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Green Transformation of the New Energy Vehicle Industry in the Yangtze River Delta Driven by Technological Innovation: Synergistic Impact Mechanism of Economic and Environmental Benefits

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Abstract: Given quickly the economy and society are developing, Chinese environmental problems are becoming increasingly prominent, so my country needs to carry out a green transformation of the industry. New energy vehicles are of great significance in implementing the "dual carbon" goals and promoting sustainable development. The region of the Yangtze River Delta, as the "Silicon Valley" of new energy vehicles in my country, is the core area for the development of the New Energy Vehicle (NEVs) industry. From the perspective of the market of China's NEVs industry, my country still faces realistic challenges such as resource shortages and insufficient innovation. This article examines the synergistic impact mechanism of the green transformation of the new energy vehicle sector in the Yangtze River Delta to improve economic and environmental benefits and explores how to promote the transformation and upgrading of the green industry through technological innovation. Concurrently, additional recommendations are proposed for the ecological transformation of the new energy vehicle sector.

Keywords: Yangtze River Delta, new energy vehicles, green transformation, economic benefits, environmental benefits.

1. Introduction

In recent years, people's over-reliance on fossil energy in production and life has led to large-scale emissions of greenhouse gases, including carbon dioxide, making global warming and environmental pollution increasingly serious. In recent years, news reports of rising sea levels and melting snow mountains in some coastal areas have become common, extreme climate change has occurred from time to time, and natural disasters have occurred frequently around the world. This has sounded the alarm for mankind and requires sufficient attention and cannot be left alone [1]. In this context, new energy vehicles have become the key to the green transformation of the global manufacturing industry due to their substitutability for fossil energy and the integration of technological innovation. The new energy vehicle industry not only shoulders the environmental responsibility of energy conservation and emission reduction in transportation but also brings coordinated growth of economic and environmental benefits to China through its own energy utilization and transformation of industrial models. As the world's largest new energy vehicle market, China is promoting the industry from scale expansion to high-quality development through technological innovation. Its green transformation

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experience has exemplary significance for the transformation of manufacturing in developing countries.

2. Research on the mechanism of the green transformation of NEVs in the Yangtze River Delta region driven by technological innovation

2.1. The role of technological innovation in promoting the transformation of the new energy vehicle industry

Technological innovation is the core driving force of the green transformation of the new energy vehicle industry. It is particularly critical in improving vehicle performance, increasing cruising range, and saving manufacturing costs. First, the important breakthroughs in lithium battery technology by enterprises in the Yangtze River Delta region have improved the overall performance level of new energy vehicles. For example, companies such as CATL have improved the overall performance of new energy vehicles by increasing battery energy density and optimizing battery systems. According to official website data, the energy density of the Kirin battery used by CATL can reach 255Wh/kg, and the energy density of the lithium iron phosphate battery system can reach 160Wh/kg. The use of power batteries has been ranked first in the world for eight consecutive years. In terms of cruising range, the charging infrastructure in the Yangtze River Delta region has been continuously improved, and battery technology has continuously broken through the original boundaries, which has significantly expanded the cruising range of new energy vehicles. According to the database for new energy vehicles, the cruising range of some high-end new energy vehicles in China has reached 550 kilometers, far exceeding traditional fuel vehicles. In addition, the ongoing enhancement of the New Energy Vehicle (NEVs) sector supply chain in the Yangtze River Delta region has formed a synergistic effect. It has significantly decreased the manufacturing costs of new energy cars and made the development of NEVs in China sustainable [2]. The reduction in production costs is due to the innovation of materials, manufacturing processes, and reduced energy consumption. These technological innovations have promoted the transformation and upgrading of automobile manufacturing towards higher technological content and higher added value, formed a new industrial structure, and promoted the evolution of the automobile industry's structure towards green and efficient directions [3].

2.2. Paths and strategies for green transformation of the new energy vehicle industry in Yangtze River Delta region

To achieve high-quality development of the economy and society, the Yangtze River Delta should accelerate the green transformation of the new energy vehicle industry and concentrate on advancing research and development and innovation of new energy vehicles. First, building a green production mode is the basis for the green transformation of the new energy vehicle industry in the Yangtze River Delta. The green production mode not only includes the use of clean energy but also includes the reuse of resources and the treatment of waste resources. For example, the Yangtze River Delta region optimizes production lines and forms a regional specialization model to process reusable resources for secondary use, thereby reducing resource waste. At the same time, waste gas and waste paint generated in automobile production can be captured by activated carbon adsorption, condensation and other methods to capture toxic gases brought by the production process, thereby reducing the pollution of harmful gases to the environment. Secondly, strengthening green supply chain management is also an important method to achieve green transformation. Enterprises advocating green supply chain management should cooperate with environmentally friendly suppliers to ensure that raw materials meet environmental protection requirements. In this manner, it can enhance the utilization rate of basic materials and decrease energy consumption during the product output process,

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thereby enhancing ecological innovation [4]. Green supply chain requires manufacturers to implement environmental protection measures from the process of raw material adoption, production to sales, thereby reducing environmental pollution. The new energy vehicle industry should cooperate with suppliers to promote the purchase of clean energy or green raw materials, optimize logistics and transportation methods, and reduce carbon emissions during the transportation of raw materials. The Yangtze River Delta region's advanced R&D technology and technological and scientific advancements capabilities should accelerate the intelligentization of battery technology, charging facilities, etc. Therefore, the Yangtze River Delta region should make a concerted effort to establish a talented crew, actively cultivate and introduce talents with broad vision, innovative thinking, and advanced technology at home and abroad, and enhance innovative thinking and innovation capabilities [5]. At the same time, relying on their outstanding educational resources, scientific research institutions should cooperate with many universities around them.

3. Analysis of the synergistic impact mechanism of economic and environmental benefits

3.1. Economic benefit analysis

With the popularization of new energy vehicles and technological advancement, the new energy vehicle industry in the Yangtze River Delta has become an important engine for economic growth. At the industrial scale level, the scale of the Yangtze River Delta's new energy vehicle industry continues to expand, making outstanding contributions to regional economic growth.

The National Bureau of Statistics' data indicates that the output of new energy vehicles in 2024 will reach 13.168 million units, an increase of 38.7% over the previous year. The value contributed by industrial enterprises in the Yangtze River Delta, beyond the specified size, rose by 8.7% year-on-year, 4.5 percentage points greater than the national industrial enterprises that exceed the designated size. The output of new energy vehicles in the Yangtze River Delta accounts for more than 40% of the national total. In the first half of 2023, the output of new energy vehicles in Shanghai reached 612,000 units, a year-on-year increase of 65.7%; BYD and Ideal both set up in Changzhou, Jiangsu, and the cumulative production of vehicles in the first half of the year accounted for nearly 67% of the total output in Jiangsu Province; in Xuancheng, Anhui, there are more than 600 auto parts companies set up in this area [6].

At the consumer market level, the swift development of new energy vehicles has driven the expansion of the Yangtze River Delta market. According to the National Bureau of Statistics, In comparison to the end of 2016, the quantity of new energy vehicles in operation had increased by approximately 5.6 times, reaching 7.84 million. The proportion of new energy vehicles had also increased by 2.0 percentage points to 2.6%, and the number of new energy vehicle sales had increased by approximately 5.9 times to 3.52 million by the end of 2021. According to the latest statistics, In 2023, China's new energy vehicle sales will surpass 5 million, representing over 50% of the global new energy vehicle market [7]. By the National Bureau of Statistics' "Series of Reports on the Achievements of Economic and Social Development in the 75 Years since the Founding of New China," in 2023, The Yangtze River Delta region's GDP will surpass 30 trillion yuan , amounting to 30,504.5 billion yuan, which accounts for 24.4% of the national total. The green transformation of new energy vehicles in the Yangtze River Delta has injected new vitality into local economic development and driven regional economic growth.

3.2. Environmental benefit analysis

The green transformation of the NEVs sector in the Yangtze River Delta has significantly improved the environmental quality of the region and made positive contributions to climate change. First, the green transformation of the Yangtze River Delta's new energy vehicle industry has a significant effect

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on reducing greenhouse gas emissions. Traditional fuel vehicles rely on fossil energy such as oil in operation. The large amount of greenhouse gases, such as carbon dioxide, produced by the combustion of fossil energy is the main source of urban air pollution. New energy vehicles can achieve almost zero emissions by optimizing energy use and electric drive. In the past few years, the Yangtze River Delta region has actively promoted the development of new energy, such as wind power and hydropower, providing clean electricity for new energy vehicles and effectively reducing carbon oxide emissions at the source. According to the National Bureau of Statistics, from the perspective of regional pollutant emissions, in 2022, the exhaust sulfur dioxide emissions in the Yangtze River Delta region will be 186,000 tons, a decrease of about 90% from 2015. In addition, the green transformation in the Yangtze River Delta is significant in the enhancement of air quality. With its professional model, the Yangtze River Delta region began to recycle and process waste batteries, reducing radiation pollution caused by the accumulation of waste batteries. By recycling used batteries, the mining of metals such as lithium and cobalt can be effectively reduced, thereby reducing particulate matter emissions. According to the National Bureau of Statistics, in 2022, the average concentration of fine particulate matter (PM2.5) in the ambient air of the Yangtze River Delta region was 31 micrograms per cubic meter, a decrease of 41.5% from 2015. In 2022, the average proportion of good days in the air quality index (AQI) of 41 cities in the Yangtze River Delta was 83.0%, an increase of 8.9 percentage points from 2018. The ecological transition of new energy vehicles in the Yangtze River Delta has significantly reduced greenhouse gas emissions and improved air quality [8].

4. Conclusion

The green transformation of the NEV industry in the Yangtze River Delta region has played a pivotal role in fostering the synchronized advancement of economic and environmental advantages. As the core driving force, technological innovation has promoted breakthroughs in battery technology, charging facilities, and intelligent services, providing a strong driving force for industrial development. By reshaping the industrial chain structure and optimizing energy utilization efficiency, the new energy vehicle industry has not only expanded the consumer market and promoted regional economic growth but also significantly improved environmental quality by reducing pollutant emissions and improving resource utilization efficiency, achieving a win-win situation of economic growth and ecological environment protection.

However, the future development of the NEVs sector in the Yangtze River Delta region still faces many challenges. First, the breakthrough of technological innovation is difficult to guarantee, and the speed of technological progress may not be as fast as the growth of market demand. The optimization of the industrial chain and the resource allocation of new energy still need to be coordinated. Secondly, there is uncertainty in market demand and consumer acceptance, which may affect the growth rate of the industry. Finally, the sustainability and implementation of relevant policies will also become a bottleneck for industrial development.

Therefore, improving relevant policies and measures while ensuring the continuous advancement of technicle innovation and optimizing the allocation of industrial resources is an important measure to advance the sustainable growth of the NEVs industry in the Yangtze River Delta. In the future, China should vigorously support automobile manufacturers to sign cooperation agreements with numerous scientific research institutions and vigorously build a talent team, actively cultivate and introduce talents with broad vision, innovative thinking and advanced technology at home and abroad, and enhance innovative thinking and innovation capabilities. Secondly, people must clearly define the development positioning of the new energy vehicle industry in my country to identify the breakthrough point for market-oriented development, comprehensively consider technical level and cost factors, and determine the key models to be developed, reduce dependence on foreign high-end

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technology imports, and thus stabilize its foothold in the competitive consumer market. Finally, the government should introduce more clear and forward-looking strategic development policies, increase support for green technology innovation and market promotion, and provide subsidies.

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