Research on Green Supply Chain Management in New Energy Vehicle Industry: A Case Study of BYD

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Abstract: Nowadays, the environmental awareness of society as a whole is constantly improving, and the new energy industry is also developing rapidly. The development and demand for green supply chains in various industries are increasing daily. To achieve sustainable development, the automotive industry, as a high-energy-consuming and polluting industry, has gradually changed its products and production methods. Based on the purpose of green development, it not only embodies the concept of green environmental protection in terms of energy use, but also undergoes green transformation in the industrial chain and supply chain, aiming to achieve low-carbon emission reduction and minimize environmental harm as well as full-chain costs. As a trailblazer in China's new energy vehicle industry, BYD has paved the way for the exploration of green and sustainable development by making significant contributions. The purpose of this study is to investigate the construction and management of a green supply chain system in the new energy vehicle industry, using BYD as an example.

1 INTRODUCTION

Due to the advancement of industry and human society, the global economic pattern has been deeply reconstructed. The global climate is undergoing drastic changes, and resource and environmental problems are becoming prominent. The climate crisis cannot be delayed (Liu & Yan, 2025). The international community is adopting various sustainable development plans and means to implement emission reduction and ecological civilization construction. How to improve the ability to manage the climate crisis from all dimensions and achieve green development has also become a key issue in the meantime. The green supply chain represents the cross-integration of environmental consciousness, efficient resource utilization and all supply chain links. It constitutes a significant mechanism for realizing green manufacturing and promoting sustainable development. The goal is to achieve maximum resource efficiency across the supply chain ecosystem through systematic management, all while reducing environmental impact to the lowest feasible level. The traditional supply chain system cannot be compared to the green supply chain system, which integrates the concept of the whole life cycle of products and the extension of producer responsibility with the traditional supply chain. It uses the huge power of the government, enterprises and public consumption to drive the green transformation. The development of green supply chains has become unstoppable and has become a key driving force for global supply chains and industrial chains (Liu & Yan, 2025). As the low-carbon economy continues to improve, China has set the Dual Carbon Goals of reaching carbon peaking by 2030 and carbon neutrality by 2060.The CO2 emissions of the automotive industry are significantly higher than those of other industries, so new energy vehicles have emerged. Meanwhile, the global energy system is undergoing a profound revolution and the electric vehicle industry is gradually occupying an important strategic position in green development. The global new energy vehicle industry has experienced rapid growth in recent years, driven by factors such as increasing environmental awareness, technological advancements, and supportive government policies and is expected to dominate the automotive market in the coming years. The technological innovation of eco-friendly vehicles is

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constantly advancing. Battery technology is gradually maturing, and autonomous driving is constantly developing. Governments around the world are increasingly investing in the construction of charging facilities for new energy vehicles. The upstream and downstream enterprises of the industrial chain cooperate more closely. Various parts enterprises and vehicle enterprises develop together. However, within the supply chain, carbon emissions and resource waste from logistics operations have become major environmental concerns. From production to sales, manufacturing and processing time constitutes merely 10%, with nearly 90% of the total time attributed to logistics processes, including warehousing, transportation, loading/unloading, sub-packaging, distribution processing, and information handling. Upstream energy consumption is high, and carbon emissions are huge, so supply chain emission reduction actions deserve more research. For the purpose of achieving sustainable development and reducing operational costs, the new energy vehicle (NEV) industry places emphasis on building a green supply chain system. Consumers are more likely to select companies that have environmental responsibility for their product selection due to the growing awareness of environmental protection throughout society.

This study seeks to evaluate the current state of green supply chain management and investigate the creation of a green supply chain system in the new energy vehicle market. BYD is the market leader when it comes to new energy vehicles. Its green supply chain is integral to the automotive industry process and its business encompasses the entire industrial chain of new energy vehicles, with a complete system and typical characteristics. Taking BYD as an example, this study examines the current state of BYD's supply chain and proposes development suggestions for the advancement of green supply chain management in NEV.

2 THE STATUS QUO OF GREEN SUPPLY CHAIN MANAGEMENT IN NEV

2.1 Industrial Policy Environment

Driven by technological breakthroughs, the NEV industry has become a trailblazer for innovation in the global automotive sector, providing new development opportunities for China to transform from a Big Country of Imitation to a Strong Country of Automobile Manufacturing. To promote the early achievement of the national carbon peak goal, the Ministry of Industry and Information Technology (MIIT) issued the Measures for the Parallel Management of Corporate Average Fuel Consumption and New Energy Vehicle Credits for Passenger Vehicles in September 2017. Among these, the Double Credit carbon emission management model and national subsidy policies have driven the transformation of the traditional automotive industry toward new energy vehicles. China's NEV production climbed from 84,000 units in 2014 to 9.587 million units in 2023, indicating significant progress in China's transition to a green and electrified automotive industry (Sun, 2025). In the context of phased NEV development , the upstream raw material manufacturers of green energy vehicles account for a huge proportion of carbon emissions (Yang & Xuan, 2025). According to McKinsey, emissions from the production of materials for electric vehicles are expected to account for 45% of total vehicle life cycle emissions by 2025 and about 85% by 2040 (Yang & Xuan, 2025). Although the carbon emissions of new energy vehicles relying on electric vehicles in the process of driving are zero all carbon emissions are transferred to the production end (Chen , 2018). Qiao (Qiao, Zhao, Liu, Jiang & Han, 2017) et al. compared the carbon emissions of pure electric vehicles and traditional fuel vehicles in China from three aspects: different materials, components and energy consumption, and the results showed that the carbon emissions of pure electric vehicles were 15.0~15.2t, about 50% higher than that of traditional fuel vehicles (Yang & Xuan, 2025).

The Guiding Opinions of the General Office of the State Council on Actively Promoting Supply Chain Innovation and Application issued by the General Office of the State Council in October 2017 shows that new development is a defining characteristic of the supply chain concepts , such as innovation, coordination, green, openness and win-win, thereby fostering supply chain innovation and growth. This approach facilitates mutually beneficial collaboration and synchronized development among upstream and downstream enterprises in the supply chain, while promoting the establishment of a green industrial system covering all links. Green supply chain management is promoted throughout the product life cycle and the demonstration is carried out in the automobile and other industries, which will strengthen supervision, establish a harmonized green standard, certification and labeling regime , support green industries and facilitate the construction and sustainable development of green supply chain

systems. Reverse logistics is encouraged to be constructed based on the supply chain,as shown Figure 1. Reverse logistics distinguishes itself from the traditional supply chain. Its extension part realizes the improvement of resource utilization in the chain, focusing on the recycling and reuse of products from multiple parties in the automobile, electronics and other industries and optimizing the network layout of reverse logistics. The supply chain of new energy vehicles encompasses vehicle manufacturers, parts producers, suppliers, retailers, and other enterprises. Across the entire industry, low-carbon innovation in the NEV supply chain has emerged as an unavoidable trend and a critical pathway to drive the transition toward low-carbon emission reduction.

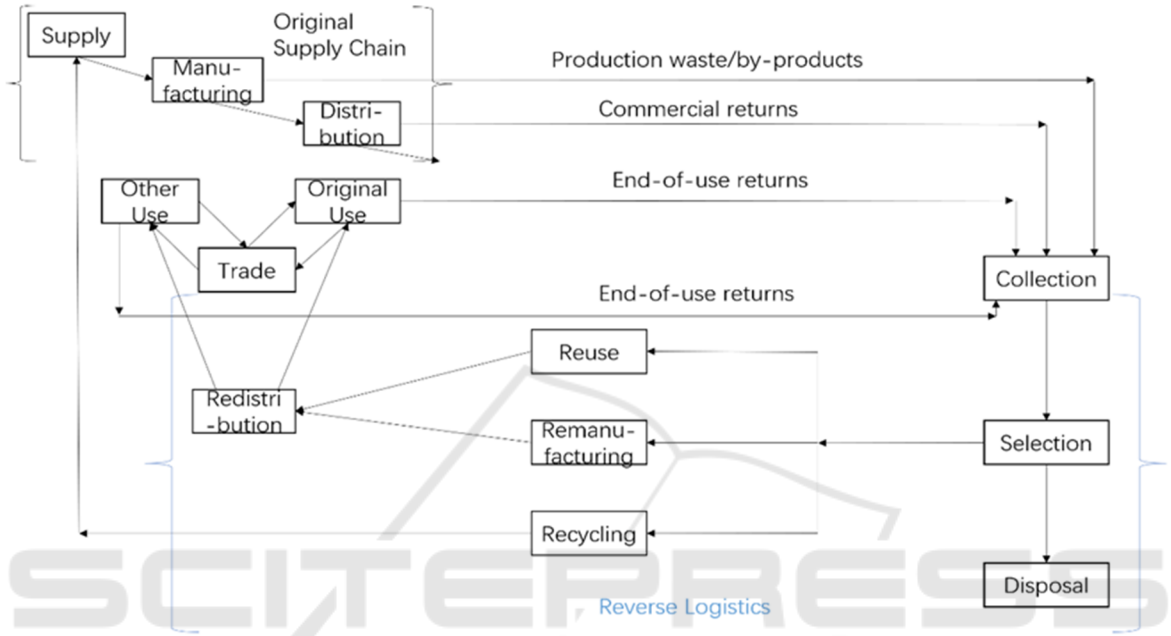

Figure 1: Reverse logistics. (Picture credit: Original)

2.2 Industrial Chain Structure and Key Links

With regard to the new energy vehicle industry, the supply chain spans multiple stages, including the procurement, production, and distribution of critical components such as power batteries, motor drives, electronic control units, and body structural parts. In recent years, the price fluctuations of key raw materials have been obvious, which has increased the difficulty of cost control. The inventory turnover of various production bases needs to be improved and the planning of logistics and distribution links is not good. The arising of various issues has led to an increase in supply chain costs. Therefore, the improvement and resolution of existing problems is made possible through the improvement of the supply chain management system. Unlike the linear flow of traditional supply chains, reverse logistics introduces a return-and-recycle mechanism, thus transforming the supply chain into a closed loop. Based on traditional supply, production and marketing, the recyclable materials in the process are re-put into the industrial chain for use, improving resource utilization, while reducing carbon emissions and costs. The Ministry of Industry and Information Technology's Green Supply Chain Management Evaluation Requirements pointed out that the green supply chain will run through the concept of environmental protection and resource conservation throughout the whole process of enterprises from product design to raw material procurement, production, transportation, storage, sales, use, scrapping and recycling, so that enterprises can achieve environmental protection while carrying out economic activities. Integrated green supply chain activities include green procurement, logistics, design, products, packaging, sales, and waste recycling. Its specific performance in the new energy vehicle industry chain can be manifested in the supply of sustainable raw materials and environmentally friendly parts (green procurement), the substitution of clean energy for the use of non-renewable energy and production quality control (green production), low-carbon transportation modes such as railway transportation and water transportation as well as

intelligent physical management (green logistics), power battery recycling and recycling of waste parts (waste recycling), etc.

3 CASE STUDY OF BYD's GREEN SUPPLY CHAIN MANAGEMENT

3.1 Company Profile of BYD

BYD stands as a globally leading integrated enterprise in the new energy and technology domains. Originating from the production of rechargeable batteries, it first ventured into the lithium-ion battery industry in 1997, and became Nokia's first Chinese lithium-ion battery supplier in 2002. The business scope of the BYD brand covers four major fields: electronics, automobiles, new energy, and rail transit. With over 30 industrial parks worldwide, it has completed a strategic deployment across six continents. BYD takes battery technology as the core to promote the iteration of new energy vehicles, energy storage systems and other technologies. It has rich experience in research and development in the field of new energy vehicles and strong technical strength. Its products also have high visibility and competitiveness in the global market. BYD has made a series of important achievements in the field of NEV. The industrial chain layout is strengthened and R&D technology is continuously developed, BYD will continue to strive to advance new energy vehicle technology innovation and foster the sustainable development of the global NEV industry. It will continue to be committed to helping achieve the Dual Carbon goal through zero-emission solutions (Yang, 2024).

Table 1: From January to November 2024,China's New Energy Vehicle Manufacturers will be Ranked TOP10 in Retail Sales

Rank	The name of the business	Sales volume(10,000) units	Year-on-year growth	Market share
1	BYD Auto	331.52	37.80%	34.50%
2	Geely Automobile	75.41	94.30%	7.90%
3	Tesla China	57.42	8.80%	6.00%
4	SAIC GM-Wuling	55.71	42.60%	5.80%
5	Changan Automobile	55.03	60.60%	5.70%
6	Ideal car	44.20	35.70%	4.60%
7	Cialis Motors	35.58	379.20%	3.70%
8	Chery Automobile	35.39	252.30%	3.70%
9	GAC Aion	33.08	-24.80%	3.40%
10	Great Wall Motors	25.33	21.30%	2.60%

As can be seen from Table 1, BYD is the new energy vehicle manufacturer with the highest sales volume and market share, which has great reference value for other automobile companies in the same industry when studying enterprise value. In addition, BYD has repeatedly received an A ESG rating, indicating that BYD is doing well in promoting its sustainable development strategy. Therefore, BYD was selected as the research object to explore its green supply chain management (Sun, 2025).

3.2 BYD's Green Supply Chain Management Strategy

By embedding green supply chain management into its corporate strategy, BYD has set a benchmark for the automotive industry to demonstrate how environmental responsibility can be integrated with business growth, aiming to achieve sustainable growth through low-carbon procurement, eco-friendly production, and responsible distribution. It has built a low-carbon supply chain system covering the whole life cycle of R&D, production, logistics and recycling around the three major contents of technological innovation, full-chain collaboration and a standardization system. BYD has established a carbon data management platform covering suppliers, following ISO14067 unified data collection standards and training suppliers to improve data quality to ensure transparency and traceability of scope emissions. For the procurement of materials, BYD gives priority to low-carbon material suppliers, incorporates environmental protection indicators into the supplier assessment system and forces upstream enterprises to upgrade their technology.

3.3 Green Supply Chain Management Practices

BYD has invested more than 150 billion RMB in technology R&D and innovation, covering battery technology, photovoltaic energy storage, intelligent logistics and other fields, providing underlying support for carbon reduction in the supply chain.

BYD's independently developed blade battery has initiated a new form of energy storage. Employing a lithium -iron-phosphate (LFP) structure, the blade battery has a milder environmental impact compared to the common nickel-cobalt-manganese (NMC) and nickel-cobalt-aluminum (NCA) compositions utilized by the majority of other EV producers. Additionally, it achieves a 30% boost in energy density and a cumulative decrease of 65 million tons in carbon emissions. LFP batteries also feature higher recyclability at the end of their lifecycle, enhancing environmental sustainability while cutting production costs. (de Sousa, C., Daniel Morais, 2024). However, the blade battery faces some problems, for example, the discharge capacity of the blade battery is only 80% of the normal temperature in a low temperature environment (-20°C), while the ternary lithium battery can be maintained at 86%. This attenuation of low-temperature endurance may weaken consumers' confidence in lithium iron phosphate batteries and affect the purchase decisions of users in the north.

BYD has deep technology accumulation and a complete industrial chain layout in the field of photovoltaic energy storage. Its technology covers core links such as photovoltaic power generation, energy storage batteries, energy management systems (EMS), and intelligent inverters, forming an integration of photovoltaic and storage. BYD's photovoltaic module technology uses high-efficiency monocrystalline silicon PERC cell technology, with a conversion efficiency of more than 22%, supporting bifacial power generation design and increasing power generation per unit area. At the same time, lightweight flexible components have been developed, which are suitable for special scenarios such as industrial and commercial roofs and carports, reducing installation costs.

BYD set up China's first zero-carbon park headquarters for an automaker in 2022, which has become a model for other zero-carbon parks in the country. At the Pingshan headquarters park, BYD has achieved 100% utilization of new energy vehicles. In the park, all production processes utilize its self-developed pure electric forklifts, pallet trucks, cleaning vehicles, etc., aiming to realize 100% green logistics and achieve a cumulative reduction of 245,681.89 tons of carbon dioxide equivalent. (Zhang, 2023).

3.4 Digital Empowerment

BYD has built a full-chain digital system covering R&D, production, supply chain, marketing and service through the model of technology self-research + ecological integration to promote the digital transformation of enterprises to intelligence. To facilitate digital transformation, the company has formed a steering committee for digital transformation and a dedicated office, tasked with ensuring its efficient advancement and practical implementation (Zhou & Zhang, 2025). In terms of technology manufacturing, BYD has realized the digital upgrade of the whole process, introduced AI visual inspection in the production process of batteries and monitored the surface quality of battery cells in real time with a detection accuracy of 99.99%, reducing labor costs by 70%. BYD's Pingshan plant uses an EMS system to visualize water, electricity and gas consumption data, reducing unit energy consumption by 18%. In the realm of integrating photovoltaic (PV) power generation with energy storage, BYD has linked its PV power generation and energy storage system to an intelligent microgrid, boosting the self-sufficiency rate of green electricity to 45%.

4 CONCLUSIONS

There is a definite positive correlation between BYD's green supply chain management and its corporate value, which is not only the practice of environmental responsibility, but also an important source of its technical barriers and cost advantages, establishing a reproducible model of mutual commercial and social value for the global NEV sector. Building on the above findings, NEV companies can benchmark against BYD to systematically enhance their supply chain management capabilities. Enterprises are advised to further strengthen the green supply chain management standard system, ensuring that green transformation can be implemented across the entire supply chain. Enterprises should also take a leading role in enhancing collaboration with suppliers, distributors, and other upstream and downstream enterprises. This involves optimizing procurement strategies, strengthening the alignment of environmental protection standards, achieving efficient resource utilization and waste reduction, and

jointly advancing the sustainable development of green supply chains. Enterprises should continue to strengthen the construction and management of the green information platform, improve the level of information transparency in the whole chain, create a green image of enterprises, and enhance corporate visibility and social recognition. In the long run, although the company's R&D expenditure and production costs may be increased in the early stage, enterprises must reinforce their ability to innovate independently, continuously improve the technology level of new energy vehicles, and invest in green production and logistics. Enterprises should improve resource utilization, strive to reduce carbon emissions in the production and transportation process and maximize the market competitiveness of products by reducing the environmental impact and optimizing the production process. Enterprises need to dynamically track green manufacturing policies and actively participate in certification to enhance brand premium. Enterprises should also proactively engage in international environmental protection cooperation and exchanges, draw insights from global practices, and actively compete with international counterparts to continuously enhance their green development capabilities.

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