

Research on Current Development, Impact and Future Exploration of China's New Energy Vehicles in Northeast China

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Abstract. China's new energy vehicle (NEV) market has experienced rapid growth in recent years, driven by the national "double carbon" strategy and the goal of carbon neutrality by 2050. The Northeast region, as a key industrial base in China, holds unique advantages and potential for the development of the electric vehicle (EV) industry. It is imperative for the region to align with national strategies and intensify research on EVs to accelerate the country's overall development. This paper begins by analyzing the current status of the EV market in the Northeast region. Through a regional case study, it identifies various challenges, including low consumer acceptance, inadequate technological innovation, insufficient charging infrastructure, and policy support gaps. Feasible solutions are proposed to address these challenges. These include enhancing technical research to optimize battery performance in low temperatures, fostering synergy within the industry chain, expanding charging facilities to meet market demand and improve consumer acceptance, and enhancing policy support. The paper aims to contribute to the healthy development of the NEV market in Northeast China and support China's sustainable development goals. It offers actionable insights and recommendations for policymakers and industry stakeholders in the Northeast region and nationwide, facilitating the refinement of strategies to drive the growth of the EV industry.

Keywords: New Energy Vehicle; Northeast China; Policy.

1. Introduction

1.1. Research Background

With the increasing global attention to mitigating carbon emissions and protecting the environment, the development of new energy vehicles has emerged as an essential path for advancing the goal of sustainable development. China is now the world's largest new energy vehicle market. In recent years, China's new energy vehicle industry has seen rapid growth in production and sales volume, with Chinese brands like BYD, Weilai, and Xiaopeng rising rapidly. At the same time, the Northeast area of China, a major industrial base, offers distinct benefits and huge potential for the creation of new energy vehicles. The government in the Northeast region has introduced a number of relevant favorable policies in recent years to actively encourage the development of the new energy cars industry as well as the enthusiasm of consumers to purchase electric cars, including car purchase tax deduction, providing subsidies, and promoting the construction of high-quality charging infrastructure. New energy vehicle producers have also boosted their investments in the Northeast to support the advancement and manufacturing of these vehicles. However, there are still significant difficulties like range per charge and performance stability because of the harsh winter weather in the Northeast, which also results in consumers in this area preferring traditional cars using gasoline rather than electric cars. According to the Ministry of Public Security, the number of new energy vehicles in China reached 20.41 million [1]. And 7.43 million new energy vehicles were registered nationwide in 2023, while the total number of registered vehicles in the three northeastern provinces is less than 300,000, accounting for only 4%, showing that the popularity of new energy vehicles in Northeast China is far less than in other regions. There are very broad prospects for future development [2]. China's development of new energy cars cannot be limited to Shanghai, Shenzhen, and other cities with strong electric car markets, and the inadequate development of Northeast China also needs great

attention. As an important industrial base in China, the northeast region has a strong automobile manufacturing foundation and rich resource conditions, and it should play an important role in the development of new energy vehicles.

The study of the further development of new energy vehicles in northeast China plays a crucial role in the transition from traditional energy to clean energy. On the one hand, new energy vehicles, as a clean mode of transport, can help reduce carbon emissions in the Northeast and even the country. It is important for facing climate change and allowing Northeast China to make up for its lack of momentum in low-carbon development. In addition, China has imported traditional energy sources such as oil and natural gas for a long time. By vigorously developing the new energy vehicle industry in the Northeast, it is also able to optimize its energy structure and enhance its national energy security, which is of great motivation and significance to China's goal of achieving carbon neutrality by 2060.

1.2. Literature Review

In recent years, research on new energy vehicles in Northeast China has been highly important and has also become the focus of many scholars and scientific personnel. Today, many research findings have been achieved. For example, in 2023, Yutong's new energy light Truck successfully started under extremely cold weather of minus 18 degrees and still maintained excellent performance in the later test of rapid temperature rise [3]. This achievement is undoubtedly a strong proof of the unlimited potential of the future development of electric vehicles in Northeast China. However, due to their special geographical location and historical reasons, the further development of the new energy vehicle industry in this region still needs to be improved. For the widespread "range anxiety" problem, Xin Guobin, Vice-minister of Industry and Information Technology said at the high-level forum of the China Electric Vehicle held in March 2022, there are still many shortcomings in new energy vehicles' adaptability to low temperatures, and it is necessary to further innovative ideas and improve measures to solve relevant problems [4]. Sun Fengchun, the academician of the Chinese Academy of Engineering, proposed at the 2023 China Automobile Charging and Replacing Ecological Conference that "At present, China's new energy automobile industry has entered a comprehensive market expansion period, and the main contradiction in the promotion and application of new energy vehicles has shifted from "range anxiety" to "energy anxiety", and the service capability of the charging infrastructure has become the main focus of the industry to build a high-quality charging and replacing industry [1]. It can be seen that the improvement of battery technology and charging infrastructure coverage in Northeast China are the two fundamental problems to solve the bottleneck of electric vehicle development. Based on this view, it is conducive to encouraging the continuous improvement of technology in infrastructure construction, but the practical application related to market popularization and policy support is not taken into account. Based on these views,

This paper will further explore consumers' knowledge, attitudes, purchase intention for new energy vehicles, and their factors in Northeast China in order to provide more accurate market analysis and marketing strategies.

The majority of the studies now have concentrated on the growth of the electric vehicle market in China, and some provinces have shown success. However, there hasn't been much research done on consumer acceptance and new energy vehicle purchasing behaviors in Northeast China, despite the significant contributions that policies and technologies have made to the market's expansion. This paper will further explore consumers' attitudes, purchase intentions of new energy vehicles and their influencing factors in Northeast China in order to provide more accurate market analyses and marketing strategies.

1.3. Research Framework

Firstly, this paper analyses the development of new energy vehicles in the Northeast region today. In addition, a brief case study in the Northeast region will be used to fully examine the impact on the Northeast region as well as the issues associated with the underdevelopment of new energy vehicles

in this region, and the reasons behind this will also be thoroughly analyzed. Finally, based on these impacts and problems, corresponding policy recommendations and marketing strategies are proposed, with the aim of offering actionable insights and recommendations to refine strategies for policymakers.

2. Case Description

The global new energy vehicle industry is generally facing the problem of low-temperature adaptability. The cold weather in Northeast China caused by the drop in electric vehicle batteries and energy decay is the fundamental reason why new energy vehicle sales in the Northeast region are far lower than in the Southern region. For the new energy vehicle owners in the last few years, every winter will have to suffer a big test. Charging time is long, the range is short, and turning on the heat will even make the problem worse. Facing these serious problems, many people believe that if northern residents want to choose new energy vehicles, home garages, charging piles, and spare fuel cars are the basic conditions [4].

In November 2022 and 2023, a snowstorm in Changchun led to a queue of electric vehicles for power replacement due to the extreme cold weather conditions [5]. At the time, Changchun was hit by unexpected and heavy snowfalls, which led to severe disruptions in the transport system, including taxi services. As the battery life of electric taxis was affected, many taxis were unable to continue operating and, therefore, required battery replacement. Under such circumstances, a large number of taxi drivers went to charging stations to queue up for battery replacement, creating a large-scale queuing incident for battery replacement. Some electric vehicles even run out of power while queuing up, and they cannot even hold out until they finish queuing up to have their batteries replaced [6]. As a result, these vehicles can only call for a tow truck, and many taxi drivers can only choose not to go out, which seriously affects their daily lives. At the same time, the shortage of charging facilities, along with factors such as heavy snow closure and unstable power supply, resulted in long waiting and queuing periods, causing serious trouble for the public. The poor performance of electric vehicle batteries under low temperatures and the difficulty of switching to a new battery have highlighted a major problem in the promotion and popularisation of electric vehicles in the Northeast.

3. Analysis of the Problem

3.1. Influence Identified

3.1.1. Insufficient consumer acceptance and cognition.

In an era of the great popularity of new energy vehicles, the Northeast has always been different from other regions, and in the above case, it can be easily seen that when in cold temperatures, the power batteries of electric vehicles will suffer from performance degradation and power depletion, resulting in a significant reduction in driving range. This will undoubtedly lead to a higher degree of consumer reliance on fuel vehicles, which are relatively more stable in terms of starting and driving in cold weather. Due to a relatively low level of awareness and acceptance of electric vehicles, many consumers still have misgivings about the performance, safety, and range of electric vehicles in cold weather, leading to a low willingness to purchase vehicles and difficulty in forming a positive perception of electric vehicles, leading to their preference for conventional fuel-efficient vehicles when purchasing a car. Such consumption habits and market preferences further limit the popularity and innovative development of electric vehicles.

3.1.2. Insufficient innovation vitality and market competitiveness.

Consumers will be less willing to buy electric cars in Northeast China due to the range and performance issues in winter, which will also affect the market scale and development speed of the new energy vehicle market. The restricted market scale may lead to the development of the related industrial chain, limiting the improvement and development of the industry chain and further

affecting the input and motivation for innovation. However, innovation requires innovators to work through complex intellectual labor and production activities, and the development of electric vehicles requires the enhancement of core technologies while facing the difficulties and limitations of innovation in the Northeast region, which means that it is difficult for enterprises to obtain sufficient economic returns to support R&D and innovation activities, which makes the relevant enterprises face difficulties in technological innovation and industrial upgrading. The contradiction between these two things will eventually lead to the lack of innovative vigor in the new energy vehicles industry.

3.2. Problem Identified Analysis

3.2.1. Reduced endurance and performance caused by weather.

The weather in the Northeast can have an impact on electric vehicles, especially in the winter. Since temperatures in winter in the Northeast are typically low, this can affect the performance and range of the electric vehicles' batteries. Low temperatures increase the internal resistance of the battery, which affects the charging and discharging efficiency of the battery and also slows down the chemical reaction rate of the battery, reducing its capacity and power output. This may lead to a reduction in the range of electric vehicles and inconvenience to the vehicle owner when traveling. In addition, the low temperature may also affect the charging efficiency of the tram, making the charging time longer, and may even be unable to fill the situation. Therefore, further research on batteries is of great importance.

3.2.2. Charging infrastructure's low coverage.

For electric vehicle users in Northeast China, apart from the range issue, the biggest concern is the charging issue. The relative lag in charging infrastructure coverage is one of the biggest problems for consumers.

Through the above case, it is also clear that the charging infrastructure coverage in the Northeast is not sufficient, and the number of switching stations is also one of the main reasons for Changchun's heavy snowstorm switching difficulty. According to the data of China Charging Union, in 2023, the increment of charging infrastructure will be 3,386,000 units, up 30.6% year-on-year, a pile-vehicle incremental ratio of 1:2.8 [7]. Until the end of 2021, Changchun has built 2 charging stations, 2 power stations, 18 bus charging stations, all kinds of charging piles 1577, public charging and switching infrastructure service is seriously insufficient [8]. Although the promotion of new energy vehicles in recent years in the Northeast is strengthening, compared to the Southern region, the popularity of new energy vehicles is still small. This also affects the speed and scale of charging infrastructure construction, making the supply and demand of charging facilities relatively tense. Furthermore, the construction and operation of charging infrastructure require a large amount of capital investment, while the level of economic development in the northeast region is relatively lagging, which, to some extent, limits the construction speed. As a result, the number of charging stations is relatively small and unevenly distributed, leading to an imbalance between supply and demand at some charging stations. This supply-demand conflict is even more prominent in extreme weather conditions, making it even more difficult for drivers to switch to a new charger.

3.2.3. Insufficient policy support.

Northeast China also has shortcomings in relevant policy strategies. First of all, in terms of market share, according to the data released by the People's Government of Heilongjiang Province, the sales of new energy vehicles in Heilongjiang Province accounted for 28.3% of all automobile sales, but it still needs to be improved compared with other cities [8]. The study found that the vehicles in Northeast China are still dominated by traditional fuel vehicles, and the proportion of new energy electric vehicles and hybrid electric vehicles is relatively low. It shows that the intensity and effect of the promotion of new energy vehicles in the region need to be strengthened.

One of the reasons is that policy support and subsidies are not strong enough compared with other regions. Taking Shanghai as an example, Shanghai not only actively responded to the national purchase tax reduction policy but also formulated a series of local policies according to its own situation, such as free special license support, charging infrastructure construction subsidies to encourage consumers to buy new energy vehicles, the maximum subsidy can get 10,000 yuan under more simple conditions. In Northeast China, although there are purchase tax reduction and exemption policies for new energy vehicles at the national level, local governments may lack more specific and targeted policy measures to promote the development of the local, new energy vehicles industry, like car purchase subsidies, charging facilities construction, and charging cost concessions. The subsidy policy in the region varies due to the local economic situation and the different promotion goals for new energy vehicles. The subsidy policy is relatively conservative, and the maximum subsidy is 7,000 yuan for the purchase of more than 300,000 electric vehicles.

4. Suggestion

4.1. Promotion in Technology and Industry Chain Cooperation

Due to the extremely low-temperature in the Northeast, strengthening the battery, charging technology, thermal management technology, motors, and other key components of the low-temperature performance of the R&D to improve the stability and reliability of the new energy vehicles in cold environments is conducive to alleviating users' "range anxiety". Jilin Automotive Electronics Association Secretary-General Li Riguang said, through years of research and development, the promotion of new energy vehicles in the alpine region of the low-temperature resistant technology has achieved substantial progress, and most of the mainstream EVs can normally start in the low-temperature and maintain a certain range, which gradually meets the need of buyers in Northeast and other alpine regions [9]. This has laid a foundation for further improvement in electric vehicle technology, but it also provides a technical guarantee for improvement in market share.

Secondly, the Northeast region's new energy vehicle industry is currently more concentrated in the midstream and downstream, which is responsible for vehicle manufacturing and automotive sales and service, respectively, especially in the midstream of the manufacturing side, while the upstream industry is insufficient which is responsible for mining and processing of raw materials, as well as batteries, motors, electronic control and other components of the production. Since Northeast China has a strong manufacturing base and abundant resources, providing strong support for the development of new energy vehicles, the region should combine this strong advantage to strengthen the construction of the industry chain synergistic development mechanism and strengthen the supply of raw materials, components and other aspects of the supply security to improve the development of upstream industries and form a complete industry chain.

4.2. Improvement in Coverage of Charging Infrastructure

Due to the special geographical location of northeast China, compared with the cities with rapid development in new energy vehicles, like Shanghai and Guangdong, their vast land resulted in a more dispersed layout of charging facilities, which failed to meet the needs of all users. Therefore, the layout and construction of charging facilities, especially in the remote areas of Northeast China, must ensure that the coverage and density of those should meet market demand. On the other hand, the government should promote the intelligent and network development of charging facilities to improve charging efficiency and service quality. For example, introducing an application that can help users find available nearby charging piles may perfectly fulfill users' needs, which can also relieve the "energy anxiety" of users.

At present, in order to support the promotion and application of new energy vehicles, the Northeast region is gradually improving infrastructure such as charging piles and improving the convenience of replenishing energy. According to the estimation of ownership by the end of 2023, in order to meet

the charging demand for new energy vehicles, Shenyang will strive to build 33,000 charging terminals by the end of 2023, including 10,000 public charging terminals and 23,000 private charging terminals, and increase the “vehicle-to-pile ratio” to 2.1:1, which will reach the level of similar cities in the south [10]. This undoubtedly promotes the comprehensive construction of charging facilities.

4.3. Policy Optimization

On November 11, Wang Kuijun, the editor of Guandong Automobile Network, mentioned in an interview that “According to the situation of new energy vehicle batteries at this stage, the Northeast region is currently not suitable for the wide promotion of using pure electric vehicles (PEV).” In contrast, plug-in hybrid electric vehicles (PHEV) are more appropriate in the cold weather in Northeast China [5].” It can be seen that at this stage, due to the great impact of weather on EV travel, people should be encouraged to purchase PHEVs rather than PEVs. The government should continue to increase policy support for new energy vehicles, including car purchase subsidies, tax incentives, and other incentives, in order to reduce consumer purchase costs and improve the market competitiveness of new energy vehicles. At the same time, the government should encourage enterprises to strengthen cooperation with universities and research institutes and attract excellent scientific research enterprises to carry out technological innovation work to promote the progress of new energy vehicle technology, research and development, production, and marketing.

5. Conclusion

5.1. Key Findings

This paper discusses the impacts and problems of new energy vehicles in the region, as well as the corresponding suggestions based on a case in Northeast China. It can be clearly seen that the current new energy vehicle industry in Northeast China has different degrees of problems, such as low consumer acceptance, lagging technological innovation, imperfect infrastructure, and insufficient policy support etc. These problems not only limit the market promotion and popularization of new energy vehicles but also affect the synergistic development of the entire industrial chain. In view of these problems, this paper puts forward the corresponding suggestions one by one. Firstly, technologies should be improved, and the cooperation between the upstream and downstream enterprises of the industry chain should be strengthened to promote technological innovation and industrial upgrading so as to improve the overall performance and market competitiveness of new energy vehicles. Secondly, infrastructure construction should be intensified to improve supporting facilities such as charging piles and power exchange stations to enhance convenience. At the same time, the government should introduce more favorable industrial policies, improve the effectiveness and implementation of policies, and encourage enterprises to increase investment and R&D efforts.

5.2. Research Value

This paper comprehensively analyzes the problems of new energy vehicle development in Northeast China and proposes specific solutions so that the industry can more accurately identify the bottlenecks and obstacles, as well as provide policymakers with directions for policy formulation and improvement. Furthermore, this paper not only mentions the shortcomings of the industry but also illustrates the excellent results and progress achieved today, which helps consumers and investors more clearly recognize the development prospects and potential of this industry, thus improving market acceptance and promoting the industry to develop in a healthier and more sustainable direction.

5.3. Limitations

The major limitation of this paper is theoretical depth. The paper adopts more qualitative research methods, including literature analysis and historical review, while quantitative analysis uses mathematical tools such as statistics to process and analyze data to find out the relationship, trend, or

pattern between variables is lack. It is necessary to continue to explore in depth in the future to get more objective and verifiable test results.

Future research needs to explore the influencing factors and mechanisms of the development of new energy vehicles in a more in-depth manner through more extensive data collection and analysis, combined with theoretical discussions, so as to obtain more accurate information on the current situation and development trend of new energy vehicle market and finally can provide more guiding suggestions for policy-making and enterprise decision making.

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