Mohammad (2022) found that facilitating conditions have negative influence on a consumer's intention to adopt an electric vehicle. Still, Habich-Sobiegalla, Kostka and Anzinger (2019) found that charging infrastructure does not drive intentions of customers to purchase EVs. Additionally, Verma, Verma and Khan (2020) asserted that lack of physical infrastructure constitutes a barrier to EV adoption. Nonetheless, Zink, Valdes and Wuth (2020) showed a significant difference on the effect of private, semi-public, and public charging infrastructures on EV adoption.

Haustein, Jensen and Cherchi (2021) found that new fast charging facility has a significant effect on electric vehicle adoption. Sierzchula et al. (2014) found that charging infrastructure is significant in predicting EV adoption. Egnér and Trosvik (2018) found a general effect of the number of public charging facilities on the EV adoption. The findings of Gómez Vilchez et al. (2019) confirm that charging stations

(instrumented) have a positive and significant impact on EV purchase. Yet, McDermott (2017) found that improve access to charging infrastructure is the most effective element that increases the sales of EVs.

On the other hand, Gupta & Rhoads (2022) noted that limited availability of public charging stations discourages potential EV buyers. Besides, Kester et al. (2018) found that infrastructure support for public and apartment charging, generally accelerate EV diffusion. Additionally, Rezvani et al. (2015) found that availability of charging station outside the home, has significant influences on EV adoption decision of customers. Hence, actual, and perceived charging availability are key to EV adoption. The study of Wang, Ozden and Tsang (2023) found that performance expectations positively influence EV adoption intention. Still, Bhat et al. (2022) found that performance expectancy is positively related to intention of consumer to adopt an electric vehicle. In contrast, Peters, Van der Werff, and Steg (2018) found that adopting an EV for technological reasons is not consistent across adopters. Nevertheless, Reiner et al. (2020) established that general and practical perception about functional attributes of an electric vehicle is key to its adoption by customers.

In a related study, Sovacool et al. (2019) found that expected vehicle performance determined willingness to adopt electric vehicles. Degirmenci and Breitner (2017) have established that performance of EVs is discovered to be more important in influencing car purchase, than other factors. Consistently, Rezvani et al. (2015) found that vehicle performance has significant influence on EV adoption decision of customers. Hence, electric vehicle performance is key to EV adoption. Bhat et al. (2022) found that technological enthusiasm has a significant effect on intention of customers to adopt an electric vehicle. Di Foggia (2021) discovered that awareness of

technical characteristics of vehicles affect the decision-making of fleet managers to procure EVs. Accordingly, Reiner et al. (2020) emphasized that adequate awareness and knowledge of EVs, how the technology works and what that means for functionality, can have a substantial impact on EV adoption. In the same way, Gupta, and Rhoads (2022) contended that lack of awareness and education about EV technology hinder EV adoption.

However, Haustein et al. (2021) contend that EV adoption requires people to be aware of the ongoing improvements in vehicle technology. Hence, technology knowledge deficiency biases consumers against EVs adoption. Nevertheless, Pan, Wang, Li and Wu (2024) found that sustainability awareness and knowledge-based experienced were key contributors to the repurchase intention of EVs. Habich-Sobiegalla et al. (2019) found that technical readiness is key driver of customers' intention to purchase EVs. Additionally, Pandak et al. (2024) reported that knowledge of electric vehicle plays a significant influence on the intention to adopt EVs.

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2.6 Economic Factors and Electric Vehicle Adoption

In this study, economic factors refer to the financial and market-related elements that influence the feasibility, adoption, and sustainability of EVs (Chaturvedi, Kulshreshtha, Tripathi, & Agnihotri, 2023). These factors are critical in determining the overall cost-effectiveness, funding, and economic impact of transitioning to electric public transportation. It has been operationalized as vehicle cost, charging facilities, and economic benefits which are the second set of independent variables. Vehicle cost includes the initial purchase price of electric vehicles, as well as ongoing maintenance and operational costs. This study measures vehicle cost by comparing the total cost of ownership (TCO) of electric buses and taxis with their internal combustion

engine counterparts. TCO includes purchase price, maintenance costs, fuel/charging costs, and depreciation (Hawkins et al., 2013). Charging facilities cost refer to the physical spaces and infrastructure where EVs are charged, including the types of chargers available (e.g., fast chargers, standard chargers), their power output, and the waiting time for charging. This is measured by the number, type, and utilization rate of charging facilities cost in public transportation hubs (Li et al., 2019). Economic benefits pertain to the financial advantages of using electric vehicles over conventional vehicles. These include savings on fuel costs, reduced maintenance expenses, and potential government subsidies or incentives. Economic benefits are quantified through cost-benefit analysis and financial performance reports of public transportation fleets (Buhmann, Rialp-Criado, & Rialp-Criado, 2024).

Pandak et al. (2024) found that purchasing price is an important predictor of customers' intention to adopt EVs. Di Foggia (2021) discovered that financial information related to cost of vehicle and expected payback period of investment greatly affect the decision-making of fleet managers to procure EVs. The study of Wang et al. (2023) found that price value has a positive influence on EV adoption intention. Li, Wang, and Xie (2020) found that the purchase price exerts a significant influence on consumers' willingness to adopt EVs. Reiner et al. (2020) found that financial factors have a substantial impact on EV adoption; these include purchase price (Total Cost of Ownership, TCO). While, Gupta and Rhoads (2022) noted that high upfront cost of EVs poses a significant barrier to adoption, as it may exceed the purchasing power of consumers in developing countries. Despite, Sierzchula et al. (2014) discovered that EV price is significant in predicting a country's EV adoption. Notwithstanding, Gómez Vilchez et al. (2019) find that the electric car purchase price was rated in all the markets as the top (i.e., first) factor influencing EVs purchases. Similarly, the findings of

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Grandi (2020) demonstrates that the cost of purchase has a significant correlation with EV adoption.

Furthermore, McDermott (2017) found that purchase price of the vehicle is the most effective element that increase the sales of EVs. Equally, Sovacool et al. (2019) found that cost considerations determined willingness to adopt electric vehicles. Habich-Sobiegalla et al. (2019) found that price is a key driver of customers' intention to purchase EVs. The findings of Imran and Mohammad (2022) indicate further that a significant relationship exists between price and electric vehicle adoption. Hence, customers place more importance on price than any other factors when deciding whether to adopt an electric vehicle. Additionally, Rezvani et al. (2015) found that cost factors (i.e., how much money a car costs) influences EV adoption decision of customers significantly. Hence, vehicle cost is key to EV adoption.

Deka (2022) found that lower intention to adopt EV is not significantly influenced by higher cost. While, Li et al. (2020) found that power cost is a significant factor that influence consumers' willingness to adopt EVs. Still, the study of Reiner et al. (2020) accentuated that financial factors have a substantial impact on EV adoption, especially the running costs (cost of charging). Correspondingly, Gupta and Rhoads (2022) noted that cheaper source of energy can facilitate the adoption of EVs. Likewise, Kester et al. (2018) profound that cost reduction mechanisms can be used to accelerate the EV adoption in several countries. Correspondingly, Rezvani et al. (2015) found that cost of charging battery in a station outside the home, has positive influence decisions of customers to adopt EV. In addition, Sierzchula et al. (2014) discovered that charging facility (fuel) cost in significant in predicting a country's EV adoption. Hence, charging facility cost is key to EV adoption.

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Bhat et al. (2022) found that perceived benefits have a positive effect on intention of customers to adopt an electric vehicle. Equally, Featherman, Jia, Califf and Hajli (2021) found that perceived benefits obtainable by EV adoption influenced EV purchase decisions. Yet, Li et al. (2020) found that greater perception of economic benefits is a significant factor that facilitate consumers' willingness to adopt EVs. However, the findings of Deka (2022) showed that the desire to achieve personal gain has no direct influence on the formation of intention to adopt EV. In a different study, Sovacool et al. (2019) found that perceived benefits determined willingness to adopt electric vehicles. In the same way, Peters et al. (2018) found that adopting an EV for financial (economics) reasons is not consistent across adopters. Nonetheless, Reiner et al. (2020) established that perception about economic benefits play a significant role in the adoption of electric vehicle by customers. Hence, perceived economic benefits is key to EV adoption.

The study conducted by Lin, Chen, and Xie (2018) examined the economic impact of the deployment of electric vehicles in China and found that the development of electric vehicle infrastructure can generate many jobs. Studies have shown that the manufacturing, installation, and maintenance of charging stations, as well as the production of components for electric vehicles, help create jobs and stimulate economic growth. In addition, implementing an effective governance mechanism for EV infrastructure can attract investment and boost revenue generation. A study by Zhang, Su, and Gao (2019) investigated the economic benefits of EV charging infrastructure development in China. Studies have shown that the establishment of charging stations not only supports the growth of the electric vehicle market, but also generates revenue through charging fees, parking fees, and service fees.

In addition, the adoption of electric vehicles, driven by efficient governance mechanisms, can reduce dependence on fossil fuels and lower operating costs. This, in turn, can lead to savings for individuals and businesses (Ghosh & Dey, 2024). The study conducted by Zhang, Chen, and Tan (2020) explores the cost advantages of electric vehicles in terms of fuel and maintenance expenses. The study concluded that EV owners experience significant cost savings compared to traditional car owners, which can positively impact their disposable income and contribute to overall economic well-being.

2.7 Technical Factors and Infrastructure Governance Mechanisms

According to Li et al. (2020), technical factors encompassed attributes like charging infrastructure/stations, vehicle performance, and technical knowledge. Accordingly, scholars have empirically established that technical factors such as charging infrastructure, vehicle performance and technical knowledge/characteristics are critical determinants of EV adoption among customers in different domains (Wang et al., 2023; Di Foggia, 2021; Manutworakit, 2021). Once more, Li et al. (2020) found that charging stations, vehicle performance and technical knowledge have a significant influence on consumers' willingness to adopt EVs. However, Harahap et al. (2023) asserted that infrastructure governance mechanisms provide a conduit within which technical factors accelerate the adoption of electric vehicles among customers. Equally, literature showed that governance mechanisms such as economic, regulatory, and social infrastructure or installation contributed greatly in accelerating the effect of charging infrastructure; vehicle performance / performance expectation; and technical knowledge on adoption of electric vehicles (Harahap et al., 2023; Bhat et al., 2022; Peters et al., 2018).

Zhang et al. (2018) conducted one of the key studies in this area. They analyzed the job creation potential of China's electric vehicle industry. The study found that the rapid growth of the electric vehicle market has led to the creation of many jobs in various industries, including manufacturing, R&D, and infrastructure development (Zhang et al., 2018). Li et al. (2017) conducted a comprehensive analysis of the revenue generation associated with EV adoption. Their research shows that the increased demand for electric vehicles has spurred revenue growth in industries such as automotive manufacturing, battery production, and charging infrastructure development (Li et al., 2017). In terms of economic growth, several studies have highlighted the positive impact of EV adoption. Zhang et al. (2019) conducted an economic assessment of electric vehicles in China and found that the widespread adoption of electric vehicles has the potential to make a significant contribution to economic growth by increasing investment, improving productivity, and enhancing competitiveness (Zhang et al., 2019).

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In addition, Zhou et al. (2020) examines the economic benefits of electric vehicles in terms of reducing oil imports and lowering energy costs. The findings suggest that the transition to electric vehicles can enhance energy security, reduce dependence on fossil fuels, and allocate resources to other production sectors, thereby contributing to overall economic growth (Zhou et al., 2020). In addition to these studies, other researchers have also investigated the economic benefits of adopting electric vehicles in specific regions.

Moreover, Chen et al. (2018) analyzed the economic impact of electric vehicles in California and found that the widespread adoption of electric vehicles can lead to significant economic benefits, including increased taxes, reduced healthcare costs, and

increased productivity (Chen et al., 2018). In addition, studies conducted by Wang et al. (2016) in Europe and Han et al. (2015) in South Korea also highlighted the positive economic impact of EV adoption, including job creation, income generation, and economic growth (Wang et al., 2016). Overall, an analysis of the jobs, income generation, and economic growth generated by the adoption of electric vehicles shows that the transition to sustainable transportation solutions can lead to significant economic benefits. These benefits cover various sectors and regions, stimulate job opportunities, promote income growth, and contribute to the overall economic development.

2.8 Economic Factors and Infrastructure Governance Mechanisms

According to Li et al. (2020), economic factors involved attributes such as vehicle cost (cost related to purchase), cost of charging (fueling) and perceived benefits. Accordingly, scholars have empirically found that economic factors – namely: vehicle cost, charging cost and perceived economic / financial benefits are critical determinants of EV adoption among customers in different domains (Wang et al., 2023; Deka, 2022; Reiner et al., 2020). Again, Li et al. (2020) found that the purchase price (vehicle cost), power (charging) cost and greater economic benefits perception have a significant influence on consumers' willingness to adopt EVs. However, Harahap et al. (2023) contend that infrastructure governance mechanisms provide a platform within which economic factors accelerate the adoption of electric vehicles among several customers. Equally, literature showed that governance mechanisms such as economic, regulatory, and social infrastructure or installation contributed greatly in accelerating the effect of vehicle cost; charging cost; and technical knowledge adoption of electric vehicles (Gupta, Bansal, & Bankoti, 2024; Bhat et al., 2022).

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In addition, the development of electric vehicle infrastructure and the transition to electric mobility can drive innovation and technological advancements that will contribute to the growth of the clean energy industry. A study by Xu, Cheng, and Wang (2017) investigated the economic impact of China's electric vehicle industry and highlighted the potential for technological innovation, job creation, and industrial upgrading. The economic benefits brought by the effective urban infrastructure governance mechanism of Hunan electric vehicles are obvious. These benefits include job creation, income generation, cost savings, and the promotion of clean energy innovation. By implementing a effective infrastructure governance mechanisms framework, Hunan can capitalize on the economic opportunities presented by the transition to sustainable transport solutions.

2.9 Infrastructure Governance Mechanisms and Electric Vehicle Adoption in Hunan Province

An assessment of the existing EV public transport infrastructure governance mechanisms in Hunan is essential to assess the effectiveness of current practices and identify areas for improvement. This section aims to assess the strengths and weaknesses of governance structures and processes, and to examine coordination and cooperation between relevant government agencies and stakeholders in Hunan. By analyzing the existing mechanisms, valuable insights can be gained to enhance the development and implementation of EV infrastructure in the region. When evaluating the effectiveness of the public transport infrastructure governance of the existing EV infrastructure in Hunan, several studies have revealed the key factors influencing its success. Chen et al. (2017) highlighted the importance of government support, financial incentives, and technological progress in driving the development of EV charging infrastructure in China. They stressed the importance of proactive policy

measures to encourage private investment and facilitate the deployment of charging stations. This is consistent with an assessment of Hunan's public transport governance mechanisms, where the level of support and financial incentives provided by the Hunan government to stakeholders can have a significant impact on infrastructure development.

The strengths and weaknesses of the existing public transport infrastructure governance structure and processes of electric vehicle infrastructure in Hunan are analyzed. Jiang et al. (2018) studied the current situation and problems faced by the construction of electric vehicle charging infrastructure in China. They identified inadequate planning, uncoordinated development and underinvestment as key challenges impeding the effectiveness of governance mechanisms. Similarly, Liu et al. (2021) investigated the impact of urban EV infrastructure construction on residents' car travel in Changsha. They found that although the development of charging infrastructure has increased the accessibility of electric vehicles, there are still challenges in the availability and distribution of charging stations. The studies highlight the need for improved planning, coordination, and investment strategies to address weaknesses in Hunan's existing governance structures and processes.

Examining coordination and collaboration between relevant government agencies and stakeholders is critical to assessing the public transport infrastructure governance mechanisms of Hunan's EV infrastructure. Wang et al. (2019) analyzed the factors influencing the development of EV charging infrastructure in China using an integrated framework of geographic information systems (GIS) and multi-criteria

decision-making. They stressed the importance of effective coordination among various stakeholders, including government departments, power utilities and charging station operators, to ensure the smooth implementation of infrastructure projects. Xiong et al. (2017) also highlighted the importance of policy recommendations and stakeholder collaboration to promote charging infrastructure development. These findings highlight the need for greater coordination and cooperation between Hunan government agencies, power utilities, and private sector entities to facilitate the successful implementation of EV infrastructure.

Li et al. (2019) conducted a regression analysis to examine the impact of government policies, charging infrastructure availability, and financial incentives on EV adoption in Hunan. Their research found a positive correlation between the presence of supportive policies, the availability of charging infrastructure, and higher EV adoption. Similarly, Yang et al. (2020) used statistical techniques, including correlation analysis, to identify the factors influencing the adoption of electric vehicles in Hunan. Their findings show that the accessibility and proximity of charging stations, as well as the availability of charging infrastructure in residential areas, can significantly impact EV adoption.

Studies conducted by Zhang et al. (2018), Li et al. (2021), Wang et al. (2019), and Huang et al. (2017) demonstrated the importance of statistical analysis in assessing the impact of urban infrastructure governance mechanisms on EV adoption. These findings provide valuable insights for policymakers and stakeholders in Hunan to

strengthen infrastructure development and promote the widespread adoption of electric vehicles in the region.

2.10 Mediating Effect of Infrastructure Governance Mechanisms

In this study, infrastructure governance mechanisms are operationalized as the policies, regulations, and institutional frameworks that govern the development and management of EV public infrastructure. This includes government policies on EV incentives, regulations for charging station installations, and public-private partnerships. Governance effectiveness is measured by the comprehensiveness and enforcement of these policies and the level of coordination between different governmental and non-governmental stakeholders (Geels, 2014). In the context of adopting electric vehicles (EVs) in Hunan's public transport infrastructure governance, these mechanisms play a crucial mediating role in balancing the interplay between technical and economic factors.

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First and foremost, infrastructure governance mechanisms ensure that the development and deployment of EVs and related infrastructure are well-coordinated and integrated within the broader urban transportation system. This holistic approach prevents fragmented efforts and optimizes resource utilization. By involving various stakeholders (government agencies, transport operators, technology providers, and the public), these mechanisms facilitate alignment of interests and objectives, ensuring that all parties work towards common goals.

Secondly, governance mechanisms provide a framework for creating and enforcing regulations that support EV adoption, such as emission reduction targets, standards for vehicle and charging infrastructure, and incentives for clean energy use. They enable

the design and implementation of financial incentives and subsidies that reduce the economic barriers to EV adoption, making it more attractive for public transport operators to switch to electric fleets. Thirdly, Governance mechanisms ensure efficient allocation of resources for developing charging infrastructure, upgrading the power grid, and integrating renewable energy sources, addressing both technical and economic challenges. They establish and enforce standards for the safety, reliability, and interoperability of EVs and charging infrastructure, addressing technical concerns, and building public trust in the new technology.

Fourthly, public infrastructure governance mechanisms help manage and mitigate costs associated with EV adoption by optimizing investments in technology and infrastructure, and ensuring long-term financial sustainability through efficient operations and maintenance practices. They facilitate public-private partnerships (PPPs) that leverage private sector expertise and funding, reducing the financial burden on the public sector and accelerating the deployment of EV infrastructure.

Fifthly, governance mechanisms can support research and development (R&D) initiatives that drive technological innovations in EVs, batteries, and charging systems, addressing technical limitations, and reducing costs over time. They provide a framework for continuously adapting and updating policies and regulations to keep pace with technological advancements and changing market conditions, ensuring that the infrastructure remains relevant and effective.

Using public infrastructure governance mechanisms as a mediator in this study is justified due to their ability to harmonize the diverse and often conflicting needs of stakeholders, manage resources efficiently, support technological and economic goals,

and ensure the long-term success and sustainability of the EV transition. These mechanisms provide a structured and adaptable approach to addressing the complex challenges associated with EV adoption, ultimately leading to a more sustainable and effective urban transportation system.

Due to pressures related to energy conservation and environmental protection, the government in China has implemented numerous infrastructure governance mechanisms aimed at promoting the development of electric vehicles. These policies have been categorized in various studies. For instance, Lu (2022) identifies key incentives focused on charging infrastructure, fiscal subsidies, tax exemptions, and R&D investments. Yuan et al. (2015) outline five main aspects of incentive policies in China: industrial development, development planning, demonstration projects, financial subsidies, and tax exemptions. Meanwhile, Ming Xuan (2021) categorizes incentive policies into six groups in China: macro policies, demonstration policies, preferential tax policies, scientific and technological innovation policies, industrial management policies, and infrastructure policies.

Wang et al. (2020) conducted a survey among EV owners in Hunan to collect data on their perceptions of governance mechanisms, charging infrastructure availability, and policy support. They analyzed the survey data using statistical techniques to examine the relationship between these factors and EV adoption. The results show that good governance mechanisms, including well-planned charging infrastructure and supporting policies, have a positive impact on EV adoption. Quantitative analysis plays a crucial role in assessing the impact of urban infrastructure governance mechanisms on EV adoption in Hunan. Through further quantitative analysis, researchers can gain valuable insights into the effectiveness of current governance

practices and identify areas for improvement that will contribute to the development of sustainable low-carbon transport solutions in Hunan.

Research also examines and summarizes EV incentives within specific countries such as China, Japan, the United States, Germany, Lithuania, Norway, and Austria. Comparative studies like those by Zhang, Rao, Xie, & Liang (2014) review electric vehicle policies across the United States, Europe, Japan, and China, focusing on financial incentives, technical support, and charging infrastructure, recommending cross-country learning and customization of policies to local socio-economic contexts. Zhou et al. (2015) similarly analyze EV incentives across the United States, China, Japan, and select European nations, noting a correlation between increased market share of EVs and enhanced incentives.

Harahap et al. (2023) identified that governance mechanisms, such as economic incentives, legal frameworks, and infrastructure development, including special electricity tariffs, discounted prices, energy subsidies, dedicated parking, and charging points, alongside increased public awareness and vigilant policy oversight, effectively promote EV adoption. Grandi (2020) similarly emphasized that government interventions, particularly through incentives that influence purchase costs, play a crucial role in fostering EV adoption. Woodley, Rossetti, and Nunes (2023) demonstrated the variety of government policies aimed at stimulating EV adoption. In addition, Trencher, Taeihagh, and Yarime (2020) examined governance measures used by governments to accelerate EV development and diffusion. They found that supply-side measures, focusing on infrastructure development, are crucial, while demand-side measures heavily rely on public subsidies, with regulatory measures showing less impact on vehicle demand. Gupta and Rhoads (2022) highlighted how technological

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advancements and economies of scale are expected to reduce EV costs, enhancing their attractiveness to consumers.

Moreover, Kester et al. (2018) observed that infrastructure governance mechanisms targeting cost reduction through taxation exemptions and support for public and residential charging infrastructure accelerate EV diffusion. Conversely, Grandi (2020) found that certain infrastructure governance mechanisms like local policies or infrastructure provision, such as free ferry rides, do not significantly impact EV adoption. Instead, they emphasized that national incentives and awareness-raising efforts by authorities are critical factors. Ryghaug and Skjølsvold (2023) illustrated how political and economic conditions can drive EV diffusion. They underscored the importance of infrastructure governance mechanisms aligned with national policies and economic incentives in influencing EV adoption rates.

2.11 Underpinning Theories

2.11.1 Extension of Technology Acceptance Model (TAM2)

The Technology Acceptance Model 2 (TAM2), proposed by Venkatesh and Davis (2000), extends the original TAM by introducing social influence and cognitive instrumental processes as key determinants of technology adoption. At its core, TAM2 posits that perceived usefulness (PU) and perceived ease of use (PEOU) are central drivers of user intention and behavior, but these perceptions are shaped by subjective norms, voluntariness, image, job relevance, output quality, and result demonstrability. In the context of Hunan's public sector, TAM2 is particularly relevant, as EV adoption does not occur in a purely voluntary market environment but within institutional frameworks where organizational mandates, social expectations, and government policy strongly influence decision-making. The application of TAM2 therefore

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provides a powerful explanatory framework to analyze how technical, economic, and governance factors interact with user perceptions to determine the adoption of EVs.

From the perspective of PU, economic benefits are among the most salient drivers. For public transportation authorities and operators, EVs promise long-term financial savings through reduced fuel costs, lower maintenance expenses, and potential subsidies. These benefits make EVs appear more useful relative to traditional vehicles, reinforcing organizational acceptance. Technical factors also contribute directly to PU, particularly vehicle performance and energy efficiency. Reliable EV performance, adequate driving range, and technological robustness enhance perceptions that EVs are practical and capable of supporting public transportation needs. Thus, both economic and technical factors converge to shape the perceived usefulness of EVs, aligning with TAM2's assertion that users adopt technologies when they clearly support operational goals and organizational efficiency.

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Perceived ease of use (PEOU) is equally important, as it reflects the effort required to adopt and operate EV technology. In Hunan's context, PEOU is strongly tied to the availability and usability of charging infrastructure and the level of technical knowledge among operators. If charging stations are accessible, reliable, and easy to integrate into daily workflows, EV adoption becomes less burdensome. Similarly, when drivers, technicians, and administrative staff possess the technical expertise to manage and maintain EV fleets effectively, the technology is perceived as easier to use. These conditions illustrate how PEOU is reinforced by both infrastructural readiness and human capability. TAM2 thus helps explain why technical knowledge and infrastructure development are not only operational necessities but also psychological enablers of technology acceptance.

Social influence is another critical dimension of TAM2, particularly in public sector contexts where decisions are shaped by government mandates and institutional norms. In Hunan, subjective norms are reinforced by strong national policies promoting electrification, public expectations for greener transport, and the reputational value of aligning with sustainability targets. TAM2 predicts that in mandatory usage environments, subjective norms exert strong effects in the early stages of adoption, creating compliance-based motivation to transition to EVs. Over time, however, as experience with EV technology increases, cognitive evaluations of usefulness and ease of use take precedence. In this way, TAM2 provides a dynamic account of adoption, showing how initial policy-driven obligations evolve into sustained acceptance once benefits and ease of integration are demonstrated.

Cognitive instrumental processes, which include job relevance, output quality, and result demonstrability, further illuminate adoption in Hunan's public sector. Transportation authorities assess whether EVs align with key operational goals such as reliability, passenger capacity, and route efficiency. If EVs are perceived to meet these criteria while delivering visible environmental and economic benefits, the case for adoption is strengthened. However, TAM2 also recognizes that positive perceptions must be supported by enabling mechanisms. In this study, infrastructure governance mechanisms serve as the mediating factor that connects technical and economic determinants with TAM2 constructs. Policy incentives, subsidies, funding for infrastructure, and coordinated planning ensure that perceptions of PU and PEOU are not undermined by systemic barriers. Governance thus acts as the bridge that allows subjective norms, technical evaluations, and economic feasibility to translate into actual adoption behavior.

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In summary, TAM2 provides a comprehensive theoretical framework for understanding EV adoption in Hunan's public sector by linking technical factors (charging infrastructure, vehicle performance, technical knowledge) and economic factors (vehicle cost, charging facilities, economic benefits) with perceptions of usefulness and ease of use. It also emphasizes the role of social influence and cognitive instrumental processes in shaping adoption intentions, particularly in a context where government policy mandates and societal expectations are central. Crucially, the mediating role of infrastructure governance mechanisms highlights that positive perceptions alone are insufficient; they must be supported by institutional structures that align technical readiness and economic incentives. By applying TAM2, this study conceptualizes EV adoption not merely as a technological transition but as a socially and institutionally embedded process, providing nuanced insights into how acceptance is formed, reinforced, and sustained within the public sector.

2.11.2 Social Technical System Theory (STS Theory)

The Socio-Technical Systems (STS) Theory offers a comprehensive lens through which the adoption of electric vehicles (EVs) in Hunan's public sector can be understood. At its core, STS emphasizes that technological transitions succeed only when the technical and social subsystems of an organization or society evolve in tandem (Trist & Bamforth, 1951). In the case of EV adoption, technical factors such as charging infrastructure, vehicle performance, and the technical knowledge of operators represent the foundational technological capacities that determine whether public transportation systems can effectively integrate EVs into their fleets. For example, the availability and reliability of charging infrastructure are not only technological requirements but also conditions that shape user confidence, operational planning, and cost efficiency. Similarly, vehicle performance, including durability,

range, and maintenance demands, directly affects adoption decisions but is also contingent on the capacity of organizations to manage these vehicles within existing service structures. Technical knowledge, meanwhile, represents the human capital dimension of the technical subsystem, where skills and expertise among transport authorities and operators determine the degree to which innovations can be deployed successfully (Trist & Bamforth, 1951).

Yet technical readiness alone does not guarantee successful adoption; it must be aligned with economic factors that define feasibility and long-term sustainability. Within the STS framework, economic factors such as vehicle cost, the availability and distribution of charging facilities, and anticipated economic benefits act as complementary drivers or barriers. High procurement costs or insufficient charging access can undermine otherwise promising technical innovations, while the perception of long-term economic benefits, such as reduced operational costs, lower fuel expenditures, and financial incentives, can enhance willingness to adopt. Importantly, these economic elements also carry a social dimension, as they are shaped by broader institutional priorities, public sector budget constraints, and national subsidy programs. Thus, STS theory underscores that economic considerations are not merely financial but are embedded within organizational practices, policy mandates, and social expectations (Trist & Bamforth, 1951).

Infrastructure governance mechanisms function as the critical mediating link between the technical and economic subsystems, ensuring that alignment occurs and that adoption is both feasible and sustainable. Governance mechanisms encompass policies, regulations, funding strategies, and coordination structures that integrate technical advancements with economic incentives. In Hunan, for instance, the challenges of

underdeveloped charging networks, high upfront vehicle costs, and uneven institutional capacity highlight the importance of governance in creating enabling conditions. Policies that mandate electrification, provide targeted subsidies, or establish technical standards serve as structural interventions that bridge gaps between what is technologically possible and what is economically viable. Equally, coordinated planning among government agencies, municipal authorities, and private operators is required to ensure that investments in charging infrastructure and fleet upgrades align with actual public transport needs. By embedding accountability, monitoring, and stakeholder collaboration into the system, governance mechanisms mediate the tension between technical constraints and economic pressures, allowing the socio-technical system to evolve toward greater sustainability.

In the context of Hunan's public sector, STS theory thus provides a nuanced explanation of why adoption outcomes cannot be attributed solely to technological readiness or financial considerations. Instead, adoption emerges from the systemic interaction between technical and economic factors, mediated through governance processes that align infrastructure development, resource allocation, and stakeholder engagement. This holistic perspective highlights that failures in adoption often result from misalignment: advanced EV technologies may remain underutilized if charging infrastructure is inadequate, while generous subsidies may have limited effect if technical performance or operator expertise is lacking. Conversely, when technical, economic, and governance subsystems are effectively co-evolved, adoption is accelerated, producing not only environmental benefits but also institutional learning and social acceptance. By applying STS theory, this study frames the adoption of EVs in Hunan's public sector as the outcome of a dynamic socio-technical system, where

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sustainable success depends on the balanced integration of human, technological, economic, and institutional dimensions.

2.12 Theoretical Framework

This study adopts an integrated theoretical framework that combines Technology Acceptance Model 2 (TAM2) and Socio-Technical Systems (STS) Theory to examine the adoption of electric vehicles (EVs) in the public sector of Hunan Province. The integration is necessary because EV adoption in public transportation cannot be fully explained either by individual-level perceptions of technology or by systemic governance structures alone. Instead, adoption outcomes emerge from the dynamic interaction between perceptions of usefulness and ease of use (TAM2) and the alignment of social and technical subsystems (STS). From the TAM2 perspective, public sector stakeholders, such as transport authorities, fleet managers, and operators, evaluate EV adoption based on perceived usefulness (PU), which includes factors such as cost efficiency, operational performance, and compliance with environmental mandates, and perceived ease of use (PEOU), which reflects ease of integration into fleet operations, maintenance requirements, and charging accessibility. In the public sector context, TAM2's extensions of subjective norms, image, and voluntariness are particularly relevant, since adoption decisions are strongly shaped by policy mandates and reputational considerations within bureaucratic and institutional structures. These factors influence whether decision-makers are motivated to adopt EVs despite financial or technical constraints. Table 2.1 (next page) showed the operational definitions and theoretical mapping of constructs.

Table 2.1
Operational Definitions and Theoretical Mapping of Constructs

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Construct	Theoretical Mapping (TAM2 / STS)	Measurement Indicators	Source(s)
Charging Infrastructure	PEOU (TAM2)	Availability of charging stations; accessibility across routes; ease of integration into operations	Adapted from Davis (1989); Venkatesh & Davis (2000); STS applications in mobility (Trist, 1981)
EV Performance	PU (TAM2)	Reliability; driving range; energy efficiency; maintenance requirements	Davis (1989); Venkatesh & Davis (2000)
Technical Knowledge	PEOU (TAM2)	Operator training; knowledge of EV operation; ability to troubleshoot and maintain vehicles	Venkatesh & Davis (2000); STS alignment studies
Vehicle Cost	PU (TAM2)	Purchase cost; lifecycle costs; affordability relative to budget	Davis (1989); TAM2 adoption studies
Charging Facilities	PEOU (TAM2)	Affordability of charging; convenience of payment and usage; availability during operation	Venkatesh & Davis (2000); EV adoption literature
Economic Benefits	PU (TAM2)	Fuel cost savings; reduced maintenance costs; long-term financial efficiency	Davis (1989); EV policy adoption research
Infrastructure Governance Mechanisms	STS (social subsystem mediation)	Policy support; regulatory enforcement; institutional coordination; stakeholder collaboration	Trist (1981); socio-technical governance literature
EV Adoption (Public Sector)	TAM2 (PU & PEOU) + STS alignment	Degree of fleet electrification; intention to expand EV use; compliance with policy mandates	Adapted from TAM2; STS applications in public sector transitions

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While TAM2 highlights these critical decision-making perceptions, it does not sufficiently account for the structural and systemic barriers that characterize EV adoption in second-tier regions such as Hunan. STS theory provides an essential complement by emphasizing that successful technological transitions require alignment between the technical subsystem, including vehicle reliability, charging infrastructure, and technical expertise, and the social subsystem, which encompasses governance mechanisms, institutional capacity, and stakeholder collaboration. Misalignment between these subsystems explains why positive perceptions of EV usefulness may not translate into actual adoption when infrastructure is lacking, or why favorable policies may not yield results when institutional coordination is weak.

Building on these theoretical foundations, this research constructs a multidimensional model that integrates technical, economic, and governance factors into the analysis. Technical dimensions such as charging infrastructure, EV performance, and operator technical knowledge represent the core technological capabilities required for adoption, aligning with both TAM2's emphasis on ease of use and STS's focus on technical systems. Economic considerations, including vehicle cost, accessibility and affordability of charging facilities, and long-term financial benefits, directly shape perceived usefulness and feasibility in the public sector. Governance mechanisms, in turn, are conceptualized as a mediating force that links technical and economic conditions to adoption outcomes, as they determine how infrastructure is developed, policies enforced, and institutions coordinated to support EV integration.

The dependent variable in this framework is the adoption of EVs in public sector within Hunan Province. The choice of Hunan is theoretically and empirically significant, as it represents a second-tier province where the implementation of

national EV policies is constrained by slower economic development, uneven infrastructure, and fragmented governance compared to first-tier cities like Beijing, Shanghai, and Shenzhen. By situating the study in Hunan, the research directly addresses the national challenge of ensuring that ambitious policies, such as the New Energy Vehicle Industry Development Plan (2021–2035), achieve meaningful outcomes in regions that lag technologically and institutionally.

Ultimately, this integrated framework contributes to theory by bridging technology acceptance and socio-technical perspectives into a single analytical lens. It advances TAM2 by situating perceptions of usefulness, ease of use, and social influence within the governance-driven realities of public sector adoption, and it extends STS by incorporating decision-making perceptions into its account of socio-technical alignment. In doing so, the framework provides a holistic model for analyzing sustainable technology adoption in the public sector and offers practical insights for policymakers, highlighting the need to enhance perceived usefulness and ease of use while simultaneously strengthening governance and socio-technical integration to ensure successful EV adoption.

2.13 Conclusion

This chapter reviews the existing literature on the technical and economic factors influencing the adoption of electric vehicles (EVs) in public sector, with a specific focus on infrastructure governance mechanisms in Hunan, China. The review provides a theoretical foundation for understanding the complex interplay of these factors and highlights key studies, theories, and frameworks that inform this research. A review of global trends in EV adoption, emphasizing the rapid growth and technological advancements in the sector. Key statistics, such as the number of EVs in use worldwide,

are presented to contextualize the global shift towards electrification. An overview of China's leadership in the EV market, including national policies, market dynamics, and the strategic importance of EVs in reducing urban pollution and achieving carbon neutrality goals.

Analysis of critical technical aspects such as battery technology, vehicle performance, durability, and maintenance. Emphasis is placed on the advancements and challenges in these areas that impact the feasibility of EVs in public transportation. Discussion on the availability, accessibility, charging speed, compatibility, and standardization of charging infrastructure. The importance of developing a robust and efficient charging network is highlighted. Exploration of the initial purchase price, total cost of ownership (TCO), and operational costs of EVs compared to traditional vehicles. The role of subsidies, incentives, and financing options in mitigating economic barriers is discussed. Evaluation of the long-term economic benefits, including fuel and maintenance savings, environmental and health improvements, and job creation in the EV sector.

Review of governance mechanisms that oversee infrastructure development and operation. This includes policies, regulations, institutions, and processes that facilitate EV adoption. Examination of government policies and regulatory frameworks that promote EV adoption, such as emission reduction targets, technical standards, and financial incentives.

Application of this theory to understand the interplay between social, technical, and organizational factors in EV adoption. Exploration of the model's relevance in balancing environmental, economic, and social sustainability in the context of EV

adoption. This literature review establishes a comprehensive understanding of the technical and economic factors influencing EV adoption in Hunan's urban public transportation system. It underscores the importance of infrastructure governance mechanisms in mediating these factors and provides a theoretical and empirical basis for the subsequent chapters of the thesis. The review identifies gaps in the existing literature and sets the stage for the research methodology and analysis to follow.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Chapter Three provided a comprehensive account of the research framework, hypotheses formulation, and study design. It commenced by outlining the research framework, systematically developed through a critical review of literature to ensure theoretical grounding and empirical relevance. To strengthen the conceptual base, the study adopted the Social Technical System Theory and the Extension of the Technology Acceptance Model (TAM2) as underpinning lenses. From these perspectives, nineteen research hypotheses were proposed, reflecting the logical relationships among the constructs. The chapter then elaborated on the overall research design, beginning with a discussion of the research philosophy and methodological orientation guiding the investigation. It also addressed strategies for data collection, including techniques to ensure accuracy, reliability, and representativeness of responses. Emphasis was placed on the sampling process, where the sampling technique was justified in relation to study objectives, and sample size determination explained to establish adequacy for statistical analysis.

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In addition, the measurement of variables was detailed, covering construct operationalization and the rationale for adopting or adapting validated scales. The chapter also highlighted procedures undertaken in the pilot test, which evaluated the clarity, reliability, and validity of the instrument prior to the main survey. Finally, it provided an in-depth account of the data analysis methods, explaining statistical techniques applied to test the hypotheses and ensure robust interpretation of results. A concluding summary integrated the key aspects of the chapter and set the stage for the subsequent presentation of findings.

3.2 Research Framework

According to the extant literature, a research framework is a structured plan or model that guides a research project. It outlines the key concepts, variables, and their relationships, providing a clear structure for the study (Sekaran, 2003). The framework serves as a blueprint for the research, helping to organize the study's design, data collection, and analysis processes (Sekaran & Bougie, 2013). It ensures that the research is systematic, coherent, and focused, aligning the research objectives with appropriate methodologies and theoretical foundations. The research framework often includes hypotheses, research questions, and theoretical models that inform the study's direction and scope (Sekaran & Bougie, 2010). Cavana, Delahaye, and Sekaran (2001) stated that a framework can effectively describe a research study by clearly explaining and outlining the logical relationships among various factors relevant to the research problem. Consequently, the literature suggests that researchers have the option to either create a new research framework or use an existing, tested one.

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In this study, an existing research framework from prior studies was adapted. The rationale for adopting and adapting an existing research framework for this study because firstly, using an existing research framework provides a solid foundation built on previous studies, ensuring that the fundamental concepts and relationships have already been tested and validated (Hair, Black, Babin, & Anderson, 2010). This enhances the credibility and reliability of the current research. Secondly, the chosen framework is relevant to the specific context of the research (Hair et al., 2010). It aligns with the technical and economic factors influencing electric vehicle adoption and the role of infrastructure governance mechanisms, providing a suitable structure for examining these dynamics in Hunan's urban public transportation system. Thirdly, adapting an existing framework saves time and resources (Sekaran & Bougie, 2013). It allows the researcher to focus on the specific nuances of the study rather than developing a new framework from scratch, thus streamlining the research process (Hair et al., 2010).

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Fourthly, using a framework that has been employed in previous studies facilitates comparative analysis (Hair, Celsi, Money, Samouel, & Page, 2011). It allows the researcher to compare findings with other studies, identifying similarities and differences that can contribute to a deeper understanding of the research problem. Fifthly, while the framework is adopted, it can be adapted to fit the specific context of Hunan's urban public transportation system. This customization ensures that the framework accurately reflects the local context's unique characteristics and challenges, enhancing the research findings' applicability and relevance (Hair, Money, Samuel, & Page, 2007). In summary, the adoption and adaptation of an existing research framework for this study provide a reliable, efficient, and comprehensive approach to exploring the interplay of technical and economic factors in the adoption of electric

vehicles within the context of infrastructure governance in Hunan's urban public transportation.

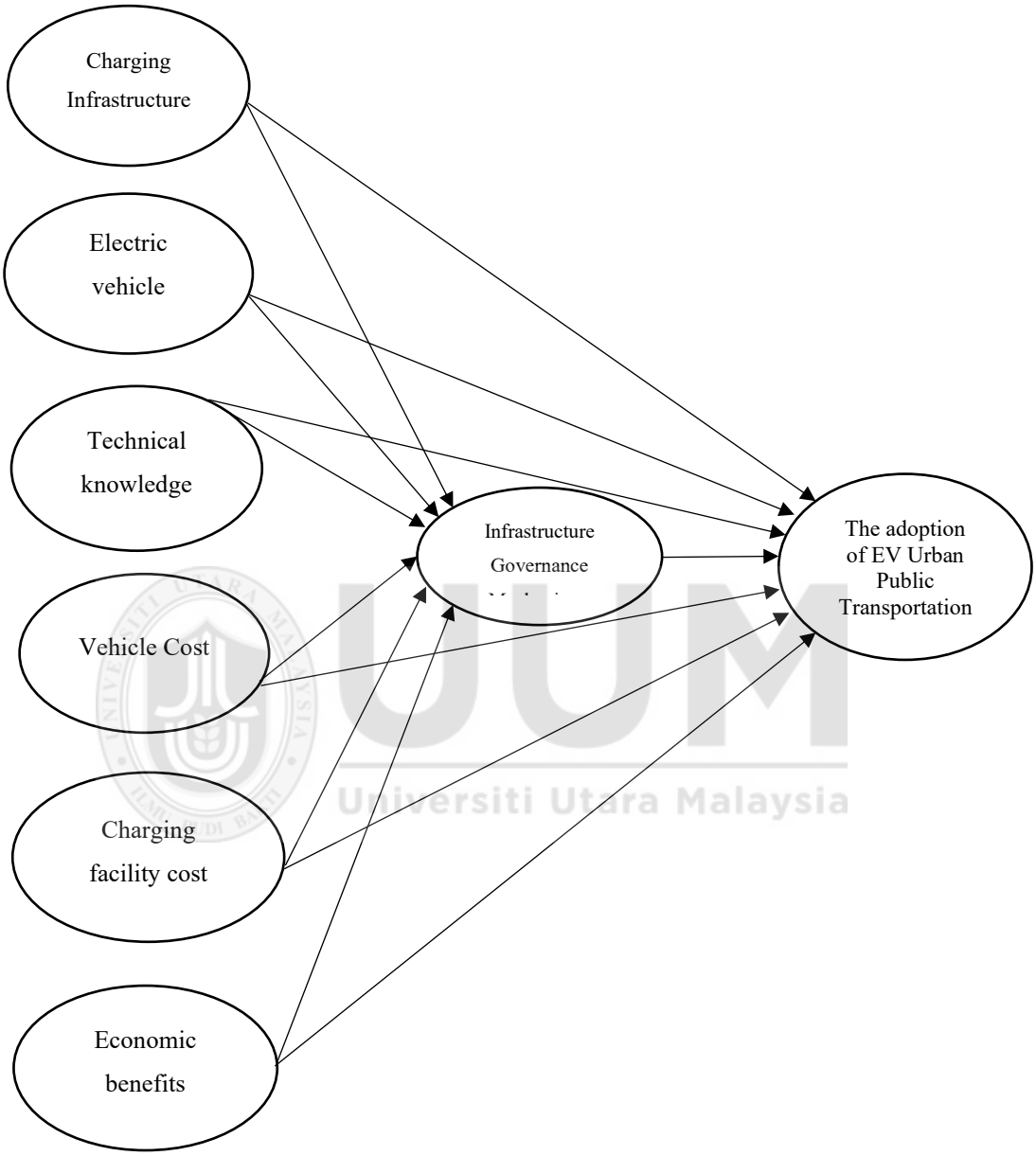

Figure 3.1 Research Framework & its Proposed Relationships

As illustrated in Figure 3.1, the research model incorporates charging infrastructure, electric vehicle performance, and technical knowledge (technical factors), along with vehicle cost, charging facilities, and economic benefits (economic factors) as independent variables. Infrastructure governance mechanisms serve as the mediator,

while the adoption of urban public sector electric vehicle transportation in Hunan, China is the dependent variable. The research framework proposes that technical and economic factors have a direct and positive relationship with the adoption of electric vehicles, mediated by infrastructure governance mechanisms, within Hunan's urban public transportation system.

3.3 Hypotheses Development

Hypothesis development is the process of formulating specific, testable statements or predictions based on theoretical foundations and existing literature (Zikmund, Babin, Carr, & Griffin, 2010). These hypotheses outline the expected relationships between variables and serve as a guide for empirical research. In essence, hypothesis development is a critical step in the research process that bridges theory and empirical investigation, ensuring that the research is structured and focused on addressing specific predictions (Zikmund, 2000). Based on the above narration and based on the proposed research framework, nineteen hypotheses are formulated.

3.3.1 Technical Factors and Electric Vehicle Adoption

Pandak, Piaralal, and Rethina (2024) reported that availability of charging stations plays a vital role on the intention to adopt EVs. Harahap et al. (2023) found that charging infrastructure such as special electricity tariffs, more robust batteries, faster or free charging, and higher storage density can effectively promote EV. Reiner, Beard, Park and Kinnear (2020) established that charging infrastructure is a critical in EV adoption, as consumers need access to charging at very near, even at work, or availability of nationwide public charging infrastructure to enable long journeys.

However, Bhat, Verma, and Verma (2022) and Imran and Mohammad (2022) found that facilitating conditions have negative influence on a consumer's intention to adopt an electric vehicle. Still, Habich-Sobiegalla, Kostka and Anzinger (2019) found that charging infrastructure does not drive intentions of customers to purchase EVs. Additionally, Verma, Verma and Khan (2020) asserted that lack of physical infrastructure constitutes a barrier to EV adoption. Nonetheless, Zink, Valdes and Wuth (2020) showed a significant difference on the effect of private, semi-public, and public charging infrastructures on EV adoption.

Haustein, Jensen and Cherchi (2021) found that new fast charging facility has a significant effect on electric vehicle adoption. Sierzchula et al. (2014) found that charging infrastructure is significant in predicting EV adoption. Egnér and Trosvik (2018) found a general effect of the number of public charging facilities on the EV adoption. The findings of Gómez Vilchez et al. (2019) confirm that charging stations (instrumented) have a positive and significant impact on EV purchase. Yet, McDermott (2017) found that improve access to charging infrastructure is the most effective element that increases the sales of EVs.

On the other hand, Gupta, and Rhoads (2022) noted that limited availability of public charging stations discourages potential EV buyers. Besides, Kester et al. (2018) found that infrastructure support for public and apartment charging, generally accelerate EV diffusion. Additionally, Rezvani et al. (2015) found that availability of charging station outside the home, has significant influences on EV adoption decision of customers. Hence, actual, and perceived charging availability are key to EV adoption. Therefore, this study postulated that;

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H1: Charging infrastructure exerts significant effect on urban public electric vehicle adoption.

The study of Wang, Ozden and Tsang (2023) found that performance expectations positively influence EV adoption intention. Still, Bhat et al. (2022) found that performance expectancy is positively related to intention of consumer to adopt an electric vehicle. In contrast, Peters, Van der Werff, and Steg (2018) found that adopting an EV for technological reasons is not consistent across adopters. Nevertheless, Reiner et al. (2020) established that general and practical perception about functional attributes of an electric vehicle is key to its adoption by customers.

In a related study, Sovacool et al. (2019) found that expected vehicle performance determined willingness to adopt electric vehicles. Degirmenci and Breitner (2017) have established that performance of EVs is discovered to be more important in influencing car purchase, than other factors. Consistently, Rezvani et al. (2015) found that vehicle performance has significant influence on EV adoption decision of customers. Hence, electric vehicle performance is key to EV adoption. Thus, this study postulated that;

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H2: Electric vehicle performance exerts significant effect on urban public electric vehicle adoption.

Bhat et al. (2022) found that technological enthusiasm has a significant effect on intention of customers to adopt an electric vehicle. Di Foggia (2021) discovered that awareness of technical characteristics of vehicles affect the decision-making of fleet managers to procure EVs. Accordingly, Reiner et al. (2020) emphasized that adequate awareness and knowledge of EVs – how the technology works and what that means

for functionality, can have a substantial impact on EV adoption. In the same way, Gupta and Rhoads (2022) contended that lack of awareness and education about EV technology hinder EV adoption.

However, Haustein et al. (2021) contend that EV adoption requires people to be aware of the ongoing improvements in vehicle technology. Hence, technology knowledge deficiency biases consumers against EVs adoption. Nevertheless, Pan, Wang, Li and Wu (2024) found that sustainability awareness and knowledge-based experienced were key contributors to the repurchase intention of EVs. Habich-Sobiegalla et al. (2019) found that technical readiness is key driver of customers' intention to purchase EVs. Additionally, Pandak et al. (2024) reported that knowledge of electric vehicle plays a significant influence on the intention to adopt EVs. Hence, technical knowledge is key to EV adoption. Thus, this study postulated that;

H3: Technical knowledge exerts significant effect on urban public electric vehicle adoption.

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3.3.2 Economic Factors and Electric Vehicle Adoption

Pandak et al. (2024) found that purchasing price is an important predictor of customers' intention to adopt EVs. Di Foggia (2021) discovered that financial information related to cost of vehicle and expected payback period of investment greatly affect the decision-making of fleet managers to procure EVs. The study of Wang et al. (2023) found that price value has a positive influence on EV adoption intention. Li, Wang and Xie (2020) found that the purchase price exerts a significant influence on consumers' willingness to adopt EVs. Reiner et al. (2020) found that financial factors have a

substantial impact on EV adoption; these include purchase price (Total Cost of Ownership, TCO).

While, Gupta and Rhoads (2022) noted that high upfront cost of EVs poses a significant barrier to adoption, as it may exceed the purchasing power of consumers in developing countries. Despite, Sierzchula et al. (2014) discovered that EV price is significant in predicting a country's EV adoption. Notwithstanding, Gómez Vilchez et al. (2019) find that the electric car purchase price was rated in all the markets as the top (i.e., first) factor influencing EVs purchases. Similarly, the findings of Grandi (2020) demonstrates that the cost of purchase has a significant correlation with EV adoption.

Furthermore, McDermott (2017) found that purchase price of the vehicle is the most effective element that increase the sales of EVs. Equally, Sovacool et al. (2019) found that cost considerations determined willingness to adopt electric vehicles. Habich-Sobiegalla et al. (2019) found that price is a key driver of customers' intention to purchase EVs. The findings of Imran and Mohammad (2022) indicate further that a significant relationship exists between price and electric vehicle adoption. Hence, customers place more importance on price than any other factors when deciding whether to adopt an electric vehicle. Additionally, Rezvani et al. (2015) found that cost factors (i.e., how much money a car costs) influences EV adoption decision of customers significantly. Hence, vehicle cost is key to EV adoption. Thus, this study postulated that;

H4: Vehicle cost exerts significant effect on urban public electric vehicle adoption.

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Deka (2022) found that lower intention to adopt EV is not significantly influenced by higher cost. While, Li et al. (2020) found that power cost is a significant factor that influence consumers' willingness to adopt EVs. Still, the study of Reiner et al. (2020) accentuated that financial factors have a substantial impact on EV adoption, especially the running costs (cost of charging). Correspondingly, Gupta and Rhoads (2022) noted that cheaper source of energy can facilitate the adoption of EVs.

Likewise, Kester et al. (2018) profound that cost reduction mechanisms can be used to accelerate the EV adoption in several countries. Correspondingly, Rezvani et al. (2015) found that cost of charging battery in a station outside the home, has positive influence decisions of customers to adopt EV. In addition, Sierzchula et al. (2014) discovered that charging facility (fuel) cost in significant in predicting a country's EV adoption. Hence, charging facility cost is key to EV adoption. Thus, this study postulated that;

H5: Charging facility cost exerts significant effect on urban public electric vehicle adoption.

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Bhat et al. (2022) found that perceived benefits have a positive effect on intention of customers to adopt an electric vehicle. Equally, Featherman, Jia, Califf and Hajli (2021) found that perceived benefits obtainable by EV adoption influenced EV purchase decisions. Yet, Li et al. (2020) found that greater perception of economic benefits is a significant factor that facilitate consumers' willingness to adopt EVs. However, the findings of Deka (2022) showed that the desire to achieve personal gain has no direct influence on the formation of intention to adopt EV.

In a different study, Sovacool et al. (2019) found that perceived benefits determined willingness to adopt electric vehicles. In the same way, Peters et al. (2018) found that adopting an EV for financial (economics) reasons is not consistent across adopters. Nonetheless, Reiner et al. (2020) established that perception about economic benefits play a significant role in the adoption of electric vehicle by customers. Hence, perceived economic benefits is key to EV adoption. This study postulates that;

H6: Economic Benefits exerts significant effect on urban electric vehicle adoption.

3.3.3 Technical Factors and Infrastructure Governance Mechanisms

According to Li et al. (2020), technical factors encompassed attributes like charging infrastructure/stations, vehicle performance, and technical knowledge. Accordingly, scholars have empirically established that technical factors such as charging infrastructure, vehicle performance and technical knowledge/characteristics are critical determinants of EV adoption among customers in different domains (Wang et al., 2023; Di Foggia, 2021; Manutworakit, 2021). Once more, Li et al. (2020) found that charging stations, vehicle performance and technical knowledge have a significant influence on consumers' willingness to adopt EVs.

However, Harahap et al. (2023) asserted that infrastructure governance mechanisms provide a conduit within which technical factors accelerate the adoption of electric vehicles among customers. Equally, literature showed that governance mechanisms such as economic, regulatory, and social infrastructure or installation contributed greatly in accelerating the effect of charging infrastructure; vehicle performance / performance expectation; and technical knowledge on adoption of electric vehicles

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(Harahap et al., 2023; Bhat et al., 2022; Peters et al., 2018). Thus, this study postulated that;

H7: Charging infrastructure exerts significant effect on urban public infrastructure governance mechanisms.

H8: Electric vehicle performance exerts significant effect on urban public infrastructure governance mechanisms.

H9: Technical knowledge exerts significant effect on urban public infrastructure governance mechanisms.

3.3.4 Economic Factors and Infrastructure Governance Mechanisms

According to Li et al. (2020), economic factors involved attributes such as vehicle cost (cost related to purchase), cost of charging (fueling) and perceived benefits. Accordingly, scholars have empirically found that economic factors – namely: vehicle cost, charging cost and perceived economic / financial benefits are critical determinants of EV adoption among customers in different domains (Wang et al., 2023; Deka, 2022; Reiner et al., 2020). Again, Li et al. (2020) found that the purchase price (vehicle cost), power (charging) cost and greater economic benefits perception have a significant influence on consumers' willingness to adopt EVs.

However, Harahap et al. (2023) contend that infrastructure governance mechanisms provide a platform within which economic factors accelerate the adoption of electric vehicles among several customers. Equally, literature showed that governance mechanisms such as economic, regulatory, and social infrastructure or installation contributed greatly in accelerating the effect of vehicle cost; charging cost; and

technical knowledge adoption of electric vehicles (Grandi, 2020; Bhat et al., 2022). Based on this assertion, this study postulated that;

H10: Vehicle cost exerts significant effect on urban public infrastructure governance mechanisms.

H11: Charging Facility Cost exerts significant effect on urban public infrastructure governance mechanisms.

H12: Economic Benefits exerts significant effect on urban public infrastructure governance mechanisms.

3.3.5 Infrastructure Governance Mechanisms and Electric Vehicle Adoption

Trencher, Taeihagh and Yarime (2020) examined how governance mechanisms' measures provide supporting infrastructure to accelerate the diffusion process of EVs. According to findings, infrastructure considered as supply side measures was used by government to accelerate EVs diffusion. Yet, the findings showed that public subsidies conceptualized as demand-side measures has significant influence on EV adoption. However, regulatory measures fail to stimulate vehicle demand. Likewise, the study of Pandak et al. (2024) established that government policy mechanisms play vital role on the intention of customers to adopt EVs.

Harahap et al. (2023) found that governance mechanisms such as economic and legal instruments / infrastructure through introduction of special electricity tariffs, discounted prices, and energy subsidies, as well as dedicated parking space and charging points, increased public awareness and ensuring vigilant policy oversight can effectively promote EV. In addition, study of Wang et al. (2023) found that governance

facilitating condition hold significant potential impact in fostering the adoption of EV adoption intention.

Manutworakit (2021) established that government monetary policy measures like tax exemption, zero parking fees or reduced toll, and non-monetary measures like raising awareness and more charging stations are critical in improving EV adoption. Li et al. (2020) found that all existing governance policy instruments (tax exemption, information provision and convenience instruments) can positively and highly affect consumer preferences for EVs. Lopez-Behar et al. (2019) identified financial/fiscal, regulatory and information/awareness measures as critical governance infrastructure for electric vehicles adoption.

Achıaw and Kanol (2021) found that governance element mechanisms in terms of political, economic, and energy infrastructure, as well as technology readiness and manufacturing capacity are predictors that drive EV adoption in developed nations. Zimm (2021) mentions that influential countries adopt effective governance mechanisms to facilitate EV adoption. Kumar et al. (2020) found that government can manage resources to provide opportunities through various infrastructure to reduce cost of EV and improve purchasing power of customers, and stimulate EV adoption.

Friis (2020) suggested for governance of mobility that may incorporate multiple change agents to design practice-based interventions that can stimulate EV adoption. On the other way, the results of Grandi (2020) demonstrated that governance mechanisms in form of installation, local policies and charging infrastructures or free ferry rides do not have a significant impact on electric cars' adoption. Notwithstanding, Fournel (2022) reported that infrastructure development contributed significantly to

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EV adoption. Hence, infrastructure governance mechanisms are key to EV adoption. This, study postulates that;

H13: Infrastructure governance mechanisms exert significant effect on urban public electric vehicle adoption.

3.3.6 Mediating Effect of Infrastructure Governance Mechanisms

Harahap et al. (2023) found that governance mechanisms such as economic and legal instruments / infrastructure through introduction of special electricity tariffs, discounted prices, and energy subsidies, as well as dedicated parking space and charging points, increased public awareness, and ensuring vigilant policy oversight can effectively promote EV. Grandi (2020) demonstrates that governance mechanisms in form of installation, local policies and charging infrastructures. Grandi (2020) demonstrates that the cost of purchase can greatly influence EV adoption, with the intervention of government incentives. Woodley, Rossetti, and Nunes (2023) showed that various government policies have been adopted to stimulate electric vehicles adoption.

Trencher, Taeihagh and Yarime (2020) examined the effect of governance measures used by government to accelerate the development and diffusion of EVs. According to findings, supply side measures that accelerate EVs diffusion focus on infrastructure. On the other hand, the influence of demand-side measures on EV adoption, completely rely on public subsidies. However, regulatory measures fail to stimulate vehicle demand. Moreover, Gupta and Rhoads (2022) found that technological advancements and economies of scale in the EV industry are expected to decrease the cost of EVs, making them more affordable and attractive to consumers.

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Kester et al. (2018) found that policy mechanisms that target cost reduction (taxation exemptions and infrastructure support for public and apartment charging) accelerate EV diffusion. The findings of Grandi (2020) demonstrates that governance mechanisms in form of installation, local policies and charging infrastructures or free ferry rides do not have a significant impact on electric cars' adoption. Elucidating further that governance mechanism – authorities' involvement in terms of national incentives and raising awareness is significantly correlated with electric vehicles adoption. Accordingly, the study of Ryghaug and Skjølsvold (2023) illustrated how political and economic conditions stimulate EV diffusion. Therefore, this study postulated that;

H14: Infrastructure governance mechanisms mediate the effect of charging infrastructure on urban public electric vehicle adoption,

H15: Infrastructure governance mechanisms mediate the effect of electric vehicle performance on urban public electric vehicle adoption,

H16: Infrastructure governance mechanisms mediate the effect of technical knowledge on urban public electric vehicle adoption,

H17: Infrastructure governance mechanisms mediate the effect of vehicle cost on urban public electric vehicle adoption,

H18: Infrastructure governance mechanisms mediate the effect of charging facility cost on urban public electric vehicle adoption, and;

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H19: Infrastructure governance mechanisms mediate the effect of economic benefits on urban public electric vehicle adoption.

3.4 Research Paradigm

In conducting empirical research, once the research questions and objectives are identified based on a research problem, and hypotheses are formulated as preliminary answers to these questions, the next step involves designing the research to facilitate data collection and empirical analysis to support these hypotheses. The research design acts as a blueprint for systematically collecting, measuring, and analyzing data aligned with the study's research questions (Sekaran & Bougie, 2013). It is crucial to choose a research design that is most appropriate for the specific study to effectively gather, measure, and analyze data based on the research questions derived from the research problem.

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Researchers interpret research paradigms in terms of philosophical perspectives, beliefs, and fundamental principles that guide their conduct during investigations (Guba & Lincoln, 1994). Two widely acknowledged paradigms are interpretivism and positivism. Positivism, historically traced back to Auguste Comte, a prominent 19th-century French philosopher, emphasizes objective reality and often employs quantitative methods such as experiments and statistical techniques to explore cause-and-effect relationships between variables (Creswell, 2017). In contrast, anti-positivist, or constructivist paradigms, rooted in thinkers like Edmund Husserl, challenge positivist views and highlight the subjective and socially constructed nature of reality (Willis, 2007).

Interpretivist assumptions are based on two primary tenets: firstly, human beings are social entities, and their behaviors can be qualitatively studied through methods such as observations, case studies, and interviews (Neuman & Robson, 2012); secondly, interpretivists argue that social reality is constructed through interactions between researchers and participants, making it socially subjective and constructed (Creswell, 2017; Guba & Lincoln, 1994). On the other hand, positivist philosophy asserts that social reality exists independently of researchers and should be investigated using objective methods. Positivists focus on quantitative approaches to test hypotheses and establish empirical evidence, using techniques like correlation and regression analysis to explore relationships among variables (Scotland, 2012; Creswell, 2017).

Positivist approaches are commonly employed by researchers to test hypotheses, establish empirical evidence, draw deductive conclusions, and determine causal relationships among variables (Tashakkori & Teddlie, 1998; Bell & Bryman, 2007). This approach is valued for its rigor in theory testing and the generalizability of findings (Bell & Bryman, 2007; Deshpande, 1983), leveraging quantitative measures, statistical evidence, causal theories, and opportunities for replication (Neuman & Robson, 2012; Hair et al., 2011). Given this study's focus on testing all the nineteen hypotheses related to charging infrastructure, electric vehicle performance, and technical knowledge (technical factors), vehicle cost, charging facilities, and economic benefits (economic factors), the mediation of infrastructure governance mechanisms and the adoption of urban public sector electric vehicle transportation in Hunan, China, a positivist approach is adopted. This choice aligns with objectivist ontological and epistemological positions, emphasizing the suitability of positivism for hypothesis testing, determining causal relationships among variables, and presenting findings

using statistical analyses such as correlation and regression (Creswell, 2017; Hair et al., 2014; Scotland, 2012).

3.5 Research Design

According to Hair, Celsi, Money, Samouel, and Page (2011), the purpose of research design is to clearly outline the direction of a research project or the steps followed in accomplishing it. Therefore, the study divides research design into: (1) Philosophy, which includes epistemological and ontological considerations (Saunders, Lewis, & Thornhill, 2009), and (2) Methodology, which focuses on the population and sample size, unit of analysis, sampling frame, data collection procedure, and data analysis techniques (Bryman, 2012). Consequently, research philosophy has been defined as the accumulation and growth of knowledge in a specific discipline, while epistemology pertains to what knowledge is acceptable in social science research (Bryman, 2008).

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Scholars such as Saunders et al. (2009) and Bryman and Bell (2007) have identified the following universally accepted research ontologies or epistemologies: (a) Positivism , which involves a scientific approach to research, where social reality is often investigated through inductive methods (knowledge and data gathering) or deductive methods (hypotheses testing within the realm of existing theory); (b) Realism, which involves a scientific approach to investigating natural phenomena through empirical realism (evaluation of social reality based on experience and data analysis) or critical realism (assessment of social reality based on events, identified structures, or experience); and (c) Interpretivism, which is based on the assumption that in the social world, human behaviors can be investigated by researchers through their uniqueness and respective social roles (Scotland, 2012).

Researchers have identified the following common research designs among business and management scholars: (a) Case Study, which involves rigorous and complete analysis of cases (Bryman, 2012), or in-depth investigation and exploration of real-life phenomena (Yin, 2008); (b) Descriptive, which seeks to describe the characteristics of subjects based on certain observable phenomena (Hair et al., 2011), and can be cross-sectional or longitudinal, where quantifiable data on concerned variables is obtained and analyzed quantitatively to describe patterns of association (Bryman, 2012) and differences among variables (Hair et al., 2011); and (c) Exploratory Studies – which seek to discover new patterns, themes, ideas, or relationships using quantitative or qualitative techniques such as digital videos, photographs, survey design, interviews, case studies (Hair et al., 2011).

Since the aim of the study is to explore the impact of charging infrastructure, electric vehicle performance, and technical knowledge (technical factors), as well as vehicle cost, charging facilities, and economic benefits (economic factors) through the mediation of infrastructure governance mechanisms, a quantitative research approach and cross-sectional design were deemed most suitable, as all responses were to be collected at a single point in time from the sampled population elements (Sekaran & Bougie, 2013). According to Cooper, Schindler, and Sun (2006), a cross-sectional survey is described as a method of obtaining data from respondents at once or alternatively signified as a snapshot method of collecting responses from the sampling elements. Literature establishes that a cross-sectional survey design is most appropriate and helpful in obtaining adequate data for testing relationships among variables and evaluating hypothesized relationships (Zikmund, 2000). Thus, the study adopted a cross-sectional survey design, as it is most suitable for distributing survey questionnaires to decision makers of China's urban public sector electric vehicle

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transportation in Hunan, China (refer to Appendix A – survey in English, Appendix B – survey in Mandarin).

Partial Least Squares-Structural Equation Modelling (PLS-SEM) version 4.0.9.9 and the latest version of the Statistical Package of the Social Sciences (SPSS) version 29 are both used in the analysis of the research data. The study employed a systematic sampling strategy in the sample selection. Correlation analysis, common method variance, and non-response bias are all evaluated using SPSS (Sekaran, 2003). However, PLS-SEM is primarily used to evaluate the structural model (testing the hypothesized links) and the measurement model (establishing the validity and reliability of the research instruments) (Hair et al., 2012, 2014).

3.6 Measurement of the Research Variables

A concept in research can be evaluated using various criteria in either an objective or subjective manner. Although a correlation has been shown between subjective and objective measures, several studies in management and entrepreneurship have used subjective indicators. The primary reason for this is the lack of availability of objective data (Sekaran & Bougie, 2013). As a result, researchers can assess constructs indirectly using proxy variables (Hair et al., 2014). Consequently, all constructs in this study have been measured using subjective indicators (Dawes, 2008). Each measure item was adapted from existing literature and adapted for use with a particular construct.

A construct can be measured using one or more elements (Dawes, 2008). When a construct is measured using a single indicator, it is referred to as a single item measurement. Multiple measures, as the name suggests, use several indicators to measure a construct (Dawes, 2008). In this study, multiple items were used to measure

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each construct. This approach increases accuracy (although it does not eliminate error entirely) and is likely to capture the varied dimensions of the concept (Hair, Tomas, Ringle, & Sarstedt, 2017). The research framework of this study consists of eight variables: (i) the adoption of urban public electric vehicle transportation, (ii) infrastructure governance mechanisms (iii) charging infrastructure, (iv) electric vehicle performance, (v) technical knowledge, (vi) vehicle cost, (vii) charging facilities, and (viii) economic benefits.

All items for the eight variables mentioned above are measured on 5-point Likert scales (Dawes, 2008). The Likert scale is considered ideal for a study of this kind, especially when objective data are not easily available, due to the characteristics of the respondents and the nature of the information needed in social science (Dawes, 2008). According to Dawes (2008), there are various types of Likert scales, including three, four, five, seven, and more points. For this study, a five-point Likert scale has been used, with values ranging from 1 to 5: 1 for strongly disagree, 2 for disagree, 3 for neither agree nor disagree (neutral), 4 for agree, and 5 for strongly agree. It is claimed that five-point Likert scales have the potential to produce better results compared to higher rating scales. The five-point Likert scale has been utilized in many studies (Hair et al., 2011).

3.6.1 Measurement of the adoption of electric vehicle

The adoption of urban public sector electric vehicle transportation in Hunan, China is measured with ten (10) subjective measures. All items were reflected in the questionnaire and allocated scores ranging from 1 to 5 of Likert scales. The highest score is fifty points (10 x 5 points), establishing highest level of adoption of urban public electric vehicle transportation. While, the lowest score is ten points (10 x 1

point). The items for this dependent variable are adopted from Yildiz, Çiğdem & Meidutė-Kavaliauskienė, (2024) with composite reliability of 0.94. The ten items are adapted in the context of urban public sector electric vehicle transportation in Hunan, China, and they are as follow:

1. Urban public sector transportation agency is interested in buying an EV.
2. Urban public sector transportation agency has a plan to buy an EV in the coming years.
3. Urban public sector transportation agency prefers to buy an EV over a traditional vehicle.
4. When Urban public sector transportation agency is buying a new car, it will buy an environmentally friendly EV.
5. Urban public sector transportation agency would recommend others to buy an electric vehicle when they plan to buy a vehicle.
6. It would be good for Urban public sector transportation agency to have an EV.
7. Buying an EV is a good idea for Urban public sector transportation agency.
8. It is smart for Urban public sector transportation agency to buy an EV.
9. Urban public sector transportation agency looks forward to more brands and models of EVs being available on the market.
10. Urban public sector transportation agency would be willing to pay more for a vehicle that is less harmful to the environment.

3.6.2 Measurement of infrastructure governance mechanisms

Infrastructure governance mechanisms in this study is measured with eleven (11) subjective measures with three aspects of (i) Government policy support, (ii) Financial incentives, and (iii) Publicize promotional activities. All items were reflected in the

questionnaire and allocated scores ranging from 1 to 5. The highest score is fifty-five points (11 x 5 points), establishing highest level of infrastructure governance mechanisms. While, the lowest score is eleven points (11 x 1 point). The eleven items for this mediation variable are adopted and adapted from Sovacool et al., (2019), Imran & Mohammad, (2022), Zambrano-Gutierrez et al., (2018) and Jowin (2023) with Cronbach's Alpha of 0.77, Composite Reliability 0.85, and Cronbach's Alpha 0.862 respectively. The eleven items of infrastructure governance mechanisms are:

1. Government policy support through direct government subsidies (e.g., a rebate).
2 Government policy support through low interest loans.
3. Government policy support through tax exemptions and reductions.
4. Government policy support through easy access to registration for green vehicles.
5. Financial incentives through grants.
6. Financial incentives through electric vehicle supply equipment financing.
7. Financial incentives through tax subsidies.
8. Financial incentives through research and development.
9. Publicize promotional activities by raising EV awareness and education.
10. Publicize promotional activities EV uptake and usage.
11. Publicize promotional activities by establishing EV as a competitive alternative to conventional gas-powered vehicles.

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3.6.3 Measurement of Charging Infrastructure

Charging infrastructure in this study is measured with nine (9) subjective measures. All items were reflected in the questionnaire and allocated scores ranging from 1 to 5. The highest score is forty-five points (9 x 5 points), establishing highest level of Charging Infrastructure. While, the lowest score is nine points (9 x 1 point). The items

for this independent variable are adopted and adapted from Bhat, Verma, & Verma (2022) with composite reliability of 0.856 and Wang, Ozden and Tsang (2023) with composite reliability of 0.83. The nine items of charging infrastructure are:

1. If there are adequate normal charging points in and around the city.
2. If there are adequate fast charging points in and around the city.
3. If there are adequate battery swap stations in and around the city.
4. If urban public transportation agency is provided monetary benefits such as tax exemption, free parking etc.
5. If urban public transportation agency is provided with other benefits such as reserved parking spaces, access to HOV lanes etc.
6. The public infrastructure for EV is available.
7. The EV infrastructure for urban public transportation is available.
8. The EV infrastructure at work is available.
9. The EV infrastructure on highway is available.

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3.6.4 Measurement of Electric Vehicle Performance

Electric vehicle performance in this study is measured with thirteen (13) subjective measures. All items were reflected in the questionnaire and allocated scores ranging from 1 to 5. The highest score is seventy-five points (13 x 5 points), establishing highest level of electric vehicle performance. While, the lowest score is thirteen points (13 x 1 point). The items for this independent variable are adopted and adapted from Bhat, Verma, & Verma (2022) with composite reliability of 0.832, and Wang, Tang, & Pan (2018) with composite reliability of 0.75. The thirteen items electric vehicle performance are:

1. The EVs in the current market have an acceptable standard of quality in terms of body material.

2. The EVs in the current market have an acceptable standard of performance in terms of "pleasure of the ride."

3. The EVs in the current market have an acceptable standard of performance in terms of speed, acceleration, etc.

4. The EVs in the current market require less maintenance than the conventional vehicles.

5. The acceleration time of EVs is short and the power is strong.

6. EVs are easy to handle without gearbox.

7. EVs are safe.

8. The noise of EVs is small.

9. The battery life of EVs is long.

10. The driving range of EVs is long.

11. There are enough EV models for consumers to choose.

12. The interior and appearance of EVs are fashionable and cool.

13. EVs have excellent digital entertainment and navigation functions.

3.6.5 Measurement of Technical Knowledge

Technical knowledge in this study is measured with six (6) subjective measures. All items were reflected in the questionnaire and allocated scores ranging from 1 to 5. The highest score is thirty points (6 x 5 points), establishing highest level of technical knowledge. While, the lowest score is six points (6 x 1 point). The six (6) items for this independent variable are adopted and adapted from Peters, Van der Werff, & Steg, (2018) with internal composite reliability of 0.59 and Huang, Lin, Lim, Tseng, & Zhou (2021) with composite reliability of 0.79. The six items are:

1. Urban public transportation agency is quite advanced on the latest technological developments.

2. An EV is equipped with the latest technology.

3. I know the integration of EVs and ICT to enhance assisted driving.

4. I know the collaborative discharge capability of EV batteries and its application scenarios.

5. I know the technological performance (such as charging time, acceleration, driving comfort and driving range) of EVs.

6. I know the technological advantages of EVs over gasoline vehicles.

3.6.6 Measurement of Vehicle Cost

Vehicle cost in this study is measured with seven (7) subjective measures. All items were reflected in the questionnaire and allocated scores ranging from 1 to 5. The highest score is thirty-five points (7 x 5 points), establishing highest level of vehicle cost. While, the lowest score is seven points (7 x 1 point). These items are adopted and adapted from Sovacool, Abrahamse, Zhang, & Ren (2019) with Cronbach's Alpha of 0.78, and Aye (2024) with composite reliability of 0.72. The seven items of vehicle cost are:

1. Purchase cost of EV is relatively high compared to cost of gasoline vehicle.

2. Fuel costs of EV is relatively high compared to fuel cost of gasoline vehicle.

3. Maintenance costs of EV is relatively high compared to maintenance cost of gasoline vehicle.

4. Depreciation cost of EV is relatively high compared to depreciation cost of gasoline vehicle.

5. An electric vehicle is affordable.

6. The price of electric vehicles is reasonable.

7. In general, the price of electric vehicles is more expensive than conventional vehicle.

3.6.7 Measurement of Charging Facilities Cost

Charging facilities cost in this study is measured with five (5) subjective measures. All items were reflected in the questionnaire and allocated scores ranging from 1 to 5. The highest score is twenty-five points (5 x 5 points), establishing highest level of vehicle cost. While, the lowest score is five points (5 x 1 point). These items are adopted and adapted from Habich-Sobiegalla, Kostka & Anzinger (2019) with Cronbach's Alpha of 0.80. The five items of charging facilities cost are:

1. EV can only be charge at certain predetermined locations.

2. The costs of charging EVs are high.

3. EVs take too long to charge, as there are no enough charging stations.

4. EV is not for long journeys, as they are not as fast.

5. The sensation of driving a car with a petrol/diesel engine is much more enjoyable.

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3.6.8 Measurement of Economic Benefits

Economic benefits in this study are measured with eleven (11) subjective measures. All items were reflected in the questionnaire and allocated scores ranging from 1 to 5. The highest score is fifty-five points (11 x 5 points), establishing highest level of economic benefits. While, the lowest score is eleven points (11 x 1 point). These items are adopted and adapted from Sovacool et al., (2019) with Cronbach's Alpha of 0.80; and Mun (2022) with composite reliability of 0.83. The eleven items of economic benefits are:

1. EVs are easy to use and operate.

2. EVs are safe to use and operate.

3. EVs are reliable alternative compared to gasoline vehicle.

4. EVs are alternate way of increasing our agency's savings.

5. EVs have attributes needed to preserve the environment.

6. I think that the use of electric vehicles helps save fuel costs.

7. I think that the management and maintenance cost of electric vehicles tend to be lower than that of non-electric vehicles.

8. I think that subsidies and tax deductions for electric vehicles help reduce costs.

9. I think that the cost of electric vehicles is more expensive than internal combustion engine vehicles.

10. I think that cost is burdensome when replacing battery in electric vehicles.

11. I think that the usage of electric vehicles helps reduce costs overall.

To sum all the above items 'measurements, Table 3.1 below highlighted the Constructs, Measurement Items, and Source References

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Table 3.1
Constructs, Measurement Items, and Source References

Construct	Measurement Items	Source(s)
Adoption of Electric Vehicle (DV)	10 items (e.g., interest in buying EV, future purchase plans, preference over traditional vehicles, recommendation to others, willingness to pay more for eco-friendly vehicles)	Yildiz, Çiğdem, & Meidutė-Kavaliauskienė (2024), CR = 0.94
Infrastructure Governance Mechanisms (Mediator)	11 items across three aspects: (i) Government policy support (subsidies, loans, tax exemptions, registration ease) (ii) Financial incentives (grants, EVSE financing, R&D, tax subsidies) (iii) Promotional activities (awareness campaigns, EV uptake, competitiveness against conventional vehicles)	Sovacool et al. (2019), Imran & Mohammad (2022), Zambrano-Gutierrez et al. (2018), Jowin (2023); α =

Construct	Measurement Items	Source(s)
		0.77–0.862; CR = 0.85
Charging Infrastructure (IV)	9 items (e.g., adequacy of normal and fast charging points, swap stations, workplace/highway/public infrastructure, monetary and non-monetary benefits)	Bhat, Verma, & Verma (2022), CR = 0.856; Wang, Ozden, & Tsang (2023), CR = 0.83
Electric Vehicle Performance (IV)	13 items (e.g., body quality, speed/acceleration, maintenance, safety, noise, battery life, driving range, model variety, digital features, interior/exterior design)	Bhat, Verma, & Verma (2022), CR = 0.832; Wang, Tang, & Pan (2018), CR = 0.75
Technical Knowledge (IV)	6 items (e.g., awareness of technological developments, ICT integration, collaborative discharge, performance specifications, advantages over gasoline vehicles)	Peters, Van der Werff, & Steg (2018), CR = 0.59; Huang, Lin, Lim, Tseng, & Zhou (2021), CR = 0.79
Vehicle Cost (IV)	7 items (e.g., purchase, fuel, maintenance, depreciation costs, affordability, price reasonableness, comparison with conventional vehicles)	Sovacool, Abrahamse, Zhang, & Ren (2019), α = 0.78; Aye (2024), CR = 0.72
Charging Facilities Cost (IV)	5 items (e.g., limited charging locations, high charging cost, long charging times, unsuitability for long journeys, preference for petrol/diesel vehicles)	Habich-Sobiegalla, Kostka, & Anzinger (2019), α = 0.80
Economic Benefits (IV)	11 items (e.g., ease of use, safety, reliability, cost savings, fuel savings, environmental preservation, lower maintenance, subsidies, battery replacement burden, overall cost reduction)	Sovacool et al. (2019), α = 0.80; Mun (2022), CR = 0.83

3.7 Data Collection

3.7.1 Population of the Study

The purpose of posing a research question is to provide answers to complex phenomena that are significant to the target population, which is the group of people

studying the subject. According to Creswell (2014), this group of people, objects, events, or items that a researcher identifies and examines is referred to as the population in research. Consequently, the population in a study encompasses all the elements or entities the researcher investigates to draw conclusions. To conduct a study effectively, it is crucial to determine the population under investigation to select the appropriate sample size (Sekaran & Bougie, 2010).

On November 13, 2023, China's Ministry of Industry and Information Technology and the Ministry of Transport, together with the National Development and Reform Commission, the Ministry of Finance, the Ministry of Ecology and Environment, the Ministry of Housing and Urban-Rural Development, the Energy Administration, and the Post Bureau, officially issued 《the Notice on Launching the First Batch of Pilot Regions for the Comprehensive Electrification of Vehicles in the Public Domain》15 cities, including Ordos, Beijing, Shenzhen, Chongqing, Chengdu, and Xiamen, among others are the pilot cities (China Daily 2023). The initiative aims to significantly expand the use of new energy vehicles in public services and establish supporting infrastructure such as charging and battery swapping stations. The announcement proposed a 1:1 ratio of cars and charging piles for public domain vehicles, and about 1 million new public charging piles were needed to complete the goal. The exploration and formation of several replicable and promotable experiences and models are encouraged to play a leading role in the comprehensive market-oriented expansion of new energy vehicles and the construction of a green and low-carbon transportation system. Buyers of electric vehicles in the public sector mainly include the following categories:

1. Government agencies: In response to environmental protection policies, government agencies may purchase electric vehicles for official use.

2. Public institutions: are generally institutions set up by the state with a certain public welfare nature such as public transportation group, post office, Sanitation office, post office, taxi company, educational institutions, environmental protection agency may purchase electric vehicles to reduce operating costs and environmental pollution. As state-owned enterprises and public institutions, they need to show their social responsibility and green image.

Hunan Province is an appropriate research site because it represents a rapidly developing region in China where urban public transportation agencies are actively transitioning toward electric vehicle (EV) adoption under national and provincial policy directives. In Hunan, there are numerous government agencies and public institutions involved in urban public transportation. Specifically, over 200 such entities manage and operate the extensive network of buses, vans, and lorries across various cities (Jiawen & Chuanglin, 2015). These organizations are integral to the planning, implementation, and maintenance of the public transit system, ensuring that the mobility needs of urban populations are effectively met. Their collaborative effort reflects both the scale and the complexity of urban transportation management in China, making Hunan a representative context for studying the adoption of EVs in the public sector. Moreover, Hunan has been positioned as a pilot area for new energy vehicle initiatives, supported by government incentives, infrastructure investments, and local manufacturers driving the diffusion of EV technology. This context provides a unique opportunity to examine adoption dynamics within an emerging but strategically significant market.

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Regarding generalizability, the findings of this study are not intended to achieve statistical generalization to all Chinese provinces, as the sampling is localized to Hunan. Instead, the results are analytically generalizable in the sense that the insights derived from Hunan's institutional, infrastructural, and policy environment can inform theoretical understanding and provide a transferable framework applicable to other regions undergoing similar transitions. The study therefore emphasizes theoretical transferability rather than broad statistical representativeness, offering valuable contributions to knowledge on EV adoption in public transportation systems within comparable socio-political and infrastructural contexts.

3.7.2 Sampling Frame & Size

Researching an entire population is known to be extremely challenging, if not impossible, due to time and resource constraints, as well as the impact of a large sample size on measurement quality (Sekaran & Bougie, 2010; Tayie, 2005). To address these challenges, researchers can select an appropriate sample size from the target population (Creswell, 2014). Typically, a representative sample of the population under study is chosen for analysis (Hair et al., 2011). According to Creswell (2014), a research sample should be representative of the target population that the study aims to explore and generalize about. Financial, scheduling, labor, and measurement constraints are the main reasons for examining a sample rather than the entire population (Hair et al., 2011). The sample size for this study was determined using the Krejcie and Morgan table, which is an effective method for identifying the correct sample size to represent a given population (Krejcie & Morgan, 1970).

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According to Krejcie and Morgan (1970), Table for Determining Sample Size of a Known Population, a sample size of 132 government agencies that involve in urban public transportation, drawn from a population of 200 urban public sector transportations (known population) operated by various government agencies and public institutions, in Hunan, China has been selected for the study (China Ministry of Industry and Information Technology (MIIT), 2020).

Table 3.2
Table for Determining Sample Size of a Known Population.

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: N is Population Size; S is Sample Size *Source: Krejcie & Morgan, 1970*

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According to Hair, Tomas, Ringle, and Sarstedt (2017), researchers can conduct individual G-power evaluations to ensure the minimum sample size required for a study is met. For this investigation, the suitability of the chosen sample size was confirmed using G-power analysis (3.1.9.7). Determining the appropriate sample size

is crucial for successful research (Salkind, 2006), as it minimizes sampling errors and enhances cost, time, and effort efficiencies (Sekaran & Bougie, 2010; Salkind, 2006). Various studies have established G-power analysis as an effective statistical technique for determining sample size (Hair et al., 2017; Faul et al., 2007). Through G-power analysis, the issue of inadequate sample size is avoided. An a priori G-power analysis indicated that 153 government agencies that involve in urban public transportation, were needed to validate the minimal sample requirement for a study with seven predictive factors (see figure 3.2). Based on the differing sample size requirements, the researcher decided to take more sample size, which is 153 government agencies that involve in urban public transportation. Therefore, the researcher will contact and collect 3 survey questionnaires from each 153 government agencies that involve in urban public that will make up the total collected survey questionnaires of 459.

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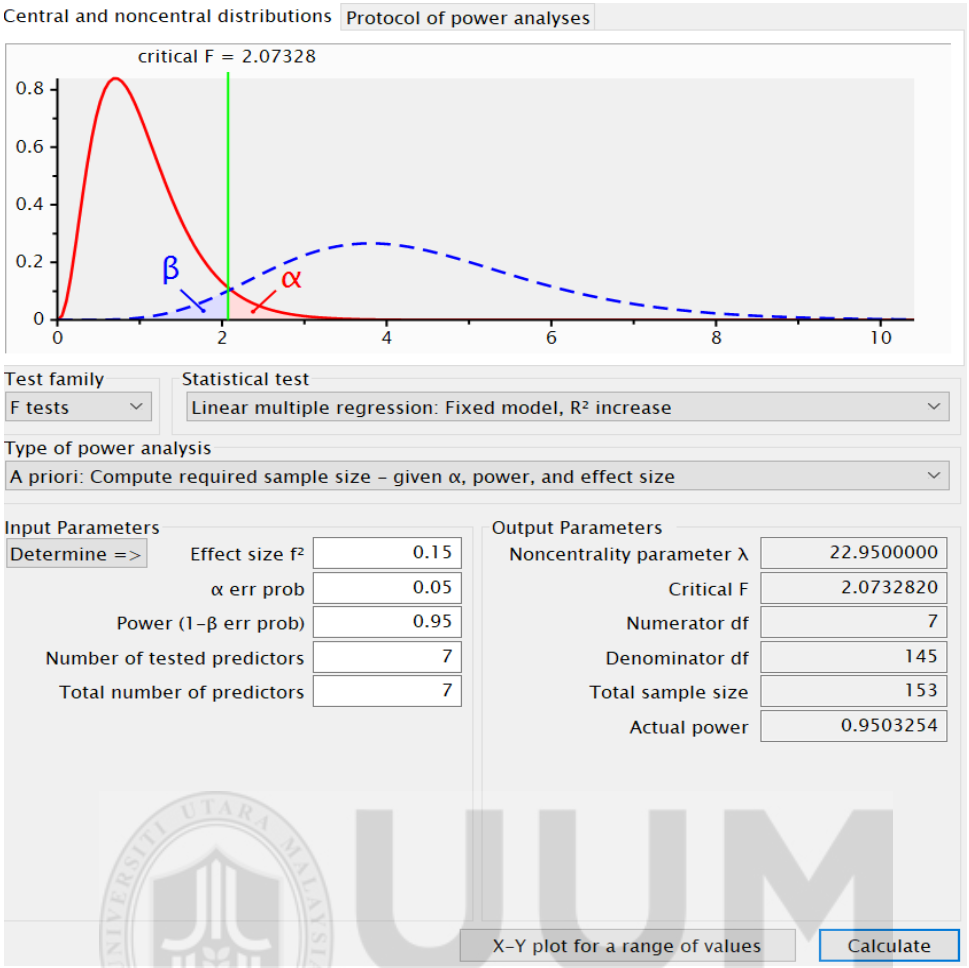

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Figure 3.2 G-Power Analysis (3.1.9.7)

3.8 Sampling Techniques

This study adopts a cross-sectional quantitative approach to investigate the research objectives. To ensure representativeness of the sample and reduce potential bias, a systematic random sampling method will be employed. In this approach, respondents are selected systematically from the target population by choosing every *kth* element from an ordered sampling frame (Creswell, 2014). The procedural structure of systematic random sampling provides greater consistency compared to simple random sampling, as it introduces a clear selection interval that minimizes the likelihood of clustering or uneven representation (Creswell & Creswell, 2017). By spreading the selection evenly across the population, this method enhances coverage and reduces

sampling error, thereby improving the accuracy and reliability of the findings. To further ensure objectivity, the starting point of the sampling process will be determined randomly, which prevents any bias arising from a non-random initial selection.

Systematic random sampling is a form of probability sampling, which, according to Saunders, Lewis, and Thornhill (2007), balances the resources required for data collection and verification against the accuracy and generalizability of the results. To this study, the sampling frame consists of 153 government agencies involved in urban public transportation in China. From each agency, three decision makers (department heads) will be systematically selected, producing a total sample of 459 potential respondents. The survey questionnaires will be administered both offline and online to maximize accessibility and response rates.

The choice of decision makers as respondents is deliberate, as they occupy pivotal positions in shaping and executing policies related to electric vehicle (EV) adoption in public sector. Their responsibilities span several critical domains, including: policy formulation to set adoption targets and design incentive schemes; regulatory oversight of EV deployment standards and infrastructure requirements; allocation of financial resources to support EV adoption and charging facilities; promotion of research and technological advancements in battery efficiency and public EV fleet performance; public awareness campaigns to enhance acceptance and sustainable mobility choices; collaboration with automakers, technology providers, and urban planners to align transportation goals; and continuous monitoring and evaluation of EV policy impacts to inform future improvements. Through their multifaceted role, decision makers act as key agents in advancing China's transition toward sustainable urban transportation.

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Systematic random sampling is particularly well-suited for this study for three reasons. First, unlike stratified or cluster sampling, which require prior grouping or categorization of respondents, systematic random sampling is simpler to implement when the sampling frame is already well-structured, such as the official list of government agencies. Second, it ensures that respondents are selected evenly across the population, which prevents overrepresentation of certain agencies or regions and thereby reduces selection bias. Third, the method is cost- and time-efficient, as it avoids the complexity of creating strata or clusters while still retaining the rigor of probability-based selection. These advantages make systematic random sampling a practical yet statistically robust technique for ensuring representative participation of decision makers across multiple government agencies.

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3.8.1 Stepwise Procedure of the Sampling Process

1. Establish the sampling frame: Compile a verified list of the 153 government agencies involved in urban public transportation.
2. Define the interval (*k*): Determine the sampling interval by dividing the total number of decision makers in the frame by the required sample size.
3. Random starting point: Select the first decision maker randomly to avoid systematic bias.
4. Systematic selection: From the starting point, select every *kth* decision maker until three respondents are chosen from each agency.
5. Survey administration: Distribute a total of 459 questionnaires (3 per agency) using both offline and online platforms to maximize coverage.
6. Data validation: Cross-check returned responses to ensure that the selection rule was applied consistently and without substitution bias.

By following this structured procedure, the study ensures transparent, unbiased, and replicable sampling, thereby strengthening the credibility and generalizability of the findings.

3.8.2 Ethical consideration in Survey Administration

Administering questionnaire surveys involving government agencies in China requires careful attention to ethical considerations, given the involvement of governmental institutions, cultural sensitivities, and legal frameworks. A key concern is informed consent and voluntary participation. Government officials or employees must be fully informed about the purpose of the research, how the data will be used, and the confidentiality measures in place, with written consent obtained where possible. Respondents should be made aware of their right to withdraw at any time without repercussions, and it must be emphasized that participation is voluntary, free from coercion or implied obligation arising from their professional roles. This is especially important in hierarchical government structures, where employees may feel compelled to participate. Another important aspect is confidentiality and anonymity. Strict measures must be taken to ensure that responses remain confidential, with identifiable information anonymized unless explicit consent is given. This includes removing details such as roles, departments, or other identifiers that may link responses to individuals. In reporting findings, anonymity should be maintained so that no responses can be traced back to specific officials or departments, thereby protecting participants from potential professional or political repercussions, particularly if their views are critical or divergent.

Researchers must also address issues of avoiding coercion and conflict of interest. To prevent coercion, participants should be reassured that their involvement is voluntary and that their responses will not affect their professional standing. In cases where the research is commissioned or funded by government agencies, safeguards should be established to avoid conflicts of interest, ensuring that respondents do not feel pressured to align their answers with institutional expectations. Furthermore, approval

from relevant authorities is essential. Surveys of this nature may require authorization from local government bodies, relevant ministries, or municipal authorities, as unauthorized data collection could be viewed with suspicion or lead to legal consequences. Ethical clearance from institutional review boards (IRBs) at academic or research institutions, both local and international, may also be necessary to confirm compliance with ethical standards.

Attention must also be given to post-survey considerations such as reporting and dissemination. If agreed upon, results should be communicated transparently to the participating agencies, ensuring objectivity and avoiding misrepresentation of findings to align with government expectations. When publishing results, particularly in international outlets, political sensitivities should be respected, and findings framed responsibly so as not to expose participants or create political discomfort.

Finally, the rights and well-being of participants must remain a priority throughout the research process. Researchers should ensure that participants are protected from any form of harm, physical, emotional, or professional—that may arise from their involvement, especially if their responses include criticism of government policies. In addition, when sensitive topics are addressed, debriefing participants to explain the purpose of the questions and offering clarification or support may be necessary. Overall, conducting questionnaire surveys with government agencies in China requires a thoughtful, ethically grounded approach that balances adherence to national regulations with respect for international ethical standards. Clear communication with officials, strict protection of participants' rights, and continuous ethical oversight are critical to maintaining the integrity of the research while safeguarding the welfare of all respondents.

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3.9 Validity and Reliability

The concepts of validity and reliability are cornerstone principles in research and survey design. They are crucial for ensuring that a survey instrument accurately measures the intended subject matter and produces consistent results (Morse, Barrett, Mayan, Olson, & Spiers, 2002). Hence, irrespective of the research approach chosen, it is imperative to consider issues concerning the validity and reliability of the instruments (Fisher & King, 2010; Golafshani, 2003).

3.9.1 Reliability Test

Reliability refers to the consistency and stability of measurements taken by a survey instrument over time and across different conditions. It assesses how consistently the instrument produces similar results under uniform circumstances (Sekaran & Bougie, 2013; Gray, 2004; Golafshani, 2003). A reliable survey instrument consistently yields the same or similar results upon repeated administration, providing researchers with confidence in the stability of the variables being measured (Sekaran & Bougie, 2010). This reliability enables researchers to compare data collected at different points in time, which is particularly valuable in longitudinal studies or research involving repeated measurements to track changes or trends (Gray, 2004).

In this study, the internal consistency and reliability of the adapted measurement scales were evaluated using both Cronbach's alpha and composite reliability. Cronbach's alpha is a statistical measure used to assess the internal consistency, reliability, and homogeneity of scales or groups of related items within research instruments such as surveys or questionnaires (Hair et al., 2017). It ranges from 0 to 1, where a higher alpha coefficient indicates greater internal consistency among the items. Typically, a Cronbach's alpha of 0.70 or higher is considered acceptable for reliability, although

this criterion may vary depending on the study's context and objectives. Higher values of Cronbach's alpha closer to 1 indicate stronger internal consistency (Sekaran & Bougie, 2010; Raykov, 2007). Researchers use Cronbach's alpha during the development and validation of survey instruments to ensure that items are reliable and consistently measure the intended construct, especially when dealing with multi-item scales or questionnaires designed to assess complex constructs (Sekaran & Bougie, 2010).

On the contrary, Composite reliability (CR) is a metric used within structural equation modeling (SEM) to evaluate the internal consistency and reliability of a latent construct or composite variable. Like Cronbach's alpha, CR measures the extent to which multiple indicators or observed variables reliably represent a latent variable (Henseler, Ringle & Sarstedt, 2015; Rigdon, 2014). Composite reliability ranges from 0 to 1, mirroring Cronbach's alpha, with higher values indicating stronger internal consistency and reliability. While specific thresholds may vary depending on the context, a CR of 0.70 or higher is typically considered adequate for satisfactory reliability. In exploratory research, values between 0.60 and 0.70 or higher are generally deemed acceptable (Creswell, 2014; Hair et al., 2017).

3.9.2 Validity Test

Validity pertains to the extent to which a survey instrument accurately measures its intended target. It assesses how well the instrument captures the desired construct and its appropriateness (Sekaran & Bougie, 2013; Gray, 2004). In social science research, validity is typically evaluated through discriminant validity, convergent validity, and content validity tests (Sekaran & Bougie, 2013). This study specifically examined content validity, convergent validity, and discriminant validity because most of the

constructs under investigation are reflective (Hair et al., 2017). The type of validity test that requires endorsement from experts in the field is content validity. In this study, Mr. Li Rui Ming, Senior Director of Intelligent Network Link Attachment in New Zotye Automobile, China has been chosen to become an expert to review the questionnaire instrument (Appendix E- Mr. Li's Resume attached). Content validity evaluates whether a measurement instrument (e.g., questionnaire, survey, test) adequately covers the entire range of the concept it is intended to measure (Hair et al., 2017). Experts in the field review the instrument to determine:

1. If the items are relevant to the construct being measured.
2. Whether the items comprehensively represent the domain of the construct.
3. If there are any unnecessary or missing items.

Professionals or academics with expertise in the specific subject area evaluate the items (Hair et al., 2017) for:

1. Relevance: Are the items directly tied to the construct?
2. Clarity: Are the items easy to understand?
3. Comprehensiveness: Are all aspects of the concept covered?

Based on expert feedback, items may be added, removed, or revised to improve the instrument (Mr. Li's expert review has been attach as Appendix D).

Convergent validity, as defined by Hair et al. (2017), examines the correlation between different measurement instruments intended to measure similar constructs. It determines whether scores from theoretically similar instruments are positively correlated, demonstrating that they measure the same construct effectively. Statistically, convergent validity is confirmed when item loadings exceed 0.70 or when the average variance extracted (AVE) is 0.50 or higher. An AVE of 0.50 suggests that

more than half of the variance in the indicators is explained by the construct (Hair et al., 2014, Hair et al., 2013). The AVE is calculated by dividing the sum of squared loadings by the total number of indicators (Hair et al., 2017). Discriminant validity, on the other hand, evaluates how distinct a measurement tool is compared to others intended to measure different constructs. It examines whether scores from one tool do not correlate significantly with scores from tools measuring different concepts (Hair et al., 2017).

A common method to assess discriminant validity is through cross-loadings. If an indicator's loading on its intended construct is higher than its correlation with any other constructs, discriminant validity is supported (Hair et al., 2017). Additionally, the Fornell-Larcker criterion, proposed by Henseler et al. (2015), is useful for evaluating discriminant validity within structural equation modeling (SEM). It compares the square root of the AVE for each construct with the correlations between constructs. If each construct's AVE is higher than its correlations with other constructs, discriminant validity is demonstrated (Camisón & Villar-López, 2012).

3.9.3 Content Validity

Content validity is a form of validity that assesses how well a measurement instrument, such as a test, survey, or questionnaire, comprehensively covers the entire scope of the construct or concept it aims to measure. Essentially, content validity determines whether the items or questions in the instrument adequately represent a thorough and relevant sampling of the content domain it intends to assess (Sekaran & Bougie, 2013). This type of validity is typically established through expert judgment, where specialists in the field review the instrument's items and provide feedback on whether they

sufficiently encompass the essential aspects of the construct. These experts may include subject matter specialists, practitioners, or individuals with relevant expertise.

3.10 Data Analysis Technique

The data analysis methodology outlines the processes and statistical tools employed to evaluate the data and test hypotheses for drawing valid conclusions (Tayie, 2005). This study utilized both descriptive and inferential statistical techniques generated by the survey instrument designed for the investigation. Descriptive statistics, as described by Creswell (2012), were used to characterize the trends within specific datasets from the research instrument, while inferential analysis was applied for comparing or relating multiple study variables. The data analysis was conducted using Partial Least Squares-Structural Equation Modeling (PLS-SEM) 4.0.9.8 and the Statistical Package for the Social Sciences (SPSS) version 29.

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PLS-SEM is advantageous for adjusting measurement errors and indirectly assessing latent variables through indicators and proxies (Hair et al., 2017). It is particularly suited for handling complex modeling challenges often encountered in social science research, such as non-normal data distributions, small sample sizes, mediation and moderation effects, and formative constructs (Chin, 1998). However, Dana and Dawes (2004) noted that the predictive power of out-of-sample analyses can be affected by sample size limitations, a consideration echoed by Hair, Ringle, and Sarstedt (2013) emphasizing the importance of representative samples for valid inference in PLS-SEM.

Contrary to the confirmatory nature of Covariance-Based SEM (CB-SEM), which focuses on objective parameter estimates, PLS-SEM optimizes path model values

(Henseler & Sarstedt, 2013). Researchers choose PLS-SEM for its robust predictive capabilities, less stringent assumptions, capacity to handle intricate models and data, and suitability for small sample sizes (Hair et al., 2012). The process of PLS analysis includes stages for assessing construct validity and reliability in both measurement and structural models (Chin et al., 2010). This involves evaluating individual item reliability, concept reliability, convergent validity, and discriminant validity to ensure the reliability and validity of construct measurements before drawing conclusions about relationships between constructs (Hair et al., 2010; Chin et al., 2010). Data collected through questionnaires in the field were coded and entered IBM SPSS version 29 for initial processing. After verifying data accuracy and addressing any missing values, demographic data was described and contrasted using SPSS's descriptive statistical tools. Subsequently, the data underwent primary analysis and further scrutiny using PLS-SEM.

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3.11 Unit of Analysis

One of the most important things to do when conducting research is to determine the unit of analysis. It has been determined that in research, a unit of analysis refers to objects of study, such as an individual, a group, a program, a company, or a community, state, or country (Mertens, 1998). The study's variables highlighting the significant roles of charging infrastructure, electric vehicle performance, and technical knowledge (technical factors), as well as vehicle cost, charging facilities, and economic benefits (economic factors). It also explores the mediation of infrastructure governance mechanisms and the adoption of urban public sector electric vehicle transportation in Hunan, China were operationalized from a firm-level perspective based on the body of literature that was available (Halac, 2015). In China, decision makers within government agencies, such as Heads of Departments (HODs), play a crucial role in

shaping policies and leading initiatives concerning urban public electric vehicle (EV) transportation. Their roles encompass several key responsibilities:

1. Policy Formulation: Decision makers establish the strategic direction for urban EV transportation policies. This includes setting targets for EV adoption, creating incentives for manufacturers and consumers, and developing regulations governing EV infrastructure and operations.

2. Regulatory Oversight: They supervise the implementation of regulations that affect EV deployment, including vehicle standards, requirements for charging infrastructure, and operational guidelines for public transportation fleets.

3. Financial Support: Decision makers allocate funding and subsidies to bolster the development of EV infrastructure, such as charging stations and battery swapping facilities. They also offer financial incentives to encourage the uptake of EVs by public transportation operators.

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4. Technology Development: They promote research and development efforts aimed at advancing EV technology, enhancing battery efficiency, and improving the performance of electric public transportation vehicles.

5. Public Awareness and Education: Decision makers lead public outreach campaigns to raise awareness about the benefits of EVs, advocate for sustainable transportation choices, and address any public concerns or misconceptions.

6. Collaboration and Stakeholder Engagement: They engage with industry stakeholders, including automakers, technology providers, and urban planners, to

foster cooperation and ensure alignment with national and local transportation objectives.

7. Monitoring and Evaluation: Decision makers monitor the progress of EV adoption and evaluate the impact of policies on urban transportation systems, energy consumption, and environmental sustainability. This data guides future policy adjustments and enhancements.

Overall, decision makers within China's government agencies play a pivotal role in facilitating the transition toward urban public electric vehicle transportation. Their efforts aim to mitigate carbon emissions, bolster energy security, and promote sustainable urban development.

3.12 Pilot Study

A pilot study refers to a preliminary investigation conducted on a small scale before the main research project begins. Its purpose is to test and refine research procedures, gather initial data, and identify potential issues that may arise during the full-scale study (Bryman, 2012). The primary goal of a pilot study is to assess the feasibility of the research design and methods, allowing researchers to make necessary adjustments before proceeding to a larger and more resource-intensive study (Tayie, 2005). During a pilot study, researchers evaluate and test various procedures and protocols that will be utilized in the main study, such as data collection methods, experimental manipulations, survey instruments, and other research tools. This process helps identify logistical challenges and ensures the smooth implementation of the research plan (Tayie, 2005). Researchers also assess the clarity, appropriateness, and effectiveness of their research instruments, such as questionnaires or surveys, through

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participant feedback and observations, aiming to enhance the reliability and validity of these instruments (Bryman, 2012).

In this study, a pilot test was conducted to validate and ensure the reliability of the instruments to be used. Fifty questionnaires were randomly distributed to Heads of Department in urban public transportation government agencies in Hunan, China, resulting in the collection of 40 surveys, or 80% of the total. Additionally, five incomplete questionnaires were deemed unsuitable for analysis. After retrieving the administered questionnaires, SPSS version 29 and PLS-SEM 4.0.9.8 were employed to assess the internal consistency reliability of constructs and discriminant validity.

3.12.1 Confirmatory Factor Analysis

In this study, all items used to measure the latent variables were adopted from previously validated studies. This approach emphasizes the importance of ensuring that the measurement scales are both reliable and valid. Consequently, a Confirmatory Factor Analysis (CFA) was conducted to rigorously evaluate the construct validity and reliability of the measurement model. The CFA process was carried out using the Consistent Partial Least Squares (PLS) Algorithm (Factor) Function available in PLS-SEM (Partial Least Squares - Structural Equation Modeling), which is particularly well-suited for analyzing complex relationships in latent variable modeling. Before proceeding with the statistical analysis, all items associated with the latent variables were meticulously prepared to ensure accuracy and consistency. This involved carefully coding each item and systematically entering the data into the SPSS software (Statistical Package for the Social Sciences). The structured input of the data served as the foundational step for the subsequent analysis. The details of this data preparation process, including the coding and organization of the measurement items, are

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presented in Table 3.1, which provides a comprehensive overview of the input data and its alignment with the research framework.

Table 3.3
Variables and Measurements

Constructs	Items	Coding
Infrastructure Governance Mechanism	Government policy support through direct government subsidies (e.g., a rebate).	IGM1
	Government policy support through low interest loans.	IGM2
	Government policy support through tax exemptions and reductions.	IGM3
	Government policy support through easy access to registration for green vehicles.	IGM4
	Financial incentives through grants.	IGM5
	Financial incentives through tax subsidies.	IGM6
	Financial incentives through electric vehicle supply equipment financing.	IGM7
	Financial incentives through research and development.	IGM8
	Publicize promotional activities by raising EV awareness and education.	IGM9
	Publicize promotional activities for EV uptake and usage.	IGM10
	Publicize promotional activities by establishing EV as a competitive alternative to conventional gas-powered vehicles.	IGM11
Charging Infrastructure	If there are adequate normal charging points in and around the city.	CHI1
	If there are adequate fast charging points in and around the city.	CHI2
	If there are adequate battery swap stations in and around the city.	CHI3
	If urban public transportation agency is provided monetary benefits such as tax exemption, free parking etc.	CHI4
	If urban public transportation agency is provided with other benefits such as reserved parking spaces, access to HOV lanes etc.	CHI5
	The public infrastructure for EV is available.	CHI6
	The EV infrastructure for urban public transportation is available.	CHI7
	The EV infrastructure at work is available.	CHI8
	The EV infrastructure on highway is available.	CHI9
Electric Vehicle Performance	The EVs in the current market have an acceptable standard of quality in terms of body material.	EVP1
	The EVs in the current market have an acceptable standard of performance in terms of "pleasure of the ride."	EVP2
	The EVs in the current market have an acceptable standard of performance in terms of speed, acceleration, etc.	EVP3
	The EVs in the current market require less maintenance than the conventional vehicles.	EVP4
	The acceleration time of EVs is short and the power is strong.	EVP5
	EVs are easy to handle without gearbox.	EVP6
	EVs are safe.	EVP7
	The noise of EVs is small.	EVP8
	The battery life of EVs is long.	EVP9
	The driving range of EVs is long.	EVP10
	There are enough EV models for consumers to choose.	EVP11

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	The interior and appearance of EVs are fashionable and cool.	EVP12
	EVs have excellent digital entertainment and navigation functions.	EVP13
Technical Knowledge	Urban public transportation agency is not behind on the latest technological developments.	TKN1
	An EV is equipped with the latest technology.	TKN2
	I know the integration of EVs and ICT to enhance assisted driving.	TKN3
	I know the collaborative discharge capability of EV batteries and its application scenarios.	TKN4
	I know the technological performance (such as charging time, acceleration, driving comfort and driving range) of EVs.	TKN5
	I know the technological advantages of EVs over gasoline vehicles.	TKN6
Vehicle Cost	Purchase cost of EV is relatively high compared to cost of gasoline vehicle.	VC1
	Fuel costs of EV is relatively low compared to fuel cost of gasoline vehicle.	VC2
	Maintenance costs of EV is relatively low compared to maintenance cost of gasoline vehicle.	VC3
	Depreciation cost of EV is relatively high compared to depreciation cost of gasoline vehicle.	VC4
	I can afford an electric vehicle.	VC5
	I think the price of electric vehicles is reasonable.	VC6
	In general, the price of electric vehicles is more expensive than conventional vehicle.	VC7
Charging Facility Cost	I would not be able to charge EV at home.	CFC1
	EVs are too expensive to charge.	CFC2
	EVs take too long to charge, as there are no enough charging stations.	CFC3
	I can't use EV for long journeys, as they are not as fast.	CFC4
	I just prefer the sensation of driving a car with a petrol/diesel engine.	CFC5
Economic Benefit	EVs are easy to use and operate.	ECB1
	EVs are safe to use and operate.	ECB2
	EVs are reliable alternative compared to gasoline vehicle.	ECB3
	EVs are alternate way of increasing our agency's savings.	ECB4
	EVs have attributes needed to preserve the environment.	ECB5
	I think that the use of electric vehicles helps save fuel costs.	ECB6
	I think that the management and maintenance cost of electric vehicles tend to be lower than that of non-electric vehicles.	ECB7
	I think that subsidies and tax deductions for electric vehicles help reduce costs.	ECB8
	I think that the cost of electric vehicles is more expensive than internal combustion engine vehicles.	ECB9
	I think that cost is burdensome when replacing battery in electric vehicles.	ECB10
	I think that the usage of electric vehicles helps reduce costs overall.	ECB11
Electric Vehicle Adoption	Urban public sector transportation agency is interested in buying an EV.	EVA1
	Urban public sector transportation agency has a plan to buy an EV in the coming years.	EVA2
	Urban public sector transportation agency prefers to buy an EV over a traditional vehicle.	EVA3
	When Urban public sector transportation agency is buying a new car, it will buy an environmentally friendly EV.	EVA4
	Urban public sector transportation agency would recommend others to buy an electric vehicle when they plan to buy a vehicle.	EVA5
	It would be good for Urban public sector transportation agency to have an EV.	EVA6
	Buying an EV is a good idea for Urban public sector transportation agency.	EVA7
	It is smart for Urban public sector transportation agency to buy an EV.	EVA8

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Urban public sector transportation agency looks forward to more brands and models of EVs being available on the market.	EVA9
Urban public sector transportation agency would be willing to pay more for a vehicle that is less harmful to the environment.	EVA10

In addition to the foundational analyses, the reliability and validity of the multi-item questionnaire utilized in this study were meticulously evaluated by employing several robust statistical procedures recommended by Hair et al. (2010) and Hair et al. (2014). These procedures were chosen for their established credibility in assessing the robustness and consistency of measurement models in social science research. The primary aim of this rigorous evaluation was to ensure that the measurement model met the required statistical standards, thereby validating its suitability for addressing the study's research objectives.

To achieve this, multiple criteria were examined. First, the goodness of fit of the overall model was assessed using the Standardized Root Mean Square Residual (SRMR), a widely accepted metric for evaluating model fit by quantifying the discrepancy between observed and predicted correlations. Next, the individual item reliability was examined through an analysis of outer loadings, where items with loadings above the recommended threshold were retained to confirm their contribution to the latent construct. Furthermore, construct reliability was scrutinized by calculating both the Composite Reliability (CR) and Cronbach's Alpha for each latent variable. These measures collectively ensured that the constructs exhibited internal consistency, with CR emphasizing the shared variance of items and Cronbach's Alpha addressing their overall coherence.

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For assessing construct validity, two complementary measures were employed. The first was the Average Variance Extracted (AVE), which measures the amount of variance captured by the construct in relation to the variance due to measurement error,

ensuring convergent validity. The second was an evaluation of discriminant validity, aimed at confirming that each construct was distinct and not overly correlated with other constructs in the model. These stringent evaluations, grounded in the recommendations of Hair et al., provided robust evidence of the reliability and validity of the measurement scales used in this study. According to the results of the Confirmatory Factor Analysis (CFA) illustrated in Figure 3.1, the evaluation of individual item reliability was conducted by applying a threshold for outer loadings, as suggested by Hair et al. (2014). Specifically, items with outer loadings greater than 0.5 were considered reliable and retained in the measurement model. This criterion reflects the extent to which an observed variable reliably contributes to its corresponding latent construct. Items meeting or exceeding this threshold are deemed to have sufficient explanatory power, thereby ensuring the integrity of the model's measurement properties.

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Conversely, items with outer loadings below 0.5 were considered weak indicators and were excluded from the model, following the established guidelines. This step is essential as retaining items with poor outer loadings can undermine the overall reliability and validity of the construct. Removing such items is a critical precondition for achieving a satisfactory Average Variance Extracted (AVE), which must exceed the recommended minimum value of 0.5 to demonstrate acceptable convergent validity. AVE measures the proportion of variance captured by the construct in relation to the total variance, and achieving this benchmark ensures that the retained items collectively provide a robust representation of their associated construct.

Based on these standards, the constructs evaluated in this study demonstrated satisfactory reliability and validity. Specifically, the latent variables Charging Infrastructure, Vehicle Cost, Charging Facility Cost, and Electric Vehicle Adoption were found to exhibit strong factor loadings, with all retained items achieving outer loadings well above the 0.5 threshold. This indicates that the items used to measure these constructs adequately reflect their respective underlying dimensions. The alignment of these results with recommended methodological practices underscores the rigor of the model evaluation process and reinforces the reliability of the measurement framework adopted in this research.

In the process of refining the measurement model, several items were excluded from their respective constructs due to failing to meet the necessary statistical thresholds for reliability and validity. Specifically, within the Infrastructure Governance Mechanism (IGM) construct, 4 out of the 11 original items—namely, IGM7, IGM8, IGM9, and IGM11, were removed. These items were excluded because their outer loadings fell below the acceptable threshold of 0.5, as outlined by Hair et al. (2014). Their removal was deemed necessary to enhance the construct's overall reliability and to ensure that the retained items accurately and consistently measured the latent variable.

Similarly, within the Electric Vehicle Performance (EVP) construct, 3 out of the 13 original items, EVP1, EVP4, and EVP8, were eliminated from the model for the same reason. The exclusion of these items helped to improve the model's fit and the construct's convergent validity, as evidenced by an increase in the Average Variance Extracted (AVE) to levels exceeding the minimum recommended value of 0.5. This

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adjustment ensured that the remaining items collectively captured the essence of the construct more effectively.

Additionally, within the Technical Knowledge (TKN) construct, 1 out of the 6 items, TKN4, was removed. This decision was based on its failure to meet the required outer loading criterion, which suggested that it did not sufficiently contribute to the construct's measurement. Similarly, for the Economic Benefit (ECB) construct, 1 out of the 11 original items, ECB3, was excluded for the same reason. The removal of these underperforming items not only enhanced the internal consistency of their respective constructs but also improved the overall reliability of the measurement model. These iterative refinements, guided by established statistical criteria, highlight the rigorous process undertaken to ensure that each construct is measured with precision. By retaining only those items that demonstrated strong factor loadings and contributed meaningfully to their respective constructs, the measurement model was optimized for accuracy and validity, laying a robust foundation for the subsequent structural model evaluation.

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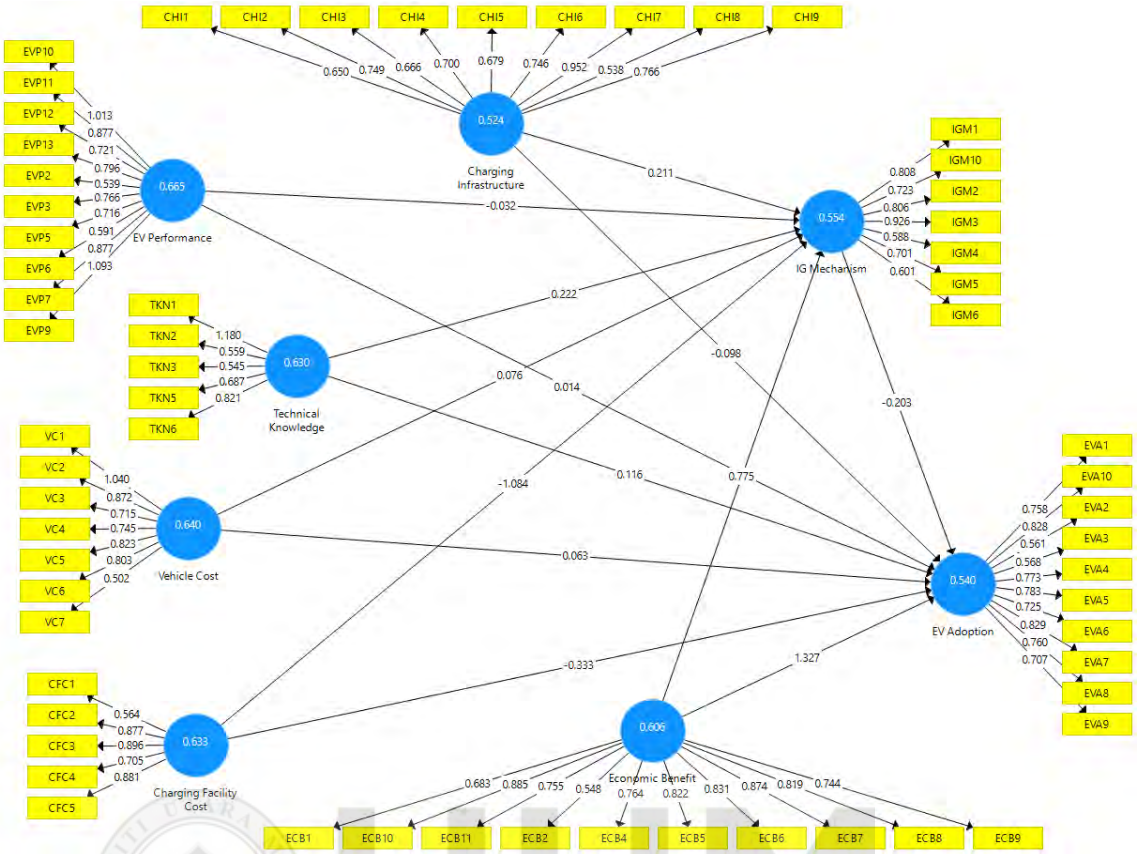

Figure 3.3 Model Assessment

The results of the Confirmatory Factor Analysis (CFA) provided robust evidence of the reliability and validity of the measurement model employed in this study. Specifically, the CFA revealed that the model exhibited a Standardized Root Mean Square Error (SRMR) value of 0.115, which indicates an acceptable level of goodness of fit when evaluated against the benchmark established by Hair et al. (2009). Although the SRMR value does not fall below the ideal threshold of 0.08 for strong model fit, it remains below the acceptable upper limit of 0.50, signifying a reasonable approximation of the observed data to the hypothesized model. This level of fit demonstrates the adequacy of the model structure for subsequent structural equation modeling analyses.

Furthermore, the CFA results, as presented in Table 3.2, showed that all the latent variables in this study met or exceeded the recommended thresholds for key reliability and validity metrics. These latent variables include Infrastructure Governance Mechanism, Charging Infrastructure, Electric Vehicle Performance, Technical Knowledge, Vehicle Cost, Charging Facility Cost, Economic Benefit, and Electric Vehicle Adoption. Each of these constructs exhibited Composite Reliability (CR) values ranging from 0.889 to 0.951, Cronbach's Alpha values between 0.886 and 0.950, and Average Variance Extracted (AVE) values spanning from 0.524 to 0.665.

The CR values, all exceeding the recommended minimum of 0.7, indicate a high level of internal consistency among the items measuring each construct. Similarly, the Cronbach's Alpha values, which also surpass the 0.7 threshold, further confirm the reliability of the constructs, ensuring that the items reliably measure their respective latent variables. The AVE values, which range from 0.524 to 0.665 and all exceed the minimum threshold of 0.5, validate the adequacy of the model in terms of convergent validity. This suggests that the items collectively explain a significant proportion of the variance in their respective constructs, thereby substantiating the theoretical foundations of the model.

Overall, these findings affirm that the measurement model is both reliable and valid, as it meets established benchmarks for internal consistency, reliability, and validity. This high level of alignment with recommended statistical standards underscores the robustness of the model in capturing the underlying dimensions of the constructs. Consequently, the CFA results provide a solid foundation for the subsequent evaluation of the structural relationships among the latent variables in the study,

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ensuring that the findings derived from the analysis are both credible and theoretically meaningful (Hair et al., 2014).

Table 3.4
Confirmatory Factor Analysis Results

Constructs	Items	Loadings	Cronbach's Alpha	Composite Reliability	AVE
Infrastructure Governance Mechanism	IGM1	0.808	0.897	0.895	0.554
	IGM2	0.806			
	IGM3	0.926			
	IGM4	0.588			
	IGM5	0.701			
	IGM6	0.601			
	IGM10	0.723			
Charging Infrastructure	CHI1	0.650	0.908	0.907	0.524
	CHI2	0.749			
	CHI3	0.666			
	CHI4	0.700			
	CHI5	0.679			
	CHI6	0.746			
	CHI7	0.952			
	CHI8	0.538			
	CHI9	0.766			
Electric Vehicle Performance	EVP2	0.539	0.951	0.950	0.665
	EVP3	0.766			
	EVP5	0.716			
	EVP6	0.591			
	EVP7	0.877			
	EVP9	1.093			
	EVP10	1.013			
	EVP11	0.877			
	EVP12	0.721			
	EVP13	0.796			
Technical Knowledge	TKN1	1.180	0.908	0.886	0.630
	TKN2	0.559			
	TKN3	0.545			
	TKN5	0.687			
	TKN6	0.821			
Vehicle Cost	VC1	1.040	0.930	0.923	0.640
	VC2	0.872			
	VC3	0.715			
	VC4	0.745			
	VC5	0.823			
	VC6	0.803			
	VC7	0.502			
Charging Facility Cost	CFC1	0.564	0.889	0.893	0.633
	CFC2	0.877			
	CFC3	0.896			
	CFC4	0.705			
	CFC5	0.881			
Economic Benefit	ECB1	0.683	0.935	0.938	0.606
	ECB2	0.548			
	ECB4	0.764			
	ECB5	0.822			
	ECB6	0.831			
	ECB7	0.874			
	ECB8	0.819			
	ECB9	0.744			
	ECB10	0.885			
	ECB11	0.755			
Electric Vehicle Adoption	EVA1	0.758	0.918	0.920	0.540
	EVA2	0.561			
	EVA3	0.568			
	EVA4	0.773			
	EVA5	0.783			
	EVA6	0.725			
	EVA7	0.829			

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EVA8	0.760
EVA9	0.707
EVA10	0.828

The validity of the research measures was further assessed using the correlation matrix presented in Table 3.3, following the guidelines proposed by Hair et al. (2014). This approach provides a comprehensive understanding of the relationships between the latent variables and ensures that multicollinearity, an issue that could compromise the integrity of the model, is not present. The results of the correlation matrix evaluation revealed that all the exogenous variables, including Infrastructure Governance Mechanism, Charging Infrastructure, Electric Vehicle Performance, Technical Knowledge, Vehicle Cost, Charging Facility Cost, and Economic Benefit, exhibited significant correlations. Importantly, these correlations were consistently below the threshold of 0.8, which is widely recognized as the critical limit for potential multicollinearity issues in structural equation modeling. The absence of extreme correlations among the constructs suggests that each variable retains sufficient discriminant validity and does not excessively overlap with others.

By ensuring that none of the inter-variable correlations exceeded 0.8, the findings confirm that the exogenous variables are distinct and independently contribute to the research model. This is a critical requirement in social science research, as excessively high correlations (e.g., above 0.85 or 0.90) would indicate redundancy among constructs, undermining their ability to provide unique explanatory value. Additionally, the absence of extreme correlations enhances the overall interpretability of the results, as it allows the study to confidently attribute variations in the dependent variable to distinct contributions from each exogenous variable. This finding reinforces the robustness of the model and aligns with best practices in latent variable

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analysis, ensuring that the constructs maintain their conceptual and statistical distinctiveness. Overall, the correlation matrix serves as strong evidence of the model's validity and underscores the methodological rigor applied in this research.

Table 3.5
Latent Variable Correlation

	Charging Facility Cost	**Charging Infrastructure**	**EV Adoption**	**EV Performance**	**Economic Benefit**	**IG Mechanism**	**Technical Knowledge**	**Vehicle Cost**
Charging Facility Cost	1.000							
Charging Infrastructure	0.491	1.000						
EV Adoption	0.745	0.693	1.000					
EV Performance	0.554	0.494	0.486	1.000				
Economic Benefit	0.724	0.702	1.058	0.460	1.000			
IG Mechanism	-0.270	0.334	0.200	-0.037	0.254	1.000		
Technical Knowledge	0.538	0.319	0.372	0.386	0.327	-0.028	1.000	
Vehicle Cost	0.627	0.729	0.802	0.652	0.761	0.191	0.325	1.000

The assessment of discriminant validity among the latent constructs was conducted following the well-established criterion proposed by Fornell and Larcker (1981). This method utilizes the square root of the Average Variance Extracted (AVE) as the benchmark for evaluating whether each construct is sufficiently distinct from other constructs in the research model. The discriminant validity analysis, as summarized in Table 3.4, provides critical evidence to support the validity of the constructs and their measurements. According to the results, the square root of the AVE for each latent

variable, namely, Infrastructure Governance Mechanism, Charging Infrastructure, Electric Vehicle Performance, Technical Knowledge, Vehicle Cost, Charging Facility Cost, Economic Benefit, and Electric Vehicle Adoption—exceeded the corresponding inter-construct correlations in both the rows and columns. This indicates that the latent variables are more strongly correlated with their own indicators than with the indicators of any other construct in the model. Such results confirm that each construct shares more variance with its assigned measurement items than with any other variable, satisfying the Fornell-Larcker criterion and confirming the adequacy of discriminant validity.

The absence of cross-loadings or significant overlap between constructs further strengthens this conclusion. By loading strongly and appropriately in their respective rows and columns, the latent variables demonstrated their conceptual distinctiveness, ensuring that the constructs in the model are independent and do not suffer from multicollinearity. This independence is crucial for structural equation modeling, as it allows for the accurate estimation of relationships among constructs without interference from overlapping variances. Moreover, the demonstrated discriminant validity not only enhances the theoretical robustness of the measurement model but also assures the reliability of subsequent structural model evaluations. These results indicate that the constructs employed in this study are well-defined and uniquely measure their intended dimensions, providing a solid foundation for the exploration of the hypothesized relationships. Overall, the findings from Table 3.4 provide strong empirical evidence that discriminant validity is not a concern in this research, highlighting the rigor and validity of the measurement model.

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Table 3.6
Discriminant Validity

	Charging Facility Cost	Charging Infrastructure	EV Adoption	EV Performance	Economic Benefit	IG Mechanism	Technical Knowledge	Vehicle Cost
Charging Facility Cost	**0.795**							
Charging Infrastructure	0.491	**0.729**						
EV Adoption	0.745	0.693	**0.802**					
EV Performance	0.554	0.494	0.486	**0.815**				
Economic Benefit	0.724	0.702	1.058	0.460	**0.778**			
IG Mechanism	-0.270	0.334	0.200	-0.037	0.254	**0.745**		
Technical Knowledge	0.538	0.319	0.372	0.386	0.327	-0.028	**0.794**	
Vehicle Cost	0.627	0.724	0.735	0.652	0.761	0.191	0.325	**0.800**

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3.13 Summary of the Chapter

Chapter three provides a detailed account of the methodology adopted in this study, encompassing multiple critical components to ensure a systematic and rigorous approach to the research process. The discussion begins with an explanation of the research design, which serves as the overarching framework guiding the study's structure and execution. This is followed by a description of the target population, offering insights into the demographic or organizational groups under investigation, and the criteria used to define their inclusion. The section also elaborates on the determination of the sample size and the sampling approach employed, highlighting the strategies used to ensure representativeness and minimize bias.

Furthermore, operational definitions and the measurements of key variables are clearly articulated, providing a basis for how constructs were conceptualized and quantified in alignment with the study's objectives.

In addition, the data collection methods and procedures are comprehensively outlined, detailing the tools, techniques, and steps taken to gather accurate and relevant data from respondents. The data analysis methods are also explained, specifying the statistical techniques and software utilized to interpret the data and address the research questions. To ensure the credibility of the findings, the section describes the process for evaluating the validity and reliability of the measurement instruments. This includes discussing the methods used to assess the consistency, accuracy, and robustness of the data collection tools. Furthermore, the rationale for conducting a preliminary investigation is emphasized, outlining its importance in refining the methodology and ensuring the feasibility of the research design. Collectively, chapter three lays a strong methodological foundation, ensuring the study adheres to rigorous academic standards and produces reliable, valid, and meaningful result.

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CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

4.1 Introduction

Chapter Four analyzed the research data to address the study's objectives. Before the main analysis, a summary of the response rate was provided to clarify survey participation and data collection efficiency. Preliminary data analysis procedures were conducted to ensure data quality, including handling missing values and outliers. Key statistical considerations, such as descriptive statistics, common method bias, and non-response bias, were examined to validate measurement instruments and confirm data representativeness. The chapter also reviewed the assumptions of multiple regression analysis, including linearity, normality, homoscedasticity, and multicollinearity. Additionally, the measurement and structural models were assessed for reliability, validity, and predictive relevance, testing hypothesized relationships and the model's ability to predict outcomes. These steps ensured the rigor and credibility of the findings.

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4.2 Response Rate

In this study, 459 questionnaires were distributed to employees who occupy different managerial positions and have also been participating in the decision-making process in urban public transportation government agencies in Hunan, China. Accordingly, Table 4.1 shows that this study achieved a 40% response rate as 183 questionnaires were successfully returned. Whereas, 276 respondents did not return the questionnaires, accounting for 60% unreturned questionnaires. Yet, 17 questionnaires translated to 3% of the total questionnaires were invalid and therefore, excluded from the statistical analysis.

Table 4.1
Response Rate

Questionnaire	Frequency	Percentage
Distributed	459	100%
Returned	183	40%
Unreturned	276	60%
Excluded	17	3.7%
Valid	166	36%

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4.3 Data Cleaning

Pallant (2020) emphasizes that data cleaning is a critical step in ensuring the accuracy and reliability of statistical outcomes. In line with this assertion, meticulous data cleaning procedures were conducted in this study to maintain the quality of the dataset and confirm its suitability for multivariate analysis. Specifically, missing values were thoroughly assessed and appropriately replaced to prevent biases or distortions in the results. This step ensured the completeness and consistency of the dataset, enhancing its integrity. Additionally, outliers, which could potentially skew the statistical analysis

and compromise the validity of the findings, were carefully identified and subsequently removed from the dataset. By addressing these issues, the data was refined to meet the rigorous standards required for multivariate analytical techniques. This process not only upheld the robustness of the analysis but also contributed to the overall reliability and credibility of the research findings.

4.3.1 Missing Values

Missing values are defined as the absence of numbers, values, or scores within a dataset, often resulting from errors made by researchers during data entry or by respondents when completing the questionnaire (Hair et al., 2019). To address this issue, missing values were evaluated using descriptive statistics, specifically the frequency function in SPSS. The analysis revealed a small number of missing values, which were subsequently replaced using the series mean method, following the recommendations of Pallant (2020).

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4.3.2 Outliers

An outlier is defined as an atypical or extreme data point within a dataset that can potentially distort the analysis by concealing true causal effects or leading to the underestimation or overestimation of the causal relationships between variables (Tabachnick & Fidell, 2019). To address this issue, outliers in the dataset were identified and assessed through descriptive statistical analysis using the descriptive function in the Statistical Package for the Social Sciences (SPSS). Based on the results of this analysis, a total of 17 questionnaires were identified as outliers. Specifically, the following data points, 7, 18, 19, 21, 24, 31, 65, 117, 118, 135, 148, 152, 160, 170, 173, 181, and 183, were detected as extreme values. Consequently, these identified

outliers were systematically removed from the dataset to ensure the accuracy and reliability of the subsequent statistical analysis.

4.4 Descriptive Statistics

Descriptive statistics involve a thorough examination of the respondents' profiles through various analytical measures, such as frequency and percentage distributions (Sekaran & Bougie, 2016). These methods help to gain a clear understanding of the demographic and characteristic makeup of the participants (Hair et al., 2019). In addition to these measures, the analysis also includes the calculation of the mean and standard deviation for the variables under study. The mean provides insight into the average scores of the variables, offering a central tendency of the data, while the standard deviation reflects the extent of variability or dispersion within the dataset. This combined approach allows for a comprehensive understanding of both the individual characteristics of the respondents, based on their unique traits, and the overall patterns of the variables, highlighting the distribution and range of scores within the data (Sekaran & Bougie, 2016). By using these statistical techniques, the researcher can gain a deeper insight into the nature of the respondents and the variability of the key variables in the study (Sekaran & Bougie, 2016).

4.4.1 Profile of Respondents

Pertaining to personal profile of respondents, the descriptive statistics showed that the gender disposition is broken down into male and female, in which 117 out of 166 respondents are male; while, the number of female respondents is 49 out of 166 total respondents. Highlighting further that males were the majority who accounted for 70.5%; unlike, females' counterpart who accounted for 29.5% of the total respondents.

Still, the descriptive statistics showed that in terms of age group, respondents who are in age group 20-30 years old are 15, accounting for 9% of total respondents. On the contrary, respondents who are in the age group 31-40 years old are 47, which is second majority and accounted for 28.3% of total respondents. Yet, the outcome showed that majority of the respondents are in the age group of 41-50 years old (61 respondents), accounting for 36.7% of total respondents. However, respondents who are above 51 years old are 43, appearing as the third majority and accounting for 25.9% of total respondents.

Additionally, in terms of working experience, the outcome indicated that 8 respondents have working experience of 1-5 years, accounting for 4.8% of total respondents. Also, the outcome indicated that most of the respondents serve the transportation agencies for a period above 6 years. This is particularly demonstrated as 35 out of 166 respondents have working experience of 6-10 years; 39 out of 166 respondents have working experience of 11-15 years; 46 out of 166 respondents have working experience of 16-20 years; and 38 out of 166 respondents have working experience above 20 years. Thus, accounting for 21.1%, 23.5%, 27.7% and 22.9% of the total respondents. In the same vein, the descriptive statistics showed that majority of the people who responded to the questionnaires have postgraduate educational background, with 7 out of 166 respondents having Upper Secondary Education; 39 out of 166 respondents having undergraduate qualification; 50 out 166 respondents having associate degree; 39 out of 166 respondents having master's degree; and 31 out 166 respondents having doctoral degree. Thus, accounting for 4.2%, 23.5%, 30.1%, 23.5%, and 18.7% of the total respondents. Details are shown in table 4.2 below.

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Table 4.2
Personal Profile of Respondents

S/No.		Variables	Frequency	Percentage (%)
1.	Gender	Male	117	70.5
		Female	49	29.5
2.	Age	Between 20 -30 years old	15	9.0
		Between 31 -40 years old	47	28.3
		Between 41 -50 years old	61	36.7
		Above 51 years old	43	25.9
3.	Working Experience	1- 5 years	8	4.8
		6- 10 years	35	21.1
		11- 15 years	39	23.5
		16-20 years	46	27.7
		More than 20 years	38	22.9
4.	Educational Background	Upper Secondary Education	7	4.2
		Undergraduate	39	23.5
		Associate Degree	50	30.1
		Master's Degree	39	23.5
		Doctoral Degree	31	18.7

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Likewise, the descriptive statistics showed that the occupational profile of respondents is grouped based on the department, job title, and decision-making roles of respondents. In terms of departmental disposition, Urban Planning and Development Department has the highest number of people who responded to the questionnaire (31 respondents), followed by Transportation Bureau/Department that has 30 respondents; Economic Development Bureau/Department and Energy Bureau/Department that have 29 and 28 people who responded to the questionnaire. Accounting for 18.7%, 18.1%, 17.5% and 16.9% of respondents. However, the department that has the fifth largest respondents in the survey is Environmental Protection Bureau/Department (21 respondents). On the other hand, Science and Technology Bureau/Department has 19 respondents and Government Affairs Office has 8 respondents, accounting for 12.7%, 11.4% and 4.8% of total respondents, respectively.

Correspondingly, the descriptive statistics showed that majority of the respondents who participated in the survey are occupying managerial positions such as Managers, Analysts, Chief Officers, Coordinators, Analysts, Strategists and Specialists, with those occupying Directorship position participating less in the survey because of nature of their jobs. According to the outcome, 34 respondents are Electric Vehicle (EV) Infrastructure Project Managers; 30 respondents are Urban Mobility Coordinators; 24 respondents are Managers of Renewable Energy Projects; 21 respondents are Chief Environmental Policy Officers; 19 respondents are Economic Policy Analysts (EV Sector); 15 respondents are Innovation and Technology Specialists and 14 respondents are Urban Development Strategists. Thus, accounting for 20.5%, 18.1%, 14.5%, 12.7%, 11.4%, 9% and 8.4% of total respondents. However, 9 respondents who accounted for 5.4% of total respondents, are Directors of Transportation Planning.

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Moreover, the descriptive statistics showed that most of the respondents who participated in the survey make critical decisions in the areas of Technology Development, Regulatory Oversight, Policy Formulation and Collaboration, and Stakeholder Engagement. Based on this outcome, 42 respondents play a key decisional role in technology development, 31 respondents play a key decisional role around regulatory oversight, 30 respondents play a key decisional role in policy formulation, and 25 respondents play a key decisional role in collaboration and stakeholder engagement. Accounting for 25.3%, 18.7%, 18.1% and 15.1% of the total respondents. On the other hand, respondents who play key decisional roles in areas of Public Awareness and Education, Financial Support, and Monitoring and Evaluation are 19,

10, and 9 respondents; accounting for 11.4%, 6%, and 5.4% of the total respondents. Details are shown in Table 4.3 on the next page.

Table 4.3
Occupational Profile of Respondents

S/No.		Variables	Frequency	Percentage (%)
1.	Department	Transportation Bureau/Department	30	18.1
		Energy Bureau/Department	28	16.9
		Environmental Protection Bureau/Department	21	12.7
		Economic Development Bureau/Department	29	17.5
		Urban Planning and Development Department	31	18.7
		Science and Technology Bureau/Department	19	11.4
		Government Affairs Office	8	4.8
2.	Job Title	Director of Transportation Planning	9	5.4
		Manager of Renewable Energy Projects	24	14.5
		Chief Environmental Policy Officer	21	12.7
		Urban Mobility Coordinator	30	18.1
		EV Infrastructure Project Manager	34	20.5
		Economic Policy Analyst (EV Sector)	19	11.4
		Urban Development Strategist	14	8.4
		Innovation and Technology Specialist	15	9.0
3.	Decision-Making Role	Policy formulation	30	18.1
		Regulatory oversight	31	18.7
		Financial Support	10	6.0
		Technology Development	42	25.3
		Public Awareness and Education	19	11.4
		Collaboration and Stakeholder Engagement	25	15.1
		Monitoring and Evaluation	9	5.4

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4.4.2 Mean and Standard Deviation

Mean is a common statistical method of determining average scores among research variables, measure of central tendency; on the other hand, standard deviation is a measure of dispersion that aims to showcase variability of scores among variables in a dataset (Sekaran & Bougie, 2019; Groves et al., 2011). The mean represents the measure of central tendency, indicating the average response score for each variable and reflecting the overall perception of respondents toward electric vehicle adoption. In contrast, the standard deviation measures the degree of dispersion, showing how much individual responses vary around the mean (Sekaran & Bougie, 2019; Groves et al., 2011). A smaller standard deviation indicates greater consensus among respondents, while a larger value reflects wider variation in perceptions.

Accordingly, the mean and standard deviation of variables were assessed and from the outcome, the research variables have average scores and standard deviation that ranges from 3.3312 to 4.4422 and 0.45915 to 1.36377. In Table 4.4, the means of the research variables range from 3.3312 to 4.4422, suggesting that respondents generally reported high levels of agreement across most factors. The standard deviations range from 0.45915 to 1.36377, showing that while there is strong consensus for certain variables (e.g., charging facility cost and economic benefit), perceptions diverge more widely for others, particularly EV performance. Overall, the results demonstrate that respondents in the public sector of China hold strong positive perceptions toward EV adoption and its associated factors, including charging infrastructure, vehicle cost, technical knowledge, economic benefits, and governance mechanisms. These findings highlight that the adoption of EVs is widely supported, though perceptions of vehicle performance remain comparatively more varied.

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Table 4.4
Mean and Standard Deviation

Variables	Mean	Standard Deviation
EV Adoption	4.3283	.62570
IG Mechanism	4.2719	.83614
Charging Infrastructure	4.1933	.79884
EV Performance	3.3312	1.36377
Technical Knowledge	4.3867	.73431
Vehicle Cost	4.2823	.82583
Charging Facility Cost	4.4422	.45915
Economic Benefit	4.3759	.50156

4.5 Common Method Variance

Common method variance (CMV) refers to a type of measurement-induced bias that arises from errors in the research instrument or the use of repetitive items when measuring variables (Podsakoff et al., 2024). This bias can lead to inaccurate research findings by either inflating or deflating the observed causal relationships between variables due to artificial or spurious correlations (Bagozzi & Yi, 1991). To evaluate the presence of common method bias in this study, Harman's single-factor test was conducted. The results of this analysis, as presented in Table 4.5, indicate that the average variance extracted is 37.288%, which is notably below the recommended threshold of 50%. This outcome suggests that common method bias is not a significant concern in this study, and the measurement model maintains acceptable validity and reliability.

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Table 4.5
Harman's Single Factor Test

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	23.893	37.925	37.925	23.491	37.288	37.288
2	8.675	13.770	51.695			
3	3.212	5.099	56.794			
4	2.825	4.484	61.278			
5	2.431	3.859	65.137			
6	1.925	3.056	68.193			
7	1.548	2.457	70.650			
8	1.409	2.236	72.886			
9	1.317	2.090	74.976			
10	1.193	1.894	76.870			
11	1.111	1.764	78.634			
12	1.056	1.676	80.310			
13	.936	1.485	81.796			
14	.851	1.351	83.147			
15	.758	1.203	84.350			
16	.727	1.153	85.503			
17	.689	1.094	86.597			
18	.638	1.012	87.609			
19	.581	.922	88.532			
20	.544	.863	89.395			
21	.485	.771	90.165			
22	.466	.740	90.905			
23	.459	.728	91.633			
24	.437	.693	92.326			
25	.381	.605	92.931			
26	.353	.560	93.491			
27	.307	.487	93.979			
28	.283	.450	94.429			
29	.273	.434	94.862			
30	.264	.419	95.281			
31	.244	.388	95.669			
32	.243	.386	96.055			
33	.229	.364	96.419			
34	.199	.316	96.735			
35	.190	.301	97.037			
36	.166	.264	97.301			
37	.161	.256	97.557			

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38	.144	.228	97.785			
39	.130	.206	97.991			
40	.116	.184	98.175			
41	.112	.178	98.354			
42	.099	.157	98.511			
43	.096	.153	98.663			
44	.091	.144	98.807			
45	.083	.132	98.939			
46	.078	.124	99.063			
47	.073	.116	99.179			
48	.067	.107	99.286			
49	.058	.092	99.379			
50	.056	.089	99.468			
51	.045	.071	99.539			
52	.044	.069	99.608			
53	.042	.067	99.674			
54	.034	.054	99.729			
55	.028	.045	99.774			
56	.027	.043	99.816			
57	.025	.040	99.856			
58	.023	.036	99.892			
59	.019	.030	99.922			
60	.016	.025	99.947			
61	.014	.022	99.969			
62	.011	.018	99.987			
63	.008	.013	100.000			

Extraction Method: Principal Axis Factoring.

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4.6 Non-Response Bias

Non-response bias is a type of bias that occurs when there is an error in sample estimation or a failure to adequately represent the target population due to incomplete responses or lack of participation (Groves, Fowler, Couper, Lepkowski, Singer, & Tourangeau, 2011). This form of bias can significantly impact the accuracy and generalizability of research findings. To address and mitigate this potential bias, the procedure outlined by Lindner, Murphy, & Briers (2001) was adopted. This approach involves comparing the means of early and late respondents to assess whether any significant differences exist between the two groups. Specifically, the paired t-test

statistical technique was employed to test for such differences, ensuring that the responses from the two groups were comparable. In alignment with this methodology, the responses of 166 respondents were divided by two (2) and grouped into early response (83) and late response (83). This division allowed for a more rigorous comparison and provided insight into whether the timing of responses had any substantial influence on the results.

Table 4.6
Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Early Response	273.5351	83	25.44133	2.79255
	Late Response	250.6556	83	43.92438	4.82133

The findings in Table 4.6 and Table 4.7 showed that there is no significant difference between early and late respondents, particularly as the value of mean and standard deviation ranges from 273.5351 to 250.6556 and 25.44133 to 43.92438, respectively.

Table 4.7
Paired Sample Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Early Response – Late Response	22.87952	54.52494	5.98489	10.97367	34.78537	3.823	82	.000

4.7 Assumptions of Multiple Regression

In empirical research aiming to establish causal relationships between variables, it is crucial that the data meet certain foundational assumptions to ensure the validity of the analysis. According to Pallant (2020), these assumptions include normality, multicollinearity, linearity, and heteroscedasticity. These are fundamental conditions that, if not satisfied, can lead to inaccurate conclusions and unreliable results. To address this issue, this study followed the procedures outlined by Tabachnick and Fidell (2019), which provide a structured approach for testing and ensuring that the data meets the essential assumptions required for conducting multiple regression analysis. By adhering to these recommended procedures, the study aimed to confirm that the data was appropriate for multiple regression analysis, thereby increasing the reliability and robustness of the findings.

4.7.1 Normality

The purpose of the normality test is to determine whether the dataset approximates a normal distribution, which is an underlying assumption for many parametric statistical techniques such as regression and structural equation modeling. Normality ensures that the data are symmetrically distributed around the mean and follow a bell-shaped curve, thereby enhancing the reliability and validity of statistical inferences (Tabachnick & Fidell, 2019). In this study, normality was examined using skewness and kurtosis statistics, as these measures capture the symmetry and peakedness of the distribution. Following Kline's (2023) recommended thresholds, skewness values less than 3 and kurtosis values not exceeding 10, the results in Table 4.8 confirm that all variables fall within acceptable limits, with skewness ranging from -0.226 to -2.288 and kurtosis ranging from -0.235 to 5.264. These outcomes indicate that the data do not deviate

significantly from normality. Consequently, the assumption of normality is satisfied, which validates the appropriateness of applying parametric methods in subsequent analyses and strengthens confidence in the robustness of the study's results.

It is also important to note that slight departures from normality are generally not problematic in large samples, as parametric techniques such as regression and SEM are considered robust to modest deviations (Hair et al., 2022). Given the adequate sample size in this study, the minor variations in skewness and kurtosis observed across some variables are unlikely to bias the statistical estimates, further reinforcing the validity of the analyses conducted.

Table 4.8
Skewness and Kurtosis

Variables	**Skewness**		**Kurtosis**	
	Statistic	Std. Error	Statistic	Std. Error
EV Adoption	-1.409	.188	1.614	.375
IG Mechanism	-1.780	.188	2.308	.375
Charging Infrastructure	-1.432	.188	1.450	.375
EV Performance	-.226	.188	-1.715	.375
Technical Knowledge	-2.288	.188	5.264	.375
Vehicle Cost	-1.802	.188	2.537	.375
Charging Facility Cost	-1.214	.188	1.449	.375
Economic Benefit	-.744	.188	-.235	.375

Similarly, the normality test was assessed graphically as the essence is to generate evidence and show that the data is evenly distributed. Thus, Figure 4.1 below shows that the bars in the histogram are tightly connected. Suggesting that the normality assumption is satisfied.

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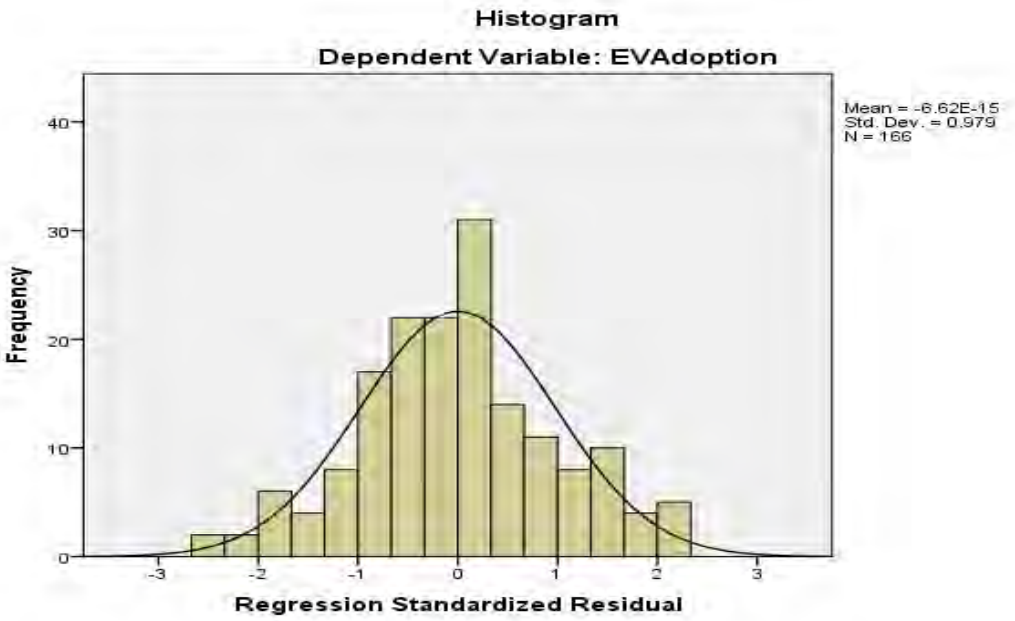

Figure 4.1 Normality

4.7.2 Multicollinearity

This assumption suggests that two (2) or more independent variables should not have a collinear, perfect, or extreme correlation, because it can impair the outcome of regression analysis and mislead the result (Pallant, 2020). Hence, the multicollinearity problem is assessed using tolerance and variance inflation factor (VIF). According to the outcome in Table 4.9 (next page), there is no multicollinearity problem among variables as the value of tolerance is less than 1 and VIF is less than 10.

Table 4.9
Tolerance and VIF

Variables	Tolerance	VIF
IG Mechanism	.131	7.638
Charging Infrastructure	.360	2.779
EV Performance	.703	1.422
Technical Knowledge	.698	1.433
Vehicle Cost	.105	9.559
Charging Facility Cost	.343	2.918
Economic Benefit	.278	3.603

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4.7.3 Linearity

The linearity assumption suggests that the relationship between the variables in the research data should be linear (Hair et al., 2019). To assess this assumption, a normal probability plot was utilized, where the points should ideally align closely along a straight line, indicating a linear relationship (Tabachnick & Fidell, 2019). In this study, Figure 4.2 demonstrates that the expected cumulative probability and the observed cumulative probability are closely aligned, with both following a near-linear pattern. This visual alignment provides strong evidence that the linearity assumption is met, confirming that the relationship between the variables can be appropriately modeled as linear (Tabachnick & Fidell, 2019).

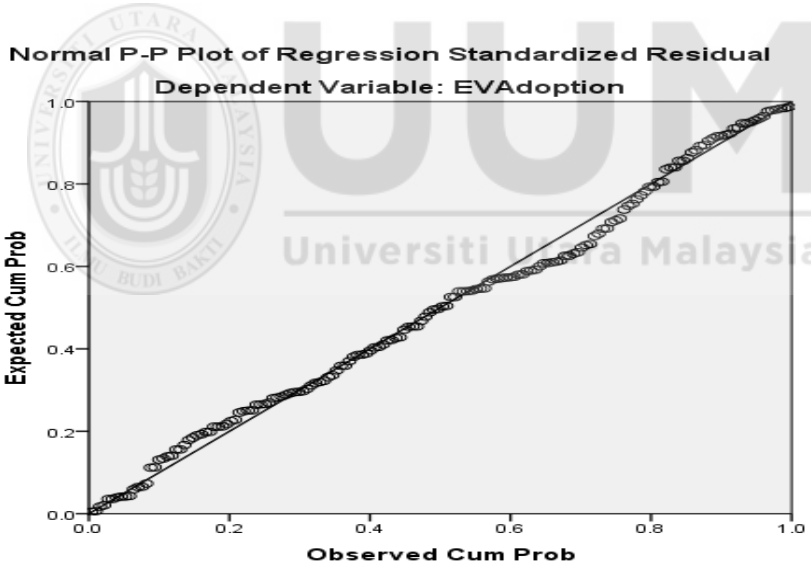

Figure 4.2 Linearity

4.7.4 Heteroscedasticity

The assumption of homoscedasticity implies that the variability of the residuals, or the prediction errors, should be consistent across all levels of the independent variable (Hair et al., 2019). In other words, the residuals should exhibit no patterns and should be evenly spread around the zero axis, indicating that the variance is constant. To

assess this assumption, a scatter plot was utilized, where the regression standardized residuals are plotted against the standardized predicted values (Hair et al., 2019). For homoscedasticity to hold, the residuals should be randomly scattered around the zero axis, without any discernible trends or clustering.

As depicted in Figure 4.3, the scatter plot shows that the research data is evenly distributed along the zero axis, with no significant patterns or deviations. This visual inspection of the plot indicates that the variability of the residuals remains constant across all levels of the predicted values, thereby satisfying the assumption of homoscedasticity (Tabachnick, & Fidell, 2019). The absence of any systematic patterns in the plot further confirms that the assumption holds, ensuring the appropriateness of the regression model for the analysis (Tabachnick & Fidell, 2019).

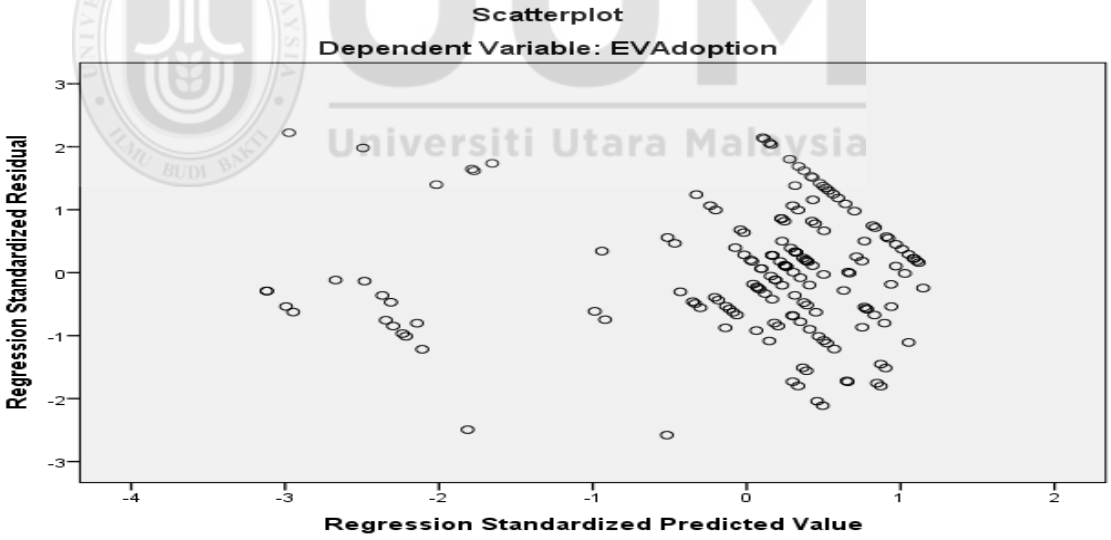

Figure 4.3 Heteroscedasticity

4.8 PLS-SEM Analysis

In this study, Partial Least Squares-Structural Equation Modeling (PLS-SEM) was employed to evaluate the measurement model, the structural model, and the predictive

relevance of the proposed framework. PLS-SEM is widely recognized as a contemporary and robust statistical technique that is particularly suited for analyzing complex models. It provides a comprehensive approach to determining the reliability and validity of measurement instruments while also enabling researchers to establish and quantify cause-and-effect relationships between exogenous and endogenous variables (Hair et al., 2014). This methodological approach was chosen due to its ability to handle complex relationships in the context of this study, where multiple constructs and indicators were assessed. Specifically, PLS-SEM was utilized to test the hypothesized effects of the exogenous variables on the endogenous variable, offering precise insights into the strength and significance of these relationships. Furthermore, the research framework, depicted in Figure 4.4, was conceptualized, and assessed as a reflective model. Reflective modeling was appropriate in this context because it assumes that the indicators are manifestations of their underlying constructs, ensuring a robust assessment of the relationships within the framework.

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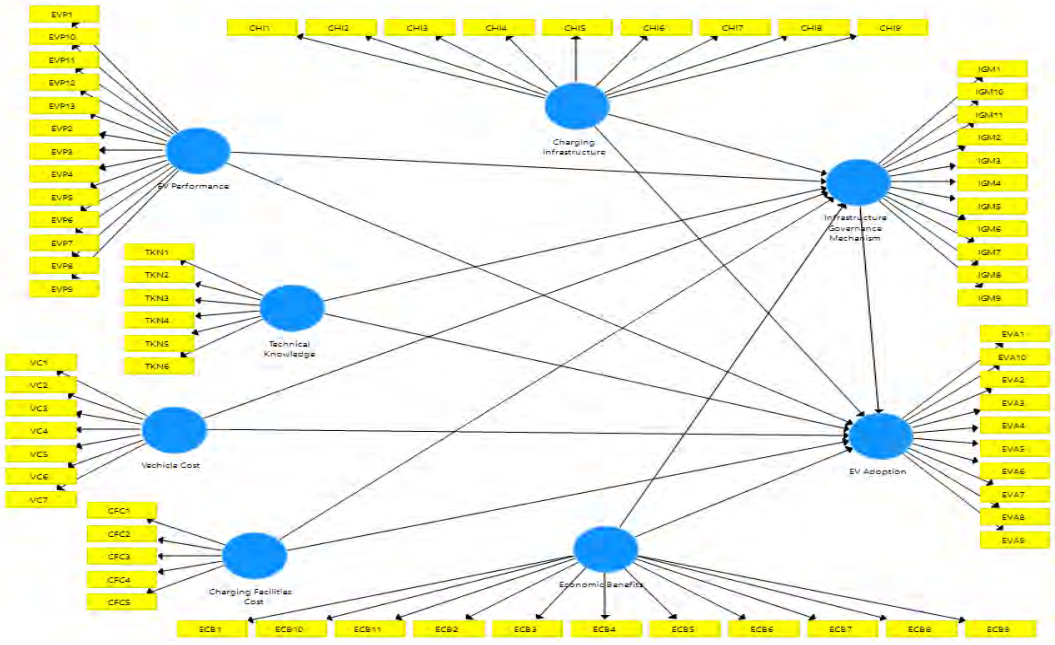

Figure 4.4 Reflective Research Model

4.8.1 Measurement Model Assessment

The essence of the measurement model is to ascertain the reliability and validity of research instruments (Hair et al., 2014). The reliability indicates the level of consistency among items that measure latent variables. In contrast, the validity indicates the ability of items to be unique in measuring research constructs, using convergent and discriminant validity. Figure 4.5 (next page) shows the assessment of the measurement model.

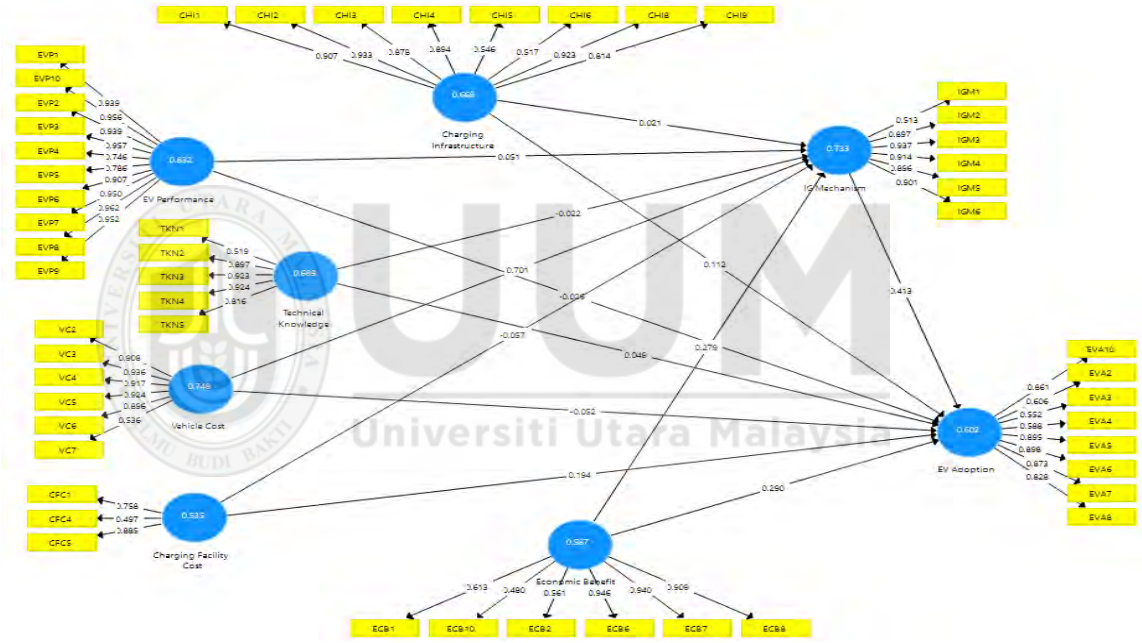

Figure 4.5 Measurement Model

4.8.1.1 Individual Item Reliability

In empirical study, outer loadings were used to determine individual item reliability. Hence, it is a good measure of reliability, particularly when the factor loadings/weights of items that measure the instrument exceeded the minimum threshold value of 0.4 (Hair et al., 2014). Notwithstanding, a deletion of item indicators that have insufficient loading was suggested by Hair et al. (2014), as a criterion of achieving average

variance extract (AVE) of 0.5 and above. Accordingly, table 4.10 showed that CFC2 and CFC3; CHI7; ECB3, ECB4, ECB5 and ECB9; EVA1 and EVA9; IGM7; and VC1; were deleted for latent variables such as charging facility cost; charging infrastructure; economic benefit; electric vehicle adoption; infrastructure governance mechanism; and vehicle cost to achieve AVE above 0.5.

4.8.1.2 Internal Consistency Reliability

Internal consistency refers to the extent to which item indicators consistently and accurately measures their associated latent variables, with minimal error, across repeated observations (Hair et al., 2014). It is a critical aspect of measurement reliability, ensuring that the items within a construct work cohesively to represent the underlying concept they are designed to measure. Kline (2023) highlights that Cronbach's alpha or composite reliability values exceeding 0.6 are generally considered adequate indicators of internal consistency. Such thresholds are widely accepted in empirical research, as they signify a reasonable level of coherence among the items comprising a construct. In this study, composite reliability was employed as the primary metric for assessing the internal consistency of the research instruments. Composite reliability is often preferred over Cronbach's alpha due to its ability to account for different indicator loadings, providing a more accurate measure of reliability in models with varying factor loadings.

The findings, as presented in Table 4.10, reveal that all latent variables included in the study demonstrated acceptable levels of internal consistency, with composite reliability values ranging from 0.767 to 0.980. These results confirm the reliability of the constructs and suggest that the item indicators are well-aligned with their respective latent variables, ensuring the robustness of the measurement model. This

alignment underscores the reliability of the research instruments and their suitability for use in subsequent structural model assessments.

4.8.1.3 Convergent Validity

Convergent validity refers to the extent to which a set of items measuring a particular construct are strongly correlated, indicating that they effectively represent the same underlying concept while remaining distinct from other constructs (Hair et al., 2014). This concept emphasizes that items designed to measure a specific latent variable should demonstrate a high degree of uniqueness in capturing that construct, differentiating it clearly from other variables in terms of their level of convergence. To evaluate convergent validity, the Average Variance Extracted (AVE) is a widely utilized metric. AVE reflects the amount of variance captured by a construct relative to the amount of variance due to measurement error. An AVE value of 0.5 or higher is generally regarded as the threshold for acceptable convergent validity, as it indicates that the construct explains at least 50% of the variance in its associated indicators.

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In this study, AVE was used to assess the convergent validity of the latent variables. The results, as summarized in Table 4.10, demonstrate that all the latent variables achieved acceptable levels of convergent validity, with AVE values ranging from 0.535 to 0.832. These findings confirm that the constructs in the measurement model sufficiently capture the variance of their indicators, ensuring that the latent variables are well-defined and distinct from other constructs in the model. This evidence supports the reliability and validity of the research instruments and their appropriateness for subsequent analyses.

Table 4.10
Outer Loadings/Construct Reliability and Validity

Variables	Items	Loadings	Composite Reliability	Cronbach's Alpha	AVE
Charging Facility Cost	CFC1	0.758	0.767	0.578	0.535
	CFC4	0.497			
	CFC5	0.885			
Charging Infrastructure	CHI1	0.907	0.939	0.925	0.668
	CHI2	0.933			
	CHI3	0.878			
	CHI4	0.894			
	CHI5	0.546			
	CHI6	0.517			
	CHI8	0.923			
	CHI9	0.814			
Economic Benefit	ECB1	0.613	0.889	0.850	0.587
	ECB10	0.480			
	ECB2	0.561			
	ECB6	0.946			
	ECB7	0.940			
	ECB8	0.909			
EV Adoption	EVA10	0.861	0.921	0.901	0.602
	EVA2	0.606			
	EVA3	0.552			
	EVA4	0.588			
	EVA5	0.895			
	EVA6	0.898			
	EVA7	0.873			
	EVA8	0.828			
EV Performance	EVP1	0.939	0.980	0.977	0.832
	EVP10	0.956			
	EVP2	0.939			
	EVP3	0.957			
	EVP4	0.746			
	EVP5	0.786			
	EVP6	0.907			
	EVP7	0.950			
	EVP8	0.962			
	EVP9	0.952			
IG Mechanism	IGM1	0.513	0.941	0.921	0.733
	IGM2	0.897			
	IGM3	0.937			

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	IGM4	0.914			
	IGM5	0.896			
	IGM6	0.901			
Technical Knowledge	TKN1	0.519	0.915	0.882	0.689
	TKN2	0.897			
	TKN3	0.923			
	TKN4	0.924			
	TKN5	0.816			
Vehicle Cost	VC2	0.908	0.945	0.927	0.748
	VC3	0.936			
	VC4	0.917			
	VC5	0.924			
	VC6	0.896			
	VC7	0.536			

4.8.1.4 Discriminant Validity

Discriminant validity refers to the extent to which a construct is distinct and uncorrelated with other constructs, ensuring that the items measuring one variable do not overlap significantly with items measuring different variables (Hair et al., 2014). This concept emphasizes the ability of measurement items to uniquely represent their intended construct, both at the individual item level and the overall construct level. To assess discriminant validity, two commonly used approaches are the square root of the Average Variance Extracted (AVE) and the cross-loading criterion. According to these methods, items should load more strongly on their respective constructs than on any other constructs. Specifically, the square root of the AVE for each construct should exceed the correlations with other constructs, and items should demonstrate higher loadings on their designated construct in both rows and columns.

In this study, the Fornell-Larcker Criterion was applied to evaluate discriminant validity. The results, as presented in Table 4.11 (on the next page), indicate that all latent variables demonstrated strong loadings on their respective constructs, both in

rows and columns. This finding suggests that the constructs are sufficiently distinct from one another, satisfying the requirements for discriminant validity. Consequently, the measurement model confirms an adequate level of discriminant validity, reinforcing the robustness and appropriateness of the research instruments for the study.

Table 4.11
Fornell-Larcker Criterion

	Charging Facility Cost	**Charging Infrastructure**	**EV Adoption**	**EV Performance**	**Economic Benefit**	**IG Mechanism**	**Technical Knowledge**	**Vehicle Cost**
Charging Facility Cost	**0.838**							
Charging Infrastructure	0.737	**0.817**						
EV Adoption	0. 776	0.769	**0. 822**					
EV Performance	0.250	0.394	0.245	**0.912**				
Economic Benefit	0. 731	0.766	0. 766	0.186	**0. 873**			
IG Mechanism	0.796	0.781	0.856	0.306	0.872	**0.876**		
Technical Knowledge	0.507	0.463	0.516	0.274	0.526	0.479	**0.830**	
Vehicle Cost	0.860	0.825	0.866	0.306	0.895	0.923	0.513	0.865

Additionally, using the cross-loading criterion all items must load highly in their own constructs both in rows and columns. Therefore, Table 4.12 shows that all the items that measure the latent variables have loaded strongly in their own constructs both in rows and columns. Suggesting that the latent variables have adequate level of discriminant validity.

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Table 4.12
Cross-Loading

	Charging Facility Cost	Charging Infrastructure	Economic Benefit	EV Adoption	EV Performance	IG Mechanism	Technical Knowledge	Vehicle Cost
CFC1	**0.758**	0.369	0.560	0.522	0.043	0.455	0.358	0.543
CFC4	**0.497**	0.233	0.240	0.346	-0.049	0.292	0.148	0.285
CFC5	**0.885**	0.817	0.855	0.812	0.375	0.833	0.504	0.880
CHI1	0.652	**0.907**	0.727	0.713	0.326	0.745	0.450	0.784
CHI2	0.688	**0.933**	0.715	0.721	0.437	0.745	0.467	0.774
CHI3	0.648	**0.878**	0.648	0.671	0.273	0.629	0.391	0.722
CHI4	0.630	**0.894**	0.677	0.671	0.287	0.687	0.361	0.718
CHI5	0.253	**0.546**	0.276	0.257	0.169	0.255	0.217	0.308
CHI6	0.350	**0.517**	0.337	0.314	0.131	0.245	0.241	0.293
CHI8	0.674	**0.923**	0.715	0.719	0.468	0.733	0.444	0.772
CHI9	0.711	**0.814**	0.684	0.708	0.350	0.750	0.371	0.743
ECB1	0.532	0.373	**0.613**	0.435	0.127	0.480	0.358	0.480
ECB10	0.283	0.133	**0.480**	0.353	-0.131	0.280	0.246	0.274
ECB2	0.505	0.347	**0.561**	0.387	0.005	0.326	0.251	0.438
ECB6	0.796	0.779	**0.946**	0.843	0.265	0.867	0.520	0.895
ECB7	0.823	0.771	**0.940**	0.847	0.179	0.857	0.468	0.873
ECB8	0.743	0.762	**0.909**	0.871	0.191	0.861	0.483	0.855
EVA10	0.733	0.728	0.803	**0.861**	0.229	0.798	0.429	0.810
EVA2	0.479	0.350	0.475	**0.606**	0.089	0.458	0.165	0.471
EVA3	0.407	0.213	0.421	**0.552**	-0.088	0.393	0.222	0.400
EVA4	0.467	0.354	0.492	**0.588**	0.049	0.461	0.274	0.408
EVA5	0.791	0.741	0.817	**0.895**	0.270	0.823	0.428	0.840
EVA6	0.741	0.790	0.781	**0.898**	0.321	0.816	0.529	0.805
EVA7	0.727	0.717	0.767	**0.873**	0.249	0.797	0.563	0.789
EVA8	0.627	0.599	0.710	**0.828**	0.198	0.695	0.434	0.646
EVP1	0.249	0.396	0.190	0.232	**0.939**	0.303	0.255	0.304
EVP10	0.235	0.405	0.199	0.249	**0.956**	0.310	0.238	0.300
EVP2	0.181	0.351	0.121	0.193	**0.939**	0.258	0.245	0.235
EVP3	0.224	0.360	0.152	0.204	**0.957**	0.263	0.249	0.276
EVP4	0.166	0.304	0.128	0.132	**0.746**	0.198	0.180	0.206
EVP5	0.194	0.270	0.125	0.185	**0.786**	0.219	0.207	0.228
EVP6	0.256	0.327	0.180	0.281	**0.907**	0.299	0.297	0.301
EVP7	0.241	0.386	0.195	0.197	**0.950**	0.283	0.246	0.295
EVP8	0.287	0.408	0.197	0.282	**0.962**	0.328	0.293	0.330
EVP9	0.211	0.365	0.181	0.225	**0.952**	0.286	0.262	0.282
IGM1	0.326	0.171	0.395	0.396	-0.111	**0.513**	0.165	0.334
IGM2	0.728	0.729	0.810	0.817	0.232	**0.897**	0.435	0.854
IGM3	0.764	0.763	0.840	0.822	0.384	**0.937**	0.463	0.849
IGM4	0.683	0.744	0.782	0.780	0.364	**0.914**	0.439	0.851
IGM5	0.739	0.697	0.793	0.805	0.263	**0.896**	0.501	0.850
IGM6	0.741	0.717	0.762	0.780	0.264	**0.901**	0.373	0.854
TKN1	0.218	0.172	0.187	0.141	0.054	0.130	**0.519**	0.148

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TKN2	0.438	0.426	0.468	0.444	0.285	0.425	**0.897**	0.467
TKN3	0.476	0.427	0.503	0.500	0.234	0.458	**0.923**	0.497
TKN4	0.497	0.481	0.528	0.510	0.253	0.465	**0.924**	0.500
TKN5	0.403	0.326	0.390	0.415	0.234	0.389	**0.816**	0.391
VC2	0.740	0.762	0.808	0.825	0.303	0.864	0.476	**0.908**
VC3	0.822	0.798	0.883	0.834	0.283	0.899	0.503	**0.936**
VC4	0.771	0.786	0.820	0.769	0.373	0.868	0.503	**0.917**
VC5	0.815	0.722	0.800	0.773	0.256	0.841	0.470	**0.924**
VC6	0.793	0.775	0.809	0.766	0.264	0.810	0.364	**0.896**
VC7	0.459	0.315	0.440	0.459	0.014	0.382	0.328	**0.536**

4.8.2 Structural Model

Structural equation modelling using Smart PLS entails assessment of causality between exogenous variables and endogenous variable. Accordingly, Hair et al. (2014) asserted that structural equation modelling enables researchers to establish causal effect between variables, and as well, determine the extent an intervening variable enhance the casual effect between predicting and criterion variables. Hence, this assessment is established based on R-square, effect size, t-value, p-value, and predictive relevance. Details of the assessment are shown in Figure 4.6 on the next page.

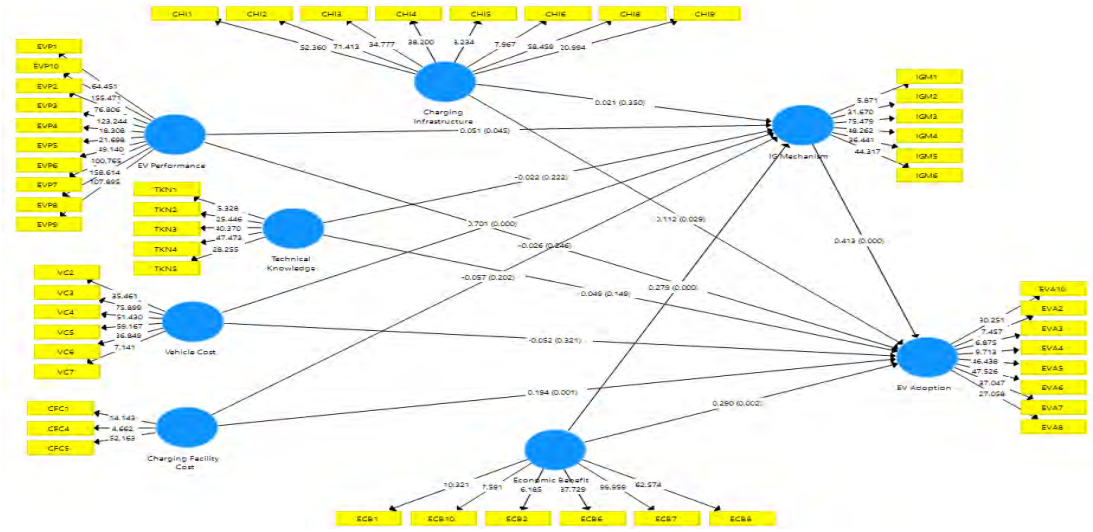

Figure 4.6 Structural Model

4.8.2.1 Testing of Direct Influence

In establishing causal effect between the exogenous and endogenous variables – namely: charging infrastructure, electric vehicle performance, technical knowledge, vehicle cost, charging facility cost, economic benefit, infrastructure governance mechanism, and electric vehicle adoption among public transportation agencies in China; standardized coefficient, t-values and p-values were used as a benchmark. Based on this criterion, a value of -1 implies a negative effect, on the other hand, a value of +1 symbolizes a positive effect. Accordingly, a t-value above 1.342 demonstrated a significant effect between variables. Additionally, the p-value symbolizes whether the effect is significant at 0.01, 0.05, and 0.1 significance levels, or otherwise.

Therefore, the findings in Table 4.13 show the direct effect of charging infrastructure, electric vehicle performance, technical knowledge, vehicle cost, charging facility cost, economic benefit, and infrastructure governance mechanism on electric vehicle adoption among public transportation agencies in China. According to the finding's, firstly, charging infrastructure has a direct positive and significant effect on electric vehicle adoption in China ($\beta = 0.112$; t-value = 1.895; p-value = 0.02). Secondly, economic benefit has a direct significant positive effect on electric vehicle adoption in China ($\beta = 0.290$; t-value = 2.862; $p< 0.002$). Thirdly, charging facility cost also has a direct significant positive effect on electric vehicle adoption in China ($\beta = 0.194$; t-value = 3.241; $p< 0.001$). However, electric vehicle performance has no direct significant effect on electric vehicle adoption in China ($\beta = -0.026$; t-value = 0.688; p-value = 0.246), technical knowledge also has no direct significant effect on electric vehicle adoption in China ($\beta = 0.049$; t-value = 1.041; p-value = 0.149). Equally,

vehicle cost has no direct significant effect on electric vehicle adoption in China (β = -0.052; t-value = 0.464; p-value = 0.321). Notwithstanding, the infrastructure governance mechanism has a direct significant effect on electric vehicle adoption in China (β = 0.413; t-value = 3.786; p< 0.000).

Table 4.13
Direct Effect

	Beta	Standard Beta	t-value	p-values	Decision
Charging Facility Cost -> EV Adoption	0.194	0.060	3.241	0.001	Supported
Charging Facility Cost -> IG Mechanism	-0.057	0.068	0.834	0.202	Not Supported
Charging Infrastructure -> EV Adoption	0.112	0.059	1.895	0.029	Supported
Charging Infrastructure -> IG Mechanism	0.021	0.054	0.387	0.350	Not Supported
EV Performance -> EV Adoption	-0.026	0.037	0.688	0.246	Not Supported
EV Performance -> IG Mechanism	0.051	0.030	1.700	0.045	Supported
Economic Benefit -> EV Adoption	0.290	0.101	2.862	0.002	Supported
Economic Benefit -> IG Mechanism	0.279	0.077	3.626	0.000	Supported
IG Mechanism -> EV Adoption	0.413	0.109	3.786	0.000	Supported
Technical Knowledge -> EV Adoption	0.049	0.047	1.041	0.149	Not Supported
Technical Knowledge -> IG Mechanism	-0.022	0.028	0.767	0.222	Not Supported
Vehicle Cost -> EV Adoption	-0.052	0.111	0.464	0.321	Not Supported
Vehicle Cost -> IG Mechanism	0.701	0.068	10.353	0.000	Supported

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Furthermore, the findings show that electric vehicle performance has a direct significant effect on the infrastructure governance mechanism in China (β = 0.051; t-value = 1.700; p-value = 0.04). Economic benefit also has no direct significant effect on the infrastructure governance mechanism in China (β = 0.279; t-value = 3.626; p-value = 0.00). Furthermore, the findings show that charging infrastructure has no direct significant effect on the infrastructure governance mechanism in China (β = 0.021; t-value = 0.387; p-value = 0.350). Charging facility costs have no direct significant effect on the infrastructure governance mechanism in China (β = -0.057; t-value = 0.834; p-value = 0.202). Likewise, technical knowledge has no direct significant effect on the infrastructure governance mechanism in China (β = -0.022; t-

value = 0.769; p-value = 0.222). Notwithstanding, vehicle cost has a direct significant effect on the infrastructure governance mechanism in China (β = 0.701; t-value = 10.353; p-value = 0.000).

4.8.2.2 Assessment of Coefficient of Determination (R2)

The coefficient of determination (R^2) is a statistical measure that reflects the extent to which exogenous (independent) variables can explain the variance in an endogenous (dependent) variable (Hair et al., 2014). In other words, it indicates how well the independent variables collectively predict or account for changes in the dependent variable. A higher R^2 value, typically expressed as a percentage, signifies a stronger contribution of the independent variables to the dependent variable, implying that the model has a greater explanatory power (Chin, 1998). In alignment with this understanding, the results presented in Table 4.14 reveal that the combined effects of charging infrastructure, electric vehicle performance, technical knowledge, vehicle cost, charging facility cost, economic benefit, and the infrastructure governance mechanism accounted for 83.5% of the variance in electric vehicle adoption in China. This high percentage demonstrates a strong relationship between these exogenous factors and the adoption rate of electric vehicles.

Furthermore, the analysis also showed that charging infrastructure, electric vehicle performance, technical knowledge, vehicle cost, charging facility cost, and economic benefit collectively explained 86.6% of the variance in the infrastructure governance mechanism in China. These findings indicate that the R^2 values in both cases are considerably high, signifying a substantial and robust predictive capability of the independent variables in explaining the dependent variables. This suggests that the

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model effectively captures the key factors influencing both electric vehicle adoption and infrastructure governance in the Chinese context.

4.8.2.3 Assessment of Effect Size (f2)

Determination of effect size is the ability of exogenous variables to predict the endogenous variable, using the value of f2 which is interpreted as either substantial, medium, or lower. According to Chin (1998), the greater the value of f2 the stronger the effect of the independent variables on the dependent variable. Thus, Table 4.14 shows that the infrastructure governance mechanism (0.138), economic benefit (0.076), and charging facility cost (0.053) have a stronger effect on electric vehicle adoption in China; followed by charging infrastructure (0.022) and technical knowledge (0.010).

On the other hand, electric vehicle performance (0.003) and vehicle cost (0.001) have a weaker effect on electric vehicle adoption in China. Additionally, the findings showed that vehicle cost (0.466) has the highest effect on the infrastructure governance mechanism in China, followed by economic benefits (0.095) and electric vehicle performance (0.015). However, charging facility cost (0.006), technical knowledge (0.002), and charging infrastructure (0.001) have a lower effect on the infrastructure governance mechanism in China.

Table 4.14
Effect Size and Coefficient of Determination

		EV Adoption	IG Mechanism
Coefficient of Determination	R Square	0.835	0.866
	R Square Adjusted	0.828	0.861
Effect Size	Charging Facility Cost	0.053	0.006
	Charging Infrastructure	0.022	0.001
	EV Performance	0.003	0.015
	Economic Benefit	0.076	0.095
	IG Mechanism	0.138	
	Technical Knowledge	0.010	0.002
	Vehicle Cost	0.001	0.466

4.8.3 Assessment of Mediating Effect

In assessing the mediating effect, standardized coefficients, t-values, and p-values were used as benchmarks. Based on this criterion, a value of -1 implies a negative mediating effect; while a value of +1 symbolizes a positive mediating effect. Accordingly, the t-value below 1.46 demonstrated an insignificant effect of the mediating variable. Moreover, the p-value symbolizes whether the effect is significant or otherwise. Interestingly, Table 4.15 shows that the infrastructure governance mechanism exerts a significant mediating effect on the relationship between electric vehicle performance and electric vehicle adoption among public transportation agencies in China ($\beta = 0.021$; $t = 1.479$; $p < 0.07$). Similarly, the results showed that a stronger mediating effect of the infrastructure governance mechanism exists on the relationship between economic benefit and electric vehicle adoption among public transportation agencies in China ($\beta = 0.115$; $t = 2.567$; $p < 0.005$). Yet, the findings provide strong support for the effect of the infrastructure governance mechanism on the relationship between vehicle cost and electric vehicle adoption among public transportation agencies in China ($\beta = 0.289$; $t = 3.757$; $p < 0.000$).

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However, the result could not provide support on the effect of infrastructure governance mechanism as mediator on the relationship between charging infrastructure and electric vehicles adoption (β = 0.009; t-value = 0.361; p-value = 0.359); charging facility cost and electric vehicles adoption (β = -0.023; t-value = 0.784; p-value = 0.217); as well as, technical knowledge and electric vehicles adoption among public transportation agencies in China (β = -0.009; t-value = 0.737; p-value 0.231).

Table 4.15
Mediating Effects

	Beta	Standard Beta	t-value	p-values	Decision
Charging Facility Cost -> IG Mechanism -> EV Adoption	-0.023	0.030	0.784	0.217	Not Supported
Charging Infrastructure -> IG Mechanism -> EV Adoption	0.009	0.024	0.361	0.359	Not Supported
EV Performance -> IG Mechanism -> EV Adoption	0.021	0.014	1.479	0.070	Supported
Economic Benefit -> IG Mechanism -> EV Adoption	0.115	0.045	2.567	0.005	Supported
Technical Knowledge -> IG Mechanism -> EV Adoption	-0.009	0.012	0.737	0.231	Not Supported
Vehicle Cost -> IG Mechanism -> EV Adoption	0.289	0.077	3.757	0.000	Supported

4.8.4 Assessment of Predictive Relevance (Q2)

Predictive relevance (Q^2) measures the ability of exogenous (independent) variables to accurately predict the outcomes of endogenous (dependent) variables within a research model (Hair et al., 2014). This metric evaluates the model's predictive accuracy beyond merely explaining variance, offering insight into how well the model forecasts future data outcomes. According to Chin (1998), a higher Q^2 value indicates stronger

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predictive power, reflecting the model's effectiveness in predicting the dependent variable based on the independent variables. The interpretation of Q^2 values typically follows established thresholds: a value of 0.35 or higher suggests strong predictive relevance, a value around 0.15 indicates moderate predictive relevance and a value near 0.02 reflects weak predictive relevance.

As illustrated in Figure 4.7, the analysis demonstrates that the combined influence of charging infrastructure, electric vehicle performance, economic benefit, technical knowledge, charging facility cost, vehicle cost, and the infrastructure governance mechanism on the adoption of electric vehicles in China yields a Q^2 value of 0.472. This value significantly exceeds the threshold for strong predictive relevance, confirming that these exogenous variables possess substantial predictive power in explaining and forecasting the adoption rate of electric vehicles in the Chinese context. This high Q^2 value reinforces the model's reliability and validity, suggesting that the identified factors are critical predictors in understanding electric vehicle adoption trends in China.

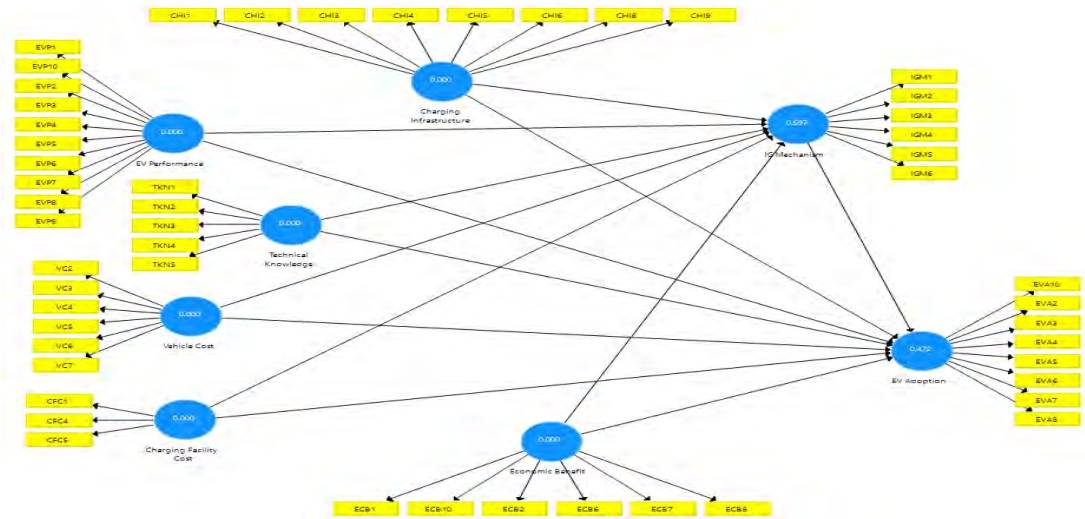

Figure 4.7 Predictive Relevance

Furthermore, Table 4.16 shows that the predictive relevance of charging infrastructure, electric vehicle performance, economic benefit, technical knowledge, charging facility cost, and vehicle cost on infrastructure governance mechanism in China, is substantial which is 0.597.

Table 4.16
Predictive Relevance

	SSO	SSE	Q^2
Charging Facility Cost	498	498	
Charging Infrastructure	1328	1328	
EV Adoption	1328	700.60	0.472
EV Performance	1660	1660	
Economic Benefit	995.99	995.99	
IG Mechanism	996	401.59	0.597
Technical Knowledge	830.00	830.00	
Vehicle Cost	996.00	996.00	

4.9 Summary of Research Hypotheses

The summary of the hypotheses testing results is shown in Table 4.17, and based on the outcome, H_1 which stipulated that charging infrastructure exerts a significant effect on urban public electric vehicle adoption is supported. While, H_2, H_3, and H_4 postulated that electric vehicle performance exerts a considerable effect on urban public electric vehicle adoption, technical knowledge exerts a significant effect on urban public electric vehicle adoption, and vehicle cost exerts a significant effect on urban public electric vehicle adoption, were not supported. Nevertheless, the outcome showed that H_5 and H_6 which assumed that charging facility cost exerts a significant effect on urban public electric vehicle adoption and economic benefits exert a significant effect on urban electric vehicle adoption, were supported. Furthermore, the outcome showed that H_7 which stipulated that charging infrastructure exerts a

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significant effect on urban public infrastructure governance mechanisms is not supported. Surprisingly, H_8 which postulated that electric vehicle performance exerts a significant effect on urban public infrastructure governance mechanisms is supported. However, H_9 which presumed that technical knowledge exerts a significant effect on urban public infrastructure governance mechanisms is not supported. Interestingly, H_{10} which postulated that vehicle cost exerts a significant effect on urban public infrastructure governance mechanisms is supported. In contrast, the outcome showed that H_{11} which assumed that charging facility costs exert significant effect on urban public infrastructure governance mechanisms is not statistically supported. Notwithstanding, the study found that H_{12} which postulated that economic benefits exert a significant effect on urban infrastructure governance mechanisms, and H_{13} which presumed that infrastructure governance mechanisms exert a significant effect on urban public electric vehicle adoption, were supported.

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Additionally, the outcome indicated that the effect of infrastructure governance mechanisms as mediators is paradoxical; on one hand, as in H_{15}, H_{17}, and H_{19}, infrastructure governance mechanisms significantly mediated the effect of electric vehicle performance on public sector's electric vehicle adoption; vehicle cost on urban public electric vehicle adoption; and economic benefits on urban public electric vehicle adoption. On the other hand, as in H_{14}, H_{16}, and H_{18}, infrastructure governance mechanisms failed to mediate the effect of charging infrastructure on urban public electric vehicle adoption; technical knowledge on electric vehicle adoption; and charging facility cost on public electric vehicle adoption.

Table 4.17
Summary of Research Hypotheses

Research Hypotheses		Results
H_1	Charging infrastructure exerts a significant effect on public sector's electric vehicle adoption.	**Supported**
H_2	Electric vehicle performance exerts a significant effect on public sector's electric vehicle adoption.	Not Supported
H_3	Technical knowledge exerts a significant effect on public sector's electric vehicle adoption.	Not Supported
H_4	Vehicle cost exerts a significant effect on public sector's electric vehicle adoption.	Not Supported
H_5	Charging facility costs exert a significant effect on public sector's electric vehicle adoption.	**Supported**
H_6	Economic benefits exert a significant effect public sector's electric vehicle adoption.	**Supported**
H_7	Charging infrastructure exerts a significant effect on public infrastructure governance mechanisms.	Not Supported
H_8	Electric vehicle performance exerts a significant effect on public infrastructure governance mechanisms.	**Supported**
H_9	Technical knowledge exerts a significant effect on public infrastructure governance mechanisms.	Not Supported
H_{10}	Vehicle cost exerts a significant effect on public infrastructure governance mechanisms.	**Supported**
H_{11}	Charging facility costs exert a significant effect on public infrastructure governance mechanisms.	Not Supported
H_{12}	Economic benefits exert a significant effect on public infrastructure governance mechanisms.	**Supported**
H_{13}	Infrastructure governance mechanisms exert a significant effect on public sector's electric vehicle adoption.	**Supported**
H_{14}	Infrastructure governance mechanisms mediate the effect of charging infrastructure on public sector's electric vehicle adoption.	Not Supported
H_{15}	Infrastructure governance mechanisms mediate the effect of electric vehicle performance on public sector's electric vehicle adoption.	**Supported**

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H_{16}	Infrastructure governance mechanisms mediate the effect of technical knowledge on public sector's electric vehicle adoption.	Not Supported
H_{17}	Infrastructure governance mechanisms mediate the effect of vehicle cost on public sector's electric vehicle adoption.	**Supported**
H_{18}	Infrastructure governance mechanisms mediate the effect of charging facility costs on public sector's electric vehicle adoption.	Not Supported
H_{19}	Infrastructure governance mechanisms mediate the effect of economic benefits on public sector's electric vehicle adoption. .	**Supported**

4.10 Research Objectives and Hypotheses Results

Research Objective 1: To examine the direct influence of technical factors (charging infrastructure, EV performance, and technical knowledge) on the adoption of EV in the public sector of Hunan, China.

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The results reveal that charging infrastructure (H_1) is a strong determinant of EV adoption, confirming prior scholarship that infrastructure accessibility is a "gateway condition" for electrification (e.g., Sovacool et al., 2018). In Hunan's public transport sector, where large fleets depend on predictable routes and schedules, the availability of charging stations is not merely convenient but operationally indispensable. The non-significance of EV performance (H_2) contrasts with findings in private consumer studies, where range anxiety and technological sophistication are dominant concerns (Li et al., 2020). In the public sector, performance concerns are neutralized by centralized planning, government-backed fleet procurement, and maintenance systems that minimize individual risk perceptions. Similarly, technical knowledge (H_3) was not

significant, which reflects the institutionalized nature of knowledge transfer: drivers and operators in the public sector are trained within organizational frameworks, reducing reliance on individual knowledge. Taken together, these findings suggest that adoption is infrastructure-led, not performance- or knowledge-led. This nuance challenges the generalization of consumer adoption models to public institutional contexts and points to the primacy of systemic support in shaping outcomes.

Research Objective 2: To analyze the direct influence of economic factors (vehicle cost, charging facilities cost, and economic benefits) on the adoption of EV in the public sector of Hunan, China.

The results underscore a reconfiguration of economic logic in public sector adoption. Vehicle cost (H_4) was not significant, a striking divergence from much of the EV adoption literature, where high upfront costs are consistently cited as barriers (Wang et al., 2017). In Hunan, procurement costs are largely absorbed by government subsidies and institutional budget allocations, diluting their influence on adoption decisions. In contrast, charging facility costs (H_5) and economic benefits (H_6) were significant, underscoring that ongoing operational economics, rather than acquisition costs, drive decision-making. Public authorities prioritize total cost of ownership and demonstrable cost savings, particularly fuel substitution, reduced emissions penalties, and lower long-term maintenance costs. This suggests that in institutional contexts, economic adoption drivers are not front-loaded but are assessed across the lifecycle. Theoretically, this supports a shift from upfront-cost frameworks to lifecycle economics in adoption modeling for public transport systems.

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Research Objective 3: To explore the indirect effects of technical factors (charging infrastructure, EV performance, and technical knowledge) on the adoption of EV in the public sector of Hunan, China, mediated by infrastructure governance mechanisms.

Governance mediation revealed a layered dynamic. EV performance (H_{15}) significantly influenced adoption when mediated by governance, confirming that technical improvements matter only when embedded in institutional frameworks such as fleet procurement criteria, performance standards, or regulatory benchmarks. However, charging infrastructure (H_{14}) and technical knowledge (H_{16}) showed no mediation effect, indicating that governance mechanisms in Hunan do not yet systematically integrate these dimensions. Infrastructure is instead managed operationally at the municipal level, while technical knowledge is handled through training modules rather than governance oversight. This asymmetry points to a governance–technology alignment gap, where governance structures prioritize performance standards but fail to institutionalize infrastructure planning and knowledge development as strategic levers. Critically, this limits the system's ability to harness the full potential of technical advancements. It also highlights that the mediation effect of governance is selective, not universal, amplifying some variables while bypassing others.

Research Objective 4: To assess the indirect effects of economic factors (vehicle cost, charging facilities cost, and economic benefits) on the adoption of EV in the public sector of Hunan, China, mediated by infrastructure governance mechanisms.

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Economic factors displayed stronger mediation effects than technical ones. Both vehicle cost (H_{17}) and economic benefits (H_{19}) had significant mediated effects, demonstrating that governance plays a decisive role in translating economic conditions into adoption outcomes. Centralized procurement policies, budgetary approvals, and cost-benefit evaluations filter economic signals into actionable institutional decisions. In contrast, charging facility cost (H_{18}) was not mediated, suggesting that it remains a routine operational concern, not elevated to governance-level strategic planning. This differentiation indicates that governance prioritizes strategic economics (procurement, benefits) while relegating operational economics (facility costs) to lower administrative levels. Such prioritization reflects institutional rationalities, where higher-level governance mechanisms are more concerned with fiscal sustainability and efficiency than with day-to-day operational expenditures. Importantly, this reinforces governance as a value amplifier, strengthening the salience of cost and benefit considerations in decision-making.

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Research Objective 5: To investigate the role of infrastructure governance mechanisms in facilitating EV adoption in the public sector of Hunan, China.

The analysis strongly affirms the centrality of governance. H_{13} confirmed the direct positive influence of governance on adoption, while significant mediation effects for EV performance (H_{15}), vehicle cost (H_{17}), and economic benefits (H_{19}) highlight governance as both an independent determinant and a transmission mechanism. Governance is thus not peripheral but the fulcrum through which technical and economic factors are translated into adoption realities. However, the lack of mediation for charging infrastructure (H_{14}), technical knowledge (H_{16}), and charging facility

costs (H_{18}) reveals blind spots where governance has not yet institutionalized potentially influential factors. In Hunan, where over 200 agencies and institutions coordinate urban transport (Jiawen & Chuanglin, 2015), this fragmentation makes governance coherence indispensable. Without governance acting as an integrative mechanism, the adoption process risks inefficiency and inconsistency. The findings therefore position governance not only as a facilitator but as the decisive enabler of EV adoption in complex institutional ecosystems. All the above discussion on the relationship of five research objectives and nineteen hypotheses result in this study can be summarized in Table 4.18 (next page), highlighting the research objectives (5), associated hypotheses (19), results, and key insights.

Table 4.18
Linkages between Research Objectives and Hypotheses Results

Research Objective (RO)	Associated Hypotheses	Results	Key Insights
RO1: To examine the direct influence of technical factors (charging infrastructure, EV performance, and technical knowledge) on the adoption of EV in the public sector of Hunan, China.	H1: Charging infrastructure → EV adoption	**Supported**	Infrastructure strongly drives adoption.
	H2: EV performance → EV adoption	**Not Supported**	Performance not decisive in public adoption.
	H3: Technical knowledge → EV adoption	**Not Supported**	Knowledge has limited influence.
RO2: To analyze the direct influence of economic factors (vehicle cost, charging facilities cost, and economic benefits) on the adoption of EV in the public sector of Hunan, China.	H4: Vehicle cost → EV adoption	**Not Supported**	Upfront costs less relevant due to subsidies.
	H5: Charging facility costs → EV adoption	**Supported**	Operational facility costs matter.
	H6: Economic benefits → EV adoption	**Supported**	Long-term cost savings drive adoption.
RO3: To explore the indirect effects of technical factors on EV adoption mediated by infrastructure governance mechanisms.	H7: Charging infrastructure → Governance	**Not Supported**	No indirect effect through governance.
	H8: EV performance → Governance	**Supported**	Governance captures performance standards.
	H9: Technical knowledge → Governance	**Not Supported**	Governance does not amplify knowledge.

Research Objective (RO)	Associated Hypotheses	Results	Key Insights
	H14: Governance mediates charging infrastructure → EV adoption	**Not Supported**	No mediation effect found.
	H15: Governance mediates EV performance → EV adoption	**Supported**	Performance matters via governance.
	H16: Governance mediates technical knowledge → EV adoption	**Not Supported**	Knowledge not translated into adoption.
	H10: Vehicle cost → Governance	**Supported**	Costs processed through governance.
	H11: Charging facility costs → Governance	**Not Supported**	Treated operationally, not strategically.
	H12: Economic benefits → Governance	**Supported**	Governance recognizes cost-effectiveness.
RO4: To assess the indirect effects of economic factors on EV adoption mediated by infrastructure governance mechanisms.	H17: Governance mediates vehicle cost → EV adoption	**Supported**	Cost becomes relevant via governance.
	H18: Governance mediates charging facility costs → EV adoption	**Not Supported**	No mediation role.
	H19: Governance mediates economic benefits → EV adoption	**Supported**	Benefits translated into adoption decisions.
RO5: To investigate the role of infrastructure governance mechanisms in facilitating EV adoption in the public sector of Hunan, China.	H13: Governance → EV adoption	**Supported**	Governance directly enables adoption.

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As a concluding remark, the analysis of the five research objectives collectively demonstrates that electric vehicle (EV) adoption in the public sector of Hunan, China, is primarily driven by a complex interplay of technical, economic, and governance factors. Directly, charging infrastructure and charging facility costs, along with economic benefits, emerged as significant determinants of adoption, underscoring the importance of accessibility, affordability of operation, and long-term value creation. In contrast, vehicle performance, technical knowledge, and vehicle cost did not show

direct significance, indicating that technological sophistication and upfront expenses are less decisive in the public sector, where institutional support and subsidies mitigate these concerns. Indirectly, governance mechanisms played a pivotal mediating role: EV performance, vehicle cost, and economic benefits became influential only when translated into procurement policies, regulatory frameworks, and institutional decision-making. This highlights governance as the critical bridge that aligns technological and economic conditions with actionable adoption strategies. Importantly, governance also exerted a strong independent effect, confirming its central role as both an enabler and a mediator in shaping outcomes. However, the absence of mediation for charging infrastructure, technical knowledge, and charging facility costs points to underutilized opportunities for more integrated governance strategies. Taken together, these findings reveal that while infrastructure and economic incentives provide the foundation for EV adoption, it is the strength and coherence of governance structures that ultimately determine success. In Hunan's context, where over 200 government agencies and public institutions coordinate urban public transport, the evidence underscores that sustainable EV adoption requires not only technological readiness and economic viability but, more critically, effective governance mechanisms capable of orchestrating these factors into cohesive policy and practice.

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4.11 Chapter Summary

This chapter has presented a comprehensive account of the data analysis procedures and the corresponding findings of the study. It commenced with an overview of the response rate, underscoring both the effectiveness of the data collection process and the representativeness of the sample in reflecting the target population. The

preliminary stages of data preparation were then addressed, including the treatment of missing values, the identification and handling of outliers, and the overall verification of data readiness for analysis. Descriptive statistics were subsequently employed to provide an initial profile of the dataset and to highlight patterns in respondents' perceptions. To ensure methodological rigor, potential issues such as common method variance (CMV) and non-response bias were carefully examined, thereby reinforcing the reliability and validity of the data.

In addition, the chapter evaluated the assumptions underlying multiple regression analysis, namely normality, multicollinearity, linearity, and heteroscedasticity, confirming that the dataset met the required statistical conditions. Following this, both the measurement and structural models were assessed in terms of internal consistency, convergent and discriminant validity, and overall robustness, supplemented by tests of predictive relevance. Collectively, these analyses provided a strong empirical foundation for interpreting the relationships among variables, testing the research hypotheses, and deriving meaningful theoretical and practical conclusions.The next chapter builds upon these empirical findings by engaging in an in-depth discussion of how the results address the research objectives and hypotheses, highlighting their theoretical significance, practical implications, and contributions to policy and practice.

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CHAPTER FIVE

DISCUSSION, IMPLICATIONS & CONCLUSION

5.1 Introduction

Chapter Five is a critical component of this study, wherein the research findings are systematically examined in relation to the predefined research objectives and corresponding research questions. This chapter discusses the empirical findings by integrating the statistical results (as presented in Table 4.18) with the theoretical framework of the Technology Acceptance Model 2 (TAM2) outlined in Chapter Two (Table 2.1). The discussion is structured around the five research objectives (RO1–RO5), each examined in relation to the hypotheses tested, prior literature, and theoretical underpinnings. The overarching aim is to highlight how technical, economic, and governance factors interact to influence the adoption of electric vehicles (EVs) within the public transportation sector of Hunan, China. The chapter begins by presenting a comprehensive synthesis of the key findings derived from the data analysis, ensuring alignment with the study's overarching aims. Following this, an in-depth discussion is provided, contextualizing these findings within the broader academic discourse by drawing comparisons with the theoretical perspectives and empirical studies reviewed in Chapter Two. This comparative analysis highlights areas of convergence and divergence between the current study's results and existing literature, thereby reinforcing the study's contribution to the field.

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Moreover, the chapter delineates both the theoretical and practical implications of the findings. Theoretical implications address how the study extends, refines, or challenges established conceptual frameworks and models, while practical implications emphasize the potential applications of the findings in real-world settings, such as policy development, industry practices, or public-sector governance. Additionally, a critical reflection on the study's limitations is provided, acknowledging methodological constraints, potential biases, or contextual factors that may influence the generalizability of the results. These limitations are considered alongside recommendations for future research, offering insights into areas that warrant further investigation to build upon the present study's contributions. The chapter concludes with a comprehensive summary that synthesizes the key insights and reinforces the study's overall significance. This final section encapsulates the core findings, theoretical contributions, and practical takeaways, ensuring a coherent conclusion to the research.

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5.2 Recapitulation of Research Findings

Research Objective 1: Technical and Economic Factors Influencing EV Adoption

RO1 sought to examine the influence of technical and economic factors, charging infrastructure, EV performance, technical knowledge, vehicle cost, charging facility cost, and economic benefits, on public EV adoption. Of the six hypotheses tested (H_1–H_6), three were supported: charging infrastructure (H_1), charging facility cost (H_5), and economic benefits (H_6), while EV performance (H_2), technical knowledge (H_3), and vehicle cost (H_4) were not supported. The findings demonstrate that adoption is primarily driven by infrastructural enablers and economic feasibility, rather than individual perceptions of technical sophistication. Within the TAM2 framework,

charging infrastructure and economic benefits map onto cognitive instrumental processes, specifically job relevance and output quality. Their significance indicates that decision-makers evaluate EV adoption in terms of functional utility and long-term benefits, consistent with Wang et al. (2019) and Pandak et al. (2024). Conversely, the insignificance of EV performance and technical knowledge reflects the limited role of perceived ease of use in institutional adoption contexts. Adoption decisions in the public sector are less about individual technical comprehension and more about systemic readiness, policy alignment, and financial sustainability.

Interestingly, vehicle cost also lacked significance, diverging from much of the consumer adoption literature (Rezvani et al., 2015). This suggests that in public-sector contexts, cost is evaluated through total cost of ownership (TCO) and mitigated by subsidies, grants, and strategic procurement. Taken together, RO1 highlights that adoption is shaped by perceived usefulness, embedded in infrastructural support and economic viability, while ease-of-use factors are comparatively less influential.

Research Objective 2: Technical and Economic Factors Influencing Infrastructure Governance

RO2 evaluated the relationship between technical/economic factors and infrastructure governance mechanisms. Of the six hypotheses (H_7–H_{12}), EV performance (H8), vehicle cost (H_{10}), and economic benefits (H_{12}) were supported, whereas charging infrastructure (H_7), technical knowledge (H_9), and charging facility costs (H_{11}) were not supported. These results reveal that governance responses are most sensitive to economic and technological pressures. When EV performance improves or when economic benefits become evident, governance frameworks evolve to accommodate

new standards, subsidies, and investment strategies. Similarly, vehicle cost influences governance indirectly by shaping subsidy schemes, financing models, and procurement strategies. This aligns with TAM2's social influence processes, particularly subjective norms, and voluntariness, which suggest that institutional expectations and collective economic pressures drive governance adaptation.

By contrast, the non-significance of charging infrastructure indicates that physical deployment alone does not compel governance transformation unless supported by broader regulatory and institutional integration (Zink et al., 2020). Likewise, technical knowledge, while essential for operations, did not translate into governance change, underscoring that systemic reform requires more than localized expertise (Chen et al., 2024). Thus, RO2 confirms that governance evolves in response to macro-level economic and technological imperatives rather than micro-level technical or infrastructural variables.

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Research Objective 3: Direct Effect of Governance Mechanisms on EV Adoption

RO3 addressed whether infrastructure governance mechanisms directly affect public EV adoption. H_{13} was supported, confirming that governance structures significantly shape adoption outcomes. Governance frameworks encompass regulatory stability, subsidy design, inter-agency coordination, and long-term planning. Within TAM2, these governance mechanisms resemble facilitating conditions, ensuring that perceived usefulness can be translated into actual adoption. The finding is consistent with Achiaw and Kanol (2021) and Zimm (2021), who demonstrated that well-structured governance enhances adoption by reducing uncertainty, standardizing infrastructure, and creating policy consistency.

This outcome reinforces the centrality of governance in China's public transportation sector, where adoption decisions are institutional rather than individual. It validates the view that EV adoption is not merely a technological shift but a systemic transformation embedded within governance architectures.

Research Objective 4: Mediation of Governance Mechanisms

RO4 explored the mediating role of infrastructure governance mechanisms in linking technical/economic factors to adoption. Of the six mediation hypotheses (H_{14}–H_{19}), three were supported: EV performance (H_{15}), vehicle cost (H_{17}), and economic benefits (H_{19}), while charging infrastructure (H_{14}), technical knowledge (H_{16}), and charging facility costs (H_{18}) were not. The significant mediations highlight the amplifying function of governance. For instance, governance frameworks enable performance improvements to translate into adoption by establishing interoperability standards, fast-charging networks, and grid integration (H_{15}). Similarly, governance reduces vehicle cost burdens via subsidies, public procurement, and financing policies (H_{17}), while economic benefits are amplified through energy tariff adjustments, tax incentives, and long-term investment strategies (H_{19}). The non-significant mediations point to systemic gaps. Charging infrastructure, despite its direct effect on adoption (H_1), lacked governance mediation, suggesting that infrastructure availability is sufficient without requiring policy translation. Technical knowledge and charging facility costs also failed to translate through governance, reinforcing the idea that institutional reforms are selective, responding to strategic pressures but not to all technical or economic constraints.

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Overall, RO4 demonstrates that governance is not a universal mediator but a conditional enabler, intervening where systemic alignment with policy priorities exists, particularly in cost reduction and performance enhancement.

Research Objective 5: Integrated Effects of Technical, Economic, and Governance Factors

RO5 synthesized the findings across all variables to present a holistic view of EV adoption in Hunan's public sector. The results confirm that adoption is shaped by a triad of determinants: Infrastructure and economic benefits directly enhance perceived usefulness (RO1), serving as immediate drivers of adoption. Governance mechanisms directly and selectively mediate adoption (RO2–RO4), aligning with TAM2's facilitating conditions and social influence processes. Ease-of-use related factors (technical knowledge, isolated performance concerns) are comparatively weak, indicating that systemic enablers dominate over individual-level perceptions in public-sector decision-making. From a TAM2 perspective, this study reinforces the primacy of perceived usefulness over ease of use in institutional adoption contexts. Governance mechanisms operate as macro-level equivalents of social influence and facilitating conditions, enabling systemic alignment between technology and institutional priorities. In sum, RO5 demonstrates that the adoption of EVs in Hunan is not merely a function of technological availability or cost dynamics but the outcome of an integrated governance-driven ecosystem.

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5.3 Discussions

The following section discusses the findings for each of the hypotheses, which were based on this study's research questions. All the results have been tabulated in Table 4.17 in Chapter Four as discussed and concluded against the previous findings, as found in the literature review.

Hypothesis 1: Charging infrastructure significantly affects urban public electric vehicle adoption.

The empirical validation of Hypothesis 1 indicates a statistically significant and positive relationship between charging infrastructure availability and urban public electric vehicle (EV) adoption rates, as demonstrated through Partial Least Squares-Structural Equation Modeling (PLS-SEM) and structural modeling techniques. This finding suggests that as charging stations become more accessible, reliable, and technologically advanced, the uptake of urban public EVs increases correspondingly. Given that charging infrastructure is a foundational element of the EV ecosystem, its presence mitigates range anxiety, enhances fleet operational efficiency, and improves user convenience, thereby serving as a critical enabler in facilitating large-scale EV adoption.

The construction and expansion of EV charging networks are widely recognized as indispensable for the successful transition to electrified urban transportation (Zink, Valdes, & Wuth, 2020). The statistical support for this hypothesis aligns with numerous prior studies that underscore the pivotal role of charging infrastructure in shaping adoption behaviors. For instance, Wang et al. (2019) conducted a regional analysis of EV adoption in Hunan, utilizing empirical data on public and private

charging station density and EV sales across multiple cities. Their findings demonstrated a strong positive correlation between charging infrastructure expansion and EV adoption, reinforcing the significance of a comprehensive and well-integrated charging network in accelerating market penetration.

Further supporting this assertion, Pandak, Piaralal, & Rethina (2024) emphasized that the availability of charging stations is a decisive factor influencing consumer intentions to adopt EVs. Harahap et al. (2023) highlighted that infrastructure elements such as dedicated electricity tariffs, higher energy storage density, fast-changing technologies, and free-charging incentives contribute significantly to the widespread adoption of EVs. Similarly, Haustein, Jensen, and Cherchi (2021) provided empirical evidence that the deployment of fast-charging facilities exerts a statistically significant impact on EV adoption trends. Conversely, Verma, Verma, and Khan (2020) identified the lack of adequate physical infrastructure as a substantial barrier to EV adoption, further underscoring the necessity of sustained infrastructure investments to support market growth.

The statistical confirmation of Hypothesis 1 demonstrates that charging infrastructure exerts a significant positive influence on EV adoption. This aligns closely with TAM2's facilitating conditions, where the availability of external resources (in this case, reliable charging networks) reduces adoption barriers and enhances perceived usefulness by mitigating range anxiety and improving operational efficiency.

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Prior studies support this interpretation, showing that well-distributed charging facilities enhance confidence in EV feasibility (Wang et al., 2019; Haustein et al., 2021). From a TAM2 perspective, charging infrastructure not only provides technical support but also strengthens output quality and job relevance, particularly in the public sector where uninterrupted fleet operations are critical. This positions infrastructure as a decisive enabler that aligns with both functional utility and institutional adoption pressures.

Hypothesis 2: Electric vehicle performance significantly affects urban public electric vehicle adoption

Hypothesis 2 is not supported and suggests that statistical analyses (PLS-SEM, structural models) found no significant positive relationship between electric vehicle performance and urban public electric vehicle adoption. While EV performance is often considered an important determinant of adoption, its effect may be overshadowed by more critical factors such as charging infrastructure availability, government incentives, or economic considerations. While public transportation systems are under increasing pressure to transition to more sustainable and low-emission alternatives, the perceived and experienced inadequacies in EV performance remain a critical obstacle. This observation aligns with the findings of Digalwar and Rastogi (2023), who identified that concerns regarding range limitations, prolonged charging times, and suboptimal operational performance are central to the reluctance toward EV adoption in India.

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Within TAM2, performance is most closely associated with perceived ease of use and output quality. However, in the public sector context of Hunan, adoption decisions are driven less by subjective ease-of-use considerations and more by systemic enablers such as infrastructure and governance. This suggests that the TAM2 pathway of ease of use → usefulness → intention may be muted in institutional contexts. Public agencies may view EVs primarily through cost-benefit and policy lenses rather than operational performance benchmarks. Thus, EV performance may still matter at the operational stage but does not act as a decisive cognitive determinant in adoption.

Specifically, in public transit operations, route reliability, turnaround efficiency, and vehicle durability under high usage conditions are essential performance benchmarks. However, the current generation of electric buses and fleet vehicles often struggles to meet these operational demands. For instance, range anxiety becomes a logistical challenge when public buses must operate on extended urban and intercity routes without the support of well-distributed charging infrastructure. Digalwar and Rastogi (2023) similarly observed that these technical shortcomings, particularly in range and acceleration capacity, contribute to hesitation among decision-makers in public transportation planning.

Additionally, concerns around power output and load-bearing capacity have been reported, particularly in cities with varied terrains or heavy passenger traffic. Public sector transport authorities remain cautious about whether electric buses can sustain performance levels under peak conditions. These concerns, as noted by Digalwar and Rastogi (2023), are not merely perceptual but grounded in actual performance observations, further justifying resistance to immediate large-scale adoption. Overall,

this finding emphasizes the need for technological improvements tailored to the operational realities of public sector transport systems. Public transportation authorities are unlikely to transition to EVs until performance gaps, particularly related to range, durability, acceleration, and charging time, are addressed through advancements in battery technologies and vehicle engineering. Until then, performance-related apprehensions will continue to stall electrification efforts in the public mobility sector, despite supportive policy frameworks and environmental mandates.

Hypothesis 3: Technical knowledge significantly affects urban public electric vehicle adoption.

Hypothesis 3 is not supported and suggests that statistical analyses (PLS-SEM, structural models) found no significant positive relationship between technical knowledge and urban public electric vehicle adoption. Contrary to expectations, this study found no direct significant influence of technical knowledge on the adoption of electric vehicles in the urban public transportation sector. Although it was hypothesized that greater technical understanding, regarding battery systems, charging infrastructure, or vehicle maintenance, would facilitate adoption decisions, the data did not support this relationship. This finding aligns with Collet and Linke (2025), who argue that consumer powertrain choices are shaped less by technical knowledge and more by configuration simplicity, institutional preferences, and contextual constraints. In the public sector context, EV adoption is typically driven by policy mandates, cost-benefit analyses, and infrastructure availability, rather than by the technical expertise of decision-makers or operators. Moreover, in urban public transportation, adoption decisions are often made at an organizational or governmental level, where

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procurement criteria are shaped by broader strategic or political priorities rather than individual technical comprehension.

As Collet and Linke (2025) suggest, information asymmetry and reliance on standardized decision frameworks may reduce the role of technical knowledge in shaping adoption outcomes. This finding highlights the importance of institutional context and systemic enablers over individual knowledge in public mobility transitions, suggesting that interventions aimed solely at increasing technical awareness may be insufficient without parallel improvements in infrastructure, policy coherence, and operational readiness. In addition, TAM2 extends the Technology Acceptance Model by emphasizing the role of experience, voluntariness, and social influence in shaping adoption intentions. Yet the insignificance of technical knowledge indicates that perceived ease of use does not strongly drive adoption in the public sector. This finding reinforces that institutional adoption relies less on individual technical literacy and more on facilitating conditions and social influence (e.g., policy mandates, organizational norms). Again, this aligns with Collet and Linke (2025), who argue that adoption in institutional contexts is governed more by structural simplicity and systemic enablers than by user expertise. Hence, TAM2's cognitive instrumental processes dominate over individual knowledge in explaining adoption in this study.

Furthermore, Huang et al. (2021) provide additional support for this finding by showing that from the technical knowledge dimension, there was no direct and significant relationship between perceived fun and willingness to adopt EVs. Their study reinforces the idea that technical knowledge may not sufficiently motivate behavioral or attitudinal change unless it is paired with affective or experiential

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benefits. In the public sector, where functionality and cost-efficiency often outweigh user experience, technical knowledge may play a supplementary rather than a decisive role. Thus, the lack of statistical support for Hypothesis 3 suggests that while technical knowledge may play a role in the long-term efficiency and management of EV fleets, it is not a decisive factor in the adoption stage.

Hypothesis 4: Vehicle cost significantly affects urban public electric vehicle adoption. Hypothesis 4 is not supported statistically; it indicates that vehicle cost, including initial purchase price, maintenance costs, battery replacement, and operational expenses, does not have a statistically significant impact on urban public EV adoption. The current study hypothesized that vehicle cost would significantly influence the adoption of electric vehicles in the urban public transportation sector. Surprisingly, this hypothesis was not supported by the empirical analysis. While cost has been widely considered a barrier to EV adoption, particularly in consumer markets, the results of this study indicate that in the public transportation domain, vehicle cost alone does not exert a direct, statistically significant influence on adoption decisions.

This unexpected outcome is consistent with the findings of Adepetu and Keshav (2017), who investigated electric vehicle adoption in Los Angeles and discovered that vehicle cost, while important, did not operate in isolation. Their study emphasized that adoption decisions are more heavily influenced by practical concerns such as whether the EV can meet daily operational needs, and only secondarily by the upfront purchase price. Similarly, in the public sector, cost considerations are often evaluated alongside long-term operational feasibility, including lifecycle cost, range capabilities, maintenance requirements, and alignment with environmental or policy mandates. In

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urban public transportation, vehicle procurement processes are generally institutional and strategic, often supported by government subsidies, pilot programs, or green mobility policies. This changes the dynamics of how "cost" is perceived. Decision-makers in public agencies are less focused on immediate capital expenditure and more on total cost of ownership (TCO), long-term fuel savings, and emission reductions. As a result, vehicle cost may be viewed not as a constraint, but as a variable that can be mitigated through grants, public-private partnerships, or phased fleet transitions. This diminishes its direct influence on the decision to adopt EVs.

Rezvani, Jansson, and Bodin (2015) provide an important conceptual foundation for understanding this dynamic. Their comprehensive review of consumer electric vehicle adoption research highlights that price-related barriers, while often emphasized in early-stage consumer markets, are part of a broader constellation of interacting factors. These include environmental concern, perceived behavioral control, infrastructure availability, and government incentives. In institutional settings, such as municipal transit authorities, non-monetary considerations often take precedence, including environmental mandates, sustainability targets, and long-term cost-efficiency rather than upfront costs alone. TAM2 highlights that perceived usefulness often hinges on economic rationality, yet in this case vehicle cost had no direct effect. For public-sector decision-makers, procurement is shaped by subsidies, strategic budgets, and institutional facilitating conditions. Thus, the TAM2 pathway of usefulness → intention is influenced more by long-term economic benefits than by upfront cost.

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According to Deka et al. (2023), in the context of urban public transportation, where decisions are often institutional and policy-driven, motivation derived from environmental responsibility, government mandates, and organizational goals plays a pivotal role in adoption behavior. Public transport agencies may prioritize long-term sustainability, emissions reduction targets, and alignment with climate policies, which can override immediate financial concerns such as vehicle cost. This motivational framework reduces the relative importance of upfront cost as a deciding factor and shifts focus toward fulfilling broader societal and regulatory objectives. Deka et al.'s findings underscore that vehicle cost is one component among many factors influencing EV adoption intention and that intrinsic and extrinsic motivational forces may mitigate the impact of cost constraints. Thus, within the public sector, adoption decisions are less about price sensitivity and more about strategic alignment with sustainability missions and perceived organizational benefits, explaining why the hypothesis regarding vehicle cost was not supported in this study.

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Hypothesis 5: Charging facility costs exert a significant effect on urban public electric vehicle adoption

Hypothesis 5 is supported, indicating that charging facility costs, including installation, operation, and maintenance expenses, have a statistically significant impact on the adoption of urban public electric vehicles (EVs). This finding underscores the economic constraints tied to charging infrastructure development and its critical role in shaping EV adoption trends. Unlike vehicle costs, which can often be mitigated through subsidies, bulk procurement, or leasing models, charging facility costs represent a long-term capital and operational investment that fleet operators and municipalities must carefully consider. High installation costs for fast-charging

stations can discourage investment, particularly in cities with limited budgets, while land acquisition and grid connectivity costs can significantly affect feasibility in dense urban environments. Additionally, ongoing operational expenses, such as electricity tariffs, maintenance, and station upgrades, directly influence the economic viability of EV fleets.

The statistical significance of charging facility costs suggests that managing these expenses is essential for large-scale public EV adoption. Previous studies corroborate this finding. The significance of charging facility costs directly supports TAM2's facilitating conditions construct. High installation, operation, and maintenance costs influence adoption because they constrain the external environment necessary for practical EV use. Unlike vehicle cost (which can be absorbed via subsidies), charging facility costs create ongoing financial burdens that directly shape perceived usefulness and result demonstrability in TAM2. Consistent with Gupta and Rhoads (2022), cost-effective deployment strategies are essential for sustaining adoption. Within TAM2, this highlights that external support and resource availability critically condition whether perceived usefulness translates into actual adoption.

Similarly, Reiner et al. (2020) highlighted that financial factors, particularly running costs such as charging expenses, have a substantial impact on EV adoption decisions. This finding highlights the importance of cost-effective charging infrastructure deployment strategies. Potential approaches include public-private partnerships (PPPs) to share investment burdens, innovative business models such as subscription-based charging services or dynamic pricing, and government incentives or subsidies targeted specifically at charging infrastructure development. Without effective cost-

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management strategies, high charging facility costs may become a significant financial barrier to EV adoption despite growing policy support. The support for Hypothesis 5, therefore, confirms that charging facility costs play a decisive role in urban public EV adoption. Unlike vehicle costs, which can be offset by financial models and incentives, charging infrastructure development presents a long-term financial challenge that directly influences adoption decisions. Addressing these cost concerns through policy interventions, private-sector collaboration, and innovative pricing models is essential for sustaining growth in urban public EV adoption.

Hypothesis 6: Economic benefits exert a significant effect on urban electric vehicle adoption

Hypothesis 6 is supported, indicating that the perceived or actual economic benefits associated with electric vehicle (EV) adoption exert a statistically significant influence on their uptake in urban areas. This finding highlights the pivotal role of financial considerations, such as cost savings and long-term economic feasibility, in shaping adoption decisions, particularly within the public transportation sector. Economic benefits in this context encompass a range of financial advantages, including lower operational and maintenance costs compared to internal combustion engine (ICE) vehicles, significant fuel savings due to the typically lower cost of electricity, and government-provided incentives such as subsidies, tax rebates, and reduced registration fees. Additionally, EV adoption can offer potential revenue opportunities through mechanisms like carbon credits or vehicle-to-grid (V2G) applications, which allow surplus energy stored in EV batteries to be sold back to the grid. The statistical support for this hypothesis underscores the sensitivity of urban public EV adoption to economic viability, reinforcing the importance of continued and targeted financial

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incentives as an essential component of public policy aimed at accelerating EV transition.

The strong effect of economic benefits aligns perfectly with TAM2's cognitive instrumental processes: job relevance (reduced operating costs for fleets), output quality (reliable performance at lower costs), and result demonstrability (visible long-term savings). When public agencies perceive clear financial advantages, the perceived usefulness → adoption pathway in TAM2 becomes strongly reinforced. This confirms findings by Harahap et al. (2023) and Pandak et al. (2024), showing that subsidies, lower electricity costs, and reduced maintenance directly incentivize adoption. In TAM2 terms, economic benefits strengthen perceptions of utility, thereby serving as one of the most decisive predictors of adoption in institutional contexts.

Moreover, numerous studies have found a strong link between economic benefits and EV adoption rates. Wang et al. (2019) found that government subsidies and lower operating costs significantly influenced the decision to adopt EVs in Hunan. Haustein, Jensen, and Cherchi (2021) highlighted those financial incentives (e.g., free parking, toll exemptions, and congestion charge waivers) significantly contributed to increased EV adoption in urban areas. These studies reinforce the idea that financial considerations remain one of the most compelling reasons for urban EV adoption.

The statistical support for Hypothesis 6 confirms that economic benefits are a major determinant of urban EV adoption. The financial advantages of EVs, including lower operating costs, government incentives, and long-term savings, serve as key motivators for public EV adoption. Policymakers and industry stakeholders should

further enhance financial incentives, optimize cost structures, and develop innovative pricing models to sustain and accelerate EV adoption in urban environments.

Hypothesis 7: Charging infrastructure exerts a significant effect on urban public infrastructure governance mechanisms

Hypothesis 7 was not supported, indicating that the mere presence or expansion of charging infrastructure does not, on its own, exert a statistically significant influence on urban‐public‐infrastructure governance mechanisms. This outcome implies that governance structures, encompassing policy formulation, regulatory frameworks, institutional oversight, stakeholder coordination, and financial‐sustainability models, are shaped far more decisively by broader institutional and political dynamics than by infrastructure deployment alone. In other words, while charging networks are essential for electric‐vehicle (EV) adoption, they do not automatically translate into systematic governance improvements without complementary policy and institutional interventions. TAM2 emphasizes that subjective norm (social influence, institutional mandate) and perceived usefulness are stronger drivers of acceptance than ease of use in complex organizational contexts. Even though charging infrastructure makes EV adoption easier, governance structures in Hunan's public sector remain shaped by broader political, regulatory, and institutional priorities. Supporting studies (Zink et al., 2020; Verma et al., 2020) show that infrastructure provision must be accompanied by governance reforms, such as cross-agency coordination, standardization, and policy alignment, before it meaningfully influences governance.

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Thus, the TAM2 perspective clarifies why this hypothesis was unsupported: while infrastructure improves ease of use, governance change requires stronger normative and institutional pressures that go beyond technological availability. Several factors help explain this result. First, policy and regulatory frameworks governing EV infrastructure are often fragmented: charging‐station initiatives are frequently developed in isolation from wider urban‐planning or energy policy agendas, leading to institutional misalignment among transport agencies, energy regulators, and municipal planners. Second, governance mechanisms in many cities tend to be rigid or slow to evolve; even as charging networks expand, bureaucratic inertia or competing priorities, such as mass‐transit upgrades, road maintenance, or smart‐city programs, can limit the degree to which new infrastructure prompts governance reform. Third, external influences such as political leadership, public–private partnerships, digitalization trends, and market innovations frequently shape urban governance trajectories, overshadowing any direct impact of charging‐station rollout.

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Empirical evidence mirrors these observations. Zink, Valdes, and Wuth (2020) note that charging infrastructure is vital for EV diffusion but often remains weakly integrated into broader urban‐governance frameworks. Verma, Verma, and Khan (2020) contend that proactive policy and institutional coordination, rather than infrastructure expansion alone, are necessary to improve governance outcomes. Harahap et al. (2023) highlight how regulatory bottlenecks in electricity pricing, land use, and permitting diminish the effectiveness of charging investments, while Wang et al. (2019) show that successful infrastructure deployment hinges on cross‐agency coordination rather than infrastructure itself driving governance change.

Taken together, these insights confirm that charging infrastructure, though an essential component of urban EV ecosystems, does not inherently trigger governance transformation. Meaningful improvements in urban-infrastructure governance will instead require deliberate policy interventions, integrated planning, and institutional restructuring that embed charging initiatives within comprehensive, cross-sectoral frameworks, ensuring the long-term sustainability and scalability of EV adoption in urban settings.

Hypothesis 8: Electric vehicle performance significantly affects urban public infrastructure governance mechanisms

Hypothesis 8 is supported, indicating that enhancements in electric-vehicle (EV) performance, encompassing battery efficiency, extended driving range, faster charging, durability, and operational reliability, have a statistically significant, positive influence on the development, regulation, and management of urban public infrastructure. As battery technologies achieve higher energy density, longer range, and reduced charging times, policymakers and regulators are compelled to revise standards for charging equipment, battery end-of-life handling, and grid integration to keep pace with next-generation EVs. Improved range and rapid-charging capabilities also allow governance frameworks to recalibrate charging-station deployment, shifting from dense networks of slow chargers toward strategically located fast-charging hubs that can be coupled with renewable-energy sources and smart-traffic or vehicle-to-grid (V2G) systems. At the municipal level, better vehicle efficiency and lower maintenance demands accelerate fleet-electrification policies for buses, taxis, and shared-mobility services, thereby influencing budget allocations and electrification

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timelines. Moreover, high-performance EVs equipped with bidirectional charging capacity reshape urban energy governance, prompting utilities and city authorities to integrate EVs into smart-grid strategies for peak-load balancing, renewable-energy uptake, and overall grid stability. Collectively, these dynamics demonstrate that superior EV performance acts as a catalyst for adaptive, future-oriented governance mechanisms, enabling cities to craft resilient and sustainable urban-mobility ecosystems.

Within TAM2, enhanced vehicle performance directly improves output quality (reliability, efficiency, durability) and result demonstrability (tangible operational benefits such as range and fast charging). When these technical gains are visible, policymakers perceive EVs as more useful, prompting regulatory changes, infrastructure planning, and resource allocation. For example, high-performance EVs with fast-charging and extended range allow governance bodies to redesign deployment strategies, invest in grid upgrades, and revise safety standards. In TAM2 language, perceived usefulness increases as decision-makers observe improved performance delivering clear institutional outcomes. Studies by Haustein et al. (2021) and Harahap et al. (2023) support this, showing that strong performance not only enhances technical credibility but also compels governments to strengthen governance frameworks. Thus, EV performance acts as a catalyst for governance adaptation, validating TAM2's proposition that usefulness reinforced by demonstrability drives acceptance and institutional transformation.

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Hypothesis 9: Technical knowledge exerts a significant effect on urban public infrastructure governance mechanisms.

Hypothesis 9, which posited that technical knowledge exerts a significant effect on urban public infrastructure governance mechanisms, is not supported. This finding suggests that while technical knowledge is important for understanding and operating electric vehicle (EV) systems, it does not independently drive changes or improvements in governance structures related to urban EV infrastructure. Rather, governance mechanisms are typically influenced by a broader set of institutional, policy, and socio-economic factors. In TAM2, technical expertise could theoretically enhance perceived ease of use, as users with more knowledge may find systems easier to understand and integrate. However, in public sector adoption, decisions are collective, policy-driven, and less dependent on individual operator knowledge.

As Chen et al. (2024) and Collet & Linke (2025) argue, technical knowledge alone is insufficient unless embedded in broader institutional and policy frameworks. Within TAM2, the absence of a significant relationship suggests that ease of use perceptions does not dominate decision-making at governance levels. Instead, subjective norm (policy mandates, regulatory pressures) and perceived usefulness (strategic value of EV adoption) overshadow individual or technical familiarity.

This aligns with the notion that infrastructure governance requires more than just technical know-how; it necessitates stakeholder collaboration, public-private partnerships, legal mandates, and long-term planning strategies. Without these complementary elements, the presence of technical knowledge may remain underutilized or fragmented across agencies. Therefore, the lack of statistical

significance for Hypothesis 9 underscores that governance transformations in urban EV infrastructure are more likely to stem from coordinated institutional reforms than from technical knowledge in isolation.

Hypothesis 10: Vehicle cost exerts a significant effect on urban public infrastructure governance mechanisms

Hypothesis 10 is supported, indicating that statistical modeling (e.g., PLS‑SEM) confirms a significant link between vehicle cost and the governance mechanisms that shape urban public infrastructure. In practical terms, shifts in electric‑vehicle (EV) pricing, arising from manufacturing expenses, subsidies, taxation policies, or economies of scale, directly influence how cities plan, develop, and manage supporting infrastructure. When EV prices fall, governments often recalibrate subsidies, redirect incentives toward charging‑station deployment, and accelerate grid upgrades; conversely, persistent high prices lead policymakers to bolster financial aid, extend tax breaks, or offer favorable loan programs to spur uptake. Market penetration is another pivotal channel: elevated vehicle costs typically suppress adoption rates, prompting authorities to pace infrastructure expansion cautiously, whereas declining costs justify faster rollouts of chargers and grid enhancements to meet burgeoning demand. Financing strategies also evolve with affordability trends: lower prices attract greater private investment, encouraging public‑private partnerships and investment‑friendly regulations, while higher prices may require heavier public funding or risk‑mitigation measures to entice capital. Finally, urban mobility policies, especially those governing electric buses, taxis, and ride‑sharing fleets, respond to vehicle‑cost dynamics; falling

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prices make large-scale fleet electrification viable, whereas higher costs may delay full electrification in favor of hybrid solutions or incremental upgrades.

These dynamics align with Harahap et al. (2023), who argue that governance frameworks provide the economic and regulatory scaffolding that allows cost factors to accelerate EV adoption. Similarly, research by Grandi (2020) and Bhat et al. (2022) highlights how integrated governance, spanning economic incentives, regulatory measures, and social-infrastructure planning, amplifies the influence of vehicle cost, charging cost, and technical knowledge on EV uptake. By maintaining governance mechanisms that remain responsive to evolving vehicle-cost trends, urban planners can optimize infrastructure investments, enable sustained EV adoption, and advance long-term sustainable-mobility objectives.

Under TAM2, vehicle affordability influences both perceived usefulness (through long-term savings and operational efficiency) and ease of use (affordability lowers entry barriers). Governance structures act on these perceptions by adapting subsidies, procurement policies, and regulatory frameworks in response to cost fluctuations.

For instance, lower EV costs increase their perceived usefulness by improving return on investment, encouraging governance bodies to accelerate fleet electrification and infrastructure expansion. Conversely, high costs raise barriers, leading policymakers to enhance incentives or phase adoption plans. This reflects TAM2's emphasis on external variables (cost, policy) shaping adoption through usefulness perceptions. Supporting studies (Harahap et al., 2023; Bhat et al., 2022) show that governance frameworks amplify the impact of cost by designing policies that reduce price barriers and enhance affordability. Thus, TAM2 helps explain the significance of cost in

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shaping governance: by altering perceptions of usefulness and economic viability, cost becomes a key determinant of how governance adapts to EV adoption pressures.

Hypothesis 11: Charging facility costs exert a significant effect on urban public infrastructure governance mechanisms

The analysis shows that charging facility costs do not exert a statistically significant influence on the governance mechanisms that steer urban public EV infrastructure. Although cost is often foregrounded in infrastructure debates, this result aligns with Harahap et al. (2023), who argue that governance architectures function as mediating platforms through which broader economic conditions, not individual cost components, shape adoption outcomes. Other scholars likewise observe that governance arrangements, comprising economic, regulatory, and social instruments, tend to amplify rather than originate the effects of cost-side variables such as vehicle price, charging tariffs, and technical know-how (Grandi, 2020; Bhat et al., 2022). Similarly, Chen et al. (2024) found that while potential users perceive charging costs as relevant to their personal decision-making, such costs do not directly drive the systemic development of public charging infrastructure. Instead, their study emphasized that non-cost factors, such as location convenience, charging efficiency, and infrastructure accessibility, play a more central role in shaping users' adoption intent and thus indirectly influence infrastructure planning and governance.

From a TAM2 standpoint, this indicates that perceived usefulness of EV infrastructure for decision-makers in Hunan is not directly shaped by the financial burden of charging facilities. Instead, subjective norm (policy directives, societal expectations) and institutional support structures may override pure cost concerns. TAM2 emphasizes that perceived usefulness is strongly influenced by external variables and

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organizational mandates; in this case, subsidies and policy incentives dilute the salience of cost in shaping governance.

The lack of a direct statistical link between charging facility costs and governance mechanisms suggests that financial pressures associated with charging stations are largely mediated by institutional and policy contexts. In many urban settings, subsidies, tax incentives, and direct public investment offset the fiscal burden of installing and operating chargers, while public–private partnerships distribute risk and capital requirements, diluting the immediate impact of cost on governance design. Alternative financing tools, leasing arrangements, concession models, or demand-based pricing, further shift governance attention from cost recovery to regulatory compliance, service quality, and stakeholder coordination. Where EV infrastructure is already mature, marginal network expansions impose relatively minor fiscal strain; in nascent markets, costs may loom larger, implying a stage-dependent rather than universal influence. Finally, governance bodies frequently prioritize long-term sustainability goals, carbon-reduction mandates, and technological innovation over short-term financial metrics, so non-monetary drivers often overshadow cost considerations when drafting EV-infrastructure policies. Collectively, these dynamics explain why charging facility expenses, despite their practical importance, do not emerge as an independent determinant of urban infrastructure governance.

Hypothesis 12: Economic benefits exert a significant effect on urban public infrastructure governance mechanisms

The results confirm that economic benefits exert a significant influence on urban public infrastructure governance mechanisms, indicating that economic considerations play a crucial role in shaping governance frameworks. This finding aligns with prior

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research suggesting that economic incentives, financial sustainability, and cost-efficiency considerations are integral to infrastructure governance and policy formulation (Harahap et al., 2023; Grandi, 2020). Economic benefits, such as cost savings, return on investment (ROI), and revenue generation, serve as key motivators for government agencies and private stakeholders to develop, expand, and regulate public infrastructure efficiently. A well-governed infrastructure system ensures optimal resource allocation, attracting investment while maintaining long-term economic viability. Within TAM2, this aligns closely with result demonstrability, where decision-makers value clear, measurable benefits, such as fuel savings, operational efficiency, and revenue potential, when evaluating EV integration. Economic benefits enhance the perceived usefulness of EV infrastructure, as administrators see tangible improvements in resource allocation and long-term financial sustainability.

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Moreover, infrastructure governance mechanisms often prioritize economic efficiency, ensuring that resources are allocated effectively to support sustainable infrastructure growth. Governance structures that integrate economic feasibility assessments, demand forecasting, and financial risk management are more likely to facilitate EV adoption. Cities and municipalities view EV infrastructure governance as a catalyst for economic growth, creating new business opportunities, employment prospects, and market expansion in the EV sector. Governance mechanisms that prioritize economic benefits contribute to enhanced mobility, energy efficiency, and environmental sustainability, further justifying public investment. As a concluding remark, the significant relationship between economic benefits and urban public infrastructure governance mechanisms highlights the critical role of financial incentives in shaping

governance structures. To enhance governance effectiveness, policymakers and urban planners should prioritize economic sustainability, investment-friendly policies, and financial risk management strategies.

Hypothesis 13: Infrastructure governance mechanisms exert a significant effect on urban public electric vehicle adoption

The results confirm that infrastructure governance mechanisms significantly influence urban public electric vehicle (EV) adoption, underscoring the critical role of governance structures in shaping the accessibility, efficiency, and expansion of EV infrastructure. This finding aligns with existing research suggesting that well-developed governance frameworks enhance EV adoption by ensuring regulatory stability, optimizing infrastructure deployment, and facilitating stakeholder coordination. In TAM2 terms, governance mechanisms operate as subjective norm and facilitating conditions, which strongly influence perceived usefulness and intention to adopt in institutional contexts. When governance structures provide regulatory clarity, subsidies, and inter-agency coordination, decision-makers in the public sector perceive EV adoption as more useful and less risky, thereby strengthening behavioral intention.

Achiaw and Kanol (2021) identified governance mechanisms, encompassing political, economic, and energy infrastructure, as well as technology readiness and manufacturing capacity as key predictors driving EV adoption in developed nations. Similarly, Zimm (2021) highlights that leading countries implement effective governance frameworks to facilitate and accelerate EV adoption. Furthermore, Kumar et al. (2020) emphasize that government resource management plays a crucial role in

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expanding infrastructure, reducing EV costs, enhancing consumer purchasing power, and ultimately stimulating EV adoption.

Effective infrastructure governance provides clear regulatory frameworks, incentives, and policy consistency, reducing uncertainty for businesses, investors, and consumers. Well-structured governance mechanisms streamline licensing, standardize charging infrastructure, and ensure compliance with safety and efficiency regulations, thereby accelerating adoption. Governance structures that incorporate economic feasibility assessments, carbon reduction targets, and public subsidies create a favorable market for EV adoption. Effective governance mechanisms align urban mobility policies with environmental objectives, reinforcing public trust in EV infrastructure sustainability. The significant effect of infrastructure governance mechanisms on urban public EV adoption highlights the importance of well-structured policies, regulatory stability, and coordinated stakeholder efforts. To sustain EV adoption, urban planners and policymakers must strengthen governance frameworks, facilitate investment, and optimize infrastructure deployment strategies.

Hypothesis 14: Infrastructure governance mechanisms mediate the effect of charging infrastructure on urban public electric vehicle adoption

The results indicate that infrastructure governance mechanisms do not mediate the relationship between charging infrastructure and urban public electric vehicle (EV) adoption. This suggests that while charging infrastructure directly influences EV adoption, governance mechanisms may not serve as a critical intermediary in this relationship. Within TAM2, this suggests that perceived ease of use (the convenience of having chargers available) has a strong, direct influence on adoption intentions,

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independent of governance mediation. Existing literature highlights the role of governance in facilitating infrastructure development (Harahap et al., 2023; Grandi, 2020), yet this finding implies that the availability, accessibility, and efficiency of charging infrastructure independently drive EV adoption, without significant reliance on governance as a mediating factor (Bhat et al., 2022). Sierzchula et al. (2014) demonstrate that conventional policy levers, such as capital subsidies for charger installation, free public parking, or reduced registration fees, rarely translate into a proportional increase in national EV uptake. Their cross-country comparison reveals that, even in regions with extensive charger roll-outs, adoption rates remain modest unless complementary governance structures, clear regulatory standards, inter-agency coordination, and long-term funding frameworks are in place. The authors conclude that infrastructure alone lacks a sufficiently integrated policy "channel" to convert physical availability into behavioral change among fleet operators and transit agencies.

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Building on this perspective, Wang et al. (2023) find that current policy portfolios are heavily skewed toward demand-side incentives, such as purchase rebates and consumer tax credits, while neglecting supply-side measures that align infrastructure deployment with governance capacity. Critical elements like standardized charger certification, streamlined permitting, grid-upgrade mandates, and multi-stakeholder planning receive comparatively less attention. This imbalance weakens the mediating power of governance mechanisms: although chargers appear on the ground, the absence of robust policy guidance, regulatory oversight, and institutional coordination means those assets are not leveraged effectively to scale up urban public fleets.

Collectively, these studies highlight a systemic gap: charging infrastructure, in the absence of a balanced mix of supply‐ and demand‐side policies, fails to foster the governance conditions necessary for mass EV adoption. For urban public transportation systems, where fleet decisions are highly institutional, the lack of integrated governance support undermines the potential indirect pathway from infrastructure provision to widespread EV uptake. Charging infrastructure is a fundamental enabler of EV adoption, with factors such as charging station density, accessibility, and charging speed playing a direct role in influencing consumer decisions. As a result, governance mechanisms may not significantly mediate this relationship since infrastructure availability itself serves as a more immediate determinant of adoption.

Hypothesis 15: Infrastructure governance mechanisms mediate the effect of electric vehicle performance on urban public electric vehicle adoption

The results confirm that infrastructure governance mechanisms significantly mediate the relationship between electric vehicle (EV) performance and urban public EV adoption. This suggests that while vehicle performance (e.g., battery range, energy efficiency, durability) influences adoption decisions, the effectiveness of governance frameworks enhances this relationship by addressing regulatory, infrastructural, and policy-driven factors. Governance mechanisms establish regulatory frameworks for battery efficiency, charging interoperability, and vehicle safety, ensuring widespread adoption. Standardization efforts (e.g., universal charging compatibility) mitigate technological uncertainty, making EVs a more attractive option. Under TAM2, EV performance influences output quality and result demonstrability, but governance mechanisms are essential to institutionalize these benefits into perceived usefulness for fleet managers.

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In addition, infrastructure governance facilitates the development of fast-charging networks, smart grid integration, and renewable energy-powered charging stations, ensuring that EV performance advantages (e.g., longer range, faster charging) translate into practical benefits. Policies promoting subsidies for high-performance EVs and incentives for manufacturers developing energy-efficient models further reinforce adoption. The findings underscore that infrastructure governance mechanisms serve as a critical enabler in transforming EV performance improvements into widespread adoption. As such, future policy efforts should focus on strengthening governance frameworks that support infrastructure expansion, standardization, and market incentives, ensuring that technological advancements in EV performance translate into higher adoption rates.

Hypothesis 16: Infrastructure governance mechanisms mediate the effect of technical knowledge on urban public electric vehicle adoption

The hypothesis that infrastructure governance mechanisms mediate the effect of technical knowledge on public electric vehicle (EV) adoption is not supported. This outcome suggests that, despite the increasing availability of EV-related information and technical advancements, governance mechanisms alone do not serve as an effective bridge to translate user knowledge into adoption behavior in the public sector. From a TAM2 lens, this indicates that technical knowledge does not substantially alter perceived usefulness or ease of use in institutional adoption contexts. Adoption decisions in Hunan's public transport sector are driven by collective governance and external mandates rather than individual expertise. Gupta et al. (2024) provide a relevant explanation, finding that policy interventions aimed at promoting EV adoption have not significantly improved user knowledge or technical understanding

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of EV systems. Their study reveals that the design and implementation of many EV-related policies often overlook the need to educate or technically empower end-users, particularly in public or institutional transportation contexts. As a result, while governance structures may exist to support EV infrastructure, they do not necessarily enhance the public's technical literacy or influence decision-making through improved awareness or comprehension.

This finding underscores a disconnect: governance mechanisms may focus on infrastructure development, regulatory compliance, and investment planning, but without integrated strategies that enhance users' technical knowledge, such as training programs, public awareness campaigns, or user-friendly information systems, the mediating effect of governance is significantly weakened. In the context of urban public transportation, where adoption decisions involve collective, organizational, and policy-driven choices, the absence of user-focused technical education further reduces the relevance of governance mechanisms as a mediator. Therefore, without directly engaging and informing stakeholders about EV technologies, governance systems alone cannot convert technical knowledge into actionable adoption outcomes.

Hypothesis 17: Infrastructure governance mechanisms mediate the effect of vehicle cost on urban public electric vehicle adoption

The results confirm that infrastructure governance mechanisms significantly mediate the relationship between vehicle cost and urban public electric vehicle (EV) adoption. This suggests that while vehicle cost remains a major determinant of EV adoption, governance frameworks play a crucial role in reducing cost burdens through strategic policy interventions, infrastructure investments, and economic incentives. In TAM2,

cost perceptions influence both perceived usefulness (through expected cost savings) and ease of use (via affordability of adoption). Governance mechanisms, such as subsidies, tax breaks, and procurement incentives, amplify this relationship by reframing high upfront costs into long-term usefulness.

Previous studies highlight that governance mechanisms help offset high EV purchase costs through subsidies, tax incentives, and financing schemes, making EVs more accessible to a broader consumer base (Kumar et al., 2020; Zimm, 2021). Moreover, well-structured governance policies facilitate cost reductions in production, battery development, and infrastructure expansion, further stimulating market adoption (Grandi, 2020; Bhat et al., 2022). The findings underscore that vehicle cost alone is not the sole determinant of EV adoption, governance mechanisms play an essential role in mitigating cost barriers through subsidies, infrastructure expansion, and financial incentives. As such, strengthening governance-driven cost-reduction strategies can accelerate EV adoption in urban public transportation systems.

Hypothesis 18: Infrastructure governance mechanisms mediate the effect of charging facility costs on urban public electric vehicle adoption

The results indicate that infrastructure governance mechanisms do not mediate the relationship between charging facility costs and urban public electric vehicle (EV) adoption. This suggests that while charging facility costs remain a key economic factor, their influence on adoption may operate independently of governance interventions. The hypothesis states that the indirect effect of charging facility cost on electric vehicle (EV) adoption in the public transportation sector is mediated by infrastructure governance mechanisms is not supported. This indicates that, despite the presence of

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governance structures, the influence of charging facility costs does not translate effectively into increased EV adoption within public transportation systems. In other words, the governance mechanisms currently in place are not functioning as effective intermediaries between economic considerations (e.g., the cost of installing and maintaining charging facilities) and the broader objective of fostering widespread EV integration in urban transit networks. From a TAM2 perspective, the influence of charging facility costs on adoption reflects perceived ease of use (affordable and accessible charging) and perceived usefulness (economic feasibility). However, governance interventions, such as subsidies or PPPs, have not been strong enough to reshape these perceptions.

The findings of Encarnação et al. (2018) offer valuable context for understanding this result. Their study emphasized that public regulation, while necessary, is not sufficient to guarantee full adoption of EVs, especially in large-scale public systems. Regulatory initiatives, such as mandates for infrastructure installation or subsidies to reduce capital investment costs, may address surface-level economic barriers but often fail to penetrate deeper structural or behavioral impediments. In the case of charging facility costs, even when financial burdens are alleviated through subsidies or public-private partnerships, adoption may still lag if regulatory frameworks do not integrate sufficiently with operational planning, institutional coordination, and long-term strategy alignment across stakeholders.

Deka et al. (2023) further support this conclusion by showing that EV promotion policies, particularly those focused on economic incentives, often do not translate into a strong intention to adopt EVs among target users or organizations. Their research

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highlights a key issue: policy instruments that address affordability or infrastructure access may lack traction when they fail to simultaneously influence perception, trust, and readiness among users or institutional actors such as municipal transport agencies. In this regard, lowering charging facility costs through governance mechanisms may reduce logistical or financial hurdles but will not inherently lead to higher adoption rates if complementary policies around education, training, fleet integration, and maintenance infrastructure are absent or poorly executed.

The lack of a significant indirect effect also reflects a broader issue in policy design—the imbalance and fragmentation of policy instruments. Current governance approaches may be too narrowly focused on cost-based or supply-side interventions, failing to synchronize with demand-side drivers such as stakeholder engagement, behavioral nudges, or public acceptance campaigns. This echoes earlier findings from Wang et al. (2023), who observed that policy instruments are often tilted heavily toward demand-side incentives without adequate support for supply-side infrastructure coordination. Therefore, the non-significance of this mediating relationship underscores a critical policy gap. While infrastructure governance mechanisms theoretically provide a conduit through which cost-related variables could influence EV adoption, in practice, they lack the necessary integration, scope, and effectiveness to act as transformational levers, particularly in complex and capital-intensive domains like urban public transport systems. For these mechanisms to successfully mediate the relationship between charging facility cost and EV adoption, they must be embedded within a more holistic framework that includes strategic planning, regulatory consistency, inter-agency collaboration, and stakeholder participation. In conclusion, charging facility costs alone, even when addressed through infrastructure governance

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mechanisms, do not produce sufficient momentum to catalyze EV adoption in the public transportation sector. Policymakers must recognize that cost-focused governance interventions, while important, must be part of a broader, multi-dimensional strategy if they are to effectively drive the transition toward sustainable urban mobility.

Hypothesis 19: Infrastructure governance mechanisms mediate the effect of economic benefits on urban public electric vehicle adoption

The results confirm that infrastructure governance mechanisms significantly mediate the relationship between economic benefits and urban public electric vehicle (EV) adoption. This suggests that while economic benefits, such as lower operational costs, fuel savings, and long-term financial incentives, play a crucial role in EV adoption, their impact is amplified when channeled through effective governance mechanisms. Within TAM2, economic benefits enhance perceived usefulness and result demonstrability; governance structures (e.g., subsidies, tariff adjustments, and revenue-generating policies) ensure these benefits are institutionalized and communicated across decision-making processes.

Previous studies highlight that governance structures facilitate economic advantages by implementing policies that reduce the total cost of EV ownership, enhance infrastructure accessibility, and create a favorable regulatory environment for EV users (Kumar et al., 2020; Zimm, 2021). Moreover, well-designed governance mechanisms ensure that economic benefits are sustained through subsidies, incentives, and long-term strategic investments in EV infrastructure (Grandi, 2020; Bhat et al., 2022). Subsidies and tax incentives lower the upfront cost of EVs, making them more

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financially attractive to both individuals and public transportation agencies. Regulatory frameworks promoting energy-efficient charging tariffs reduce long-term operational costs, reinforcing the financial advantages of EV adoption. Governance mechanisms reduce market uncertainties by establishing clear regulations, long-term incentives, and stable energy policies, fostering investor confidence and technological advancements.

Thus, the findings underscore that economic benefits alone are not sufficient to drive widespread EV adoption; governance mechanisms play an essential role in amplifying these benefits through strategic policies, infrastructure investments, and financial incentives. Strengthening governance frameworks that align economic advantages with infrastructure expansion and regulatory support can further accelerate EV adoption in urban public transportation systems.

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5.4 Research Implications

The implications of this study contribute meaningfully to the literature on sustainable transportation and technology adoption, though they must be understood within the specific context of Hunan Province. As a mid-tier Chinese province with distinctive governance and infrastructural characteristics, Hunan provides a valuable case study, yet the findings should not be overgeneralized to the entire Chinese public sector. Instead, they are most relevant for regions with comparable administrative structures, economic development levels, and public transportation systems. Theoretically, the study advances understanding of EV adoption by integrating technical, economic, and governance factors into a single framework, thereby extending established models such as the Technology Acceptance Model (TAM) and Socio-Technical Systems Theory (STS) in the context of public sector transportation. Empirically, it fills a

notable gap by demonstrating the mediating role of infrastructure governance mechanisms in EV adoption within Hunan, highlighting how policy interventions and financial incentives influence institutional decision-making. Methodologically, the application of mediation analysis and structural equation modeling (SEM) offers a robust analytical approach that can be replicated in similar contexts. From a policy and practice perspective, the findings provide actionable insights for decision-makers in Hunan by identifying barriers and enablers of EV adoption, while also offering a foundation for comparative research in other provinces with parallel development profiles. Finally, the study opens pathways for future research by suggesting the inclusion of emerging technologies, such as AI-driven fleet management, and behavioral dimensions in EV adoption studies, alongside expanding the scope beyond Hunan to strengthen the external validity of the findings.

5.4.1 Theoretical Implications

5.4.1.1 Theoretical Implications of Technology Acceptance Model

The findings of this study carry significant theoretical implications for the Technology Acceptance Model (TAM) by extending its scope beyond individual consumer behavior to institutional decision-making processes in the adoption of electric vehicles (EVs) within the public sector. Traditionally, TAM has been applied to explain information system adoption at the individual level, emphasizing perceived usefulness (PU) and perceived ease of use (PEOU). However, this research demonstrates the model's robustness in explaining public sector adoption of technological innovations, where decisions are shaped not only by user perceptions but also by technical, economic, infrastructural, and governance-related factors. In this context, PU extends beyond individual efficiency gains to encompass organizational objectives such as operational effectiveness, environmental sustainability, and long-term cost-efficiency,

while PEOU reflects institutional readiness, including the ease of integrating EVs into existing fleets, availability of charging infrastructure, and technical maintenance capabilities.

A key theoretical advancement lies in the incorporation of infrastructure governance mechanisms as a mediating construct within TAM. The results indicate that effective governance frameworks can significantly enhance both PU and PEOU by reducing bureaucratic and logistical barriers and by aligning institutional decision-making with sustainable mobility goals. For instance, clear regulatory standards, efficient subsidy allocation, and strategic public–private partnerships were found to improve perceived ease of use by simplifying EV integration processes, while policies promoting standardization and interoperability enhanced perceived usefulness by ensuring long-term efficiency and policy compliance. This study further enriches TAM by recognizing the moderating influence of economic and policy incentives. The data reveal that economic viability conditions the strength of PU, with financial incentives, cost reductions, and long-term return on investment shaping whether perceived benefits translate into adoption. Similarly, policy interventions moderate PEOU by facilitating infrastructure readiness and reducing complexity through tax incentives, charging infrastructure expansion, and fleet electrification mandates.

Taken together, these contributions extend the theoretical boundaries of TAM, demonstrating its applicability in institutional and policy-driven contexts. Public sector adoption decisions are not solely determined by individual-level attitudes but by a network of interdependent stakeholders, including policymakers, transport authorities, urban planners, fleet managers, and technology providers. Moreover, social and environmental considerations are shown to play a critical role in shaping

PU, highlighting the need for a sustainability-oriented perspective in TAM's future development. By contextualizing TAM within the public adoption of EVs in Hunan, China, this study advances the model beyond its conventional individualistic application, integrating governance, infrastructure, and economic dimensions. Ultimately, it underscores the necessity of an enhanced TAM framework that reflects the realities of policy-driven technology adoption, institutional readiness, and sustainability imperatives, thereby offering a holistic understanding of innovation adoption in the public transportation sector.

5.4.1.2 Theoretical Implications of Socio-Technical Systems Theory

The findings of this study offer significant theoretical contributions to Socio-Technical Systems (STS) Theory by highlighting the interdependence between technological, organizational, economic, and policy-driven factors in shaping the adoption of electric vehicles (EVs) in the public sector of Hunan, China. STS theory emphasizes that technology adoption does not occur in isolation but is embedded within a complex socio-technical ecosystem, where technological advancements must be supported by social, institutional, and economic structures to ensure sustainable implementation. In this context, the study demonstrates that successful EV adoption requires a careful balance between the technical subsystem—which includes EV technology, charging infrastructure, battery systems, and energy grid capacity—and the social subsystem, which encompasses regulatory frameworks, economic policies, public sector organizations, and stakeholder collaboration. The interplay between these dimensions illustrates that technological readiness alone is insufficient; rather, systemic coordination between technical innovation and governance mechanisms is essential to facilitate the integration of EVs into public transportation networks.

A further refinement of STS theory is provided through the identification of infrastructure governance as a critical mediating mechanism that shapes adoption outcomes. The study shows that effective governance structures, such as coherent regulatory frameworks, consistent policy direction, and strategic infrastructure planning, reduce uncertainties in implementation and strengthen institutional commitment. In addition, collaborative governance arrangements involving municipal authorities, utility providers, and transport operators ensure that charging infrastructure expansion is aligned with EV deployment, reinforcing the systemic integration of technical and social subsystems. This advances STS theory by clarifying the governing role of infrastructure management in facilitating sustainable technology adoption in public sector mobility.

The study also contributes to the STS discourse on socio-technical work design by demonstrating how the introduction of EVs reshapes organizational processes, workforce development, and human–technology interaction within public sector transport agencies. Adoption requires workforce training and professional development in EV-specific maintenance, charging protocols, and energy efficiency practices. It also demands organizational change management, such as adjustments in fleet management, route planning, and energy use strategies, to optimize operations. Furthermore, operator perceptions of EV reliability, ease of use, and overall adaptability represent critical social dimensions that influence the success of adoption. These findings extend STS theory by showing how institutional work systems and human-technology interactions must evolve to accommodate sustainable mobility innovations.

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Taken together, the study proposes a holistic socio-technical framework for understanding EV adoption in the public sector. This framework integrates technological innovation, infrastructure governance, organizational adaptation, and economic policy, positioning STS as a multi-level analytical lens. Unlike traditional applications of STS, which focus largely on workplace automation and operational efficiency, this study demonstrates that EV adoption is contingent on broader economic viability, financial incentives, and systemic resilience. It further aligns with STS principles of adaptability and sustainability, showing that long-term EV adoption success depends on continuous infrastructure investment, responsive policy design, and organizational learning. In sum, this research extends STS theory by situating EV adoption within a multi-layered socio-technical ecosystem, underscoring the importance of aligning technical, organizational, and governance subsystems to enable a sustainable transition in public sector mobility systems.

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5.4.2 Practical Implications

The practical implications of this study hold considerable relevance for policymakers, transportation authorities, EV manufacturers, and urban planners, particularly in shaping strategies to accelerate the adoption of electric vehicles in the public transportation systems of Hunan, China. By identifying the technical, economic, and governance-related factors that influence adoption, the findings provide a strong foundation for policy design, infrastructure planning, industry innovation, and environmental improvement. From a policy perspective, the results underscore the need for targeted incentives and regulatory frameworks to reduce barriers such as limited charging facilities and high operational costs. Policymakers should prioritize improvements in infrastructure governance by expanding charging networks, integrating renewable energy sources, and creating supportive financial mechanisms

such as subsidies, tax incentives, and public–private partnerships. These measures can alleviate affordability concerns and encourage wider adoption across public sector transport agencies. At the same time, strengthening infrastructure governance emerges as a crucial enabler, with effective management of charging facilities, battery-swapping systems, and grid integration ensuring sustainable deployment. Smart infrastructure solutions, driven by data analytics, can optimize the placement and utilization of charging stations, while collaborative governance arrangements can facilitate innovation through public–private cooperation.

For public transport operators, the findings provide actionable insights for strategic fleet transition. Agencies can design phased adoption strategies that consider cost–benefit trade-offs, implement route optimization and battery management systems to enhance efficiency, and invest in workforce development programs to equip drivers and maintenance staff with EV-specific competencies. These operational shifts are essential to ensure a smooth and effective transition toward electrified fleets.

The study also offers valuable guidance for EV manufacturers, highlighting the importance of aligning product development with the technical and economic needs of public transport agencies. Enhancements in vehicle design, such as improved battery performance, charging speed, and durability, are critical to overcoming technical constraints that limit adoption. At the same time, manufacturers may adopt flexible business models, including leasing arrangements and battery-swapping services, to ease financial burdens for public authorities. Active participation in policy dialogues further ensures that manufacturers remain attuned to regulatory requirements and sustainability objectives, strengthening the alignment between industrial strategies and public sector needs.

Beyond institutional and industry-level implications, the findings reinforce the environmental and societal benefits of transitioning to EV-based public transport. Large-scale adoption contributes to China's carbon neutrality commitments by reducing greenhouse gas emissions, improves urban air quality by lowering air and noise pollution, and enhances social equity by providing affordable, sustainable, and accessible mobility options to urban residents.

In sum, by addressing the interplay of technical, economic, and governance challenges, this study provides a roadmap for accelerating EV adoption in Hunan's public transport sector. The findings emphasize the importance of policy support, infrastructure investment, and industry collaboration in enabling a more sustainable, efficient, and environmentally friendly urban mobility system, thereby contributing not only to regional development but also to China's broader sustainable transportation agenda.

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5.5 Research Limitations

Despite the valuable contributions of this study in advancing the understanding of factors influencing urban public electric vehicle (EV) adoption and the role of infrastructure governance mechanisms, several limitations must be acknowledged. These limitations, inherent in research design, methodology, and contextual scope, should be carefully considered when interpreting the findings and planning future studies.

1. Methodological Constraints

One of the primary limitations of this study lies in its methodological approach, particularly the reliance on quantitative data and hypothesis testing. While statistical techniques provide robust insights into relationships between variables, they may not

fully capture the nuanced behavioral, attitudinal, and policy-driven influences affecting EV adoption. A mixed-methods approach integrating qualitative insights (e.g., expert interviews, case studies, or focus groups) could have enriched the findings by providing a deeper contextual understanding. Additionally, the study employed survey-based data collection, which is susceptible to potential issues such as social desirability bias, common method bias, and self-reported measurement inaccuracies. Although efforts were made to ensure validity and reliability, respondents' perceptions may not always reflect actual behaviors or market dynamics, thereby limiting the generalizability of the results.

2. Sample and Generalizability Limitations

The study was conducted within a specific geographical context, focusing on urban public EV adoption within a particular region. While this setting provides valuable localized insights, the findings may not be fully generalizable to other regions or countries with different economic, regulatory, and infrastructural landscapes. The extent to which the results apply to cities with varying levels of EV adoption readiness, differing policy frameworks, or distinct socio-cultural influences remains uncertain. Moreover, the study's sample primarily consisted of stakeholders directly involved in urban EV adoption, such as policymakers, infrastructure planners, and potential users. However, it did not account for indirect stakeholders, such as automobile manufacturers, private investors, or environmental advocacy groups, who may also play a crucial role in shaping EV adoption dynamics. Expanding the respondent base could have provided a more holistic perspective on the challenges and opportunities in the EV ecosystem.

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3. Limitations in Theoretical and Variable Scope

While the study integrates key theoretical frameworks to analyze urban EV adoption and governance mechanisms, it does not account for all possible influencing factors. For instance, the study focused on variables such as charging infrastructure, EV performance, technical knowledge, vehicle cost, charging facility cost, and economic benefits, yet other critical determinants—such as environmental awareness, government incentives, technological innovations, and cultural attitudes toward EVs, were not explicitly included. Additionally, while infrastructure governance mechanisms were examined as both an independent and mediating variable, their operationalization may not have captured the full complexity of governance dynamics, such as policy enforcement challenges, inter-agency coordination issues, or political resistance to EV initiatives. Future research could adopt multi-level governance perspectives to explore how national, regional, and municipal policies collectively shape EV adoption trends.

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4. Temporal and Longitudinal Limitations

The study employed a cross-sectional research design, capturing data at a single point in time. While this approach is effective for analyzing immediate relationships between variables, it does not account for the evolving nature of urban EV adoption and infrastructure governance mechanisms over time. Given that technological advancements, policy changes, and consumer preferences constantly evolve, a longitudinal study tracking these trends over several years could provide a more dynamic and comprehensive understanding of adoption patterns. For instance, while the findings suggest that vehicle cost is a significant determinant, this factor may become less relevant in the future as EV prices decline due to economies of scale and

technological improvements. Similarly, the role of government subsidies and incentives may shift over time, altering the relative importance of economic benefits in adoption decisions.

5. Policy and Market Dynamics Constraints

Urban public EV adoption is strongly influenced by government policies, economic incentives, and private-sector investment, yet these factors are often subject to external disruptions, policy reversals, or global economic trends. The study's findings are based on current policy conditions, which may change over time due to shifts in political priorities, regulatory amendments, or market competition from alternative transportation solutions (e.g., hydrogen fuel-cell vehicles or improved public transit systems). Furthermore, supply chain disruptions, raw material shortages (such as lithium for batteries), and geopolitical factors can significantly impact the feasibility of large-scale EV adoption. While these macroeconomic elements were beyond the scope of this study, they remain important considerations for policymakers and future researchers analyzing the sustainability of EV adoption in urban settings.

6. Technological and Infrastructure Uncertainty

Another limitation concerns the technological and infrastructural readiness of cities to support widespread EV adoption. While this study examines charging infrastructure and facility costs, it does not comprehensively assess grid capacity, energy demand management, or the integration of renewable energy sources in charging networks. As cities transition toward smart grids and decentralized energy systems, future research should consider how these innovations interact with governance mechanisms to enhance EV adoption. Additionally, the study did not explore the impact of emerging

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mobility trends, such as vehicle-to-grid (V2G) technology, autonomous electric vehicles, and shared mobility platforms, which may significantly alter adoption patterns shortly. Addressing these technological dimensions would provide a more forward-looking perspective on urban EV integration.

While this study makes a significant contribution to understanding the factors influencing urban public electric vehicle adoption and the role of infrastructure governance mechanisms, the limitations highlight important areas for further investigation. Future research should consider employing longitudinal designs, qualitative approaches, and multi-stakeholder perspectives to deepen insights into evolving market and policy dynamics. Additionally, integrating emerging technological, economic, and behavioral variables will be essential to developing a more comprehensive framework for sustainable EV adoption in urban environments.

Despite these limitations, the study provides a strong foundation for future scholarly inquiry and offers practical implications for policymakers, urban planners, and industry stakeholders seeking to accelerate the transition to electric mobility in urban settings.

5.6 Suggestions for Future Research

Building on the findings and limitations of this study, several areas warrant further investigation to enhance the understanding of urban public electric vehicle (EV) adoption and the role of infrastructure governance mechanisms. Future research should consider methodological, theoretical, and practical advancements to provide deeper insights into the evolving landscape of EV adoption in urban environments.

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1. Expanding the Scope of Determinants Influencing EV Adoption

While this study examined key determinants such as charging infrastructure, EV performance, technical knowledge, vehicle cost, charging facility costs, and economic benefits, future research could explore additional sociocultural, technological, and policy-driven factors that influence EV adoption. Some potential areas of exploration include:

(i) Environmental awareness and pro-sustainability attitudes examine how public perceptions of climate change and environmental consciousness impact EV adoption decisions.

(ii) Government incentives and regulatory frameworks by assessing the dynamic impact of subsidies, tax credits, and emissions regulations on EV adoption over time.

(iii) Technological innovation and battery advancements by investigating the role of solid-state batteries, fast-changing technologies, and energy storage solutions in accelerating adoption rates.

(iv) Shared and autonomous EV adoption trends – Analyzing how the emergence of shared electric mobility services and autonomous EVs might influence public transportation policies and urban infrastructure planning.

2. Longitudinal and Comparative Studies Across Different Regions

Since this study used a cross-sectional design, future research could adopt a longitudinal approach to track changes in EV adoption behaviors, policy impacts, and infrastructure development over time. This would allow researchers to:

(i) Analyze adoption trends before and after policy interventions.

(ii) Assess the sustainability of EV incentives and their long-term effects.

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(iii) Compare urban and rural adoption patterns to understand regional disparities in EV accessibility and infrastructure readiness.

(iv) Comparative studies between different countries or cities with varying levels of EV adoption maturity (e.g., China, Norway, the United States, and developing economies) could offer insights into best practices and contextual challenges in scaling EV infrastructure and governance.

3. Examining the Role of Infrastructure Governance Mechanisms in Greater Detail

While this study found that infrastructure governance mechanisms mediate certain relationships between EV adoption determinants and actual adoption rates, future research could:

(i) Develop a more comprehensive governance framework incorporating factors such as multi-level governance coordination, public-private partnerships, and decentralized decision-making processes.

(ii) Analyze policy enforcement challenges in EV infrastructure development, including bureaucratic delays, regulatory bottlenecks, and competing transportation priorities.

(iii) Investigate smart grid integration and renewable energy adoption for sustainable EV charging, exploring how urban energy policies influence EV infrastructure expansion.

4. Integrating Behavioral and Psychological Perspectives

Future studies could incorporate behavioral theories such as:

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(i) The Theory of Planned Behavior (Ajzen, 1991) – To explore how attitudes, subjective norms, and perceived behavioral control affect consumers' willingness to adopt EVs.

(ii) Prospect Theory (Kahneman & Tversky, 1979) – To examine how risk perception, loss aversion, and uncertainty influence EV purchase decisions.

(iii) The Technology Acceptance Model (TAM) – To analyze how perceived ease of use and perceived usefulness shape consumer acceptance of EVs.

5. Investigating the Financial and Economic Implications of EV Adoption

Given the significance of economic benefits, vehicle costs, and charging facility costs in influencing EV adoption, future research could:

- Conduct cost-benefit analyses of urban EV policies, comparing long-term savings for consumers versus the upfront infrastructure investment required by governments and private stakeholders.
- Explore financial barriers and solutions, such as innovative leasing models, battery-as-a-service (BaaS), and micro-financing options to make EVs more accessible to lower-income populations.
- Investigate the impact of fluctuating raw material prices (e.g., lithium, cobalt, and nickel) on the long-term affordability and sustainability of EV supply chains.

6. Evaluating the Environmental and Social Impact of EV Adoption

While EV adoption is widely regarded as an environmentally friendly initiative, future studies should critically assess its broader ecological and social implications, including:

- Life-cycle environmental assessment (LCA) – Evaluating the overall carbon footprint of EVs, including battery production, recycling, and energy grid reliance.

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- Equity and accessibility issues – Investigating whether urban EV policies disproportionately benefit affluent communities while neglecting lower-income neighborhoods with inadequate charging infrastructure.

- Impact on labor markets and skill development – Examining how the shift to EVs affects traditional automotive industries, job transitions, and workforce skill demands in urban economies.

7. Exploring Emerging Business Models and Industry Collaboration

Future research could explore new business models and industry partnerships that drive EV adoption, such as:

- Public-private partnerships (PPPs) in infrastructure development, analyzing how governments and private firms can collaborate more effectively.

- Vehicle-to-grid (V2G) business models, examining how EVs could be leveraged as energy storage assets for urban electricity grids.

- Subscription-based EV ownership models – Investigating the viability of pay-per-use or subscription-based EV services that lower entry barriers for consumers.

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As a concluding remark, future research should strive to expand theoretical perspectives, employ diverse methodological approaches, and explore interdisciplinary intersections to gain a holistic understanding of urban EV adoption and infrastructure governance mechanisms. Addressing these avenues will provide policymakers, industry leaders, and researchers with actionable insights to accelerate the transition toward sustainable, efficient, and inclusive electric mobility in urban settings.

5.7 Conclusion

This chapter has presented a detailed analysis of the factors shaping electric vehicle (EV) adoption within the public sector of Hunan, China. The empirical results confirm that technical, economic, infrastructural, and governance-related dimensions significantly influence adoption patterns. In doing so, the study extends the theoretical utility of the Technology Acceptance Model (TAM) and Socio-Technical Systems (STS) Theory. Specifically, TAM is advanced by demonstrating how institutional-level factors such as policy incentives, governance mechanisms, and infrastructure readiness act as moderating and mediating conditions that extend beyond the traditional focus on individual perceptions of usefulness (PU) and ease of use (PEOU). Similarly, the incorporation of STS theory highlights the necessity of aligning technological change with broader social, organizational, and regulatory structures to secure long-term adoption outcomes in public transportation systems.

The findings also provide more nuanced insights into the drivers of EV adoption. While charging infrastructure, charging facility costs, economic benefits, and infrastructure governance emerge as decisive factors, vehicle performance, vehicle cost, and technical knowledge do not exhibit significant direct effects. This suggests that these weaker drivers may require deliberate policy interventions, targeted subsidies, or infrastructural improvements to become more influential in shaping adoption behavior. Furthermore, infrastructure governance proves to be an important mediating mechanism, though its selective influence indicates regulatory and institutional gaps that must be addressed for a more seamless transition toward EV-based public transport systems.

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From a policy perspective, the study emphasizes the importance of targeted government incentives, infrastructure expansion, organizational capacity building, and workforce training to strengthen institutional readiness for EV integration. Public–private partnerships (PPPs) are further identified as critical enablers, capable of bridging demand and supply-side requirements by ensuring that infrastructure investments keep pace with growing mobility needs.

Nevertheless, the explanatory power of this study is bounded by its limitations. The focus on a single province, Hunan, restricts the breadth of the findings, as regional disparities in governance capacity, infrastructure development, and institutional readiness are pronounced across China. Equally, the absence of a multi-tier city comparison limits the ability to generalize results across different urban hierarchies, where first-tier metropolitan areas often possess more advanced infrastructure and policy frameworks than lower-tier cities. Consequently, the findings should be interpreted with caution, recognizing their contextual specificity.

In summary, this study contributes to theory by extending TAM and STS into the institutional domain of public-sector EV adoption and provides valuable empirical insights for policymakers. However, its geographical and structural limitations underscore the need for future research that adopts multi-regional and multi-tier comparative designs. Such approaches will not only enhance the generalizability of results but also provide a more comprehensive understanding of how socio-technical and governance dynamics interact across China's diverse urban contexts. Addressing these gaps will be essential for building scalable strategies that advance sustainable EV adoption in public transportation systems nationwide.

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APPENDICES

Appendix A

Survey Questionnaires

EXPLORING THE FACTORS INFLUENCING ELECTRIC VEHICLE ADOPTION IN THE URBAN PUBLIC SECTOR TRANSPORTATION OF HUNAN, CHINA

Dear Sir/Madam,

My name is Zhao Binliang, currently pursuing a doctoral degree at the School of Government, Universiti Utara Malaysia. As part of my doctoral research, I am conducting a survey among decision makers in urban public transportation government agencies in Hunan, China. The primary objective of this study is to investigate the factors influencing electric vehicle adoption in the public sector of Hunan province, China. Your participation in this research is invaluable. I kindly request you to complete the enclosed questionnaire, which should take approximately 10 to 15 minutes of your time. Your input is crucial for the success of this study. Rest assured; your responses will remain strictly confidential. Please complete the questionnaire and return it to my email address provided below. Thank you in advance for your participation.

Yours sincerely,
Zhao Binliang
PhD Research Candidate
School of Government, Universiti Utara Malaysia
Zhaobinliang1023@126.com
+86 186 1210 8168

SECTION I

This section asks for some background information. Please be assured that your responses to these questions are confidential. Please tick [/] in the relevant box for each question.

1. What is your gender? (Only 1 option)

Male		Female	

2. What is your age group? (Only 1 option)

Between 20 -30 years old	
Between 31 -40 years old	
Between 41 -50 years old	
Above 51 years old	

3. How many years of working experience do you have in this government agency? (Only 1 option)

1- 5 years	
6- 10 years	
11- 15 years	
16-20 years	
More than 20 years	

4. Pls indicate your educational background? (Only 1 option)

Upper Secondary Education	
Undergraduate	
Associate Degree	
Master's Degree	
Doctoral Degree	

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5. Pls indicate the department in your assigned government agency that responsible for urban public sector electric vehicle (EV) policies and programs. (Only 1 option)

1. Transportation Bureau/Department	
2. Energy Bureau/Department	
3. Environmental Protection Bureau/Department	
4. Economic Development Bureau/Department	
5. Urban Planning and Development Department	
6. Science and Technology Bureau/Department	
7. Government Affairs Office	

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6. Pls indicate the job title in your assigned government agency that responsible for urban public sector electric vehicle (EV) policies and programs. (Only 1 option)

1. Director of Transportation Planning	
2. Manager of Renewable Energy Projects	
3. Chief Environmental Policy Officer	
4. Urban Mobility Coordinator	
5. EV Infrastructure Project Manager	

6. Economic Policy Analyst (EV Sector)	
7. Urban Development Strategist	
8. Innovation and Technology Specialist	

7. Pls indicate your decision-making role in your assigned government agency that responsible for urban public sector electric vehicle (EV) policies and programs.

1. Policy formulation	
2.Regulatory oversight	
3. Financial Support	
4.Technology Development	
5.Public Awareness and Education	
6.Collaboration and Stakeholder Engagement	
7.Monitoring and Evaluation	

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SECTION II

Section II aims to achieve the research objectives of 1 & 2. This section asks your assessment on how you think (or perceive) on the adoption of urban public sector electric vehicle transportation in Hunan.

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales: Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

1.	Urban public sector transportation agency is interested in buying an EV.	5	4	3	2	1
2.	Urban public sector transportation agency plans to buy an EV in the next two years.	5	4	3	2	1
3.	Urban public sector transportation agency prefers EVs over traditional vehicles.	5	4	3	2	1
4.	Urban public sector transportation agency sees EVs as aligning with its environmental goals.	5	4	3	2	1
5.	Urban public sector transportation agency would recommend EVs to other transportation agencies.	5	4	3	2	1
6.	It would be good for Urban public sector transportation agency to have an EV.	5	4	3	2	1

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7.	Buying an EV is a good idea for Urban public sector transportation agency.	5	4	3	2	1
8.	It is smart for Urban public sector transportation agency to buy an EV.	5	4	3	2	1
9.	The urban public sector transportation agency anticipates the availability of a wider variety of EV brands and models in the market.	5	4	3	2	1
10.	Urban public sector transportation agency would be willing to pay more for a vehicle that is less harmful to the environment.	5	4	3	2	1

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SECTION III

Section III aims to achieve the research objective of 3,4, & 5. This section asks your assessment on how you think (or perceive) on the infrastructure governance mechanisms in the context of adoption of urban public sector electric vehicle transportation in Hunan, Sect

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales: Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

1.	Government policy support through direct subsidies for EV purchase.	5	4	3	2	1
2.	Government policy support through low-interest loans for EV adoption.	5	4	3	2	1
3.	Government policy support through tax exemptions and reductions.	5	4	3	2	1
4.	Government policy support through streamlined registration for green vehicles.	5	4	3	2	1
5.	Financial incentives such as grants to encourage EV uptake.	5	4	3	2	1
6.	Financial incentives through tax subsidies for EV-related purchases or investments.	5	4	3	2	1
7.	Government-led promotional campaigns to encourage EV adoption and usage.	5	4	3	2	1

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SECTION IV

Section IV aims to achieve the research objective of 1 & 3. This section asks your assessment on how you think (or perceive) on the Charging Infrastructure in the context of adoption of urban public sector electric vehicle transportation in Hunan.

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales: Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

1.	Adequate normal charging points are available in and around the city.	5	4	3	2	1
2.	Adequate fast charging points are available in and around the city.	5	4	3	2	1
3.	Adequate battery swap stations are available in and around the city.	5	4	3	2	1
4.	Urban public transportation agencies receive monetary benefits, such as tax exemptions or free parking.	5	4	3	2	1
5.	Urban public transportation agencies receive additional benefits, such as reserved parking spaces or access to HOV lanes.	5	4	3	2	1
6.	Public EV charging infrastructure is readily accessible and well-distributed.	5	4	3	2	1

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7.	EV infrastructure tailored to urban public transportation is available and sufficient.	5	4	3	2	1
8.	EV infrastructure at workplaces for public transportation staff is available.	5	4	3	2	1
9.	EV infrastructure along highways is accessible and reliable.	5	4	3	2	1

SECTION V

Section V aims to achieve the research objective of 1 & 3. This section asks your assessment on how you think (or perceive) on the Electric Vehicle Performance in the context of adoption of urban public sector electric vehicle transportation in Hunan.

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales: Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

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1.	The EVs in the current market provide a smooth and enjoyable driving experience.	5	4	3	2	1
2.	The EVs in the current market offer satisfactory performance in terms of speed, acceleration, and power.	5	4	3	2	1
3.	The acceleration time of EVs is short, and their power output is strong.	5	4	3	2	1
4.	EVs are easy to operate and do not require handling a gearbox.	5	4	3	2	1

5.	EVs are safe and meet modern safety standards.	5	4	3	2	1
6.	The battery life of EVs is long enough to meet daily driving needs.	5	4	3	2	1
7.	The driving range of EVs is sufficient for long-distance travel.	5	4	3	2	1
8.	A diverse range of EV models is available for consumers to choose from.	5	4	3	2	1
9.	The design of EVs, including interior and exterior, is modern and stylish.	5	4	3	2	1
10.	EVs are equipped with advanced digital entertainment and navigation features.	5	4	3	2	1

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SECTION VI

Section VI aims to achieve the research objective of 1 & 3. This section asks your assessment on how you think (or perceive) on the Technical Knowledge in the context of adoption of urban public sector electric vehicle transportation in Hunan.

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales:

Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

1.	The urban public transportation agency actively adopts the latest technological developments in EVs.	5	4	3	2	1
2.	EVs are equipped with state-of-the-art technologies.	5	4	3	2	1
3.	I am familiar with the integration of EVs and ICT to enhance assisted driving and smart mobility.	5	4	3	2	1
4.	I understand the technological performance of EVs, such as charging time, acceleration, driving comfort, and driving range.	5	4	3	2	1
5.	I am aware of the technological advantages of EVs compared to gasoline-powered vehicles.	5	4	3	2	1

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SECTION VII

Section VII aims to achieve the research objective of 2 & 4. This section asks your assessment on how you think (or perceive) on the Vehicle Cost in the context of adoption of urban public sector electric vehicle transportation in Hunan.

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales: Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

1.	The purchase cost of an electric vehicle is higher than that of a gasoline-powered vehicle.	5	4	3	2	1
2.	The fuel cost of an electric vehicle is higher than that of a gasoline-powered vehicle.	5	4	3	2	1
3.	The maintenance cost of an electric vehicle is higher than that of a gasoline-powered vehicle.	5	4	3	2	1
4.	The depreciation cost of an electric vehicle is higher than that of a gasoline-powered vehicle.	5	4	3	2	1
5.	Electric vehicles are generally affordable for most buyers.	5	4	3	2	1
6.	The price of electric vehicles is fair, considering their features and benefits.	5	4	3	2	1
7.	Overall, electric vehicles are more expensive than conventional vehicles.	5	4	3	2	1

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SECTION VIII

Section VIII aims to achieve the research objective of 2 & 4. This section asks your assessment on how you think (or perceive) on the Charging Facilities Cost in the context of adoption of urban public sector electric vehicle transportation in Hunan.

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales: Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

1.	Electric vehicles can only be charged at limited designated locations.	5	4	3	2	1
2.	The cost of charging electric vehicles is high compared to fueling gasoline or diesel vehicles.	5	4	3	2	1
3.	Electric vehicles take too long to charge, which makes them less convenient for regular use.	5	4	3	2	1
4.	Electric vehicles are not suitable for long-distance journeys due to range limitations.	5	4	3	2	1
5.	The driving experience of petrol/diesel vehicles is more enjoyable compared to electric vehicles.	5	4	3	2	1

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SECTION IX

Section VIII aims to achieve the research objective of 2 & 4. This section asks your assessment on how you think (or perceive) on the Economic Benefits in the context of adoption of urban public sector electric vehicle transportation in Hunan.

Please read the following statement and circle the number that most accurately reflects your opinion on each statement based on these scales: Agree (5), Slightly Agree (4), neither Agree nor Disagree (3), Slightly Disagree (2) Disagree (1)

1.	Electric vehicles are easy to use and operate.	5	4	3	2	1
2.	Electric vehicles are safe to use and operate.	5	4	3	2	1
3.	Electric vehicles help our agency save costs through lower fuel and maintenance expenses.	5	4	3	2	1
4.	Electric vehicles have attributes that contribute to environmental preservation.	5	4	3	2	1
5.	Using electric vehicles helps save fuel costs.	5	4	3	2	1
6.	The maintenance and management costs of electric vehicles are lower than those of non-electric vehicles.	5	4	3	2	1
7.	Subsidies and tax deductions for electric vehicles reduce their overall costs.	5	4	3	2	1
8.	Electric vehicles are more expensive to purchase than internal	5	4	3	2	1

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	combustion engine vehicles.					
9.	Replacing an electric vehicle's battery is expensive and burdensome.	5	4	3	2	1
10.	Overall, using electric vehicles reduces costs for our agency in the long term.	5	4	3	2	1

THANK YOU FOR PARTICIPATING IN THIS SURVEY

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Appendix B

Survey Questionnaires (In Mandarin)

附录 B

调查问卷

探索影响中国湖南城市公共领域交通工具电动汽车应用的因素

亲爱的先生/女士

我叫赵斌良，目前在马来西亚大学政府管理学院攻读博士学位。作为博士研究的一部分，我正在对中国湖南城市公共领域的政府机构和公共机构的决策者进行调查。这项研究的主要目的是调查影响中国湖南省公共部门采用电动汽车的因素。您对本研究的参与非常宝贵。我恳请您填写随附的调查问卷，大约需要 10-15 分钟的时间。您的意见对本研究的成功至关重要。请放心，您的回答将严格保密。请完成问卷并将其发送至我下面提供的电子邮件地址。 提前感谢您的参与。

此致敬礼

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第 1 部分

本部分要求您提供一些背景信息。请放心，您对这些问题的回答是保密的。请在每个问题的相关方框内打勾 [/]。

1. 您的性别是？(只有一个选项）

男性		女性	

2. 您属于哪个年龄组？(只有一个选项）

20-30 岁之间	
31-40 岁之间	
41-50 岁之间	
51 岁以上	

3. 您在该政府机构有多少年的工作经验？(只有一个选项）

1- 5 年	
6- 10 年	
11- 15 岁	
16-20 岁	
20 多年	

4.请说明您的教育背景？(只有一个选项）

高中教育	
本科	
大专	
硕士学位	

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博士学位	

4. 请指出您所在的政府机构中负责城市公共部门电动汽车 (EV) 政策和计划的部门。(只有一个选项）

1. 运输局/部	
2.能源局/部门	
3.环境保护局 / 部	
4.经济发展局/部	
5.城市规划与发展部	
6.科技局 / 部	
7.政府事务办公室	

5. 请指出您所在的政府机构中负责城市公共部门电动汽车 (EV) 政策和计划的职位。(只有一个选项）

1. 交通规划主任	
2.可再生能源项目经理	
3.首席环境政策干事	
4.城市交通协调员	
5.电动汽车基础设施项目经理	
6.经济政策分析员（电动车部门）	
7.城市发展战略专家	
8.创新与技术专家	

6. 请指出您在负责城市公共部门电动汽车（EV）政策和计划的指定政府机构中的决策角色。

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1.政策制定	
2.监管监督	
3.财政支持	
4.技术开发	
5.公众意识和教育	
6.合作与利益相关者的参与	
7.监测与评估	

第 2 部分

第 2 部分旨在实现第 1 和第 2 部分的研究目标。本部分询问您对湖南城市公共领域电动汽车采用情况的看法（或感知）。

请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	城市公共领域的交通机构有意购买电动汽车。	5	4	3	2	1
2.	城市公共领域的交通机构计划在未来两年内购买一辆电动汽车。	5	4	3	2	1
3.	与传统车辆相比，城市公共领域的交通机构更青睐电动汽车。	5	4	3	2	1

4.	城市公共领域的交通机构认为电动汽车符合其环保目标。	5	4	3	2	1
5.	城市公共领域的交通机构会向其他交通机构推荐电动汽车。	5	4	3	2	1
6.	对于城市公共领域的交通机构来说，拥有一辆电动车是件好事。	5	4	3	2	1
7.	对于城市公共领域的交通机构来说，购买电动汽车是个好主意。	5	4	3	2	1
8.	城市公共领域的交通机构购买电动汽车是明智之举。	5	4	3	2	1
9.	城市公共领域的交通机构预计市场上将出现更多不同品牌和型号的电动汽车。	5	4	3	2	1
10.	城市公共部门的运输机构愿意为对环境危害较小的车辆支付更多费用。	5	4	3	2	1

第 3 部分

第 3 部分旨在实现第 3、4 和 5 项研究目标。 本部分询问您对湖南城市公共领域电动汽车采用背景下基础设施治理机制的看法（或感知）。

请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	政府通过直接补贴为电动汽车购买提供政策支持。	5	4	3	2	1
2.	政府通过低息贷款为电动汽车的采用提供政策支持。	5	4	3	2	1
3.	政府通过免税和减税提供政策支持。	5	4	3	2	1
4.	政府通过简化绿色车辆登记程序提供政策支持。	5	4	3	2	1
5.	财政激励措施，如发放补助金，以鼓励电动汽车的使用。	5	4	3	2	1
6.	通过税收补贴为电动汽车相关购买或投资提供财政激励。	5	4	3	2	1
7.	由政府牵头开展宣传活动，鼓励采用和使用电动汽车。	5	4	3	2	1

第 4 部分

第 4 部分旨在实现第 1 和第 3 项研究目标。本部分询问您对湖南城市公共领域电动汽车交通采用充电基础设施的看法（或感知）。

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请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	市内及周边有充足的普通充电桩。	5	4	3	2	1
2.	城市内外有充足的快速充电桩。	5	4	3	2	1
3.	城市内外有充足的电池更换站。	5	4	3	2	1
4.	城市公共领域交通机构可获得金钱上的好处，如免税或免费停车。	5	4	3	2	1
5.	城市公共领域交通机构可获得额外优惠，如预留停车位或使用 HOV 车道。	5	4	3	2	1
6.	公共电动汽车充电基础设施方便使用且分布合理。	5	4	3	2	1
7.	为城市公共交通量身定制的电动汽车基础设施已经到位且充足。	5	4	3	2	1
8.	在工作场所为公共领域交通工作人员提供电动汽车基础设施。	5	4	3	2	1
9.	高速公路沿线的电动汽车基础设施方便可靠。	5	4	3	2	1

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第 5 部分

第 5 部分旨在实现第 1 和第 3 个研究目标。本部分要求您评估在湖南城市公共交通领域采用电动汽车的背景下，您如何看待（或感知）电动汽车的性能。

请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	目前市场上的电动汽车可提供平稳、愉悦的驾驶体验。	5	4	3	2	1
2.	目前市场上的电动汽车在速度、加速度和动力方面的表现令人满意。	5	4	3	2	1
3.	电动汽车的加速时间短，动力输出强。	5	4	3	2	1
4.	电动汽车操作简单，无需操作变速箱。	5	4	3	2	1
5.	电动汽车是安全的，符合现代安全标准。	5	4	3	2	1
6.	电动汽车的电池寿命足以满足日常驾驶需求。	5	4	3	2	1
7.	电动汽车的行驶里程足以满足长途旅行的需要。	5	4	3	2	1
8.	有多种电动车型可供消费者选择。	5	4	3	2	1

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9.	电动汽车的设计，包括内饰和外饰，都非常现代和时尚。	5	4	3	2	1
10.	电动汽车配备了先进的数字娱乐和导航功能。	5	4	3	2	1

第 6 部分

第 6 部分旨在实现第 1 和第 3 个研究目标。本部分要求您评估在湖南城市公共交通领域采用电动汽车的背景下，您如何看待（或感知）技术知识。

请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：

同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	城市公共领域交通机构积极采用电动汽车的最新技术发展。	5	4	3	2	1
2.	电动汽车配备了最先进的技术。	5	4	3	2	1
3.	我熟悉电动汽车与信息和通信技术的整合，以加强辅助驾驶和智能交通。	5	4	3	2	1
4.	我了解电动汽车的技术性能，如充电时间、加速度、驾驶舒适性和行驶里程。	5	4	3	2	1

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5.	我知道电动车与汽油车相比具有技术优势。	5	4	3	2	1

第 7 部分

第 7 部分旨在实现第 2 和第 4 个研究目标。本部分将询问您对湖南城市公共领域电动汽车交通采用情况下的车辆成本的看法（或感知）。

请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	电动汽车的购买成本高于汽油汽车。	5	4	3	2	1
2.	电动汽车的燃料成本高于汽油汽车。	5	4	3	2	1
3.	电动汽车的维护成本高于汽油汽车。	5	4	3	2	1
4.	电动汽车的折旧成本高于汽油汽车。	5	4	3	2	1
5.	对于大多数购买者来说，电动汽车一般都能负担得起。	5	4	3	2	1
6.	考虑到电动汽车的功能和优点，其价格是合理的。	5	4	3	2	1

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7.	总体而言，电动汽车比传统汽车更昂贵。	5	4	3	2	1

第 8 部分

第 8 部分旨在实现第 2 和第 4 个研究目标。本部分询问您对湖南城市公共领域电动汽车交通采用充电设施成本的看法（或感知）。

请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	电动汽车只能在有限的指定地点充电。	5	4	3	2	1
2.	与汽油车或柴油车相比，电动车的充电成本较高。	5	4	3	2	1
3.	电动汽车充电时间太长，不便于经常使用。	5	4	3	2	1
4.	由于续航里程的限制，电动汽车不适合长途旅行。	5	4	3	2	1
5.	与电动汽车相比，汽油/柴油汽车的驾驶体验更令人愉悦。	5	4	3	2	1

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第 9 部分

第 9 部分旨在实现第 2 和第 4 部分的研究目标。本部分要求您评估在湖南城市公共领域采用电动汽车的背景下，您如何看待（或感知）经济效益。

请阅读以下陈述，并根据这些量表圈出最能准确反映您对每项陈述看法的数字：同意 (5)，略微同意 (4)，既不同意也不反对 (3)，略微反对 (2) 反对 (1)

1.	电动汽车易于使用和操作。	5	4	3	2	1
2.	电动汽车的使用和操作是安全的。	5	4	3	2	1
3.	电动汽车通过降低燃料和维护费用，帮助我们的机构节约成本。	5	4	3	2	1
4.	电动汽车的特性有助于环境保护。	5	4	3	2	1
5.	使用电动汽车有助于节省燃料成本。	5	4	3	2	1
6.	电动汽车的维护和管理成本低于非电动汽车。	5	4	3	2	1
7.	对电动汽车的补贴和税收减免降低了其总体成本。	5	4	3	2	1

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8.	与内燃机汽车相比，电动汽车的购买成本更高。	5	4	3	2	1
9.	更换电动汽车电池既昂贵又麻烦。	5	4	3	2	1
10.	总之，从长远来看，使用电动汽车可以降低我们机构的成本。	5	4	3	2	1

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感谢您参与此次调查

Appendix C

Questionnaire Instrument Translator Curriculum Vitae

(CV)

Bu Wenna
(Master of Translation, GIIT, SHISU)

1. Contact

+86 13683681841
wenna1009@163.com
Building 2, Qingnianhui Jiayuan, Chaoyang District, Beijing, China

2. Education Background
Shanghai International Studies University (SHISU)| 2009-2011 - Master of Translation (MT)

3. Work Experience

(i) CEFC Beijing International Energy Co., Ltd. | 2014.1-now（4y）
Liaison Supervisor & Translator

- Relationship maintenance with CCPIT, CCOIC, National Energy Administration and MFA; Big and high-level events coordination throughout the whole period; Selection and implementation of high-quality programs；Composition of various working plans;
- Participation in large-scale overseas M&A projects；Documents translation

(ii) Beijing Pioneer Culture Development Centre | 2013.10-2014.1（3m）
Assistant to the Secretary General &Liaison Supervisor

- Relationship maintenance with foreign embassies in China; Big and high-level events coordination throughout the whole period;

Interpretation between company leader and ambassadors to China; Daily administrative work

Beijing City-In-Love Diamond Market Co., Ltd.| 2012.7-2013.10 (1y)

Assistant to Executive VP

- Translator to the Executive VP; Commucation with other departments and feedback to the VP; Draft and release various documents; Assist VP aquire info from both HQ and subsidiaries.

Pingan Group (Shanghai HQ) | 2011.10-2012.5 (1y)

Translator to CEO

- Document translation: files submitted to CIRC, local CIRCs; reports submitted to the Group from Pingan subsidiaries; all meeting materials; CEO emails.

4. Interships

1. (Translator &Editor) Linguitronics (Taipei) Co., Ltd. (Shanghai Branch) | 2010.10
2. (Interpreter) International Musical Instruments Expo, Shanghai | 2010.10
3. (Interpreter) International Dairy Industry Expo & Senior Forum| 2009.6

5. Skills

- ✓ Abundant communication experience with government bodies, CCOIC, CCPIT and foreign embassies in China;
- ✓ Proficient translation skills in the field of finance, economy, legal contracts & business affairs;
- ✓ Strong teamwork spirit and sense of responsibility;
- ✓ Ability to organize, communicate and promote.

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Appendix D

Content Validity Survey Items – Expert Opinions &

Recommendations on Relevance, Clarity, And Comprehensiveness

1. Adoption of urban public sector electric vehicle transportation in Hunan

To assess the content validity of these survey items based on the questions provided (relevance, clarity, and comprehensiveness), the items can be reviewed systematically as follows:

1. Relevance

- Are the items directly tied to the construct?
    - Construct: Likely measuring attitudes, intentions, and preferences toward electric vehicles (EVs) in the context of urban public sector transportation agencies.
    - Assessment:
        - Items 1-4 and 7-8 directly address intentions and attitudes toward purchasing EVs.
        - Item 5 focuses on advocacy for EVs, which is related to attitude but slightly tangential to purchase intention.

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        - Item 6 ("It would be good for Urban public sector transportation agency to have an EV") captures a general positive outlook, relevant but less specific than other items.
        - Items 9 and 10 add contextual and economic perspectives but deviate slightly from direct purchase intention.

2. Clarity

- Are the items easy to understand?
    - The phrasing is straightforward, but a few issues can be improved:
        - Items like "Urban public sector transportation agency is interested in buying an EV" (Item 1) could benefit from clarification on the time frame (e.g., "currently" or "in the near future").
        - Item 9 ("Urban public sector transportation agency looks forward to more brands and models of EVs being available on the market") may require rephrasing to ensure respondents interpret it as either a desire for more choices or as an external expectation.

3. Comprehensiveness

- Are all aspects of the concept covered?
    - The items focus primarily on purchase intention, attitude, and willingness to advocate for EVs. However:
        - Perceived barriers or concerns about adopting EVs (e.g., cost, infrastructure, range anxiety) are not addressed, leaving gaps in capturing a holistic view.

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- Environmental consciousness and its influence on EV purchase decisions are briefly touched upon (Item 10) but could be expanded.
- Items about direct operational suitability or agency-specific considerations (e.g., fleet performance, long-term benefits) are missing.

Recommendations for Refinement

1. Relevance Adjustments:
    - Retain items strongly tied to purchase intentions and attitudes (e.g., Items 1-4, 7-8).
    - Reframe or clarify tangential items like 5, 9, and 10 to align better with the construct.
2. Clarity Enhancements:
    - Specify time frames in items about intentions (e.g., "in the next two years").
    - Use consistent terminology throughout.
3. Comprehensiveness Additions:
    - Include items addressing:
        - Barriers: "Urban public sector transportation agency is concerned about the cost of EVs compared to traditional vehicles."
        - Operational benefits: "An EV would align well with the operational needs of the urban public sector transportation agency."

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Refined Example Items

1. Urban public sector transportation agency plans to buy an EV in the next two years.
2. Urban public sector transportation agency prefers EVs over traditional vehicles.
3. Urban public sector transportation agency would recommend EVs to other transportation agencies.
4. Urban public sector transportation agency sees EVs as aligning with its environmental goals.

This refinement ensures a clearer, more comprehensive alignment with the construct.

2. Infrastructure Governance Mechanisms

1. Relevance

- Definition: Items must be directly tied to the construct being measured—in this case, government policy support and financial incentives for EV adoption.
- Assessment:
    - Relevant:
        - All listed items are directly tied to government policy and financial support mechanisms for EV adoption.
        - For example:
            - "Government policy support through direct government subsidies" and "Government policy support through tax exemptions and reductions" are closely tied to financial incentives.
            - "Publicize promotional activities for EV uptake and usage" adds relevance by addressing public awareness,

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which is an indirect yet important aspect of policy support.

2. Clarity

- Definition: Items must be easy to understand, free from ambiguity, and use consistent terminology.
- Assessment:
    - Strengths:
        - Most items are straightforward and use clear language (e.g., "Government policy support through low interest loans").
        - Terms like "direct government subsidies" and "tax exemptions" are commonly understood in the policy and financial domains.
    - Potential Improvements:
        - Ensure "Financial incentives through grants" and "Financial incentives through tax subsidies" specify whether they target manufacturers, users, or agencies adopting EVs.
        - Avoid potential overlap or redundancy between "tax subsidies" and "tax exemptions and reductions" by clarifying the distinction.

3. Comprehensiveness

- Assessment:
    - Strengths:
        - The items cover a broad range of policy instruments, including direct financial support (subsidies, grants), indirect financial mechanisms (loans, tax benefits), and non-financial incentives (easy registration and promotional activities).

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Refined Items

1. Government policy support through direct subsidies for EV purchase.
2. Government policy support through low-interest loans for EV adoption.
3. Government policy support through tax exemptions and reductions.
4. Government policy support through streamlined registration for green vehicles.
5. Financial incentives such as grants to encourage EV uptake.
6. Financial incentives through tax subsidies for EV-related purchases or investments.
7. Government-led promotional campaigns to encourage EV adoption and usage.

This refinement ensures the survey is relevant, clear, and comprehensive, aligning closely with the intended construct.

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3. Charging Infrastructure

1. Relevance

- Relevant:

- Items like "If there are adequate normal charging points in and around the city" and "If there are adequate battery swap stations" directly address infrastructure adequacy.

- Benefits such as "tax exemptions" or "reserved parking spaces" align with incentives that can influence EV adoption decisions.

- Potential Refinements:

- Ensure the items clearly differentiate between public EV infrastructure and infrastructure specific to urban public transportation (e.g., "EV infrastructure for urban public transportation is available").

2. Clarity

- Assessment:

  - Strengths:

    - Most items are straightforward, using clear terms like "fast charging points" and "battery swap stations."

    - The phrase "monetary benefits such as tax exemption, free parking, etc." is explicit and relevant.

  - Potential Improvements:

    - Avoid vague terms like "other benefits" in "If urban public transportation agency is provided with other benefits." Instead, explicitly list all key benefits, such as "reserved parking spaces or access to HOV lanes."

    - Replace "The public infrastructure for EV is available" with more specific phrasing, such as "Public charging infrastructure for EVs is readily accessible."

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3. Comprehensiveness

- Assessment:

  - Strengths:

    - The questions address multiple facets of infrastructure adequacy, such as normal and fast charging, battery swaps, and work/highway access.

    - Incentives like tax exemptions and reserved spaces are included, adding depth.

  Refined Items

1. Adequate normal charging points are available in and around the city.

2. Adequate fast charging points are available in and around the city.

3. Adequate battery swap stations are available in and around the city.

4. Urban public transportation agencies receive monetary benefits, such as tax exemptions or free parking.

5. Urban public transportation agencies receive additional benefits, such as reserved parking spaces or access to HOV lanes.

6. Public EV charging infrastructure is readily accessible and well-distributed.

7. EV infrastructure tailored to urban public transportation is available and sufficient.

8. EV infrastructure at workplaces for public transportation staff is available.

9. EV infrastructure along highways is accessible and reliable.

These refinements ensure alignment with the construct, clarity in language, and comprehensive coverage of all relevant aspects.

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4. Electric Vehicle Performance

1. Relevance

- Assessment:

  - Relevant:

    - Items like "The EVs in the current market have an acceptable standard of performance in terms of speed, acceleration, etc." and "The driving range of EVs is long" are clearly relevant to evaluating EV performance and user satisfaction.

    - Items addressing design and features, such as "The interior and appearance of EVs are fashionable and cool," capture aspects of consumer appeal.

2. Clarity

- Assessment:

  - Strengths:

- Most items are straightforward and use clear language (e.g., "The battery life of EVs is long").

- Technical terms like "acceleration time" and "gearbox" are familiar to most respondents with basic knowledge of vehicles.

- Potential Improvements:

- Clarify subjective terms like "pleasure of the ride" and "fashionable and cool." For example, rephrase as "The EVs provide a smooth and enjoyable driving experience" or "The design of EVs is modern and stylish."

- Replace "There are enough EV models for consumers to choose" with "There is a diverse range of EV models available for consumers."

3. Comprehensiveness

- Assessment:

- Strengths:

- Covers a broad spectrum of dimensions, including performance (e.g., speed, acceleration), safety, battery life, and design features (e.g., digital entertainment and navigation functions).

Refined Items

1. The EVs in the current market provide a smooth and enjoyable driving experience.

2. The EVs in the current market offer satisfactory performance in terms of speed, acceleration, and power.

3. The acceleration time of EVs is short, and their power output is strong.

4. EVs are easy to operate and do not require handling a gearbox.

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5. EVs are safe and meet modern safety standards.

6. The battery life of EVs is long enough to meet daily driving needs.

7. The driving range of EVs is sufficient for long-distance travel.

8. A diverse range of EV models is available for consumers to choose from.

9. The design of EVs, including interior and exterior, is modern and stylish.

10. EVs are equipped with advanced digital entertainment and navigation features.

5. Technical Knowledge

Relevance

- Assessment:

- Relevant:

- Items like "I know the technological performance (such as charging time, acceleration, driving comfort, and driving range) of EVs" and "I know the technological advantages of EVs over gasoline vehicles" are highly relevant to measuring awareness of EV technologies.

- "An EV is equipped with the latest technology" is relevant to the perception of EV technological advancement.

- Potential Refinements:

- "Urban public transportation agency is quite advanced on the latest technological developments" could be rephrased to align more explicitly with EV technology adoption in public transportation.

2. Clarity

- Assessment:

- Strengths:

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- Most items use clear language (e.g., "I know the technological advantages of EVs over gasoline vehicles").

- Potential Improvements:

- Replace vague terms like "quite advanced" in "Urban public transportation agency is quite advanced on the latest technological developments" with a more specific statement such as "Urban public transportation agency actively adopts the latest technological developments in EVs."

- Ensure consistency in addressing the respondent's perspective. For example, if the target group is agencies, avoid switching between individual knowledge and organizational actions.

3. Comprehensiveness

- Assessment:

- Strengths:

- Covers technological awareness (e.g., charging time, comfort, and driving range) and advantages of EVs over traditional vehicles.

- Incorporates the concept of ICT integration in "I know the integration of EVs and ICT to enhance assisted driving."

Refined Items

1. The urban public transportation agency actively adopts the latest technological developments in EVs.

2. EVs are equipped with state-of-the-art technologies.

3. I am familiar with the integration of EVs and ICT to enhance assisted driving and smart mobility.

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4. I understand the technological performance of EVs, such as charging time, acceleration, driving comfort, and driving range.

5. I am aware of the technological advantages of EVs compared to gasoline-powered vehicles.

This refinement ensures the questionnaire is relevant to technological awareness, clear in phrasing, and comprehensive in scope, capturing both individual knowledge and organizational readiness.

6. Vehicle Cost

1. Relevance

- Assessment:
    - Relevant:
        - Items like "Purchase cost of EV is relatively high compared to cost of gasoline vehicle" and "Maintenance costs of EV is relatively high compared to maintenance cost of gasoline vehicle" are directly related to assessing the comparative financial burden of EV ownership.
        - "An electric vehicle is affordable" and "The price of electric vehicles is reasonable" are relevant to gauging perceived affordability.
    - Potential Refinements:
        - Redundant phrasing in multiple items (e.g., "relatively high compared to") can be streamlined for simplicity without losing relevance.

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2. Clarity

- Assessment:
    - Strengths:
        - Items are generally straightforward and use common terms like "purchase cost," "maintenance costs," and "fuel costs."
    - Potential Improvements:
        - Replace vague terms like "reasonable" in "The price of electric vehicles is reasonable" with a more specific phrasing, such as "The price of electric vehicles is fair given their features."
        - Avoid ambiguity in "An electric vehicle is affordable" by specifying whether affordability refers to the upfront cost, operating costs, or overall lifecycle costs.

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3. Comprehensiveness

- Assessment:
    - Strengths:
        - Items address various cost dimensions, including purchase, maintenance, fuel, and depreciation.
        - Perceptions of affordability and overall expense are included.

Refined Items

1. The purchase cost of an electric vehicle is higher than that of a gasoline-powered vehicle.

2. The fuel cost of an electric vehicle is higher than that of a gasoline-powered vehicle.
3. The maintenance cost of an electric vehicle is higher than that of a gasoline-powered vehicle.
4. The depreciation cost of an electric vehicle is higher than that of a gasoline-powered vehicle.
5. Electric vehicles are generally affordable for most buyers.
6. The price of electric vehicles is fair, considering their features and benefits.
7. Overall, electric vehicles are more expensive than conventional vehicles.

This refined set ensures relevance to cost-related perceptions, clarity in phrasing, and comprehensiveness by covering all critical financial aspects of EV ownership.

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7. Charging Facilities Cost

1. Relevance

- Assessment:
    - Relevant:
        - Items like "EV can only be charged at certain predetermined locations" and "EVs take too long to charge, as there are not enough charging stations" are highly relevant to assessing infrastructure challenges.
        - "The costs of charging EVs are high" is relevant to financial barriers.
    - Less Relevant:

        - "The sensation of driving a car with a petrol/diesel engine is much more enjoyable" is more subjective and indirectly related to barriers, though it touches on user experience preferences.

2. Clarity

- Assessment:
    - Strengths:
        - Most items are straightforward and easy to interpret.
    - Potential Improvements:
        - Rephrase "EV can only be charged at certain predetermined locations" to "Electric vehicles can only be charged at limited designated locations" for better readability.
        - Break down "EVs take too long to charge, as there are not enough charging stations" into two separate items to address charging duration and station availability distinctly.
        - Refine "EV is not for long journeys, as they are not as fast" to specify "not as fast" in terms of charging time or vehicle speed.

3. Comprehensiveness

- Assessment:
    - Strengths:
        - Addresses charging infrastructure, financial cost, usability for long journeys, and driving experience.

Refined Items

1. Electric vehicles can only be charged at limited designated locations.

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2. The cost of charging electric vehicles is high compared to fueling gasoline or diesel vehicles.
3. Electric vehicles take too long to charge, which makes them less convenient for regular use.
4. Electric vehicles are not suitable for long-distance journeys due to range limitations.
5. The driving experience of petrol/diesel vehicles is more enjoyable compared to electric vehicles.

This refined list ensures relevance to barriers, clarity in phrasing, and comprehensiveness by addressing a broader range of potential challenges for EV adoption.

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8. Economic Benefits

1. Relevance

- Assessment:
    - Highly Relevant:
        - "EVs are easy to use and operate" and "EVs are safe to use and operate" are directly related to usability and safety perceptions.
        - "EVs have attributes needed to preserve the environment" captures environmental benefits, a critical construct for EV adoption.
        - Items about cost savings, subsidies, and tax deductions are relevant to financial feasibility perceptions.
    - Partially Relevant:

        - "EVs are an alternate way of increasing our agency’s savings" may require clarification on the specific mechanisms of savings (e.g., fuel, maintenance, or subsidies).

2. Clarity

- Assessment:
    - Strengths:
        - Most items are direct and easy to understand.
    - Potential Improvements:
        - "I think that the cost of electric vehicles is more expensive than internal combustion engine vehicles" could be rephrased to simplify: "Electric vehicles are more expensive than internal combustion engine vehicles."
        - Replace "I think that cost is burdensome when replacing battery in electric vehicles" with "Replacing an electric vehicle's battery is expensive and burdensome."

3. Comprehensiveness

- Assessment:
    - Strengths:
        - Includes aspects of usability, safety, cost (purchase, operation, and maintenance), and environmental benefits.

Refined Items

1. Electric vehicles are easy to use and operate.
2. Electric vehicles are safe to use and operate.

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3. Electric vehicles help our agency save costs through lower fuel and maintenance expenses.
4. Electric vehicles have attributes that contribute to environmental preservation.
5. Using electric vehicles helps save fuel costs.
6. The maintenance and management costs of electric vehicles are lower than those of non-electric vehicles.
7. Subsidies and tax deductions for electric vehicles reduce their overall costs.
8. Electric vehicles are more expensive to purchase than internal combustion engine vehicles.
9. Replacing an electric vehicle's battery is expensive and burdensome.
10. Overall, using electric vehicles reduces costs for our agency in the long term.

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This refined list ensures relevance by directly addressing key perceptions, clarity in phrasing for ease of understanding, and comprehensiveness by adding overlooked dimensions like reliability and total cost of ownership.

Appendix E

Content Validity Expert Curriculum Vitae (CV)

Personal resume

First Name:	Li Rui Ming	Gender:	male
Age:	51	Place of residence:	Beijing
Years of work:	Twenty years or more		Pekin
By Email:	liruiming@smarttruck.com.cn	Professional Qualifications:	PMP
Mobile phone:	13811864817		

Specialty Director:

Executive Vice President and Secretary General of the Macao Society of Artificial Intelligence and Robotics

Special expert of Expert Committee of Logistics Enterprise Branch of China Transport Association

16 years of Internet of Things, Internet of vehicles development and application and project management experience, presided over the development of Foton vehicle networking platform system, Foton E-home network platform and other large vehicle networking system, presided over the development of Green Chi TSP platform system, artificial intelligence emotional robot system, has 5 core technology patents related to car networking

Proficient in the automotive industry digital operation strategy planning and digital landing operation process management, digital operation system product design, proficient in logistics intelligent distribution, fleet management system design and development.

Scientific research experience

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Scientific research projects	Scientific research results	Characters
Industry standard setting	Participated in the White Paper on Vehicle Intelligent Robots edited by Macao University of Science and Technology and Tongji University (issued B) the relevant chapters of the professional.	Associate editor
Scientific papers	Published in the core journal of Computer Engineering and Applications: "Prediction Based Map Matching Method" paper	First Author
Science and Technology book Writing	Participated in the Interactive Design of Intelligent Vehicle Robot co-edited by Macao University of Science and Technology and Tongji University Development (will be officially published in the near future)	Associate Editor
Patents	5 patents have been granted successively	Inventors
Research and development of epidemic prediction and early warning small program	Responsible for the development and project management of wechat mini program jointly developed by Macao University of Science and Technology and Guangzhou National Laboratory.	Project manager
Intelligent robot product development	Responsible for intelligent robot research and development of Anxitong (Macau) Technology Co., LTD	Chief designer and system architect
Research and Development Projects	Led and completed the research and development of at least 5 sets of large-scale vehicle networking systems (including hardware, software platform system, mobile phone APP, etc.), and more than 3 types of intelligent cabin products	Product Leader

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Time	Agency information	Position	Major responsibilities
2022/02 - present	New Zotye Automobile	Senior director of Intelligent Network Link	Responsible for the research and development of intelligent network connection and intelligent cockpit, as well as the research and development of intelligent vehicle robots
2018/05-2021/12	Green Chi Automobile Group Beijing Institute of Intelligent Science and Technology	Vice President of the Institute	Responsible for the research and development of intelligent network connection and intelligent cabin, as well as the research and development of intelligent vehicle robots
2015/07-2018/04	Beiqi Foton Automobile Co., LTD. Foton Zhike Information Technology Service company	Deputy General Manager	Responsible for research and development of vehicle networking system for commercial vehicles
2009/03-2015/06	SK Telecom (China) Research Institute of Technology	Director, Software Development	Responsible for the research and development of iot and vehicle-connected systems
2006/10-2009/02	Motorola (China) Technology Co. LTD	Messaging team Leader	Responsible for research and development of mobile Messaging system

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2003/03-2006/09	Lenovo Research Institute, Lenovo Group	Senior Engineer	Responsible for research and development of embedded software

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