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The Application and Challenges of New Energy Vehicles in the Logistics and Distribution Sector

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Abstract: With the continuous enhancement of public environmental awareness and the promotion of sustainable development in logistics and distribution, the recognition of new energy vehicles in the logistics and distribution sector is gradually increasing due to their characteristics such as low carbon emissions and low noise. However, new energy vehicles face serious range anxiety, short driving range, low coverage of charging and swapping stations, long charging times, and lack of uniform standards, making it difficult for them to cope with the complex logistics and distribution environment. Additionally, the high initial investment in new energy vehicles hinders their promotion in the logistics and distribution sector. This article proposes suggestions such as increasing research and development efforts for new energy vehicles, accelerating the construction of charging and swapping station infrastructure, and strengthening industry collaboration to promote the standardization process, providing reference for the application of new energy vehicles in the logistics and distribution sector.

Keywords: New energy vehicles, logistics and distribution, development recommendations

1. Introduction

Since China proposed the strategic goals of "carbon peak" by 2030 and "carbon neutrality" by 2060 at the United Nations General Assembly in 2020, people have begun to pay more attention to environmental pollution and energy consumption issues. Meanwhile, the logistics industry in China has been developing rapidly. In 2023, the total social logistics volume in China reached 35.24 trillion yuan, an increase of 5.2% over the previous year. The total social logistics cost was 1.82 trillion yuan, up 2.3% over the previous year, with transportation costs accounting for the largest proportion at 9.8 trillion yuan. Traditional transportation vehicles are mainly fueled vehicles, and the extensive use of fuel vehicles has led to serious environmental and energy problems, contradicting the goals of "carbon peak" and "carbon neutrality." New energy vehicles have the characteristics of low emissions, low consumption, and low pollution. The widespread promotion of new energy vehicles can effectively alleviate environmental pollution and energy consumption problems and has been favored by major logistics companies[1]. In 2023, China's cumulative sales of new energy logistics vehicles reached 277,100, an increase of 10% over 2022. The "Development Plan for the New Energy Vehicle Industry (2021-2035)" points out that in national ecological civilization pilot zones and major areas for air pollution prevention and control, the proportion of new energy vehicle purchases should not be less

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than 80%. It is necessary to vigorously promote new energy logistics vehicles and gradually increase the proportion of new energy vehicles in urban distribution vehicles[2].

2. Overview of New Energy Vehicles and Their Current Application Status in the Logistics and Distribution Sector

2.1. Overview of New Energy Vehicles

New energy vehicles refer to automobiles that utilize unconventional vehicle fuels as power sources, incorporating advanced technologies in power control and propulsion, resulting in vehicles with new technologies and structures. Currently, existing new energy vehicles mainly include pure electric vehicles, extended-range electric vehicles, hybrid electric vehicles, fuel cell vehicles, hydrogen engine vehicles, etc. Pure electric vehicles are driven by batteries, emitting zero emissions and low noise, making them suitable for urban travel. Extended-range electric vehicles and hybrid electric vehicles combine internal combustion engines and electric motors to meet short-distance travel needs while also addressing long-distance travel requirements. Fuel cell vehicles and hydrogen engine vehicles both use hydrogen as fuel, with the main difference being that the former generates electricity through fuel cells, while the latter burns hydrogen directly in the engine, with water as the final product, making it an efficient and clean mode of transportation[3].

2.2. The current application status of new energy vehicles in the logistics and distribution sector

Due to the large space occupied by the power systems of extended-range electric vehicles and hybrid electric vehicles, which would reduce the cargo carrying capacity of logistics vehicles, and the limited availability of hydrogen refueling stations, pure electric vehicles, which are green, pollution-free, and have low noise levels, occupy a predominant position in new energy logistics vehicles[4]. Large logistics and express delivery companies such as SF Express and JD.com are gradually increasing the scale of their use of new energy logistics vehicles. As of the end of 2022, SF Express, as the largest express delivery company in China, had deployed over 26,000 new energy vehicles, covering 232 cities, including scenarios such as regular and large-item collection and delivery within cities, short-distance trunk and feeder transport, and shuttle transportation. JD Logistics has deployed approximately 20,000 self-owned new energy logistics vehicles across seven regions and over 50 cities nationwide. However, despite the vigorous development of new energy vehicles, they face serious range anxiety, slow charging speeds, and limited range, which hinder the widespread adoption and application of new energy logistics vehicles. Currently, there are mainly two ways to replenish the mid-journey electricity of new energy vehicles: fast charging and battery swapping..

2.3. Policy Support for New Energy Vehicles in the Logistics and Distribution Sector

In January 2022, the State Council's "14th Five-Year Plan" for comprehensive energy conservation and emission reduction emphasized the need to increase the proportion of new energy vehicles in logistics vehicles[5]. In 2020, Chongqing Municipality lifted restrictions on the passage of new energy pure electric light-duty trucks. Except for certain roads in the main urban areas and designated routes for truck restriction management, vehicles with Chongqing's new energy special license plates and a maximum design total weight of less than 4.5 tons are exempt from truck restriction management on most urban roads throughout the city, without the need for additional truck permits[6]. The "Convenient and Ultra-Fast Charging Action Plan for New Energy Vehicles in Chongqing (2024-2025)" aims to achieve widespread deployment of ultra-fast charging infrastructure by 2025. According to the principle of "intelligent convenience and moderate advancement," the plan includes:

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Establishing 1340 ultra-fast charging stations in the central urban area[7]. Implementing a rational layout and full coverage of ultra-fast charging infrastructure in the main urban areas and Wan Zhou District, with 430 stations[8]. Ensuring basic coverage of ultra-fast charging infrastructure in other areas, with 100 stations. Achieving full coverage of ultra-fast charging infrastructure in highway service areas, with 170 stations. Overall, constructing 2040 ultra-fast charging stations with 4000 charging piles throughout the city.

3. The Advantages and Challenges of Applying New Energy Vehicles in the Field of Logistics and Distribution

3.1. The advantages of applying new energy vehicles in the field of logistics and distribution

New energy vehicles use clean energy sources such as electricity or hydrogen, featuring zero emissions, which effectively reduces environmental pollution and meets the modern society's requirements for environmental protection[9]. Although the purchase cost of new energy vehicles may be higher, their operating costs are relatively lower, and the government has enacted a series of policies to encourage the use of new energy vehicles, such as vehicle purchase subsidies and free charging, providing financial and policy support for logistics companies to purchase and use new energy vehicles. As cities impose increasingly stringent requirements on tailpipe emissions, some cities have implemented preferential policies for new energy vehicles, such as free passage or exemption from tolls, while new energy vehicles typically have lower noise and vibration levels, minimizing their impact on residents and providing more convenient conditions for logistics distribution[10].

3.2. The challenges faced by the application of new energy vehicles in the field of logistics distribution

3.2.1. The infrastructure issues such as charging and swapping stations

The insufficient construction and coverage of charging and swapping stations pose one of the primary challenges for the application of new energy vehicles in the logistics and distribution sector. Specifically, this includes insufficient numbers of charging and swapping stations, especially during peak hours and in popular areas. The distribution of these stations is uneven, with some areas having ample facilities while others lack them. Parking facilities with charging infrastructure are scarce, with many parking lots or spaces lacking charging stations. This leads to vehicles being unable to replenish their battery while parked, necessitating them to be brought to charging and swapping stations for recharge. During the logistics and distribution process, new energy vehicles inevitably need to visit these stations for battery replenishment. While the coverage of charging and swapping stations is relatively high in first-tier cities, in some remote areas or on the outskirts of cities, the lack of these facilities restricts the use of new energy vehicles in the logistics and distribution sector.

3.2.2. The issues of driving range and charging time

The range and charging time of new energy vehicles pose another significant challenge. Despite continuous advancements in battery technology, some new energy vehicle models still suffer from short range and long charging times. Compared to the 5-10 minutes it takes to refuel a conventional vehicle, the charging time for new energy vehicles is excessively long. Although some scholars have proposed partial charging strategies, where electric vehicles determine how much charge to replenish based on their remaining battery level and the need to serve additional customers before returning to the distribution center, this approach can reduce mid-route charging time and lower charging costs.

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However, in reality, customer demands are often dynamic, and relying on having just enough battery to return to the distribution center poses significant risks. When new orders are added, there is a risk of insufficient battery capacity, leading to the need for secondary charging at the station, increasing costs and wasting time. Moreover, logistics and distribution operations require a certain level of timeliness, and spending excessive time charging en route reduces delivery efficiency.

3.2.3. The issue of standardization and safety

In the field of new energy vehicles, there are various technical standards and specifications. The inconsistency of these standards leads to compatibility issues between different models of new energy vehicles, increasing the difficulty of charging and swapping, and making the management and operation of new energy vehicles in logistics and distribution challenging. There are also safety risks associated with this inconsistency. The inconsistency of charging standards adds inconvenience for users of new energy vehicles, as different brands of vehicles may require different types of charging facilities. Therefore, establishing unified charging standards is crucial for promoting the development of new energy vehicles. New energy vehicles involve high-voltage batteries, electric motors, and other electrical components, making safety standards essential. These standards need to ensure the safety of vehicles during charging, driving, and parking, as well as their safety performance in the event of accidents. The construction of new energy vehicles differs from traditional internal combustion engine vehicles, requiring special materials and manufacturing processes. Therefore, establishing standards related to vehicle structure, materials, and manufacturing processes is an important means to ensure vehicle quality and safety. New energy vehicles typically feature intelligent connectivity functions, requiring communication with the external environment. Therefore, establishing vehicle communication and connectivity standards can ensure effective connectivity between vehicles and other vehicles, infrastructure, and intelligent transportation systems. The safety of charging facilities is crucial for the safety of users and vehicles. Establishing safety standards for charging facilities can ensure that their design, construction, and operation meet safety requirements, reducing the risk of accidents.

3.2.4. The economic viability issue

New energy vehicles have very low operating costs, but the purchase cost of the vehicles is usually high, mainly due to the high cost of key components such as batteries. Additionally, in areas with low coverage of charging and swapping stations, significant investment is required upfront for the construction of a large number of charging and swapping facilities. Therefore, the initial investment in new energy vehicles is high. Furthermore, new energy vehicles have a fast pace of technological updates, leading to relatively low resale value in the second-hand market, which also affects the return on investment for businesses investing in new energy vehicles.

4. The development suggestions for new energy vehicles in the logistics and distribution sector are as follows

4.1. Government-related policy support

The government has introduced policies to encourage logistics companies to use new energy vehicles, including vehicle purchase subsidies, tax incentives, operational subsidies, and relaxation of restriction standards. It supports research and innovation by new energy vehicle manufacturers, providing certain financial or policy support. In terms of infrastructure construction such as charging and swapping stations and standardization, it requires joint planning and layout by the government

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and enterprises. Additionally, there is a need to strengthen post-management and supervision of new energy vehicles to ensure their safe and stable operation.

4.2. Increase the construction of charging and swapping stations and other infrastructure

The government and relevant departments should increase investment in infrastructure construction such as charging and swapping stations, enhancing their coverage and density. Rational planning for the layout of charging and swapping stations should be formulated, taking into account urban development plans and transportation needs, to determine the locations and quantities of these stations and improve resource utilization efficiency. For example, in logistics parks, urban distribution centers, and around major transportation hubs, the construction of charging and swapping facilities should be accelerated. In suburban or remote areas where distribution routes are relatively fixed, distribution routes can be planned rationally, and a certain number of charging and swapping stations can be constructed along these routes to provide convenient charging and swapping services for new energy vehicles.

4.3. Strengthen industry collaboration and communication

Enhance collaboration and communication among various new energy vehicle manufacturers, as well as upstream and downstream enterprises such as logistics companies and charging facility suppliers. This collaboration aims to promote the standardization and normalization of technical standards and specifications related to new energy vehicles, including charging interface standards and battery specifications, in order to improve the compatibility and universality of new energy vehicles. Additionally, it is essential to establish a sound supporting policy and service system for new energy vehicles, including charging services, maintenance, and other aspects of support.

4.4. Strengthen technological innovation and research and development

Increase investment in technological innovation and research and development for new energy vehicles, establish innovative platforms such as industry-university joint laboratories and technology innovation centers to promote the integration and cooperation of resources from all parties, and accelerate the incubation and application of new technologies. Strengthen cooperation between industry, academia, and research institutions, establish a collaborative innovation mechanism between industry, academia, and research, and jointly conduct cutting-edge technology research and application exploration. Pay attention to the training and introduction of professional talents in the field of new energy vehicles, establish a talent training system, and cultivate a team of talents with innovation awareness and technical capabilities. Improve the performance and reliability of new energy vehicles, especially in continuous innovation in battery technology, charging technology, etc., enhance the safety and range of batteries, accelerate the charging speed of batteries, and improve the performance and competitiveness of new energy vehicles.

5. Conclusion

New energy vehicles, with advantages such as energy conservation, environmental protection, zero emissions, low operating costs, and low noise, along with policy support, are more suitable for application in urban logistics and distribution, gradually replacing conventional fuel vehicles. However, challenges such as inadequate charging infrastructure, limited range, long charging times, lack of industry standards, and high initial investment exist for new energy vehicles. To accelerate the pace of new energy vehicles' application in the logistics and distribution sector, the government should lead efforts to unite various new energy vehicle manufacturers, logistics companies, etc., to

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promote the establishment of industry standards, increase the construction of charging infrastructure, enact policies to support research and innovation by new energy vehicle manufacturers, and encourage logistics companies to extensively adopt new energy vehicles.

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