Government's Influence on The Growth of China's New Energy Vehicle Industry and Directions for Future Policy Enhancement

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Abstract. Under the background of the global "carbon neutrality" goal and the transformation of energy structure, the New Energy Vehicle (NEV) industry has become the core direction of the global automobile industry reform. As the largest market for automobile production and sales globally, China's industry has entered the mature period from the cultivation period, and the development logic has undergone a deep transformation. This paper focuses on the guiding role of the Chinese government in the NEV industry. It systematically analyzes the evolution of subsidy policies, charging infrastructure construction support policies, and power battery recycling policies, examining how these measures can effectively promote industrial development and highlighting the various problems faced during their implementation. Based on the evaluation, this paper presents policy optimization suggestions, offering practical guidance to address the challenges of industrial maturity and promote the industry's transformation towards product value-driven development, which will contribute to the global "carbon neutrality" goal and strengthen the competitive edge of China's automobile industry.

Keywords: New Energy Vehicle, Government Policies, China.

1. Introduction

The goal of global "carbon neutrality" and the acceleration of energy structure transformation have promoted the NEV industry to become the core direction of the global automobile industry transformation and also become the strategic key field of future industrial competition for various countries. As one of the main sources of carbon emissions, the traditional fossil-fueled vehicle industry is facing increasingly prominent energy security pressure and ecological environmental impact problems, while the low emission and low energy consumption technical characteristics of NEVs have become an important way to alleviate the above problems [1]. At the international level, the United States, the EU, Japan and other economies have implemented relevant industrial support policies to accelerate the development of local NEV industry [2], and the global industrial competition continues to intensify.

As the world's largest automobile production and consumption market, China is at a critical stage of the transformation and upgrading of auto industry. The development of the NEV industry has provided significant support for the upgrading of China's automobile industry. There is a long-term positive correlation between government policy incentives and the sales volume of electric vehicles, effectively accelerating their widespread adoption [3]. Since NEVs were included as a strategic emerging industry in 2009, the Chinese government has introduced a set of measures through multiple rounds of policy adjustments and systematic planning. These efforts have focused on industry cultivation, technological innovation, infrastructure development, and market regulation, all of which have contributed to the large-scale development of the NEV sector. By the end of 2024, China's annual sales volume of NEVs reached 12.866 million units, maintaining the top global position for 10 years in a row, with a market penetration rate exceeding 40% [4]. It has formed a comprehensive industrial chain covering upstream resource supply, midstream core component manufacturing, and downstream vehicle production and service. Core technical indicators such as power batteries and driving motors have reached internationally advanced level. In the 15th Five-Year Plan, NEVs were not included in the list of strategic emerging industries for the first time, marking a profound change of the industrial development. This adjustment is not a withdrawal of policy support, but rather an

inevitable shift as the industry transitions from the nurturing phase to maturity. It reflects a shift in policy direction from broad, inclusive support to more targeted and precise efforts.

In this context, it is of great value to systematically review the government's specific actions and their actual impact on the NEV industry, while considering the needs of the new phase of industrial development. This will help refine the policy framework and promote the high-quality, sustainable development of the industry.

2. Review of Past Policies

2.1. Subsidy Policies

Since 2009, China's government subsidy policy for the NEV industry has evolved through three distinct phases: broad support during, targeted guidance, and a gradual reduction as the industry matures. In 2009, China launched the national energy-saving and NEV demonstration project, with central government funding allocated for subsidies. In the same year, the Ministry of Finance announced that pilot cities would offer subsidies for the purchase of NEVs in the public service sector, officially initiating subsidies for NEVs.

In the initial stage, the subsidy is measured by the amount of electricity from the battery subsidy, but it is not targeted to the development of NEVs. Since 2013, the government has shifted the subsidy from being based on battery power to being based on battery life. At the same time, plug-in hybrid vehicles can get the same subsidy as pure electric vehicles, which is more reasonable. In 2017, the subsidy policy gradually shifted focus to promoting improvements in driving range, aiming to address the primary weakness of NEVs -- the limited range. As the technical standards increased each year, the subsidy amount decreased annually. In subsequent subsidy standards, requirements such as maximum vehicle speed, battery energy density, and energy consumption were gradually added. These changes have made it clear that the government encourages the development of long driving range, high energy density, low energy consumption of technologically advanced NEVs, and shows that the attitude of no longer supporting technologically backward products.

2.2. Construction of Charging Infrastructure

The limited range of NEVs and the "range anxiety" caused by the insufficient charging network coverage density are considered to be important obstacles to the large-scale popularization of electric vehicles [5]. Since 2015, the government has introduced a range of subsidy policies aimed at accelerating the development of charging infrastructure [6]. The rapid construction of charging networks has been largely driven by government measures and financial support [7].

On November 18, 2014, the relevant departments of the central government jointly put out an announcement, which for the first time linked the number of NEVs promoted with subsidies and rewards for charging facilities, proposed a moderately advanced construction plan, and allowed private capital to enter the charging pile industry. The early charging pile market is directly dominated by the government, the main participants are State Grid Corporation of China (SGCC) and other SOEs. In 2015, with the government officially defining the development goal, social capital entered the market, initiating large-scale investment and construction. The government’s subsidies for the construction of charging stations are primarily based on charging power, with different subsidy standards set for DC and AC charging piles. Subsidies are also differentiated according to various scenarios, such as urban areas, highways, and residential communities. The government has also introduced relevant policies to support the construction of power grids and power supply services, ensuring a reliable power supply and accessibility to charging infrastructure. Additionally, the government has guided SGCC to facilitate the connection of charging infrastructure with the grid. Charging piles are built and operated by grid enterprises, which are not permitted to charge fees for grid access. At the same time, grid enterprises provide support to operating companies in terms of electricity pricing.

2.3. Recycling of Power Batteries

As the market penetration rate and ownership of NEVs continue to grow, large-scale decommissioning of power batteries has become an unavoidable challenge for the industry. The need for specialized recycling policies has become increasingly urgent and essential. The life span of lithium-ion batteries in electric vehicles is usually 8 to 12 years, but it is highly dependent on their driving distance and charging and discharging frequency. When the battery capacity of electric vehicles is below 80%, the battery will not be able to maintain the normal battery life [8]. However, the batteries of operational vehicles such as taxis are likely to be retired within about 4 years due to their frequent use [9]. NEVs have gradually transitioned from a niche market choice to the mainstream mode of transportation. As a result, an increasing number of vehicles are reaching the end of their service life, and the number of retired power batteries is rapidly growing. This shift has transformed power battery recycling from a supplementary issue in the industrial supply chain to a core concern related to ecological safety and resource recycling.

In order to cope with this challenge, the Chinese government has formulated a series of policies to regulate and promote the recycling of power batteries. In 2015, a special policy for battery recycling was introduced. The State Council and its affiliated departments issued policies to guide enterprises in the design, production, and recycling of power batteries, and established a battery recycling system that links the entire industrial chain. Since 2018, the policy upgrade has been accelerated, and the management of traceability and standards have been strengthened. The government decided to carry out trials for the recycling of power batteries for new-energy vehicles in 17 regions. In addition, the Ministry of Industry and Information Technology and four other departments have stipulated that companies engaged in the secondary utilization of power batteries must assume primary responsibility, further clarifying the application of the producer responsibility system. Since 2021, the coverage of power battery recycling has become more comprehensive, encompassing regulations, policies, technologies, standards, and industry practices. This has accelerated the promotion of power battery recycling and utilization in the NEV sector. The recycling process gradually entering a period of standardized operation.

3. Policies Effects and Related Issues

3.1. Subsidy Policies

The Chinese government’s subsidy policy for NEVs has played a crucial role in systematically boosting the industry's growth, transitioning from nurturing to expansion and from technological followers to independent leaders. In the early stages of policy implementation, the focus was on universal measures such as purchase subsidies and tax reductions, which effectively lowered the purchasing barriers for consumers and reduced initial operational costs for companies. These measures rapidly stimulated market demand, while also allowing companies to accumulate valuable market share and financial reserves. As the industry matured, the subsidy policy gradually introduced technical thresholds, compelling companies to increase their R&D investments in key areas such as the EIC system, fast charging technologies, and other core technologies. This shift encouraged continuous product performance upgrades, accelerating the technological maturity and industry competitiveness of Chinese NEV manufacturers.

Subsidies are short-term regulatory measures used during periods of market instability or economic weakness. They cannot eliminate the long-term uncertainty in industry development and have certain limitations in different stages. Some companies view subsidies as their main source of profit, leading to a serious dependency on policies. This lack of internal motivation for core technology research and development causes them to fall into operational difficulties once subsidies are reduced. Additionally, a few companies exploit methods like data falsification and related-party transactions to claim subsidies, disrupting normal market competition. Over time, the long-term

benefits of these policies have indirectly caused overcapacity in the industry and led to disorderly price wars, which have driven down the overall profitability of the industry.

Subsidy policies are also a heavy financial burden that needs to be phased out in the future. Some countries, including the United States, Japan, and China, have begun to reduce EV subsidies [10]. As subsidies gradually diminish, the driving factors behind industry competition will inevitably shift from policy incentives to product value. Once the industry reaches maturity, the government's incentive policy should transition from encouraging consumption to fostering industrial transformation and upgrading.

3.2. Construction of Charging Infrastructure

Charging infrastructure is one of the core factors influencing consumers' decisions when purchasing NEVs. It is also a key infrastructure supporting the sustained and healthy development of the industry. The level of infrastructure development directly determines market acceptance and the industry's growth prospects. The government's relevant support policies have strengthened the top-level design for the development of charging infrastructure in China, placing it in a more important position and coordinating it from a holistic perspective. A multi-sector cooperation system has been established to promote the development of charging infrastructure, with proactive predictions of NEV growth trends, appropriate foresight in construction, and the promotion of scientific development of charging facilities, thus providing the necessary conditions for the widespread adoption of NEVs.

Currently, the construction of charging infrastructure in China has reached a certain scale, but it still faces multiple structural and operational challenges. Firstly, the regional distribution is unbalanced. The charging facilities are mostly concentrated in the developed areas along the eastern coast, central cities and urban core business districts, while the coverage rate of facilities in the underdeveloped areas, counties and rural markets in the central and western regions is very low. Some remote areas even face a total lack of charging infrastructure [11]. In cities, the insufficient supply of charging facilities in high-frequency usage areas like residential and office zones stands in stark contrast to the dense layout of facilities in certain public areas, such as industrial parks, further exacerbating resource misallocation. The unbalanced distribution is accompanied by the low overall utilization rate of facilities. According to statistics, the utilization rate of public charging piles nationwide is less than 7% [12]. Many public charging facilities have remained idle for a long time due to unreasonable site selection, imperfect surrounding infrastructure, or inaccurate navigation information. At the same time, there is a supply shortage in popular areas during peak hours, resulting in serious waste of public resources. This underutilization directly leads to the profitability difficulties of the operating industry. The initial investment in charging infrastructure is substantial, and the investment recovery cycle is long. Most operating enterprises find it difficult to establish a sustainable business model, and some facilities have even ceased operation due to a lack of funds for maintenance.

3.3. Recycling of Power Batteries

The government has made significant strides in the field of power battery recycling by constructing a systematic policy framework, which works in tandem across various aspects, including standardization, industry entry, and regulatory development. These efforts are driving the industry toward standardized, large-scale, and high-quality growth. At the technical level, by setting strict resource recovery rate and energy consumption control indicators, the policy continues to push companies to increase R&D investments and constantly optimize the dismantling and recycling process. The standardized system formed under the guidance of the policy strengthens the connection between the initial and final stage of the power battery recycling industry chain, builds a solid back-end support for the sustainable development of the whole life cycle of the NEV industry and helps the whole new energy industry form a closed-loop development ecology. The main problems at the current stage are as follows.

Firstly, the existing system of regulations and standards is not perfect, and the main regulatory responsibility is vague. At present, although there are a number of systems such as renewable

resources record, electronic appliances recycling permit, motor vehicle scrap recycling permit and hazardous waste recycling permit, there is still a lack of special access permit for the recycling of NEV power battery in this specific field, resulting in unclear market access threshold and recycling behavior is difficult to be effectively supervised.

Secondly, the price fluctuations of raw materials such as nickel, cobalt, and lithium have a profound impact on battery recycling [13], leading to fragmented collection at the social level, with the flow of materials becoming difficult to control. China's overall reserves of battery raw materials are insufficient, making the country highly vulnerable to international influences and heavily dependent on external sources [14]. In recent years, factors like production capacity planning, import conditions, and unforeseen events have caused significant price volatility for battery raw materials across various market conditions. For example, the price of lithium metal increased dramatically from around 50,000 RMB per ton in 2020 to over 500,000 RMB per ton in 2022 [15]. With the expansion of production capacity, the price of lithium metal rapidly dropped in 2023. Such large price fluctuations have compressed the profit margins of the retired battery utilization. Violating enterprises, by evading the input cost of environmental protection and safety equipment, seize resources by recycling waste batteries at high prices, thereby forming a gray industrial chain of "grabbing batteries at high prices - illegal dismantling - black market circulation", and this once led to the phenomenon of "bad money driving out good money". The illegally refurbished batteries in the market, coupled with the hidden transactions and the lack of effective traceability mechanism, have brought great hidden dangers to the market order and consumption safety.

4. Policy Optimization Recommendations

4.1. Suggestions on Incentive Policies

4.1.1 Pushing Forward the Export of NEVs

On the one hand, after years of development, the scale of China's NEV industry has expanded, technology has significantly improved, and the industrial system has gradually been perfected, giving China a strong competitive advantage. On the other hand, developed countries in Europe and the United States continue to advance carbon emission reduction efforts and provide targeted policy subsidies [16], which in turn supports the growth of international demand for NEVs. Based on this, the government can introduce relevant incentive policies to shape China's foreign trade advantages of NEVs. The government can closely align with the layout of the industrial chain and assist enterprises in exploring diverse international expansion strategies. Firstly, the government should support enterprises in setting up overseas R&D and production bases through overseas mergers and acquisitions or joint ventures, facilitating the introduction of NEV products that are better suited to local markets and more competitive. Secondly, in terms of logistics, the government can explore the establishment of a direct export network of land-sea combined transportation and factory-port linkage and build a special storage yard for NEVs to improve the efficiency of maritime export. Additionally, the government can increase the density of China-Europe freight trains and other road transportation networks to reduce the reliance on ports and shipping for NEVs. Furthermore, optimizing customs supervision processes, promoting advance declarations, and enabling direct shipment upon arrival at ports can help shorten port stay times and reduce customs clearance costs for enterprises.

4.1.2 Accelerating the Industrialization of Intelligent Connected Vehicles (ICVs)

ICV technology refers to the applications, services, and technologies that connect vehicles with their surrounding environment [17]. ICVs use intelligent systems to facilitate the exchange of information between vehicles, related devices and their surrounding environment, aiming to achieve autonomous driving, reduce traffic collisions and improve traffic congestion. After years of development, China's ICV industry has made remarkable progress in technology development, industrial ecology and application. Moving forward, the government can continue to refine relevant policies and coordinate efforts to foster the high-quality development of the industry.

The government can continue to expand the scope of pilot cities for intelligent connected vehicles, accelerate the development of supporting infrastructure for vehicle-road collaboration, and promote the intelligent construction and renovation of urban road infrastructure as well as the development of management platforms. As modern transportation systems advance rapidly, the integration of in-vehicle technologies with cloud computing has become practical [18]. The government should encourage market players to participate in the intelligent transformation of roads, as well as the coordinated layout of charging piles and communication base stations, fostering the integrated construction of roadside perception devices, 5G networks, and charging facilities. Local governments should respond positively and support the implementation of smart roads, data centers and other facilities through financial subsidies and simplified approval.

4.2. Continuing to strengthen the construction of charging infrastructure

To address the series of issues mentioned regarding the construction of charging network, the government first needs to assess the situation, identify the problems, and further investigate the number of charging facilities nationwide. It should also conduct in-depth research on the utilization rates of charging infrastructure in different scenarios and types, as well as data on vehicle owners' charging habits. A thorough study of the demand for different charging scenarios should also be conducted, with careful analysis and calculation of development and construction needs. Moreover, it is necessary to find out the demand of charging facilities on holidays and on weekdays, the difference of demand in each period, and study and analyze the reasons for the demand fluctuation.

Secondly, the government should focus on promoting the coordinated development of industries and investment growth, and promote the agglomeration and development of power battery, energy storage, charging facilities and other related industries. The government should promote the construction of charging facilities and supporting power facilities in different fields and regions and actively expand profitable investment. For projects with favorable investment benefit projections, the government can actively encourage private enterprises to increase their involvement and further promote private investment. At the same time, the government should appropriately promote the construction and upgrading of the power grid and increase related investments.

In addition, the government should focus on promoting the technical development and application of technologies, and facilitate the advancement of fast charging, high-power charging, intelligent charging, and optical storage and charging collaborative control technologies. It is also necessary to further enhance the charging facilities service platform, ensure the full integration of charging facilities, improve the charging convenience of NEVs, effectively strengthen the data analysis capabilities of the intelligent service platform, and provide data support for the strategy formulation and construction of charging facilities. Furthermore, the government should explore innovative charging application scenarios and business models.

4.3. Improving the Comprehensive Utilization System of Power Battery Recycling

The government needs to continue improving relevant regulations and standards, promote innovative policy demonstrations, and carry out special rectification efforts for illegal recycling and utilization. Specifically, the government should advance the standardization of power battery recycling, improve the construction of a standard system covering the whole recycling procedures—from transportation and storage to utilization—and ensure the rationality and applicability of these standards. Legislative research on related issues should also be conducted. Additionally, the government should introduce support policies to encourage innovation and demonstration projects from key players in the industrial chain, with a focus on cultivating the innovation and development capabilities of leading enterprises, thereby enhancing the overall resilience and competitiveness of the industry. Regarding supervision, the government should establish a traceable, fine control system to prevent businesses from issuing false invoices and fraudulently claiming tax refunds. Furthermore, it should implement joint law enforcement across multiple departments to rigorously punish illegal activities.

The government should also continue optimizing the layout of the recycling system to activate the efficiency of industrial recycling and utilization. First, specialized agencies should analyze data on vehicle distribution and population mobility within the province and scientifically plan the layout of recycling service sites. These sites should be concentrated in cities or industrial parks with a high number of new energy vehicles, so as to strengthen and improve the recycling network. Policies to support recycling points should be formulated to break brand barriers, encouraging car dealerships to jointly improve battery recycling rates. Second, local governments should investigate the current status of battery recycling enterprises, including project initiation and actual production capacity. Considering economic, environmental, and energy efficiency factors, the government should scientifically regulate project approvals based on the volume of retired batteries and end-user demand. This will help prevent the disorderly expansion of capital that could lead to overcapacity. Third, the government should guide qualified enterprises to explore overseas markets for lithium, cobalt, nickel, and other mineral resources, particularly in regions such as South America and Australia to establish stable mineral resource supply channels, stabilizing raw material prices and alleviating supply chain uncertainties.

5. Conclusions

Through multi-dimensional and phased policy layout, the Chinese government has played a pivotal role in fostering the cultivation, development and modernization of the NEV industry, driving its leapfrog development, forming a complete industrial chain, and maintaining a global leadership position. However, as the industry transitions from the cultivation phase to the maturity stage, the market transformation following the reduction of subsidies, the structural contradictions in charging infrastructure, and the systemic challenges of power battery recycling have become significant factors restricting the sustainable progress of the industry. In the future, the government needs to align with the great changes in the industry's development logic, shifting from broad-based support to targeted efforts. This approach will address the industry's weaknesses, while strengthening market regulation and standards. It will guide the industry's transition from being driven by policy incentives to being led by product value and technological innovation. By doing so, the government can lay a solid institutional foundation for the NEV industry and contribute to the global achievement of "carbon neutrality" goal.

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