

Analysis of the Reasons for the Differences in the Penetration Rate of New Energy Vehicles between the North and South of China

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ABSTRACT

By studying the differences in the penetration rate of new energy vehicles between the southern and northern parts of China, we can gain a deeper understanding of the demand characteristics, purchasing power and consumption preferences of consumers in different regions. This provides a basis for policy-making, allowing government departments to formulate differentiated industrial policies and subsidy policies based on the different situations of new energy vehicle penetration in the south and north. It also promotes infrastructure construction, and puts forward some reasonable plans and layout suggestions for the development of new energy vehicles and the construction of charging infrastructure. It promotes regional economic development. The development of the new energy vehicle industry has an important driving effect on the regional economy. It promotes sustainable development. The popularization of new energy vehicles is an important measure to achieve energy conservation and emission reduction in the transportation sector and promote sustainable development. In addition, it can also enhance consumer awareness. This research can help consumers understand the usage and development trends of new energy vehicles in different regions, helping them make more rational choices about their travel methods and vehicle types, and also increase their awareness and acceptance of new energy vehicles, promoting the healthy development of the new energy vehicle market.

KEYWORDS

New energy vehicles; Differences in penetration rates; Infrastructure; Sustainable development

1 Quotation

In recent years, the new energy vehicle (NEV) industry has developed rapidly under the impetus of national policies. In 2023, the sales volume of new energy vehicles reached as high as 9.49 million units, accounting for more than 60% of the global market share. However, in recent years, its penetration rate has shown a significant north-south disparity in China. The penetration rate in the southern regions exceeds 30%, while in some northern areas, it is still less than 10%. Since 2009, China has vigorously promoted new energy vehicles through policies such as fiscal subsidies, exemption from purchase tax, and license plate preferences. However, there are regional differences in the implementation effects of these policies. In addition, consumers in the south are more willing to try new technologies, while users in the north prefer fuel vehicles due to range anxiety. China is a major consumer of oil and has a relatively high degree of dependence on foreign countries. The development of new energy vehicles is not only more environmentally friendly, improving air quality and the ecological environment, but also can reduce the reliance on traditional fuel, decrease oil imports and enhance national energy security. However, during the promotion of new energy vehicles, some problems have been discovered. This article focuses on the "reasons for the differences in the penetration rate of new energy vehicles between the north and south of China" among them.

In the process of writing this thesis, the following two research methods were mainly employed: the literature research method. By consulting relevant policy documents, academic papers, industry reports, etc., understand the overall situation of the development of the new energy vehicle industry, policy orientation, and background information of the north and south regions in terms of economy, transportation, resources, etc., providing theoretical support and data basis for subsequent research. Data analysis method. Collect data on the number of new energy vehicle users, sales volume, growth rate, etc. in the northern and southern regions of China, as well as relevant data on economic development level and infrastructure construction related to the popularization of new energy vehicles.

1.1 Review of foreign literature

Research on the Correlation between climate and performance in use: Foreign countries have long noticed that climate factors can have a significant impact on the use of new energy vehicles. For instance, some research in the United States has focused on the performance degradation of new energy vehicle batteries in cold regions. Researchers have found that in low-temperature environments, the chemical reaction rate of batteries decreases, resulting in a significant decline in battery capacity and charging and discharging efficiency^[1]. This has led consumers in northern regions to worry about the driving range of new energy vehicles in winter, which in turn affects their purchase intention and usage frequency.

Regional differences in market acceptance: Research in some European countries shows that the acceptance of new energy vehicles by consumers in different regions is influenced by local infrastructure, cultural concepts and policies. In Nordic countries, despite the cold winters, the penetration rate of new energy vehicles remains relatively high due to well-developed charging facilities and generous subsidy policies. In some southern European countries, due to the lagging infrastructure construction, consumers' acceptance of new energy vehicles is relatively low^[2].

Research on Battery Recycling Systems: In terms of battery recycling, countries such as Germany and Japan have established relatively complete recycling systems. Germany has clarified the respective responsibilities of car manufacturers, dealers and recycling enterprises through legislation, and established a full life cycle management model from battery production to recycling^[3]; Japan, on the other hand, focuses on technological research and development to increase the recovery rate of rare metals in battery recycling and reduce recycling costs in order to address the rising battery waste rate^[4].

Through these literatures, it can be understood that China should pay attention to the impact of climatic factors on the performance of new energy vehicles. Especially in the cold regions of northern China, it is necessary to develop battery technologies that adapt to low-temperature environments and improve the performance of batteries at low temperatures to alleviate consumers' concerns about the driving range. At the same time, policy guidance is also an indispensable part. Through measures such as high subsidies and tax incentives, consumers' acceptance and purchase intention for new energy vehicles can be enhanced. Finally, in terms of battery recycling, China can draw on the experience of countries like Germany and Japan, establish a complete battery recycling system, clarify the responsibilities of all parties, increase the utilization rate of battery recycling, reduce recycling costs, and promote the sustainable development of the new energy vehicle industry.

1.2 Domestic literature review

The relationship between policy orientation and penetration rate: Numerous domestic scholars have found that policies play a crucial role in promoting the popularization of new energy vehicles. In the early days, policies such as national and local car purchase subsidies and exemption from purchase tax effectively stimulated the market demand for new energy vehicles. In the economically developed southern regions such as Guangdong and Jiangsu, the implementation of policies is strong, enterprises respond positively, and the penetration rate of new energy vehicles has increased rapidly. In some northern regions, the implementation of policies has been relatively slow, which has affected the promotion process of new energy vehicles.

Analysis of infrastructure differences: Research shows that the uneven distribution of charging infrastructure is an important factor causing the difference in the penetration rate of new energy vehicles between the south and north of China. In the south, especially in the Yangtze River Delta and Pearl River Delta regions, the density of charging piles is high and the layout is reasonable, covering the main urban areas and expressway service areas^[5]; In some northern areas, especially remote rural and mountainous regions, the number of charging piles is small and the convenience of charging is poor, which restricts the popularization of new energy vehicles^[6].

Research on Battery Waste Rate and Recycling: With the rapid growth of the number of new energy vehicles in use, the issue of battery waste rate has gradually drawn attention. By the end of 2024, the number of new energy vehicles in China had reached 31.4 million. Relevant data shows that by 2030, the amount of retired power batteries in China will reach 3.5 million tons. Domestic research has focused on how to enhance the recycling rate of batteries. So far, multiple batches of "white list" enterprises for the secondary use and regeneration of used power batteries have been released. However, there is still a problem that the standardized recycling rate is less than 25%, and a large number of used batteries flow to non-compliant enterprises^[8]. In terms of regional differences between the south and the north of China, the south, with a large number of new energy vehicles in use and a high amount of battery waste, leads the way in the research and development of recycling technologies and the construction of recycling networks. However, the north is also actively exploring battery recycling models suitable for the local area^[9].

Between 2023 and 2024, changes in domestic policies in China have also had a certain impact on the differences between the north and south regions. On the one hand, the national subsidy policies for new energy vehicles are implemented more flexibly in the southern regions. Some local governments have even provided additional preferential policies such as purchase subsidies and free parking, which have attracted a large number of consumers to buy new energy vehicles. This has thus promoted the popularization of new energy vehicles in the southern regions. In contrast, although the northern regions also have corresponding subsidy policies, the enforcement intensity and the extent of discounts are relatively small, and their appeal to consumers is limited. On the other hand, in terms of battery recycling, the governments and enterprises in the southern regions have cooperated more closely, promoting the establishment of a relatively complete battery recycling system, which has increased the recycling rate of used batteries and reduced the risk of environmental pollution. This has, to a certain extent, enhanced consumers' trust in new energy vehicles and

promoted their popularization in southern regions. However, the policy support and system construction in battery recycling in the northern regions are relatively lagging behind, which has affected the promotion of new energy vehicles.

2 The current situation of the penetration rate of new energy vehicles in the northern and southern regions of China

Table 1 The Development Trend of New Energy Vehicles in the North and South from 2020 to 2024
(Taking the Data of Shenzhen and Harbin as Examples)

Year	Shenzhen	Harbin
2020	That year, the penetration rate of new energy vehicles in China was 5%, and Shenzhen's development led the country.	The total number of vehicles in use is approximately 10,000, with new registrations accounting for 6%, and the number of public charging piles is about 2,000.
2021	In that year, the added value of the new energy industry in Shenzhen was approximately 64.2 billion yuan, and the installed capacity of new energy power generation accounted for 77% of the city's total installed capacity.	The total number of vehicles in use is approximately 18,000, with new registrations accounting for 10%, and the number of public charging piles is about 3,000.
2022	According to the number of new vehicles purchased with compulsory traffic insurance, Harbin sold 9,532 new energy vehicles in 2022, ranking 100th among all cities in China.	The total number of vehicles in use is approximately 24,000, with new registrations accounting for 15%, and the number of public charging piles is about 4,000.
2023	By the end of the year, the total number of new energy vehicles in the city exceeded 970,000, and the penetration rate of new vehicles being electrified exceeded 60%.	The total number of vehicles in use is approximately 30,000, with new registrations accounting for 20%, and the number of public charging piles is about 5,000. In 2023, the sales volume of new energy vehicles in Harbin City doubled compared with that in 2022.
2024	From January to October, the penetration rate of new energy vehicles was 75.9%, and the number of new energy vehicles in use exceeded 1.19 million, accounting for 27.4% of the total stock.	According to data from public channels, in the first half of the year, 25,565 pure electric vehicles and 45,246 plug-in hybrid (including extended-range) vehicles were registered in Harbin. Sales in July increased by 17.5% month-on-month. The cumulative sales for the first seven months reached 27,681 units, representing a year-on-year growth of 131.12%.

Data sources: The official website of the China Passenger Car Association, local statistics bureaus

From the above data, it can be seen that Shenzhen is in a leading position in the country in terms of the popularization of new energy vehicles, with the popularization rate increasing rapidly year by year. Meanwhile, the new energy vehicle market in Harbin is also constantly developing, with sales growing rapidly. However, compared with Shenzhen, there is still a considerable gap in the popularization rate.

The penetration rate of new energy vehicles in Shenzhen has soared from 5% in 2020 to 75.9% in 2024, and the reasons for this are multi-faceted. First of all, the Shenzhen municipal Government has made a very strong promotion of new energy vehicles and introduced a series of encouraging policies, including purchase subsidies, free parking, and free charging, which has greatly stimulated consumers' enthusiasm for purchasing. Secondly, Shenzhen's charging facilities are very complete. There are an adequate number of public charging piles, which are widely distributed, providing great convenience for the use of new energy vehicles. In addition, the public transportation system in Shenzhen is also highly developed, reducing citizens' reliance on private cars and thus promoting the popularization of new energy vehicles. Finally, the strong environmental awareness of Shenzhen citizens and their high acceptance of new energy vehicles are also important factors promoting the popularization of new energy vehicles.

However, during the same period, Harbin's growth rate only increased from 6% to approximately 20%. The reason lies in that Harbin's geographical environment, climatic conditions and economic structure are quite different from those of Shenzhen. Firstly, the winter in Harbin is long and the temperature is low, which puts forward higher requirements for the battery performance of new energy vehicles, making the adaptability of new energy vehicles in Harbin relatively poor. Secondly, the construction of charging facilities in Harbin lags behind. The number of charging piles is insufficient and their distribution is not wide enough, which brings inconvenience to the use of new energy vehicles. In addition,

although the public transportation system in Harbin is constantly improving, it still lags behind that of Shenzhen to some extent. The citizens' reliance on private cars is relatively high, which also affects the popularization of new energy vehicles. Finally, although the environmental awareness of Harbin citizens is gradually increasing, compared with Shenzhen, their acceptance of new energy vehicles still needs to be improved. This is also an important factor restricting the popularization of new energy vehicles in Harbin.

3 Study the analysis of influencing factors

3.1 The problem of climate adaptability

The influence of low-temperature environment on battery performance. Under cold climatic conditions, the battery performance of new energy vehicles will be significantly affected. Low temperatures can lead to a decrease in the fluidity of the electrolyte inside the battery and a slowdown in the chemical reaction rate, thereby significantly reducing the battery's energy storage capacity and discharge efficiency. This will not only shorten the driving range of new energy vehicles, but also may cause the vehicles to fail to start in extremely low temperatures, bringing great inconvenience to car owners. Frequent charge and discharge cycles in low-temperature environments will accelerate the aging process of batteries, shorten their service life, and increase the maintenance costs for car owners. Therefore, the challenge of climate adaptability, especially the impact of low-temperature environments on battery performance, is one of the key factors restricting the popularization of new energy vehicles in northern regions.

3.2 There is an imbalance between supply and demand in infrastructure

The spatial distribution of charging facilities is uneven. This problem is mainly reflected in the imbalance within cities and between urban and rural areas. In the core areas of some major cities, due to the high penetration rate of new energy vehicles, charging facilities are relatively dense. However, in the peripheral areas of cities or rural areas, charging facilities are seriously insufficient. In addition, due to the decline in battery performance in low-temperature environments, the charging speed will slow down, and in some cases, it may even fail to charge. This not only affects the normal use of car owners, but also increases their anxiety and dissatisfaction.

3.3 The predicament of industrial synergy

In the new energy vehicle industry, insufficient industrial chain support is a notable problem. Due to historical reasons and the characteristics of the industrial structure, the development of the new energy vehicle industry chain in the northern region lags behind relatively. The insufficient supply of key components has led to an increase in the production cost of the entire vehicle and reduced the competitiveness of the products. Insufficient close collaboration among enterprises in the upstream and downstream of the industrial chain will affect the overall efficiency and stability of the industrial chain. In addition, the talent suction effect is also an important factor restricting the development of the new energy vehicle industry in the north. Due to the more developed economy in the southern region, it attracts a large number of outstanding talents in the field of new energy vehicles. In contrast, the northern region has obvious disadvantages in attracting and retaining talents, resulting in a shortage of talents and affecting the innovation ability and competitiveness of the industry.

4 Conclusion

The penetration rate of new energy vehicles in the northern region is significantly different from that in the southern region. This difference is mainly caused by the combined effect of multiple factors such as the challenge of climate adaptability, the imbalance between supply and demand of infrastructure, the imperfection of relevant policies, differences in consumption behavior, and the predicament of industrial collaboration. Specifically, the climatic conditions in the northern regions have put forward higher requirements for the battery performance of new energy vehicles, increasing the difficulty of popularization. The lack and uneven distribution of infrastructure have limited the application scope of new energy vehicles. The insufficiency in policy formulation and implementation has affected the development momentum of the industry. Consumers' awareness and acceptance of new energy vehicles are relatively low, and the market development is rather difficult. The insufficient collaborative cooperation among enterprises in the upstream and downstream of the industrial chain further restricts the rapid development of the industry. To sum up, the northern region is confronted with multiple challenges in the popularization of new energy vehicles and requires comprehensive measures to address them.

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