

Economic Analysis and Research of New Energy Vehicle Promotion Model

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Abstract: New energy vehicles represent the inevitable trend of future development. Compared to traditional fuel vehicles, they are more energy-saving and environmentally friendly, effectively reducing air pollution and mitigating excessive exploitation of oil resources, a stance strongly supported by governments. However, new energy vehicles possess certain drawbacks in terms of price and usability compared to traditional counterparts. Therefore, external support is imperative for their development. This paper delineates four main sections: the background of new energy vehicle promotion and application, a comparative analysis of domestic and foreign promotion models, specific promotion suggestions, and future development prospects. By leveraging insights from economic analysis, the optimal promotion model for new energy vehicles is elucidated.

Keywords: New energy vehicle engineering; Promotion model; Economic analysis; Sustainable development

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1. Introduction

The rapid advancement of modern technology has fueled a growing demand for natural resources, yet the Earth's finite resources are dwindling. In response, the exploration of new energy sources has become imperative to meet the demands of both production and daily life. In the automotive sector, new energy vehicles represent a broad concept encompassing the use of unconventional energy sources or innovative power systems for propulsion.

Compared to traditional fuel-powered vehicles, new energy vehicles offer greater energy efficiency and environmental friendliness. They play a crucial role in reducing atmospheric pollution and alleviating the overexploitation of petroleum resources. Given their positive environmental impact, these vehicles have garnered significant support and promotion from governments, contributing to sustainable development. While traditional internal combustion engine vehicles rely on gasoline or diesel, new energy vehicles can be powered directly by electricity or alternative fuels.

However, new energy vehicles also have certain drawbacks. For instance, they face challenges in terms of price and usage compared to traditional fuel-powered vehicles. The development of new energy vehicles

necessitates encouragement and support from various sectors, with the adoption of different promotion models to expand their usage scale. Thus, external forces are required to support the development of new energy vehicles.

Expanding the scale of new energy vehicle usage through diverse promotion models is essential for their development and popularization. Despite China's advancements in technology, its new energy vehicle industry still lags behind international standards, and the supporting industrial system remains immature. Additionally, there is a relatively weak consumer willingness to purchase such vehicles. Relying solely on financial and tax policies, along with measures such as restricting the purchase of traditional fuel vehicles, is no longer sufficient to achieve sustained growth in the production and sales scale of new energy vehicles, especially with the withdrawal of subsidy policies and constraints imposed by the "dual credit" policy. In this context, relevant authorities and enterprises urgently need to innovate and explore new promotion models ^[1].

1.1. Background

As the country steadily progresses toward sustainable development, officials from the National Development and Reform Commission, the Ministry of Science and Technology, and other relevant departments of China declared, during the online proceedings of the 8th China Electric Vehicle Hundred People Forum Annual Conference in 2022, that the new energy vehicle industry has entered a new stage characterized by large-scale, high-quality, and rapid development. However, along with these achievements, new and challenging issues have emerged, demanding concerted efforts from the entire new energy vehicle industry to address them. The global automotive industry and supply chains have been significantly affected by the COVID-19 pandemic, geopolitical tensions, and regional conflicts. The unresolved shortage of automotive chips and rapidly rising prices of certain key raw materials are among the challenges faced. Furthermore, issues such as blind investments and disorderly development persist in the new energy vehicle sector. Some policies supporting promotion and application still require improvement ^[2].

1.2. Significance of study

New energy vehicles, compared to traditional fuel-powered vehicles, are more energy-efficient and environmentally friendly. They can effectively reduce air pollution and help avoid excessive exploitation of petroleum resources. Strong government support and promotion contribute to their sustainable development. While traditional vehicles rely on gasoline or diesel, new energy vehicles can be powered directly by electricity or alternative fuels. However, due to regional differences, there is still a need to improve the promotion and widespread adoption of new energy vehicles, aiming to find a promotion method suitable for local characteristics. The advantages of new energy technologies lie in their environmental friendliness, and as technology-intensive industries, they have received substantial support and promotion from various governments.

1.3. Analysis of the current domestic and international promotion methods

In 1953, Neil Borden first introduced the concept of marketing mix. Subsequently, in 1960, Professor Jerome McCarthy from the University of Michigan systematically proposed the "4P" theory, comprising "product," "price," "place," and "promotion." Philip Kotler further refined the "4P" marketing mix method, with later scholars expanding the theory to include elements such as "people," "packaging," and "public relations." Widely applied in marketing practice, the 4P theory, which is product-oriented, serves as a fundamental model for addressing marketing issues.

In contrast to the 4P marketing theory, in 1990, American scholar Professor Robert F. Lauterborn introduced the 4C marketing theory, emphasizing "customer," "cost," "convenience," and "communication" as core principles. This consumer-oriented approach builds upon the 4P marketing theory, focusing on the

centrality of people and aligning market orientation with consumer needs. The 4C concept has found extensive application in the automotive manufacturing industry, guiding manufacturers to conduct thorough market research before launching new vehicle models. This process involves collecting opinions from potential consumers to finalize the design, features, and other aspects in accordance with market expectations, thus meeting targeted market goals^[3].

In 2014, the European Union enacted stringent car carbon emission regulations, mandating a 95% reduction in average carbon emissions to 95 g/km CO₂ for passenger cars within the EU by 2020. Similarly, for commercial vehicles (trucks), a limit of 147 g/km CO₂ was set, with all new vehicles required to meet these standards by 2021. Non-compliance results in fines of 95 euros per g/km CO₂ for each vehicle^[4]. The New European Driving Cycle (NEDC), a testing standard used to measure emissions, simulates driving conditions in Europe on a treadmill-like platform without wind resistance and without using air conditioning or heating. Despite following a programmed acceleration and deceleration, there are significant differences between NEDC and Chinese road conditions, many consider it inaccurate, with the actual range being only 70%–80% of NEDC. Worldwide Harmonized Light Vehicles Test Procedure (WLTP), a testing standard established by the United Nations, provides a more realistic assessment of vehicle performance by considering globally sampled driving conditions and accounting for factors such as wind resistance and driving speed (low-speed, medium-speed, high-speed, and extra-high-speed).

To satisfy customers and achieve business goals, enterprises must consider various factors and means, starting from the characteristics of target market needs and the marketing environment. By utilizing various marketing methods based on their resources and advantages, enterprises can form a comprehensive and unified marketing strategy to achieve overall effects and strive for optimal outcomes.

China has also made significant efforts to promote the widespread adoption of new energy vehicles. Initiatives such as the “China Clean Car Action” launched in 1998 aimed at promoting diversified development in automotive energy. Government plans for industry revitalization and subsidies for new energy vehicles have stimulated local governments to promote the development of local enterprises. The issuance of the “Guiding Opinions on Accelerating the Promotion and Application of New Energy Vehicles” in 2014 by the State Council promoted the implementation and development of the national strategy for the development of Chinese new energy vehicle enterprises. In October 2020, the State Council executive meeting approved the “Development Plan for the New Energy Vehicle Industry,” and in November 2020, the State Council office issued the “Development Plan for the New Energy Vehicle Industry (2021–2035),” emphasizes the national strategy for developing new energy vehicles, demonstrating strong government support and promotion for the industry’s development.

1.4. Research ideas and content

This paper primarily provides a detailed description of four main parts: the background of promoting and applying new energy vehicles, the promotion models of new energy vehicles, the economic analysis of these promotion models, and the proposal of promotional recommendations. Based on the economic analysis, the optimal solution for the promotion model of new energy vehicles is presented.

1.5. Research methods

1.5.1. Literature collection and data collection method

An extensive review of various journals and a substantial amount of literature, employing manual, CD-ROM, and Internet-based search methods, facilitated a diligent examination and comprehension of relevant materials. The collection and analysis encompassed a wide range of materials, including central and local government policies, measures, and construction projects related to the promotion of new energy vehicles.

1.5.2. Systematic analysis and induction methods

The research methods employed in this paper primarily include systematic analysis and induction methods. These methods were utilized to summarize the different promotion models of new energy vehicles, aiming to expand their usage scale in various regions and facilitate further analysis.

1.6. Innovative points of the paper

- (1) Planning to conduct a techno-economic analysis of the promotion model for new energy vehicles from three perspectives: market demand, technological evaluation, and economic analysis.
- (2) Providing an introduction on how this promotion model, once implemented, can be applied to the real market.

2. New energy vehicle promotion model

2.1. Pilot model

In the process of promoting and applying new energy vehicles in China, a pilot model is adopted. To provide robust promotion for the development of new energy vehicles, local governments combine their promotion measures with local characteristics. On June 1, 2010, various ministries and commissions in China jointly issued the “Notice on Conducting Pilot Subsidies for Private Purchase of New Energy Vehicles,” which clearly stipulated that pilot subsidy programs for private purchase of new energy vehicles would be launched in six cities, including Beijing, Shenzhen, Shanghai, Hangzhou, Hefei, and Changchun. The highest subsidy amount was set at 60,000 Chinese Yuan (CNY) ^[5].

2.2. Government subsidy model

The so-called government subsidy model means that the government provides a certain amount of subsidies to corresponding new energy vehicle manufacturers to promote their supply of new energy vehicles. On one hand, there are economic subsidies, and on the other hand, there are technology subsidies. Both types of subsidies have a promoting effect. As shown in **Figure 1**, the supply curve will move upward along the fare axis for a certain distance, which represents the subsidy for each unit of transportation service ^[1]. This shortening of the distance makes the new supply curve become S_1 , and the new equilibrium point is E_1 . The price drops from the original P_0 to P_1 , while the demand increases from the original Q_1 to Q_0 . The subsidy lowers the price and increases the demand.

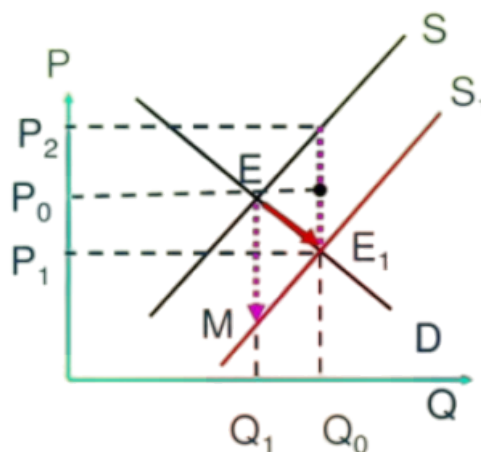


Figure 1. The effect of subsidizing consumers on the market

From 2009 to the end of 2015, the central government allocated a total of 33.435 billion CNY in subsidies to new energy vehicles and related upstream and downstream industries. While implementing subsidies and tax reduction policies, the government also expanded the market share and increased the usage rate of new energy vehicles. Simultaneously, to achieve the target of increasing the usage rate of new energy vehicles, subsidies and incentives were provided to consumers and renters of new energy vehicles by different forces. However, while promoting the development of the industry, serious problems have also emerged.

As early as 2009, the Chinese government began proposing the concept of promoting new energy vehicles for energy saving and emission reduction. The aim was to encourage consumers to purchase and use new energy vehicles by lowering the purchase price. In 2010, relevant taxes and fees for eligible new energy vehicles were exempted. In 2012, the new energy vehicle industry began entering the private car sector, and subsidies were provided to encourage consumers to choose new energy vehicle products. The subsidy was based on the energy capacity of the new energy vehicle battery pack, with a subsidy of 3,000 CNY/kWh. There were also maximum subsidy limits for different vehicle models: 60,000 CNY for pure electric vehicles, 50,000 CNY for plug-in hybrid electric vehicles, and 3,000 CNY for energy-saving vehicles with an engine capacity of 1.6 L or below ^[6].

2.3. Tax relief model

After the policy of exempting new energy vehicle purchase tax mentioned in the “Announcement of the Ministry of Finance, State Taxation Administration, Ministry of Industry and Information Technology, and Ministry of Science and Technology on the Exemption of New Energy Vehicle Vehicle Purchase Tax” expired on December 31, 2020, this tax incentive policy was extended in the “Announcement of the Ministry of Finance, State Taxation Administration, Ministry of Industry and Information Technology on the Exemption of New Energy Vehicle Vehicle Purchase Tax” ^[7]. This model reduces the tax amount that manufacturers need to pay, helping companies obtain higher profits, increasing production enthusiasm, boosting supply quantity, lowering supply prices, and promoting the development of new energy vehicles.

Compared to traditional fuel vehicles, new energy vehicles not only enjoy national subsidies but also receive many tax benefits. Firstly, the first tax benefit is the exemption of consumption tax for new energy vehicles. According to regulations, consumers are required to pay a consumption tax when purchasing conventional cars, but electric vehicles, i.e., new energy vehicles, are not subject to this tax. Secondly, according to regulations, new energy vehicles are exempt from vehicle purchase tax. Thirdly, new energy vehicles are also exempt from vehicle and vessel tax. This means that when purchasing vehicle insurance, consumers can save a significant amount of money on vehicle and vessel tax. In summary, buying a new energy vehicle can exempt consumers from consumption tax, vehicle purchase tax, and vehicle and vessel tax. Therefore, the higher the price of the purchased new energy vehicle, the more money consumers can save.

3. Technical and economic analysis of promotion model

3.1. Market demand analysis of the project

3.1.1. Necessity and urgency of projects

Although new energy vehicles are cleaner, more environmentally friendly, and more sustainable than traditional fuel vehicles, their disadvantages cannot be ignored. Concerns about battery loss, battery life, high prices, slow charging, lack of suitable charging stations, and limited endurance compared to fuel vehicles are common among users. Additionally, high maintenance and repair costs and uncontrollable factors contribute to the hesitancy of consumers to purchase new energy vehicles. Therefore, it is essential to conduct research on a promotion model suitable for the local area. With the introduction of various national laws, this promotion

model is urgently needed and must be applied to the real market, highlighting its necessity and urgency.

3.1.2. Analysis of the current situation of the project market

From a national perspective, the wholesale volume of new energy vehicles in 2020 reached 1.17 million units, marking a 12% year-on-year increase, while the retail volume of new energy vehicles amounted to 1.367 million units, reflecting a 9.8% year-on-year increase, indicative of a robust growth trend. Sales have consistently ranked first globally for six consecutive years. In 2020, spurred by the postponement of government policies, new energy vehicles reversed the previous decline in sales, achieving a growth rate of over 10% with an annual output of 1.366 million units. As depicted in **Figure 2**, China’s overall new energy vehicle sales exhibited a steady upward trajectory, with an increasing market share. However, the proportion of new energy vehicle market share in the overall automobile market remains relatively low.

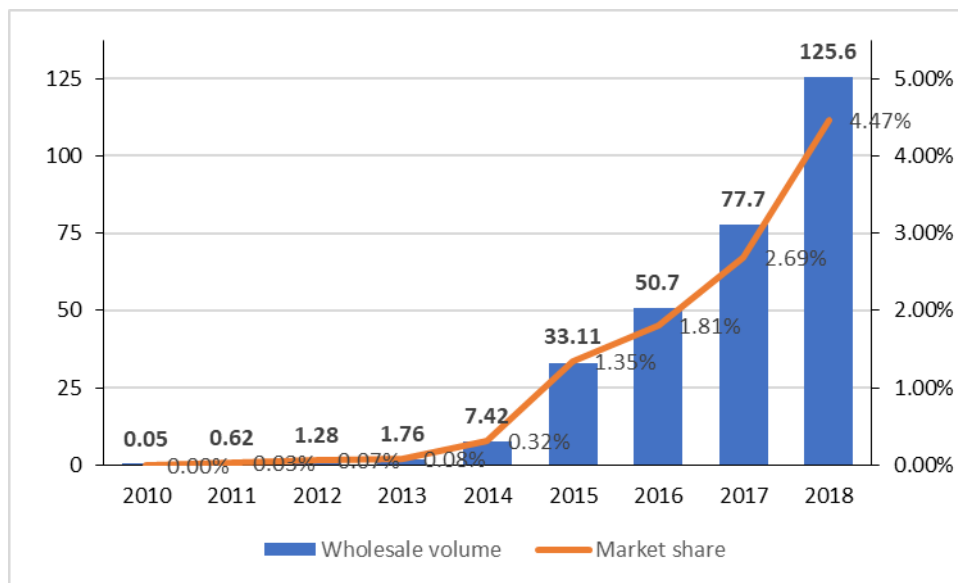


Figure 2. New energy vehicle sales during 2010–2018 (wholesale volume in ten thousand units)

3.1.3. Project market prospect

In recent years, China has introduced a series of preferential policies and support strategies for new energy vehicles, significantly promoting the sustainable development of the new energy automobile industry. Various promotion and application models of new energy vehicles have provided effective experiences for industrial development^[8,9]. Identifying a suitable promotion model for new energy vehicles conducive to local development could lead to their widespread adoption. The fuel saved through carbon reduction can be redirected to industrial production, resulting in cost savings for heavy industry development. The saved resources represent substantial assets and are conducive to China’s sustainable development goals and energy conservation and emission reduction policies. Additionally, addressing automobile exhaust emissions through new energy vehicles can improve air quality, with the benefits extending to various sectors such as climate, economy, industry, and military. Therefore, finding a suitable promotion model is essential, given its significant advantages^[10].

3.2. Technical evaluation of project implementation

Currently, there are three primary models for promoting new energy vehicles in China: the pilot model, the government financial subsidy model, and the tax preference model. This study analyzed these three different

promotion models accordingly.

3.2.1. Pilot model

The pilot model is implemented by local governments and tailored to the characteristics of each region. This approach aims to boost the sales of new energy vehicles in specific regions, thereby gradually increasing demand and facilitating the widespread adoption and development of new energy vehicles. However, this approach primarily focuses on sales numbers and may be influenced by various subjective and objective factors unique to each locality. Consequently, it may not be conducive to the long-term development of new energy vehicles or adequately address their sustained needs, rendering it unsuitable as a long-term solution.

3.2.2. Government financial subsidy model

From the perspective of transportation economics, it was understood that price subsidies for new energy vehicles primarily leverage the impact of automobile production costs on the overall market development. When government economic subsidies for new energy vehicles align with buyer needs, the demand for new energy vehicles across the market significantly increases, thereby stimulating consumer purchasing demand for such vehicles. However, a notable issue has emerged from the recent trend of market price changes for new energy vehicles. Despite the continued rise in new energy vehicle purchases, manufacturers of these vehicles have not received corresponding direct economic subsidies and preferential policies. Yet, the overall market still experiences oversupply.

It is believed that during the operational developmental phases of new energy vehicle production enterprises, the government could offer direct technical support and technical subsidies to these enterprises. If enterprises effectively apply this subsidy to actual processing and production, it can substantially reduce the cost of new energy vehicles, thus further boosting demand.

However, there are drawbacks for enterprises, as some speculative enterprises may not genuinely allocate government subsidies toward the production and development of new energy vehicles. Instead, they might misuse government subsidies to establish shell companies, leading to fraudulent practices to obtain financial subsidies. Therefore, this method also presents certain limitations and shortcomings.

Price subsidies primarily leverage the impact of price costs on the development of the new energy vehicle market. When price subsidies align with consumer demand, the market's demand for new energy vehicles significantly increases. It is imperative for the government to provide direct technical support and technical subsidies to energy vehicle enterprises during their operational and developmental phases. This approach can greatly deter speculators from misusing government subsidies for new energy vehicles for profit. Additionally, it can substantially enhance scientific and technological progress and innovation in China's new energy vehicle sector, thereby elevating the overall technological level of new energy vehicles in the country.

3.2.3. Tax preference model

Currently, the industrial development of new energy vehicles in China has expanded significantly. Despite the gradual reduction in technical and economic subsidies provided by China for the development of new energy vehicles, the level of these subsidies in China remains relatively high compared to more developed regions and countries in this field. It is believed that the government should reduce direct economic subsidies for new energy vehicle enterprises and instead focus on enhancing technical subsidies for these enterprises. By fundamentally reducing production costs and sales prices, it can partially meet consumer purchasing needs, thereby promoting an increase in demand for new energy vehicles and subsequently boosting sales^[10].

This model involves reducing the amount of tax that manufacturers need to pay, leading to a significant

influenced by improved performance of new energy vehicles and growing environmental consciousness provide a conducive environment for their promotion.

Moreover, environmental awareness can predict personal pro-environmental behavior. Consumers who use electric vehicles often exhibit stronger pro-environmental awareness. Consumers' concern about climate change influences their intention to purchase electric vehicles, especially if they view them as symbols of environmental protection ^[12].

Regarding government subsidies, while increasing subsidies may strain fiscal expenditure, reducing taxes can decrease government revenue. Establishing a comprehensive evaluation mechanism for the new energy automobile industry can effectively assess factors like sales price, service life, and safety, and ensure quality standards for subsidized enterprises ^[13]. Coordinating and integrating different promotion and application models is essential for maximizing positive effects in the promotion process.

5. The future development of the new energy vehicle promotion model

First and foremost, it is believed that the core issue in promoting new energy vehicles lies in the product itself. Considering the current development status of new energy vehicles, China's promotion model for these vehicles is not yet fully mature and cannot be universally applied. For instance, while Harbin may adopt a certain promotion model, Changchun might not, instead opting for a different approach. Some cities prioritize access or offer discounts on high-speed travel to promote new energy vehicles, while others rely on national policies related to economic and technological subsidies. However, regardless of the promotion model used, it inevitably raises issues of social equity and is only a short-term solution, serving as a temporary expedient rather than a long-term strategy. Therefore, replicating and widely promoting an existing promotion model is unrealistic. Ensuring product safety is fundamental, while cost-effectiveness and technological advancement are crucial for maintaining market competitiveness. It is imperative to address industry pain points and cater to market demands comprehensively. Thus, the development of the new energy vehicle industry requires a holistic approach, considering both constraints and opportunities.

To achieve significant development and ultimately replace traditional fuel vehicles, new energy vehicles must leverage relevant state laws and regulations, along with corresponding financial and technical subsidy plans, while continually advancing their technology. By prioritizing core technology and designing highly competitive and productive products, new energy vehicle enterprises can sustain growth amid technological and consumer shifts. Currently, China faces a period of technological and consumer change in the automobile industry. Market demand, weakening subsidy policies, and macroeconomic pressures have significantly impacted the development of new energy vehicle enterprises. Nonetheless, the government is actively addressing these challenges. Although technical and economic subsidies have been reduced to some extent, China's subsidy level remains comparatively high compared to more developed countries in the new energy vehicle industry.

Enterprises should remain confident in this context. When considering promotion and application models for new energy vehicles, they should be flexible and adapt them according to the specific urban development context. The new energy automobile industry is still in its early stages, and enterprises are navigating through uncertainties. Therefore, in promoting the application of new energy vehicles, it is essential to not only focus on the promotion model but also learn from practical experiences, summarizing gains and losses to foster the better development of new energy vehicles ^[14].

6. Conclusion

The development of new energy vehicles represents a significant step towards China's sustainable development and industrial restructuring and upgrading plans. It also serves as a crucial solution to address energy crises and environmental pollution. However, various challenges persist in the new energy vehicle sector. It is believed that the government and enterprises should collaborate closely to foster the robust development of the new energy automotive industry by enhancing technical and financial support. Drawing from current practical experiences, the overall promotion and application models can be flexibly adjusted to propel the positive growth of China's new energy vehicles.

It is imperative for the government to strategically reduce direct economic subsidies for new energy vehicles while simultaneously increasing technical and production subsidies for new energy vehicle companies. This approach aims to reduce the overall production costs of new energy vehicles, thereby lowering their prices. According to the principle of automotive economics, lower prices typically drive higher demand, thus stimulating consumer interest in purchasing new energy vehicles. Moreover, this strategy ensures that state subsidies for new energy vehicle companies are directed toward improving technology production levels and preventing fraudulent practices by certain vehicle manufacturers. Consequently, it can bolster demand for new energy vehicles, increase demand elasticity, further boost sales of new energy vehicles in China, and enhance the public's inclination toward purchasing them.

Additionally, the government can consider reducing financial subsidies for new energy vehicle enterprises and trimming tax revenues for these enterprises, while making minor adjustments using market mechanisms. It is believed that for the development of China's new energy vehicle industry, there should be a more refined evaluation mechanism in place. This mechanism would alleviate the significant fiscal burden imposed on the country and boost demand for new energy vehicles, thereby augmenting their sales and promoting their overall development.

Furthermore, with the rise in people's cultural knowledge and environmental awareness, coupled with continued international support and subsidies for the new energy automobile industry, progress and prosperity are inevitable. Through the scrutiny and refinement of various promotion models, we will undoubtedly witness corresponding value added to the advancement of new energy vehicles and related industries.

Disclosure statement

The authors declare no conflict of interest.

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