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Research on the Development of China's New Energy Vehicle Industry under the Background of Low-Carbon Economy: Taking NIO as an Example

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Abstract: With the advancement of the global low-carbon economy and the proposal of the "dual carbon" goals, the new energy vehicle industry has become an important part of China's strategic emerging industries. This paper takes NIO as an example to deeply analyze the current development status, challenges and development countermeasures of China's new energy vehicle industry under the background of low-carbon economy. Through the research on NIO's market performance, technological innovation and strategy adaptability, the problems existing in the development of NIO, such as excessive financial pressure and high debt risk, are identified, and targeted countermeasures and suggestions are put forward, aiming to provide theoretical support and practical guidance for the healthy development of China's new energy vehicle industry. This paper reveals how new energy vehicle enterprises can respond to the requirements of the low-carbon economy and achieve sustainable development through strategies such as technological innovation, market expansion and brand building.

Keywords: New Energy Vehicles; Low Carbon Economy; NIO Auto; Sustainable Development

1. Introduction

1.1 Research Background

The new wave of technological revolution and industrial transformation is continuously deepening, giving rise to numerous cutting-edge technologies and innovative changes. In core areas such as the digital economy, new energy, low-carbon economy, and bioeconomy, many emerging industries are showing a vigorous growth trend. Against the backdrop of the global commitment to promoting low-carbon transformation and achieving carbon peaking and carbon neutrality goals, the new energy vehicle sector has emerged as one of the fastest-growing and most promising emerging industries. Since 2015, China's production and sales of new energy vehicles have ranked first in the world for several consecutive years, reflecting the positive trend of industrial upgrading and the strong resilience of the economy in China.

From an international perspective, disruptive innovation offers China's new energy vehicle industry an opportunity to catch up. Under the global challenge of addressing climate change, the development and utilization of renewable energy have become an important global task. As the transportation sector is a major source of fossil energy consumption and carbon dioxide emissions, the development of new energy vehicles is a common goal for all countries. China has a solid foundation for the development of new energy vehicles, including a mature industrial system, a huge market scale and a rapidly growing digital economy, which provide strong support for the electrification and intelligent transformation of the automotive industry. However, the trade barriers and regulatory measures adopted by some developed countries against new energy vehicles, as well as the practice of using low-carbon policies as trade protection tools, have brought challenges to the international market expansion of China's new energy vehicle industry.

The Chinese government has clearly put forward the grand goal of peaking carbon emissions before 2030 and achieving carbon neutrality before 2060. The new energy vehicle industry is experiencing rapid development. In the automotive industry, reducing carbon emissions has become an important means to achieve the above two goals, and the development of new energy vehicles is a key step in realizing the carbon emission targets. On

this basis, the industry is not only confronted with opportunities for technological innovation but also for market expansion. It also faces challenges in areas such as chip supply, power batteries, charging infrastructure, and after-sales service.

As one of the leading players in China's new energy vehicle industry, NIO has demonstrated its diversified layout in terms of technology, brand building and market strategy. The key milestones and technological and market breakthroughs in NIO's development history provide a comprehensive and in-depth research case for the entire industry, revealing its growth trajectory and potential capabilities in the wave of new energy vehicle development. An in-depth study of NIO can provide practical guidance and theoretical support for the development strategy of China's new energy vehicle industry.

1.2 Research Review

1.2.1 The current research status of new energy vehicles abroad

The research field of new energy vehicle development abroad has reached a mature stage. Looking back to the early days of history, although the specific time may vary, the United States was indeed the first country to advocate the concept of energy conservation and emission reduction in automobiles. Since then, the Japanese academic circle has also made significant contributions. Scholars such as Nakata (2003) and S Pradhan (2006) have strongly demonstrated the positive role of new energy vehicles in environmental protection and their broad development potential by using feasibility analysis methods [1].

In academic research exploring the necessity of policies, Williamson (1975) defined market inefficiency as an opportunistic tendency, pointing out that its root cause lies in the rationality limitations of market participants and the imperfection of the market environment. Ishitani (2007) proposed a comprehensive framework covering the overall strategy and industrialization policies for the development of pure electric and plug-in hybrid vehicles [2]; Ahman (2006) emphasized that in the early stage of new energy vehicle research and development, national policies played a key driving role, and advocated that policy formulation should focus on core links such as R&D investment, demonstration operation and market promotion [3].

Overall, foreign scholars' research in the field of new energy vehicle development widely covers multiple aspects such as technological innovation and policy-making, and has deeply explored related factors such as policies. These research achievements provide a solid theoretical foundation and practical guidance for the progress of the global new energy vehicle industry, and at the same time clarify the current trends and challenges faced by the development of new energy vehicles.

1.2.2 The current research status of new energy vehicles in China

Domestic scholars started their research on new energy relatively late. Currently, the research results are mainly concentrated in multiple dimensions such as policy analysis, industrial development models, and regional policy research.

In terms of policy, Xiao (2011) analyzed the shortcomings of policies promoting the development of new energy vehicles. He advocated that policy support should focus on encouraging the cultivation and protection of domestic new energy vehicle brands and key technologies, and emphasized the importance of the market's self-regulating function [4]; Shi (2010) examined the coverage of policy subsidies and the challenges encountered in their implementation, and put forward suggestions for improving the policy subsidy system [5]; Zeng (2009) discussed the current development status of new energy vehicles. Specifically, the intensity of policy support has not yet reached the expected level, the market size has not been fully expanded, and at the same time, the supply of components in the industry has not been able to fully meet the demands of large-scale manufacturing [6]. Li (2011) proposed countermeasures in response to the challenges faced by China's new energy vehicle industry through relevant research. Research indicates that the current new energy vehicle industry mainly faces problems such as weak market demand and disorderly market competition. It is suggested that the government enhance its support and vigorously promote the consumption of new energy vehicles [7].

Overall, domestic research has achieved certain results in aspects such as industrial policies for new energy vehicles, industrial development models, and the implementation effects of regional policies. However, with the rapid

development of the new energy vehicle industry, theoretical research mainly focuses on the assessment of the current policy effects, while in-depth studies on industrial model innovation and technological innovation are relatively insufficient. In addition, further exploration and research are still needed on how to formulate more precise and effective policies in combination with local characteristics and resource endowments. Therefore, future research needs to pay more attention to industrial technological innovation, the improvement of market mechanisms and the dynamic adjustment of policies, in order to promote the healthy and sustainable development of China's new energy vehicle industry.

1.2.3 The current research status of low-carbon economy abroad

The UK was the first to put forward the concept of "low-carbon economy" in its white paper "Our Future Energy - Creating a Low-Carbon Economy". This white paper indicates that a low-carbon economy means achieving more considerable economic benefits with lower consumption of natural resources and reduced environmental pollution. It is not only an effective way to improve living standards and optimize the quality of life, but also provides an opportunity for the research and development, application and export of advanced technologies. At the same time, it can give rise to new business opportunities and create more job positions.

Jonson and other scholars have explored the technical feasibility of significantly reducing carbon dioxide emissions from housing in the UK, arguing that it is possible to achieve an 80% reduction in emissions by the middle of this century compared to the 1990 level using existing technologies [8]. Teers and other scholars explored the possibility of Germany reducing GHG emissions by 80% by 2050 compared to the 1990 level, arguing that it is possible to achieve both strong economic growth and a reduction in CHG emissions through the adoption of relevant policy measures [9]. MaKarov(2022) [10], Emre(2022) [11] and others respectively expounded on the concepts related to the low-carbon economy from the perspectives of traditional energy sources such as oil and natural gas and clean energy sources such as nuclear energy. They believe that the low-carbon economy is more about decarbonizing by reducing the consumption of traditional energy sources, achieving energy transformation, reducing carbon emissions, and ultimately achieving carbon neutrality.

1.2.4 The current research status of low-carbon economy in China

There is no unified definition of the concept of low-carbon economy at present. Fu (2008) holds that a low-carbon economy is one that reduces greenhouse gas emissions and slows down global climate change through technological and institutional innovation without affecting economic and social development [12]. Hu et al. (2010) hold that low-carbon economy is the social and economic form presented when human society develops to a certain advanced stage [13]; Zhang (2021) proposed that in a certain sense, low-carbon economy can be regarded as a synonym for low-carbon emissions [14]. As a strategic means, it aims to promote sustainable economic development. Gong et al. (2021) stated that a low-carbon economy can be regarded as a term for enhancing production efficiency and reducing pollutant emissions. Its aim is to alleviate the environmental burden, improve the quality of human life, and ensure the steady progress of the economy and society [15]. Liu (2020) holds that developing a low-carbon economy is a manifestation of social progress and represents a new economic development model. A low-carbon economy aims to utilize advanced technologies to develop new energy sources, thereby reducing reliance on and consumption of traditional energy, and accelerating the popularization and application of clean energy through the transformation of the economic and energy structure [16].

1.3 Relevant Concepts and Theoretical Foundations

1.3.1 Low-carbon economy

Developing a low-carbon economy and improving the current ecological environment are important ways to achieve long-term sustainable social and economic development. At present, smoggy weather occurs frequently, making the development of a low-carbon economy particularly urgent. Research has found that in addition to direct environmental problems such as photochemical smog and acid rain, the increase in carbon dioxide concentration in the atmosphere may also cause

global climate change. Against this backdrop of The Times, governments and the public around the world have put forward a series of concepts for green and low-carbon development: "low-carbon economy" and "low-carbon technology", all of which are strategies adopted to address climate change and environmental issues.

This article points out that a low-carbon economy refers to an economic growth model with "low pollution", "low emissions" and "low energy consumption" as its core features and external manifestations. Its essence lies in relying on technological innovation means to continuously improve energy utilization efficiency and optimize the energy composition structure.

1.3.2 New energy vehicles

The development of new energy vehicles in China has become relatively mature. Clean fuel vehicles refer to those that are completely or mainly driven by clean energy. They roughly include three major categories: plug-in hybrid vehicles, fuel cell vehicles, and pure electric vehicles. In recent years, China's new energy vehicle sector has achieved remarkable accomplishments that have attracted global attention, making significant contributions to the growth of the national economy and social progress. At present, China's new energy vehicle industry has entered a new stage of high-quality development.

The new energy sources adopted by new energy vehicles refer to those that are different from traditional vehicle energy sources. Their characteristics lie in high cleanliness and minimal or nearly pollution-free pollution during use. They specifically cover categories such as electricity, hydrogen energy, and bioenergy. New energy vehicles refer to automotive products that utilize new power systems, mainly or entirely rely on new energy sources as power sources, and integrate advanced power control and drive technologies. They are characterized by cutting-edge technical concepts and innovative technologies and structures [17].

2. The Current Development Status of New Energy Vehicles in China under the Background of Low Carbon

2.1 The Current Development Status of New Energy Vehicles in China

Since 2015, China's production and sales of new energy vehicles have ranked first in the world for nine consecutive years. This achievement strongly demonstrates the good momentum of China's industrial upgrading and the strong resilience of its economy. In 2023, China's auto exports successfully surpassed those of Japan and ranked first in the world. Over the years, the scale of China's new energy vehicle industry has grown rapidly, and its production and sales volume have consistently ranked first in the world for many years. According to relevant data statistics, China has achieved the phased goals set for 2025 in the "Development Plan for the New Energy Vehicle Industry (2021-2035)" ahead of schedule. In 2022, China's production of new energy vehicles reached 7.0582 million units, up by 96.9% year-on-year. Sales reached 6.887 million units, up by 93.4% year-on-year, with a penetration rate of 25.6%. This indicates that China's new energy vehicle industry has occupied an important position in the global market and is actively promoting the development of a low-carbon economy.

The market size of China's new energy vehicle industry will reach 381 billion US dollars in 2024. New energy vehicles refer to automobiles that adopt new power systems and are fully or mainly driven by new energy sources, including plug-in hybrid (including range-extended) vehicles, pure electric vehicles and fuel cell electric vehicles, etc. In 2023, the market size of China's new energy vehicle industry was 320.8 billion US dollars, with a compound annual growth rate as high as 42% over the past five years. Preliminary estimates suggest that the market size of China's new energy vehicle industry will reach 381 billion US dollars in 2024.

2.2 The Impact of Low-Carbon Economy on New Energy Vehicles

The proposal of a low-carbon economy has had a profound impact on the new energy vehicle industry. Globally, in response to climate change and environmental pollution, the development and utilization of renewable energy have become important global goals. Especially in the transportation industry, as a major area of fossil energy consumption and carbon dioxide emissions, the development of new energy vehicles has become the direction of efforts for all countries. Moreover, with the deepening of the low-carbon economy in people's minds, consumers' preference for

environmentally friendly and energy-saving vehicles is gradually increasing. New energy vehicles have gradually won the favor of consumers with their advantages such as zero emissions, low noise and low energy consumption. In addition, the government's subsidies and preferential policies for new energy vehicles have further stimulated consumers' purchasing enthusiasm. China's new energy vehicle industry has entered a stage of comprehensive market expansion, which has effectively driven the rapid development of the new energy vehicle market. The industrial chain of the automotive industry is extremely long, covering the cross-integration of multiple fields. Against this backdrop, the automotive industry is moving towards a low-carbon direction, which can drive the entire industrial chain towards low-carbonization and thereby create a favorable situation of synergy and efficiency in reducing carbon emissions.

New energy vehicles, with their green and low-carbon characteristics, hold huge market potential. With the strong support of national policies and the enthusiastic participation of enterprises, many new energy vehicle research and development companies have developed rapidly, occupied a place in the automotive industry, and quickly given birth to a series of outstanding new energy vehicle brands. At the same time, the exhaust emissions from automotive fuel are also one of the main causes of the increase in greenhouse gases. The gap between China's new energy vehicle sector and that of foreign countries is gradually narrowing. However, the corresponding personnel training system is still insufficient, and the supporting technical and accessory systems also need to be improved.

2.3 Relevant Measures Taken by NIO in the Field of Low Carbon

2.3.1 Product development stage

Nio has specially developed the Clean + material, which is renewable, recyclable, low-carbon and environmentally friendly. Materials like bio-based materials and renewable rattan and wood materials have also been incorporated into NIO's products. In terms of packaging, NIO has been striving to increase the usage rate of recyclable and shareable green packaging. Currently, the proportion of recyclable packaging used in full-truckload transportation has reached 98%. Moreover, NIO also closely collaborates with upstream raw material suppliers to control from the source and ensure the supply of low-carbon materials, keeping the core components in the supply chain in a low-carbon state for a long time.

2.3.2 Regarding the green supply chain

Nio has implemented a localization strategy. Within a 1.5-hour drive from its Hefei production base, it has set up industrial parks in Xinqiao, Lu 'an and other places. Components are supplied from these parks, significantly reducing the transportation distance of the supply chain logistics and lowering costs. Nio has also established an internal carbon pricing mechanism (ICP) within the company, providing a clear decision-making basis and direction for carbon reduction. It is one of the first domestic automakers to do so. Not only that, NIO has also joined hands with its supply chain partners to formulate carbon reduction strategies and promote coordinated carbon reduction among upstream and downstream enterprises.

The second advanced manufacturing base of NIO, which went into operation in September 2022, has performed outstandingly in green production. In 2023, this base purchased 16 million kilowatt-hours of green electricity. It can also recover approximately the same amount of waste heat as 408,000 cubic meters of natural gas each year. The factory area fully adopts LED lighting fixtures. Compared with ordinary fixtures, the energy-saving effect exceeds 50%. The factory's process cooling circulating water reuse system is also very impressive, with a circulating water volume of up to 6.63 million cubic meters and an annual water reuse rate of 99.4%. A reclaimed water reuse system has been set up in the project site. The sewage treatment station is designed to centrally treat sewage with a reuse rate of 50%. It is the first new energy vehicle factory in China to apply the concept of sponge cities to factory construction.

2.3.3 Green logistics section

Nio has always adhered to the three paths of green packaging, green warehousing and green transportation, paid attention to the green development trend of the logistics industry, and is fully committed to building a green logistics chain. Nio's goal is to use 100% non-toxic, harmless and recyclable packaging materials. When choosing warehouse resources, give priority to those with green warehouse certification. Also, work with warehouse

partners to install photovoltaic panels and LED lighting systems to promote the recycling of water resources and replace fuel-powered forklifts with lithium battery forklifts. In terms of transportation, new energy trucks and large outdoor unmanned automatic guided vehicles will be gradually introduced. By setting up distribution centers and other means, the loading rate and utilization efficiency of vehicles will be increased. Sea and rail transportation will be adopted more often, and transportation routes will be optimized, with straight-line transportation being preferred as much as possible.

2.3.4 Charging and battery swapping services

A total of 21,663 public charging piles have been built and over 1.5 million third-party charging piles have been connected, and the number of battery swaps by users has exceeded 39 million. Changan, Geely and other enterprises have all reached battery swap cooperation with NIO, jointly promoting the construction of battery swap networks and standard systems. In July 2023, NIO released a 20kWV2G charging pile. Besides fast charging, it can also discharge electricity, enabling interaction between the vehicle and the power grid. When the grid load is low, electric vehicles can absorb electrical energy. When the load is high, it can also release electrical energy. Nio has also collaborated with the Qilian Mountain National Park to build the world's first V2G photovoltaic self-circulation energy replenishment system, which was put into use in August 2023

2.3.5 Aspect of resource recycling and utilization

Nio attaches great importance to the full life cycle management of batteries and actively explores the gradient utilization of retired batteries. Through the Circular Car Laboratory project, NIO has achieved a small-batch closed-loop pilot from complete vehicles to complete vehicles, using recycled waste aluminum, wheels, magnets and copper materials, etc., to manufacture new parts. The waste generated in the production of complete vehicles will also be used in new plates, with the maximum proportion of waste added reaching up to 50%.

3. Analysis of the Current Development Status and Challenges of NIO

3.1 Overview and Development History of NIO Company

Nio Group was founded in November 2014 and is a pioneer and leader in the global smart electric vehicle market. It was jointly initiated and established by outstanding domestic Internet enterprises and leading figures such as Li Xiang, Liu Qiangdong and Tencent. Since its establishment, the company has adhered to a global perspective and clearly positioned itself as a technology enterprise with global influence. Nio's vision is to become a leading smart electric vehicle brand in technology and experience, and is committed to achieving a sustainable and better future, namely the mission of "Blue Sky Coming". Nio continues to innovate in the fields of autonomous driving, digital technology, electric powertrains and batteries, and has launched industry-leading battery replacement technology, battery as a Service (BaaS), and marketing strategies based on the "4R" theory. Nio's product line covers a variety of high-end smart electric vehicles, including ES6, ES8, EC6, ET7, etc., which have gained wide recognition in the market for their high performance and ultimate user experience. Nio has not only achieved remarkable success in the Chinese market but also actively expanded into the global market, demonstrating its global vision and layout.

Nio has been making continuous efforts in technological innovation, especially in the ET9 model, demonstrating the powerful capabilities of its flagship intelligent system. The ET9 is equipped with NIO's brand-new flagship intelligent system - Cedar, which is built on the world's leading digital architecture, the most powerful smart hardware, and the vehicle's all-domain operating system SkyOS· Tianshu. Nio has made huge investments in research and development. In 2022, it spent a total of 10.84 billion yuan on R&D, a year-on-year increase of 136%. As of August 31, 2023, the total number of patents applied for and authorized by NIO exceeded 7,300. These investments and achievements not only consolidate NIO's advantage in product quality, but also provide solid technical support for its leading position in the intelligent electric vehicle industry. As shown in Table 1.

According to the latest data (As shown in Table 1) as of February 2025, the new energy vehicle market is undergoing fierce competition and rapid reshuffling. In January 2025, Xiaopeng Motors surpassed Li Auto with a delivery of

30,000 vehicles and regained the top sales position. Nio's sales, however, have declined. In January 2025, NIO delivered 14,000 new vehicles, a year-on-year increase of 37.9%, but its new vehicle deliveries were only 8,000, a year-on-year drop of 21%. In addition, Xiaomi's car also performed strongly, delivering over 20,000 units in January, surpassing NIO for the first time and approaching or surpassing Askui. According to the prediction of the China Association of Automobile Manufacturers, the sales volume of new energy vehicles in China will reach 16 million units in 2025, with a year-on-year growth of 24.4%. However, the growth rate has slowed down significantly, and it is expected that market competition will become increasingly fierce.

Table 1. Sales Data of Domestic New Energy Vehicle Manufacturers in January 2025

ranking	Brand	January sales volume (units)	Year-on-year
1	Xiaopeng	30350	267.90%
2	Li Auto	29927	-4%
3	Zero Run	25170	105%
4	Deepal	24575	44.20%
5	AITO	20926	-36.50%
6	Xiaomi	20000+	-
7	ZEEKR	11942	-4.70%
8	LUXEED	11420	-
9	Avita	8826	25%
10	LAN Tu	8009	13.70%
11	NIO	7951	-20.90%
12	Le Dao	5912	-

3.2 NIO's Advantages in Technological Innovation and R&D Investment

Nio continuously conducts technological innovations in the fields of autonomous driving, digital technology, electric powertrains and batteries. Especially in battery replacement technology and Battery as a Service (BaaS), NIO has demonstrated a strong competitive edge. In addition, NIO invested a total of 10.84 billion yuan in research and development expenses in 2022, representing a year-on-year increase of 136%. As of August 31, 2023, the number of patents applied for and authorized by the company exceeded 7,300. Through continuous investment in research and development, NIO has been promoting the leading position of its products in terms of performance and technology, further consolidating its competitiveness in the global smart electric vehicle market.

Nio has been continuously increasing its investment in technological innovation and has launched a series of industry-leading technologies, which have driven its overall improvement in intelligent driving, electric technology and user experience. The company's independently developed Shenji NX9031 intelligent driving chip adopts an advanced 5-nanometer process, with computing power surpassing that of industry flagship chips. It can perform 50 billion computations, significantly enhancing the safety and efficiency of the intelligent driving system. This innovation makes NIO's autonomous driving experience more precise and efficient, shortens reaction time, and enhances the safety and stability of autonomous driving. As shown in Table 2.

Nio has also made breakthroughs in battery technology (As shown in Table 2.). The company has adopted the all-domain 900V high-voltage architecture technology. This innovation not only supports a 5C charge and discharge rate but also can achieve a peak charging power of up to 600kW. Thanks to this technology, NIO's electric vehicles have achieved a significant improvement in charging efficiency. Users only need to charge for 5 minutes to add 255 kilometers of driving range, effectively solving the common problem of long charging time faced by electric vehicles. The all-domain high-voltage architecture not only enhances the vehicle's power performance but also improves the overall driving experience, providing users with a more convenient driving experience.

Nio continuously leads the development of smart electric vehicles through constant technological innovation, ensuring that it always maintains a leading position in the industry in terms of product quality, charging convenience, and driving experience. These technological highlights not only lay a solid foundation for NIO's global expansion, but also keep it highly competitive in the global market.

Table 2. The Achievements of NIO in Technological Innovation

Innovative technology	Technical highlights	Technical value and function
Self-developed intelligent driving chip	The Shenji NX9031, with a 5-nanometer process and 50 billion body tubes, has	Enhance the safety and efficiency of intelligent driving, and strengthen

	computing power that surpasses that of the industry's flagship chips	
All-domain 900V high-voltage architecture	Supports a 5C charge and discharge rate, with a peak charging power of 600kw. A 5-minute charge can provide a range of 255 kilometers	Autonomous driving experience, shortening reaction time
Sky Ride full active suspension	The world's only fully by-wire intelligent chassis system, integrating by-wire steering, rear-wheel steering and fully active suspension	Improve charging efficiency, shorten charging time and enhance the convenience of using electric vehicles
Battery swapping technology	The fourth-generation battery swap station supports multiple specifications of battery packs and is compatible with multiple brands, enhancing the efficiency of battery swapping	Enhance handling accuracy and comfort, and reduce jolting and discomfort inside the vehicle
Headlamp design	Firefly's innovative headlight design enhances visibility and safety at night	Provide convenient battery replacement services to solve the problem of long charging time for electric vehicles and increase the popularity of electric vehicles
4D millimeter-wave radar	Enhance forward perception capability and improve reliability in extreme weather conditions	Enhance the safety of intelligent driving and reduce braking situations.

3.3 NIO's Product Line and Market Performance

Nio's product line covers a variety of high-end smart electric vehicles such as ES6, ES8, EC6, and ET7. These models have gained wide recognition for their outstanding performance and ultimate user experience. Especially on the ET9 model, NIO showcased the powerful functions of its flagship intelligent system, Cedar, providing consumers with a more intelligent driving experience.

Judging from the revenue data, NIO's business performance has grown in recent years. Revenue in the first quarter of 2024 was 9.909 billion yuan, a year-on-year decrease of 7.2%. Among them, the sales of automobiles were 8.381 billion yuan, a year-on-year decline of 9.1%, while the sales of other products were 1.527 billion yuan, a year-on-year increase of 5.2%. Revenue in the second quarter of 2024 was 17.45 billion yuan, representing a year-on-year growth of 98.9% and a quarter-on-quarter growth of 76.1%. The sales volume was 57,373 units, representing a year-on-year increase of 143.9% and a month-on-month increase of 90.9%. According to a research report by Guosheng Securities, NIO delivered 61,855 vehicles in the third quarter, generating revenue of 18.67 billion yuan. The revenue has increased compared to others, but it is unstable. The reason is that the unit price of vehicle sales has been affected by factors such as market competition and product structure adjustment, resulting in relatively low income. Moreover, NIO has made significant investments in measures such as sales growth, accelerated layout of battery swap stations, and adhering to the strategy of prioritizing infrastructure, leading to high overall operating costs.

The gross profit margin of the entire vehicle in the first quarter of 2024 was 9.2%, and in the second quarter it was 9.7%, an increase from 8.0% in the second quarter of 2023. The 10.7% in the third quarter was an increase from 8.0% in the third quarter of 2023 and 9.7% in the second quarter of 2024. From this data, it can be seen that NIO's gross profit margin has increased in all three quarters of 2024, especially the improvement in vehicle gross profit margin, indicating that the company has achieved certain results in cost control and product pricing.

3.4 NIO's Debt Position and Financial Challenges

Nio's total liabilities have shown an upward trend over the past few years, reflecting the significant financial support it requires for expansion and operation. In 2020, NIO's total liabilities were 22.78 billion yuan. In 2021, this figure rose to 44.82 billion yuan, with a growth rate as high as 96.76%. In 2022, it further increased to 68.617 billion yuan, representing a

year-on-year growth of 53.09%. In 2023, NIO's total liabilities reached 87.787 billion yuan, representing a year-on-year increase of 27.94%. This trend indicates that NIO is gradually relying on external financial support in the process of expanding production capacity, increasing R&D investment and expanding the market. Despite the company's continuous growth in revenue, the increase in debt levels also reflects the challenges it faces in capital operation and financial risk management.

Nio's loss situation persisted for some time. Nio reported a loss of 5.593 billion yuan in the first quarter, an increase of 14.6% year-on-year and 14.0% quarter-on-quarter. In the second quarter, the revenue was 4.995 billion yuan, an increase of 12.2% year-on-year but a narrowing of 3.5% quarter-on-quarter. In the third quarter, the revenue was 5.142 billion yuan, an increase of 11.1% year-on-year and 0.3% quarter-on-quarter.

Based on the above data, NIO's revenue and delivery volume both increased in the third quarter of 2024, but its net profit remained in a loss state. Despite this, the company achieved positive free cash flow in the third quarter, indicating certain signs of financial improvement. Moreover, the gross profit margin has increased, especially the improvement in the gross profit margin of vehicles, indicating that the company has achieved certain results in cost control and product pricing. According to the above data, NIO's losses mainly stem from its high investment in research and development and sales management expenses. Although its average selling price per vehicle is higher than that of XPeng and Li Auto, its net profit per vehicle indicator is far worse than that of its competitors, which indicates that its business model is facing significant challenges at the current stage.

Nio has a relatively high debt-to-asset ratio. As of the end of the third quarter of 2024, the company's total liabilities stood at 87.92 billion yuan, with a debt-to-asset ratio as high as 84.5%, indicating significant financial pressure. The company's profit expectations rely on the market performance of new models and its cost control capabilities. Coupled with the increasingly fierce competition in the new energy vehicle market, not only are traditional car brands such as Volkswagen and Toyota accelerating their transition to new energy vehicles, but also many emerging brands like XPeng and Li Auto are rising, and technology companies like Huawei and Xiaomi are entering the industry from other fields. Nio needs to constantly innovate and enhance the competitiveness of its products in order to maintain its leading position in the market.

4. The Problems Existing in the Development of NIO Company

4.1 Financial Stress and Liability Risk

Although NIO has made remarkable progress in recent years, especially in technological innovation, product quality and market expansion, it still faces a series of problems that need to be solved urgently during its rapid development. First of all, NIO is under considerable financial pressure. Due to the expansion of the company's business and the increase in R&D investment, NIO's debt level has continued to rise. From 22.78 billion yuan in 2020 to 87.787 billion yuan in 2023, total liabilities have nearly quadrupled. This growth trend reflects NIO's huge expenditures on expanding production capacity and technological innovation. The high asset-liability ratio will make the company face higher financing costs when raising funds. Creditors or investors will demand a higher rate of return due to the company's high financial risk, which will further increase the company's financial burden Especially in the context of fierce market competition and an unstable economic environment. How to balance expansion and financial stability will be a major challenge for NIO in its future development.

4.2 Global Market Competition Pressure

Nio is facing increasing competitive pressure in the global market. Although NIO has been continuously expanding in the Chinese market and achieved considerable success, in the international market, especially in mature markets such as Europe and North America, NIO is confronted with fierce competition from established electric vehicle enterprises like Tesla and BYD, as well as multiple emerging brands. Many emerging brands have quickly captured a portion of the market share by virtue of their flexible innovation capabilities and price competitiveness, which has put considerable pressure on NIO.

4.3 Capacity Bottlenecks and Supply Chain

Management

As the company's production scale gradually expands, NIO is still confronted with capacity bottlenecks and challenges in supply chain management. Despite NIO's continuous expansion of its production bases and investment in research and development, its current production capacity and supply chain system still cannot fully meet the rapid growth of market demand. Nio's accounts payable rose from 6.368 billion yuan in 2020 to 29.766 billion yuan in 2023. This indicates that during the process of production expansion, NIO may face pressure on capital turnover and cash flow. To maintain efficient operations, NIO must optimize its supply chain, enhance production efficiency, and address the issue of insufficient production capacity.

4.4 Profitability and Cost Control

Nio still faces a loss-making predicament in terms of profitability. Despite the continuous growth in revenue, the company has still not achieved profitability. Nio needs to expand its production and sales volume while further strengthening cost control, especially by optimizing R&D expenditures and production processes to reduce costs and increase the profit per vehicle. Nio still needs to explore more profit models, such as expanding its revenue sources through after-sales service and used car business, in order to enhance its overall profitability.

4.5 Market Demand Fluctuations and Product Update Cycles

The fluctuations in market demand and the periodicity of product updates also bring a certain degree of uncertainty to NIO. Although NIO has launched many popular high-end models, how to maintain the innovation of its products and the stability of market demand in the highly competitive market remains a challenge. Especially in terms of penetration and popularization in the mid-to-low-end market, NIO needs to further enrich its product line and accelerate the research and development and release of new models to meet the needs of different consumers and adapt to market changes.

Therefore, during its rapid development, NIO not only has to confront the pressure of market competition, but also needs to address multiple challenges in terms of funds, production capacity, profitability and other aspects. To achieve long-term sustainable development, NIO needs to adopt more flexible strategies, optimize its financial structure, strengthen supply chain management, and continuously exert efforts in global market and product innovation to ensure its competitiveness in the smart electric vehicle industry.

5. Conclusions and Suggestions

Nio has adopted comprehensive low-carbon measures in the context of a low-carbon economy, from product design, energy management to supply chain optimization and user education, to fully promote low-carbon travel and sustainable development. These related measures not only help reduce carbon emissions but also set a model for low-carbon development in the entire automotive industry, promoting the transformation of society towards a low-carbon economy.

In response to the current state of continuous profit and loss, NIO is expected to improve its current loss situation and gradually achieve profitability through measures such as a multi-brand strategy, optimizing product structure, enhancing operational efficiency, expanding the market, continuous technological innovation, and optimizing financial strategies. Moreover, in the face of fierce market competition and a complex market environment, NIO needs to flexibly adjust its strategies, maintain strategic resolve, and enhance risk management to achieve long-term sustainable development.

5.1 Improve and Optimize the Financial Structure and Control the Debt Level

Nio needs to accelerate its expansion while reasonably controlling its debt level. Excessive debt may bring about financial pressure and debt repayment risks, especially when the market environment is unstable, it may affect the financial health of the company. To address this issue, NIO can alleviate its debt pressure through diversified financing channels, such as equity financing, introducing strategic investors or issuing bonds, to ensure reasonable and flexible financing costs. At the same time, the company should strengthen cash flow management, ensure smooth capital turnover, and adjust capital expenditure in accordance with market demand to avoid financial risks brought about by excessive expansion.

5.2 Accelerate Global Market Layout and Brand Building

Facing fierce international competition, NIO should strengthen its global market layout, especially in mature markets such as Europe and North America. To enhance its brand influence, NIO can increase market acceptance through localization strategies, such as adjusting product pricing, strengthening after-sales service and customer support, etc. In addition, NIO could consider strategic cooperation with local enterprises, leveraging the resources and market channels of its partners to quickly capture market share. At the same time, efforts should be intensified to promote the brand and enhance consumers' awareness of the NIO brand, especially by strengthening the publicity of its technological advantages in smart electric vehicles.

5.3 Enhance Production Capacity and Optimize Supply Chain Management

To effectively respond to the growing market demand, NIO should further enhance its production capacity and optimize its supply chain management. The company can consider introducing automated and intelligent production equipment in key production links to enhance production efficiency and reduce the costs and errors of manual operation. At the same time, through diversified supply chain management, the reliance on a single supplier is reduced, and the flexibility and risk resistance capacity of the supply chain are enhanced. In the links of raw material procurement, manufacturing and delivery, NIO should establish closer cooperative relationships to ensure the stability of the supply chain and timely response to market demands.

5.4 Focus on Profitability and Cost Control

To enhance its profitability, NIO needs to strengthen cost control, especially in the areas of research and development and production. The company should focus on optimizing the supply chain links, reducing unnecessary expenditures, and lowering production costs and increasing the profit per vehicle through technological innovation. Nio can also explore new sources of revenue by further optimizing its after-sales service and used car business. In addition, the company should constantly explore new profit models, such as launching value-added services based on Internet of Vehicles and autonomous driving technologies, to further enhance the diversification of its revenue structure.

5.5 Promote Product Innovation and Meet Diverse Demands

Nio needs to pay more attention to product innovation, especially in penetrating the mid-to-low-end market. By launching more products that meet consumers' demands, NIO can better satisfy the diverse needs of different markets. For high-end models, NIO should maintain its technological leadership and brand value. In the mid-to-low-end market, more potential consumers can be attracted by reducing costs, optimizing configurations, and enhancing cost performance. Meanwhile, NIO should accelerate the R&D cycle of new models to ensure a rapid response to changes in market demand and maintain its competitive edge. In conclusion, NIO New Energy Vehicle Company needs to face up to the existing problems in its development process and actively take measures to solve them. Through efforts in strengthening cost control, enhancing product competitiveness, strengthening brand building and market promotion, accelerating the construction of charging infrastructure, and improving the after-sales service system, NIO is expected to achieve sustainable development in the fierce market competition.

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