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Analysis of the Development Trends of New Energy Electric Vehicle Technology in the Context of Carbon Neutrality

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Abstract: *With the increasing importance of carbon neutrality and the urgent demand for clean energy, new energy electric vehicle technology is rapidly advancing on a global scale. This article explores the trends in the development of new energy electric vehicle technology in the context of carbon neutrality and the challenges it faces, proposing corresponding strategies. The article first introduces the fundamental concepts of carbon neutrality and new energy electric vehicles, then elaborates on four major challenges, including imperfect battery technology, lack of charging infrastructure, insufficient energy supply chain, and intense market competition coupled with a lack of policy support. Subsequently, the article presents four strategies, including improving battery technology, expanding charging infrastructure, integrating sustainable energy sources, and providing policy and regulatory support, to address these challenges. These strategies are aimed at promoting the development of electric vehicle technology, accelerating the realization of sustainable mobility, and advancing the goal of carbon neutrality.*

Keywords: *carbon neutral; new energy electric vehicles; development*

1. Introduction

In modern society, global climate change and environmental pollution have become pressing concerns worldwide. The scientific community has reached a consensus that climate change is primarily caused by human activities, with greenhouse gas emissions such as carbon dioxide, methane, and nitrogen oxides being the major contributors. To address this global challenge, the international community is taking active measures, one of which is carbon neutrality, aiming to reduce net carbon emissions to zero or lower levels. In this context, the development of new energy electric vehicle technology has become a highly regarded area of focus. It not only reduces greenhouse gas emissions from road transportation but also promotes the application of sustainable energy, providing a significant solution for clean and eco-friendly future mobility [1].

Traditional internal combustion engine vehicles have long been the main source of road transportation. However, their emission issues and dependence on finite fossil fuels have raised widespread concerns. New energy electric vehicles, powered by batteries, significantly reduce tailpipe emissions, fundamentally mitigating air pollution and greenhouse gas emissions [2]. Furthermore, the rapid development and maturity of electric vehicle technology have brought them closer to or even surpassed traditional fuel vehicles in terms of performance, range, and charging convenience. Nevertheless, to achieve carbon neutrality and reduce climate change, electric vehicle technology still faces a series of challenges. Issues such as imperfect battery technology, lack of charging infrastructure, insufficient energy supply chain, intense market competition, and lack of policy support need to be addressed [3].

This article aims to explore the trends and challenges in the development of new energy electric vehicle technology in the context of carbon neutrality. It also proposes relevant strategies, ranging from improving battery technology to expanding charging infrastructure, integrating sustainable energy

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sources, and providing policy and regulatory support. This comprehensive research and reference provide insights into not only the automotive and energy industries but also government policies, scientific research, and global climate change issues [4]. Through in-depth exploration and research, the author can better understand the challenges and opportunities in this field, providing strong support for advancing the development of new energy electric vehicle technology. In this era of the new energy revolution, electric vehicle technology is poised to become the primary mode of future transportation, creating a cleaner and more sustainable future for our planet.

2. Related notion

2.1 Carbon neutralization

Carbon neutrality refers to achieving net zero emissions or carbon balance by taking a series of measures to reduce greenhouse gases such as carbon dioxide emitted into the atmosphere to the extent where they can be absorbed and stored in the natural environment [5]. This means that anthropogenic greenhouse gas emissions do not exceed the absorption capacity of the natural environment, thus curbing climate change and global warming. Carbon neutrality is one of the key strategies to combat climate change, involving deep reforms in energy, industry, agriculture, transportation, aiming to reduce carbon emissions and increase the ability to absorb carbon dioxide to achieve climate goals [6].

2.2 New-energy and electric vehicles

New energy electric vehicles refer to the use of batteries, fuel cells, hybrid power and other new power technologies, to replace the traditional internal combustion engine, to achieve the purpose of driving vehicles. Compared with traditional fuel vehicles, new energy electric vehicles have the characteristics of zero exhaust emission, low noise and high energy efficiency, and are an important solution to deal with environmental pollution and climate change. Among them, battery electric vehicles refers to the use of energy storage batteries (usually lithium-ion batteries) as an energy storage device to drive the vehicle through an electric motor. Fuel cell vehicles use hydrogen fuel cells to generate electric drive motors. Hybrid vehicles combine conventional fuel engines and electric motors to provide higher fuel economy and lower exhaust emissions [7]. The development and promotion of these new energy electric vehicles not only helps to reduce carbon emissions in the transportation sector, but also promotes the rapid development of the electric vehicle industry, promotes the innovation and application of clean energy technologies, accelerates the transformation of the energy structure, and provides strong support for sustainable development and the realization of carbon neutrality. New energy electric vehicles have become the representative of green travel in today's society, and also an important engine to promote the development of modern transportation modes to a more environmentally friendly and sustainable direction [8].

3. Challenges Faced by the Development of New Energy Electric Vehicles in the Context of Carbon Neutrality

3.1 The battery technology is not yet mature

Battery technology plays a crucial role in the development of new energy electric vehicles in the context of carbon neutrality. However, it still faces a series of challenges. Firstly, the imperfections in battery technology, such as limitations in range, charging time, and cost, directly impact the performance, convenience, and price competitiveness of electric vehicles.

Range is a major consideration for consumers choosing electric vehicles, and battery technology is currently limited in this aspect. Traditional fuel vehicles can typically travel hundreds of miles on a single tank of gas, while many electric vehicles often have lower ranges after a single charge, especially in extreme weather conditions. This limits the applicability of electric vehicles, making them more suitable for city driving rather than long-distance travel. Although battery technology is continuously improving, progress in this area is not yet ideal.

Charging time is another critical issue. Compared to the speed of refueling traditional vehicles, electric vehicles have slower charging speeds. Despite continuous improvements in fast-charging technology, it still takes a relatively long time to complete a battery charge. This inconvenience could disrupt users' travel plans, especially when fast charging is needed, such as during long journeys [9].

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Additionally, battery cost is a significant challenge. Batteries are one of the most expensive components of electric vehicles, constituting a considerable portion of the overall vehicle cost. Although battery prices have decreased in recent years, more research and innovation are still needed to further reduce the manufacturing costs of batteries, making electric vehicles more competitive.

Battery technology not only affects the performance of electric vehicles but also has implications for sustainability. Battery manufacturing involves various environmental issues, including the mining of rare metals and the disposal of used batteries. Therefore, developing more environmentally friendly battery technology is also an urgent task [10].

3.2 Lack of charging infrastructure

The lack of charging infrastructure is one of the major challenges facing the development of new energy ev technology in the context of carbon neutrality. Although new energy electric vehicles have shown great potential in environmental protection and reducing carbon emissions, the lack of charging infrastructure has limited their widespread popularity and user acceptance. The lack of charging infrastructure has a negative impact on the feasibility, convenience of use and market competitiveness of electric vehicles [11].

First, the lack of charging infrastructure limits the daily use of electric vehicles. The range of electric cars is improving, but users still need to charge them regularly. The lack of charging stations, especially in urban and rural areas, may cause users worrying about being unable to find suitable charging facilities while driving. This inconvenience would make electric cars less attractive, especially for potential car buyers worried about charging problems. Second, the lack of charging infrastructure poses a threat to the market competitiveness of electric vehicles. Automakers have invested heavily in electric vehicle technology, but they will not be able to reach their full potential without adequate charging facilities. In addition, competitors, such as traditional fuel vehicle manufacturers, will use this problem to curb the development of electric vehicles. In addition, the lack of charging infrastructure also has a negative impact on the market penetration rate of new energy electric vehicles. A key factor in how much users choose to buy electric cars is their ease of charging. If they do not have enough charging facilities, then users will feel inconvenient, which will make them more inclined to buy conventional fuel vehicles. Thus, the lack of charging infrastructure has not only affected electric vehicle sales, but also affected efforts to reduce carbon emissions and achieve carbon-neutral goals [12].

3.3 Lack of energy supply chain

The shortage of the energy supply chain is an important challenge for the development of new energy electric vehicle technology in the context of carbon neutrality. The core of new energy electric vehicles depends on battery technology, and battery production requires a large number of raw materials and energy supply chains. The issue involves everything from collecting rare metals to battery production, directly affecting the sustainability, cost and supply reliability of electric vehicles [13].

First, the manufacture of batteries requires a large number of raw materials, including rare metals such as lithium, cobalt, nickel, cobalt, and manganese. However, the supply of these raw materials is not sufficient, and their collection is limited by the environmental and social sustainability. This makes the supply chain of raw materials for batteries unstable, leading to fluctuating battery prices and sustainability problems. Second, battery production requires a lot of energy, especially in the lithium ore collection and battery manufacturing process. If this energy comes from non-renewable resources, then the environmental protection of electric vehicles will be threatened. Therefore, the lack of energy supply chain is also directly related to the environmental protection of electric vehicles and the realization of carbon neutral goals. In addition, weak links in the supply chain cause supply disruptions, which poses a risk to both electric car makers and consumers. Production of electric vehicles requires large-scale batteries, and any problems in the supply chain lead to production delays, thus affecting sales and the user experience. In addition, an inadequate supply chain has led to higher battery prices, increasing the cost of buying electric vehicles and making their market less attractive [14].

3.4 Fierce market competition and lack of policy support

Fierce market competition and lack of policy support are the dual challenges facing the

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development of new energy electric vehicle technology under the background of carbon neutrality. While NEVs have great potential to reduce carbon emissions, reduce fuel costs and drive sustainable travel, fierce market competition and insufficient policy support have limited their further development.

First of all, the fierce market competition is a prominent problem. Many automakers have invested in the electric vehicle market, resulting in a number of different brands and models of electric vehicles on the market, and consumers face a variety of choices. This competition promoted technological innovation and product improvement, but it also led to intense price competition. To attract more consumers, some manufacturers have had to lower the price of electric cars, which can affect their profitability, especially when batteries remain relatively high. Second, the lack of policy support also poses challenges to the development of electric vehicles. Government policy plays a key role in driving the development of the electric vehicle market. However, policy support in many countries and regions remains insufficient. This includes a lack of incentives such as car purchase subsidies, tax exemptions and protection of users' rights, as well as inadequate infrastructure plans such as charging stations and maintenance networks. The lack of policy support leads to a higher cost of electric vehicles than conventional fuel vehicles, reducing users' motivation to buy them. In addition, markets are also complicated by inconsistent levels of policy support in different regions. Some regions may adopt aggressive policy support measures, while others may adopt conservative policies on electric vehicles, making it difficult for manufacturers to develop a consistent marketing strategy globally. It also creates uncertainty for investors and consumers, hindering the expansion of the electric car market [15].

4. Strategies for the Development of New Energy Electric Vehicles in the Context of Carbon Neutrality

4.1 Improving Battery Technology

Improving battery technology is one of the key strategies for the development of new energy electric vehicles in the context of carbon neutrality. As the automotive industry moves towards more environmentally friendly and sustainable practices, electric vehicles, as the primary alternative to traditional fuel-powered vehicles, rely heavily on advanced and reliable battery technology. In the current context of carbon neutrality, enhancing battery technology not only enhances the performance and user experience of electric vehicles but also accelerates the adoption of green energy and reduces carbon emissions.

First and foremost, improving battery technology aims to increase the driving range of electric vehicles. Advancements in new battery materials continuously enhance the energy density of batteries, allowing them to store more energy in the same size. This increase in energy density extends the driving range of electric vehicles, implying not only longer distances between charges but also reduced charging frequency. This enhances the convenience of travel, making electric vehicles more appealing to users.

Secondly, enhancing battery technology aims to reduce charging time. The lengthy charging duration of traditional batteries has been a significant factor limiting the widespread adoption of electric vehicles. Researchers are actively developing fast-charging battery technologies to significantly shorten charging times, enabling users to charge their batteries in a brief stop, similar to refueling traditional vehicles. This greatly improves user convenience, reduces waiting times, and enhances the competitiveness of electric vehicles.

Thirdly, improving battery technology focuses on increasing the battery's lifespan and safety. The lifespan and safety of batteries are directly related to the vehicle's longevity and user safety. By enhancing battery design, manufacturing processes, and management systems, the lifespan of batteries can be prolonged, reducing maintenance and replacement costs associated with battery aging. Moreover, enhancing battery safety, by preventing issues such as overheating and short circuits, ensures user safety and boosts confidence in electric vehicles.

Additionally, improving battery technology translates to reducing battery costs. The manufacturing cost of batteries has long been a significant factor affecting electric vehicle prices. Through technological innovations, economies of scale, and reductions in raw material costs, manufacturing expenses can be lowered, leading to more competitive electric vehicle pricing. This makes electric vehicles more affordable, increasing consumer motivation to purchase and thereby stimulating rapid growth in the electric vehicle market.

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In the journey to enhance battery technology, governments, research institutions, and automobile manufacturers play pivotal roles. Governments can drive battery technology research and industrialization through funding and policy incentives. Research institutions need to intensify basic research efforts, exploring new battery materials and technologies, and providing technical support and innovative directions. Automobile manufacturers should increase research and development investments, collaborate actively with research institutions, and incorporate the latest battery technologies into practical vehicles, continually enhancing product competitiveness and user experience.

Improving battery technology stands as a crucial strategy to propel the development of new energy electric vehicles in the context of carbon neutrality. By increasing driving range, reducing charging time, extending battery lifespan, enhancing safety, and lowering costs, electric vehicle performance and market competitiveness can be continuously enhanced. This advancement will promote the widespread adoption of new energy vehicles, contributing to the realization of a clean energy future and sustainable transportation.

4.2 Expansion of Charging Infrastructure

The expansion of charging infrastructure is one of the crucial countermeasures in the development of new energy electric vehicle technology in the context of carbon neutrality. The successful promotion and user acceptance of new energy electric vehicles are directly dependent on the convenient charging infrastructure, which is the lifeline of electric vehicles driving. Expanding the charging infrastructure will not only improve the user experience, but also accelerate the adoption of electric vehicles, thus facilitating the adoption of clean energy and reducing carbon emissions.

First, the expansion of the charging infrastructure can improve the convenience of electric vehicles. Users want to charge in their daily life as easily as a traditional car. The increase of charging stations and a wider distribution can meet the charging needs of users in urban, rural areas and highways. This would make electric vehicles a more convenient means of transportation than just an alternative to urban use. Second, expanding the charging infrastructure can also improve the market competitiveness of electric vehicles. Users often worry about the range of electric cars, which areas with reliable charging infrastructure can better solve. Users know they can charge anytime, anywhere, which will increase their confidence in electric cars and make them more attractive. This is also an important selling point for manufacturers, helping to drive sales growth. Third, the expansion of the charging infrastructure can drive the adoption of clean energy. The sustainability of electric vehicles depends on the type of energy used for charging. Therefore, governments and energy companies should actively promote the development of renewable energy, and ensure that charging stations use clean energy, such as solar and wind energy, etc. This will help reduce the carbon footprint of electric vehicles and achieve the goals of carbon neutrality and climate change mitigation. In addition, expanding the charging infrastructure will also help boost employment and economic growth. The construction and maintenance of charging stations requires engineers, technicians, waiters, and other professionals, which will create more jobs. In addition, the growth of the electric vehicle industry will also stimulate the development of related industries, such as battery manufacturing and electric vehicle parts manufacturing, thus bringing new growth points for the economy.

Governments, energy companies and private companies all need to play a key role on the way to expanding the charging infrastructure. The government can provide financial support and policy incentives to encourage the construction of charging infrastructure. Energy companies can invest in clean energy and build charging stations to ensure a sustainable power supply. Private enterprises can actively participate in the construction and operation of charging infrastructure to meet the market demand.

The expansion of charging infrastructure is a crucial countermeasure for the development of new energy electric vehicle technology in the context of carbon neutrality. This will improve the convenience, market competitiveness and sustainability of electric vehicles, while also driving the adoption of clean energy, creating jobs and economic growth. Through the cooperation of governments, energy companies and private enterprises, we can achieve wider, more convenient and more sustainable electric vehicle travel, thus driving the goals of carbon neutrality and environmental protection.

4.3 Integrate sustainable energy sources

Integrating sustainable energy is one of the important countermeasures in the development of new

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energy electric vehicle technology in the context of carbon neutrality. As an environmentally friendly mode of transportation, the combination of new energy electric vehicles with sustainable energy can provide strong support for reducing carbon emissions, reducing energy dependence and promoting the use of renewable energy.

First, integrating sustainable energy sources can help to reduce carbon emissions. Conventional fuel vehicles use petroleum fuels and emit large amounts of carbon dioxide and other greenhouse gases, with adverse effects on climate change. Electric cars are powered by batteries, and if these batteries are charged from sustainable energy sources, such as solar or wind power, then the carbon footprint of electric cars will be significantly reduced. This will help the international community address the challenges of climate change and achieve the goals of achieving carbon neutrality and reducing greenhouse gas emissions. Second, integrating sustainable energy sources can reduce energy dependence. Many countries rely on imported oil, which leads to energy security and economic risks. By combining electric vehicles with sustainable energy sources, countries can reduce their dependence on imported oil and reduce their impact on the international energy market. This will help to improve energy security and reduce the economic impact of energy price fluctuations at home and abroad. Third, integrating sustainable energy sources can reduce energy costs. Renewable energy sources, such as solar and wind, cost less in the long term than conventional fossil fuels because they come from the nature world and do not need to be sourced and transported. By combining electric vehicles with sustainable energy sources, users can reduce the cost of electricity used for charging, especially with the large-scale deployment of photovoltaic power generation and wind power generation facilities. This will help to reduce the overall cost of ownership of electric vehicles and improve their competitiveness. Fourth, integrating sustainable energy sources can promote the development of renewable energy sources. The widespread use of electric vehicles will increase the demand for electricity, which can be met by sustainable energy sources. This will spur the growth of the renewable energy industry, create more jobs, and promote research and development and innovation in clean energy technologies. In addition, electric vehicles can also be used to store energy in the power system to balance energy supply and demand, and improve the stability and reliability of the power system.

To achieve the goal of integrating sustainable energy sources, governments, energy companies and consumers can adopt a range of strategies. Governments can encourage consumers and businesses to adopt sustainable energy and electric vehicles by creating incentives such as car purchase subsidies, incentives for solar cell installation and tax cuts. Governments can also invest in renewable energy infrastructure, such as solar power plants and wind farms, to ensure the supply of sustainable energy. Energy companies can actively invest in renewable energy projects, while working with electric vehicle manufacturers to provide sustainable energy supplies to electric vehicle users. Consumers can consider installing solar photovoltaic systems and buying electric cars to make full use of sustainable energy and reduce energy costs.

Integrating sustainable energy is one of the key countermeasures for the development of new energy electric vehicle technology in the context of carbon neutrality. Integrating sustainable energy contributes to the vision of clean energy and sustainable travel by reducing carbon emissions, reducing energy dependence, reducing energy costs, and driving the development of renewable energy sources. The partnership of governments, energy companies and consumers will drive this goal, creating new opportunities for environmental and economic growth.

4.4 Policy and regulatory support

Policy and regulatory support plays a crucial role in the development of new energy electric vehicle technology in the context of carbon neutrality. These support measures could provide direction for the electric vehicle market, stimulate innovation, and reduce car purchase and operating costs, while also helping to achieve carbon neutrality and reduce air pollution.

First, policy and regulatory support helps drive growth in the electric vehicle market. The government can adopt a series of incentives, such as car purchase subsidies, tax cuts and the protection of users' rights and interests, to reduce the cost of buying electric cars. This will encourage more consumers to choose electric cars and expand the market. In addition, the government can set emission standards and fuel efficiency requirements to encourage manufacturers to produce more electric vehicles and drive innovation in the industry. Second, policy and regulatory support can reduce the operating costs of electric vehicles. The government can build a charging infrastructure and provide cheap charging services, thus reducing electricity costs for users. The government can also push for electricity market reforms to ensure that electric car users have access to clean, cheap electricity. This

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will make the overall cost of ownership of electric vehicles more competitive, attracting more users to choose from electric vehicles. Third, policy and regulatory support can drive innovation in electric vehicle technology. The government can provide financial support to encourage scientific research institutions and manufacturers to conduct research and development work related to electric vehicles. The government could also establish fuel efficiency and carbon emission standards and encourage manufacturers to develop more efficient and environmentally friendly electric vehicle technologies. This will drive the entire industry toward a cleaner, more sustainable direction. Fourth, policy and regulatory support can help to promote the development of renewable energy sources. The government can set quotas for renewable energy that require energy companies to use renewable energy in electricity production. This will increase market share of renewable energy and reduce carbon emissions, while also providing cleaner energy for electric vehicles. In addition, the government can also promote the development of renewable energy sources, such as solar power and wind power, to ensure that electric car users can have access to clean charging energy sources. Finally, policy and regulatory support can help to improve the sustainability of the EV market. The government can establish a recycling and disposal system of waste batteries to reduce the environmental impact of waste batteries. The government can also encourage electric car sharing and shared rental services to reduce traffic congestion and waste of resources in cities. This will make the use of electric vehicles more sustainable and help reduce the environmental burden.

Governments, legislators, and stakeholders need to work closely together when implementing policy and regulatory support. Governments should develop sensible policies to balance consumer demand, environmental goals, and industrial innovation. Lawmakers need to pass legislation to support the implementation of policies and ensure their effectiveness and compliance. Stakeholders, including electric vehicle manufacturers, energy companies, and environmental organizations, should actively participate in the policy development and implementation process and provide professional advice and support.

Policy and regulatory support is of great significance in the development of new energy electric vehicle technology in the context of carbon neutrality. By stimulating market growth, reducing costs, driving innovation, improving sustainability and reducing carbon emissions, policy and regulatory support helps to achieve the widespread application of electric vehicle technology and promote the goals of carbon neutrality and environmental protection. The joint efforts of governments, legislators and stakeholders will provide a solid foundation for the successful development of electric vehicle technology.

5. Conclusion

In the current global context, carbon neutrality has become an urgent task aimed at reducing greenhouse gas emissions, addressing climate change, and promoting clean energy and sustainable development. In this context, new energy electric vehicles, as an environmentally friendly alternative to traditional fuel vehicles, have become a key focus of development in many countries and regions. This article aims to explore the trends in the development of new energy electric vehicle technology and the challenges faced in the context of carbon neutrality, and proposes relevant strategies. The article first introduces the basic concepts of carbon neutrality and new energy electric vehicles, and then discusses in detail the four major challenges faced by electric vehicle technology development: imperfect battery technology, lack of charging infrastructure, insufficient energy supply chain, and intense market competition and lack of policy support. Subsequently, the article proposes four strategies: improving battery technology, expanding charging infrastructure, integrating sustainable energy sources, and policy and regulatory support, to address these challenges. These strategies are aimed at promoting the development of electric vehicle technology, accelerating the realization of sustainable transportation, and promoting the goal of carbon neutrality.

Looking to the future, with the continuous advancement of technology and increasing societal demand for sustainability, new energy electric vehicle technology will continue to grow and strengthen. Ongoing improvements and developments in battery technology, charging infrastructure, integration of sustainable energy sources, as well as policy support, will further drive the widespread adoption and development of electric vehicles. However, this article also has some limitations. Firstly, due to space constraints, the detailed discussion of each challenge and strategy is not exhaustive. Further research and in-depth analysis will help better understand and address these issues. Secondly, this article is mainly based on existing knowledge and data for analysis and discussion. Future developments will bring new situations and challenges, requiring continuous updates and adjustments to the strategies.

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