SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 2.1, (2026), pp. 8762-8770
Open Access. Online & Print

DOI: 10.5281/zenodo.19865430

AN INTEGRATED THEORETICAL FRAMEWORK FOR UNDERSTANDING CONSUMERS' ADOPTION OF NEW ENERGY VEHICLES IN CHINA: A POLICY–TECHNOLOGY–BEHAVIOR PERSPECTIVE

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Received: 15/02/2026
Accepted: 18/03/2026

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ABSTRACT

Air quality is degrading in major cities globally, with steady developing clean energy technologies, there is a chance to reduce the emissions. One such instance is transforming traditional gasoline or diesel vehicles to new energy vehicles (NEVs). Many nations promoted NEVs by providing incentives, elevating public awareness and developing industrial plans. Despite these efforts, people from various countries still continue to purchase traditional vehicles instead of NEVs. This creates the need for an integrative analytical framework that integrates planned behaviour, technology reception and socio-economic situations. Numerous features play a decisive role in determining customer purchase intentions, such as environment, perceived usefulness, ease of usage, social influences, and government help. In contrast, technical trust and behavioural control play a moderating role. Also, behavioural variables and institutional interventions is scrutinized in detail based on prevailing policy measures, and industry reports. We believe that the conceptual model can serve as the paradigm for future empirical validation, and advance sustainable mobility for policymakers and manufacturers.

KEYWORDS: New Energy Vehicles (NEVs); Buying Intention; Customer Attitude; Technology Acceptance Model (TAM); Theory of Planned Behavior (TPB).

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1. INTRODUCTION

In recent years, it is apparent that the transportation domain is one of the largest contributors of worldwide greenhouse gas (GHG) emissions, accounting for nearly 24% of the total, making it imperative to enhance sustainability and efficacy in this sector [1]. Currently, NEVs include battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell vehicles (FCVs) [2]. As these NEVS provide a pathway for reducing carbon emissions, a few nations like China has dominated electric vehicle adoption owing to its strong policy measures, business initiatives, and a public acceptance of sustainability. Next to China, Europe and North America have adopted these NEVs to some extent. The main reasons for the lower adoption of these NEVs in other countries are inadequate infrastructure and public behaviour and perception. Thus, these regional differences highlight the criticalness of recognizing common driving parameters behind both regional and global NEV consumer influences [3-4].

Although the volume of manufacturing and setup for NEVs has expanded substantially, consumer reception still remains uneven across social and regional groups. Beyond features like perceived reliability and vehicle pricing, numerous other elements like accessibility of charging stations, air quality awareness continue to affect the purchasing decision of an individual [5]. Government aid like incentives and vehicle tax exemptions, plays a crucial role in market adoption. To incorporate NEVs into the common man's everyday mobility choice and sustain the progressive growth trajectory of this NEV, it is important to understand and evaluate the customers perception and behavior [6-9].

Most of the research mainly concentrated on individual parameters, such as consumer attitudes and the impact of subsidies, without completely comprehending the intricate interconnections among these aspects. To address this gap, the present study proposes a theoretical framework that incorporates sociotechnical magnitudes, policy dynamics, and paradigms derived from TAM and TPB. Hence the objective of this study is to develop a conceptual framework that elucidates how various factors shape the Chinese consumers' intentions to purchase NEVs. Also, it highlights how these elements affect one another, emphasising the importance of perceiving NEV adoption as a multidimensional and unified process. It also highlights the moderating roles of perceived behavioral control, technological trust, and prevailing social norms. The outcomes are expected to deepen the theoretical understanding of sustainable consumer behavior while offering practical supervision for policymakers and producers on reinforcing consumer self-assurance and fast-tracking the shift in the direction of cleaner modes of transportation to support the United Nations' sustainable development goals (SDGs).

2. THEORETICAL BACKGROUND

Consumers' purchase intentions for NEVs are studied using behavioral science, technology acceptance, and policy analysis. When it comes to emerging technologies, researchers have shown that one theory can't explain everything. A more comprehensive perspective is offered by combining three complementary frameworks, namely the TAM, the TPB, and policy-based socio-technical perspectives. A theoretical framework is provided by them for analyzing the relationships between institutional, technological, and psychological factors that influence China's adoption of NEVs [10].

2.1. Technology Acceptance Model (Tam)

The Davis (1989) theory of adopting and using new technologies has been widely used to explain people's behavior. Defining its main concepts requires considering perceived utility and perceived ease of use. When it comes to NEVs, the perception of usefulness is the belief that switching to an electric or hybrid car is going to result in observable benefits, such as a lower cost of fuel, easier maintenance, and a reduction in environmental impacts [11]. There are many factors that influence how easy and convenient it is for technology to be used, such as the availability of charging stations, maintenance assistance, and design of the navigation system. Consumers who consider NEVs to be reliable, user-friendly, and beneficial have been found to have a more favorable attitude towards the purchase of these vehicles than consumers who perceive them to be unreliable, complex, and unsustainable. It is important to note that, unlike other forms of consumer technology, vehicle adoption has also been dependent upon long-term trust, infrastructure, and policy support, which means that an expanded analytical framework is necessary [12].

2.2. Theory Of Planned Behavior (TPB)

In addition to the TPB (Ajzen, 1991), subjective norms and perceived behavioral control can also be incorporated into the TPB (Ajzen, 1991). As a result of subjective norms, an individual's decision-making process is influenced by the social rules that affect his or her behavior. It is clear that family opinion, peer recommendations, and cultural notions of modernity

play an important role in shaping purchasing behavior in the Chinese context where social identity and collective values are particularly prevalent. When someone perceives that they are in control of their behavior, it reflects their belief that they are capable of carrying out a certain behavior, such as having the money to purchase a car or having access to charging stations nearby. As a result of these factors, behavioral intention affects actual purchasing behavior, and this in turn influences behavior. The TPB has been included in the analysis in order to examine psychological preparedness and perceived barriers that are preventing NEV adoption outside of the technological realm [13, 14].

2.3. Policy And Socio-Technical Perspective

There is a large difference between the policy and socio-technical viewpoints when it comes to addressing the environment that either facilitates or hinders the adoption of technology, whereas TAM and TPB explain behavior at the individual level. Several government initiatives have been designed to promote the adoption of NEVs in China, such as the development of infrastructure, tax exemptions, and subsidies to encourage the purchase of the vehicles. The consumer is not only less strained financially by these actions, but they also contribute to a culture of normalizing environmentally friendly transportation in the context of lessening the financial burden for them. As a part of a broader shift towards social practices, industrial networks, and energy systems that is taking place as a result of the adoption of NEVs, according to the sociotechnical framework. Consumer decisions are influenced by both macro-level institutional factors as well as micro-level perceptions at the micro level, and this statement acknowledges both. The development of charging infrastructure, the standardization of battery technology, and the integration of smart grid technologies are just a few examples of how public investments enhance consumer confidence and perceived ease of use [15-16].

2.4. Integrated Policy–Technology–Behavior Framework

In order to explain the interaction between psychological, technical, and institutional variables that influence the purchase intention of NEVs, we propose a conceptual framework that incorporates TAM, TPB, and policy perspectives. This model is known as the Policy–Technology–Behavior (PTB) model. The relationship between consumer attitude and behavior intention can be strengthened by allowing technological trust and policy incentives to activate their roles as mediators and moderators of the relationship between consumer attitude and behavior intention. As shown in Table 1, a summary of the relationships between the key constructs is provided [17-21].

Table 1: Theoretical Constructs and Their Relationships.

Construct	Definition / Description	Theoretical Basis	Expected Relationship with Purchase Intention
Perceived Usefulness	The extent to which using an NEV enhances personal, financial, or environmental performance.	TAM	Positively influences attitude toward NEVs and purchase intention.
Perceived Ease of Use	The degree to which an NEV is perceived as convenient and effortless to operate and maintain.	TAM	Positively influences perceived usefulness and purchase intention.
Environmental Attitude	Individual concern and awareness regarding environmental protection and sustainability.	TPB	Positively influences attitude and intention to adopt NEVs.
Subjective Norm	The influence of social expectations and peer pressure on consumer decisions.	TPB	Moderates the effect of attitude on behavioral intention.
Perceived Behavioral Control	Perceived ability to purchase and use an NEV given financial and infrastructural resources.	TPB	Positively influences behavioral intention.
Policy Incentives	Government subsidies, tax exemptions, and charging infrastructure support.	Policy Theory	Mediates the relationship between perceived risk and purchase intention.
Trust in Technology	Confidence in battery safety, performance reliability, and manufacturer credibility.	Socio-Technical Theory	Strengthens the impact of perceived usefulness on purchase intention.

2.5. Conceptual Illustration

As illustrated in Figure 1, the proposed PTB framework demonstrates how these constructs interact with each other. In addition to perceived utility and ease of use, consumer attitudes towards NEVs are also influenced by environmental attitudes and subjective norms, which reinforce behavioral intentions in favor of NEVs. In addition, policy incentives have been shown to increase consumers' perception of control over their own behavior as an external motivator. The importance of dependability and security in the adoption process can be seen from

the fact that the relationship between perceived utility and purchase intention is moderated by trust in technology.

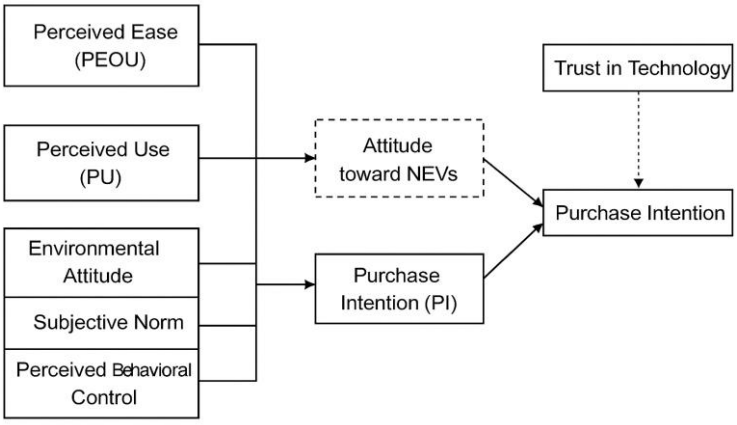

Figure 1: Conceptual Representation of the PTB Framework for NEV Adoption.

As a result of this integrated theoretical foundation, subsequent sections of the paper will explore how individual cognition, policy design, and technological trust interact to influence NEV adoption in China. Moreover, it serves as a foundation for empirical testing in subsequent studies that use quantitative techniques, such as regression analysis or structural equation modelling, in order to test the findings.

3. HYPOTHESES AND CONCEPTUAL MODEL

It is important to note that consumers' purchase intentions are shaped by a variety of technological, psychological, and policy factors that affect the adoption of NEVs in their daily lives. The purpose of this section is to describe the conceptual relationships suggested in the PTB framework, based on the TAM, TPB, and sociotechnical viewpoints. Based on the framework described above, it is possible to offer a methodical explanation as to how personal perceptions and the environment interact to influence the outcomes pertaining to the adoption of NEVs. As mentioned earlier, perceived utility and perceived ease of use are the two main technological constructs that are the basis of the model, as they both serve to explain consumers' perceptions of NEVs on the basis of their perceived utility and ease of use. A person's perception of the degree to which they believe owning and operating a NEV will improve their quality of life, i.e., by lowering operating costs, improving performance, or having a positive impact on the environment, is what is called the perceived usefulness of their NEV [24]. A NEV is perceived as being easy to use and convenient because of its simplicity and convenience, including the availability of maintenance services and charging stations, which are all integrated into the concept of perceived ease of use. It has been shown that customers are more likely to adopt favourable attitudes and increase their propensity to make a purchase if they believe that NEVs are both beneficial and easy to use at the same time.

There is a significant influence of behavioural factors derived from the TPB, environmental attitude, subjective norm, and perceived behavioural control on intention, which are all influenced by the perception of technological advancement. Environmental attitude refers to the sense of responsibility and empathy of an individual towards lessening carbon emissions. The term "subjective norms" refers to the influence of peers, family, and society on an individual's behavior. While, the perceived behaviour is the level of consumer confidence in buying and operating NEV, which is primarly influenced by affordability of NEV and availability of charging stations.

On the other hand, the PTB model incorporates a variety of social, individual, and policy-related effects. Incentives in form of tax exemptions, procurement subsidies, and accessible charging infrastructure boost the NEV buying. As a result of government support, consumers have a more favorable perception of electric vehicles and have a greater faith in their long-term feasibility. Subsidies can change the behavior of consumers as markets mature, indicating that policy design should take account of consumer readiness as well as technological advancements as the market matures. However, removing or altering subsidies may alter behavioural dynamics. In addition, as a moderating factor, technology trust is also considered in the proposed framework. In order to reinforce the impact of perceived usefulness on purchase intention, trust

in the safety of batteries, the dependability of the products, and the reputation of manufacturers can be taken into consideration. It is more likely that customers will convert their positive opinions into real purchasing decisions when they believe that NEVs are reliable, long-lasting, and technologically advanced. However, a lack of trust in technology can take away even the most positive sentiments and cause reluctance or a delay in the adoption of the technology [22-25].

In order to further facilitate further empirical research, the following claims are made in light of these relationships:

- **H1:** Perceived usefulness positively influences consumers' attitude toward NEVs.
- **H2:** Perceived ease of use positively affects perceived usefulness and attitude.
- **H3:** Environmental attitude positively influences purchase intention for NEVs.
- **H4:** Subjective norm positively influences purchase intention through social influence.
- **H5:** Perceived behavioral control positively affects purchase intention by enhancing consumer confidence.
- **H6:** The relationship between consumer attitude and purchase intention is mediated by policy incentives.
- **H7:** The association between perceived utility and intention to buy is moderated by trust in technology.

Figure 1 shows a graphic representation of these connections in the conceptual model of the system that can be seen in the figure. PTB offers a theoretical framework that integrates individual, technological, as well as policy dimensions of NEV purchase behavior in China that is useful in understanding the behavior of Chinese consumers. In the study, it is emphasized that to be able to sustainably grow a market, consumer attitudes and policy incentives must align, with ongoing technological changes serving to serve as boosters for market growth, as well as advancements in infrastructure accessibility.

4. DISCUSSION AND COMPARATIVE ANALYSIS

It has been found that the integrated PTB framework is an effective method for understanding how institutional mechanisms, technological perceptions, and individual attitudes work in conjunction to influence the adoption of new electric vehicles. In order for NEVs to be widely used in China, there needs to be a strong government intervention, in the form of preferential licensing and infrastructure development as well as purchase subsidies. The influence of behavioural and psychological factors on consumer purchasing decisions has grown more significant in recent times as the market shifts towards self-sustaining growth and policy incentives gradually decrease in importance as the market moves towards self-sustaining growth. In this section, the adoption landscape in China is compared to the adoption landscape in other emerging and developed economies and the dynamics of those adoptions are analyzed within the framework that has been outlined previously [21-22].

4.1. How Policy, Technology and Behavior Interact

A government incentive policy in China has been able to lower the cost of purchase for clean mobility vehicles while also demonstrating the government's commitment to the concept. At the beginning of the battery technology boom, tax breaks and subsidy schemes played an important role in rewarding consumers and offsetting the high price of batteries and thus fostering consumer confidence. In the past few decades, the impact of policy has changed from direct financial support to indirect mechanisms such as the development of infrastructure and technological regulation, although the production costs have decreased and the industry has matured due a decrease in production costs. In order to capture this shift, the PTB framework presents policy incentives as a mediating factor that enhances the impact of favorable consumer attitudes on purchase intentions by strengthening the influence of policy incentives. In order for consumers to act according to their environmental values and to their perceived utility of NEVs, it is necessary to have dependable policy frameworks and supportive infrastructure [18-20].

Further, there is a significant interaction between the behavioural variables and the technological advancements that are taking place. Battery life improvements, vehicle range improvements, and charging speed improvements have strengthened the perception of utility and ease of use, while continuous quality assurance has increased customer trust in the technology. NEVs not only have modern technology but also have the potential to reduce the practical concerns associated with traditional vehicles. Uneven availability of charging stations and lower battery life are affecting the consumers' confidence, especially those in rural areas [21].

4.2. Assessments On the Nevs' Adoption Status Across Different Nations

China's adoption patterns indicate the importance of policy framework, culture, and infrastructure. Strong central coordination and integration of industrial policies have led to an increase in NEV production in China. The disjointed policy framework in place as well as a sparse charging network have, on the other hand, contributed to slow adoption of electric vehicles in India, despite growing environmental awareness. Likewise, Southeast Asian nations face similar challenges, where the lack of charging stations and the sensitivity to costs are the main obstacles to introducing electric vehicles into the region. Developed markets like Europe prefer to focus on long-term sustainability, environmental identity, and lifestyle alignment as opposed to immediate financial incentives as part of their policies. Consumers are less concerned with short-term subsidies than they are with brand reputation and environmental standards, which are more important to them. There are regional differences in the growth patterns of China, which show that although the Chinese government has relied heavily on policy to drive their growth, future growth will depend on matching their technological and behavioral readiness to meet its needs without significant government participation. Table 2 gives a comparative overview of the factors affecting the adoption of NEVs in a few selected regions around the world [18-23].

Table 2: Comparative Summary of NEV Adoption Determinants in China and Selected Regions.

Category	China	India / Southeast Asia	Europe (Reference)	Key Insight
Policy Support	Strong, centrally coordinated subsidies, tax relief, and infrastructure targets (e.g., 2030 plan).	Fragmented policy with varying state-level initiatives.	Stable incentives linked to carbon targets and emission norms.	China's success is policy-driven; emerging regions require stronger coordination.
Consumer Motivation	Environmental awareness and social identity ("green status").	Economic savings and affordability.	Environmental identity and lifestyle-based motivation.	Motivation differs; cultural framing influences adoption intensity.
Infrastructure	Extensive but uneven, with rural–urban disparities.	Limited charging stations and grid reliability issues.	Well-established charging and smart-grid integration.	Infrastructure quality shapes perceived behavioral control.
Technological Perception	High trust in domestic NEV brands (e.g., BYD, NIO).	Moderate trust; dependency on imported brands.	Established confidence in quality and safety standards.	Technological reliability remains central to purchase intention.
Market Maturity	Transitioning from policy-driven to market-driven adoption.	Early-stage market with slow diffusion.	Mature market approaching adoption plateau.	China's model offers lessons for scaling adoption in emerging economies.

4.3. Implications For Policy and Industry

Comparative analysis has shown that behavioural and technological approaches must be incorporated to sustain the market growth of NEVs once government subsidies are withdrawn. Policymakers must focus on developing a robust, equitable and reliable ecosystem especially in rural areas, by expanding charging stations, standardizing recycling processes and educating consumers. NEV manufacturer can build technological trust through transparency, post-sale support and safety certifications. Marketing campaigns must show NEVs' sustainability and social value. From a theoretical perspective, the PTB framework emphasises that consumer behavior, technology, and policy tools are all interdependent parts of a broader transition towards sustainable mobility, rather than isolated forces. Comparative analysis across different nations from Table 2 also specifies that technology acceptance mainly depends on consumers' values and cultural norms apart from technology readiness and financial capabilities [15-17].

5. POLICY AND MANAGERIAL INFERENCES

5.1. Policy Inferences

Policy impacts both the demand and the supply sides of the NEV market. For first-time buyers, especially in underdeveloped rural areas, timely financial aid is required to encourage adoption and sustain motivation. To improve structural efficacy in the NEV market, direct buying grants must be gradually transformed to subsidiary incentives. To enhance consumer confidence in buying NEVs, governments should prioritise expansion of the national charging stations and battery recycling systems, rather than just financial aid.

Just adopting the same policy frameworks from other regions will not work; it has to be customised according to their own demographics and regions [21]. Rural consumers incline to prioritise affordability and convenience, whereas urban buyers place superior importance on convenience and environmental reputation. The use of a one-size-fits-

all approach in terms of incentives or subsidies runs the risk of making spatial inequality worse rather than better. It may be possible to ensure a more inclusive adoption of electric vehicles by offering microfinance assistance, community-based leasing programs, and rural charging credits tailored to the specific needs of each region. As a result, it is crucial to communicate openly and honestly with consumers the long-term policy objectives in order to maintain the trust of consumers. In the event of frequent changes or sudden withdrawals of subsidies that create uncertainty and discourage potential buyers, many buyers may become discouraged. It has been reported that combining NEV promotion with energy and environmental regulations may result in greater synergies between the two [22, 23]. In order to align the decarbonization of the transport sector with national climate targets, for example, the deployment of renewable energy sources or carbon trading schemes could be linked to the electrification of vehicles. As a result of promoting battery recycling and reuse in accordance with the circular economy principles, there is a possibility to reduce concerns about reliance on raw materials and lifecycle emissions are also reduced.

5.2. Managerial Inferences

There are several implications of the PTB framework for manufacturers and market participants, including improving after-sales assurance, consumer engagement, and technological trust. There is a direct relationship between perceptions of safety, dependability, and cost-effectiveness in order to influence purchase decisions. Business should place a high level of priority on the transparency of information about products, such as battery life expectancy, warranty coverage, and compatibility with charging devices. It is anticipated that consumer confidence will be further strengthened by ongoing research and development efforts in order to increase energy density, charging speed, and material sustainability in the coming years [20-22].

In terms of marketing, businesses must shift their focus away from technical details and place a greater emphasis on value-based communication. The emphasis on social recognition, modern design, and environmental influence are all key drivers that can fascinate diverse consumer sections. In the case of younger, urban consumers, it is theoretically useful to develop digital outreach and experiential marketing approaches, such as test drives, on-line demonstrations, or interactive mobile platforms, to influence favourable attitudes toward a brand. In order to close the psychological and informational gaps that may prevent middle-aged or first-time users of EVs from adopting the technology, partnerships with local service providers and educational initiatives may demonstrate beneficial. Furthermore, it is crucial to enhance the confidence of customers as well as dealerships and service facilities. Transparency in pricing, reliable spare parts supply, and predictable maintenance support are all factors that strengthen the long-term relationship between a brand and its customers. Further, cooperation between automakers and energy providers, in conjunction with technology companies, may lead to the development of integrated service ecosystems that cover software, maintenance, and charging, which could improve the perceived convenience [18-19] of users and user satisfaction.

5.3. Strategic Integration of Policy and Industry

Public policy must interact with industry practice in order to achieve a balanced and sustainable market for NEVs. Several policies can be adopted to support quality standards, to encourage innovation, and to ease public-private partnerships in order to accelerate diffusion while preserving competitiveness at the same time. It has been shown that government support for battery technology advancement and grid modernization, for example, can improve production costs and increase the reliability of the power grid, both of which can benefit consumers and manufacturers alike [22-24]. By using industry-wide data on user performance and behavior, policymakers will be able to identify new barriers to adoption as well as make improvements to future regulations based on this information. A final point to consider is that behavioral insights can be incorporated into marketing and policy strategies to increase their efficacy. There are several programs that have proven to be effective at promoting long-lasting behavioral change, including ones which offer real-time feedback on vehicle performance, gamify carbon-saving behaviors, or reward eco-conscious driving. The full potential of NEVs as a sustainable transportation mode is based not just on technological innovation, and policy design but also on behavioral science, [19].

6. CONCLUSIONS AND FUTURE RESEARCH

Almost all countries perceive NEVs can decarbonize the environment and improve air quality. Technology progression and policy

intervention are crucial parameters in NEV market. But as the market continues to develop, it is becoming more important than ever to comprehend the behavioral mechanisms that influence purchases intentions as the market develops. As a way of explaining how technological perceptions, behavior attitudes, and policy incentives interact, this study developed an integrated PTB framework as a means of describing how consumers make decisions related to the adoption of NEVs based on these interrelationships. Based on the results of this study, it is evident that developing favorable opinions about NEVs still depends heavily on perceived utility, usability, and environmental attitudes.

It is also important to note that how well these attitudes will translate into buying behavior depends on how well behavioral control is perceived as well as subjective norms. There is no doubt that policy incentives provide consumers with an enabling mechanism that reduces perceived risks and boosts consumer confidence, particularly at the early stages of market development. As the market moves away from policy dependence to long-term adoption, technological trust becomes a critical component of ensuring sustained adoption. As such, this demonstrates how important it is to maintain a high level of transparency in product design, product safety, and product dependability in order to build customer confidence in products. In addition, the regional comparison further reinforces the idea that one method does not suffice to explain the adoption of NEVs in a satisfactory manner. There has been an important role played by strong institutional coordination in China's success, but emerging economies still face infrastructure and affordability issues.

In contrast, in developed markets, long-term satisfaction with ownership and the sense of belonging to the environment are more important factors. To achieve inclusive and long-term adoption, market strategies and policy designs must take behavioral and cultural contexts into account when creating market strategies and policy designs. There is a need for future studies to use mixed methods as well as quantitative techniques to empirically validate the suggested framework for PTBs. It is possible to test the relationships between the identified constructs by using data-driven behavioral models, fuzzy-based multi-criteria analysis, or structural equation modelling (SEM) in order to examine the interrelationships. A longitudinal study is also needed in order to study how changes in public opinion, technology, and policy affect consumer behavior over the course of time. The use of this framework in the context of other emerging economies might be able to shed light on how cultural norms and institutional structures can affect dynamic adoption in different contexts.

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