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Research on the Impact of BYD Group's Green Innovation on Corporate Financial Performance under the Background of "Dual Carbon"

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Abstract: With the increasingly severe global climate change problem, the "dual carbon" goals (peak carbon emissions and carbon neutrality) have become a common focus of international attention. The report of the 20th National Congress of the Communist Party of China clearly emphasizes the need to accelerate the green transformation of development models, implement comprehensive strategies for frugal development, support the growth of green and low-carbon industries, and promote the concept of green consumption. At the same time, "Made in China 2025" also elaborates on the strategic concept of innovation-driven and green development centered, and strives for breakthroughs in key industries such as new energy vehicles. In such a macro environment, adopting green innovation measures by enterprises not only contributes to ecological protection but also has an undeniable impact on their economic performance and overall value. This article takes BYD Group as a case study to explore in detail the positive effects of green innovation on its economic performance. We first systematically organized and analyzed BYD's specific practices in green innovation; Then, by examining three key financial indicators, BYD's current financial situation was analyzed in depth; On this basis, combined with research data, the positive impact of green innovation on BYD's financial performance was revealed; Finally, based on the analysis results, relevant suggestions are proposed to provide reference for the sustainable development of enterprises in the context of "dual carbon."

Keywords: Dual carbon target; BYD Group; Green innovation; Corporate financial performance

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1. Introduction

Faced with the severe challenge of global climate change, governments around the world have put forward emission reduction targets to achieve carbon peak and carbon neutrality. As one of the world's largest carbon-emitting countries, China has actively responded to the call of the international community and proposed the "dual carbon" goal. In this context, the green innovation behavior of enterprises is particularly important. As a leading enterprise in the field of new energy vehicles in China, BYD Group, from a battery manufacturer to a leader in the automotive industry, relies on its technological advantages and precise market strategies to

continuously launch competitive electric vehicle models, committed to promoting the progress of new energy vehicle technology. Its green innovation practice not only promotes the sustainable development of the industry but also has a positive impact on the financial performance and value-added of the enterprise itself.

2. BYD Group's green innovation practice

Under the environmental regulations and policy guidance of national and local governments, as well as the "dual carbon" background of sustainable development, BYD Group has always adhered to the path of green and innovation in various fields such as power battery manufacturing, new energy vehicles, batteries, semiconductors, and IT, and has achieved significant results in green innovation. The independently developed blade battery with high safety, long lifespan, and high endurance has brought lithium iron phosphate and plug-in hybrid back to the forefront of industrial development, while also solving the problems of safety and resource affordability. Compared to ordinary lead-acid starter batteries, lithium iron phosphate starter batteries are a green, pollution-free, and completely lead-free product, with an average fuel consumption reduction of 0.1 liters per 100 kilometers, completely eliminating the problem of lead in conventional starter batteries causing damage to the ecological environment and meeting RoHS standard requirements [1]. The new breakthroughs in iron battery technology and dual-mode technology have also solved the global challenges of electric vehicle batteries in terms of safety, cycle life, and range. These green technologies have been applied to multiple BYD models, which have significant effects on protecting the environment and reducing pollution.

In the solar energy and energy storage product industry, BYD has built a complete vertical industry chain by utilizing its outstanding technological innovation capabilities and adopting special processes to refine polycrystalline silicon [2]. This innovation significantly reduces the cost of using solar energy, making the price of solar power comparable to coal-fired power generation, thus promoting the widespread popularity of solar energy and bringing clean energy into millions of households. In the field of energy storage, BYD's layout also began in 2008, when it established the Electric Power Science Research Institute, focusing on the research of battery energy storage technology [3]. Entering 2023, BYD has significantly accelerated its layout in the domestic energy storage market, established cooperative relationships with multiple enterprises, and successfully won multiple large-scale energy storage system projects. In terms of energy storage product innovation, BYD has launched advanced products such as the Cube energy storage system, which integrates blade battery technology and significantly improves the safety and overall performance of the energy storage system [4]. At present, BYD's energy storage products have been distributed in more than 70 countries and regions across 6 continents worldwide, with a cumulative shipment volume exceeding 6.5 GWh. Since 2022, BYD Energy Storage's global order volume has exceeded 14GWh, fully demonstrating its strong competitiveness in the international energy storage market.

BYD has mastered the core technologies of the entire industry chain, such as batteries, motors, and electronic controls, through various measures. At the same time, it has made value-oriented layouts for patents and guided relevant R&D departments to carry out comprehensive, deep-level, and multi-dimensional green technology innovation, so as to better apply them to the company's products and services. In terms of R&D personnel, the company has maintained an increasing trend from 2020 to 2023. According to the latest annual report publicly available, BYD currently has over 100,000 R&D personnel (**Table 2**); In terms of research and development funding, BYD has always insisted on high investment, with a research and development investment of nearly 40 billion Chinese yuan in 2023, increase of 97.39% compared to 2022 (**Table 3**). The cumulative number of Chinese and foreign patent applications has reached 37,869 and 10,192 respectively. It is through this strong research and development innovation that BYD has achieved explosive technological

innovation in today's green new energy vehicle industry.

Table 1. BYD Group's R&D personnel

	Year 2023	Year 2022	% change
Number of R&D staff	102,844	69,697	47.56%
Number of R&D staff as a percentage	14.62%	12.23%	2.39%
Education background of R&D staff			
Bachelor's degree	46,823	36.018	30.00%
Master's degree	23,706	7.827	202.87%
Ph.D.	1,587	590	168.98%
Age composition of R&D staff			
< 30 years old	61,337	37,302	64.43%
30–40 years old	36,182	28,606	26.48%

Table 2. R&D investment of BYD Group

	Year 2023	Year 2022	% change
Amount invested in R&D (Chinese yuan)	39,917,743,000	20,223,243,000	97.39%
R&D investment as % of operating revenue	6.63%	4.77%	1.86%
Amounts capitalized for R&D inputs	342,798,000	1,568,789,000	-78.15%
Capitalized R&D investment as a % of R&D investment	0.86%	7.76%	-6.90%

3. BYD's financial performance status

Since this article takes green innovation as the starting point, the selection of indicators should not only take into account traditional financial analysis methods and indicators, but also consider which indicators can intuitively reflect the impact of green technology innovation, pollution reduction, and resource utilization efficiency [5]. Therefore, three indicators, total asset return rate, net asset return rate, and operating cost reduction amount were selected to analyze economic performance.

(1) Return on assets (ROA): It is a financial indicator that reflects the level of income obtained by a company using all its assets. It represents the overall profitability of all assets of a company, including net assets and liabilities, and is an important indicator for evaluating the operational efficiency of the company's assets [6]. This article selects the top 5 listed brand companies in the automotive industry as representatives of the automotive industry data and compares and analyzes their average total asset return rate and net asset return rate from 2021 to 2023 (**Figure 1**). The results show that even in the face of slowing growth in the Chinese economy and increasing complexity, severity, and uncertainty in global economic development, BYD was able to maintain high profitability and achieved a significant increase in total operating revenue in 2023, with a year-on-year growth of 42.04%. BYD's ROA exceeded the industry average in both 2022 and 2023, indicating that the company has achieved strong profitability and risk control capabilities through continuous research and development of green technologies and product innovation. This also reflects the company's high asset utilization efficiency and high return on investment.

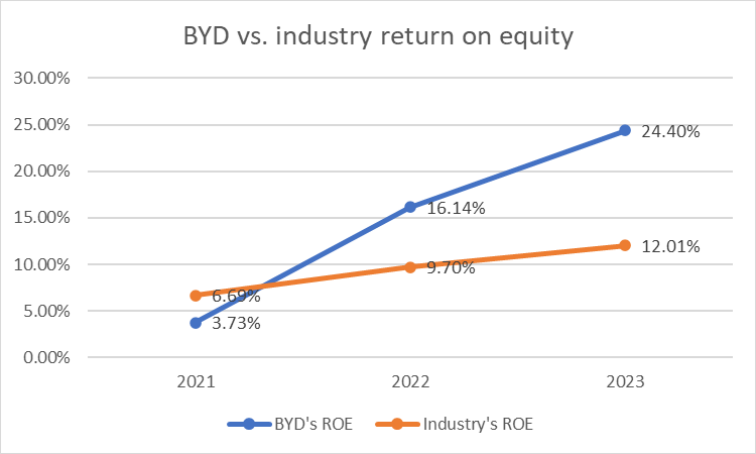

Figure 1. BYD vs. industry total return on assets.
Data source: Annual reports of various enterprises

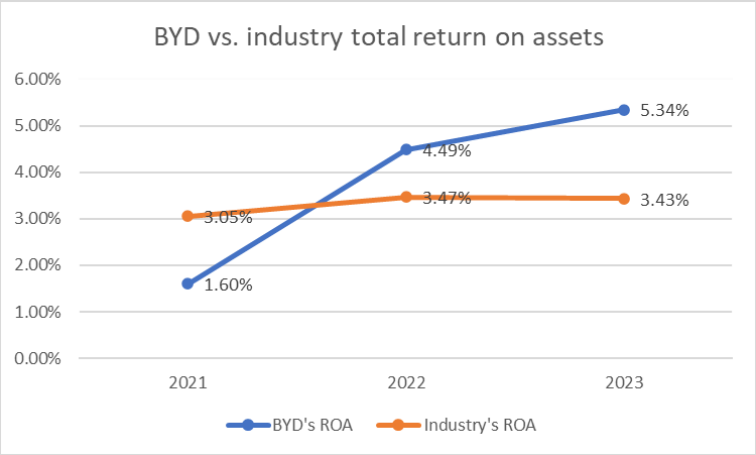

Figure 2. BYD vs. industry return on equity.
Data source: Annual reports of various enterprises

(2) Return on equity (ROE): It is an indicator that reflects the efficiency of enterprise investment, financing, and asset operation, and also represents the profitability and growth of the company, measuring the efficiency of the company's use of shareholder investment funds. The higher the indicator, the higher the return on investment by shareholders, indicating strong comprehensiveness. As shown in **Figure 2**, BYD has maintained a high return on equity in recent years, and also significantly exceeded the industry average level from 2022 to 2023, indicating that the company can continue to create value and returns for shareholders, and the management's capital operation efficiency is strong. The stable and continuous increase in the profitability of equity capital is a powerful stimulant for investors and creditors.

(3) Reduction in operating costs: Given that the cost reduction brought about by green technology innovation is difficult to accurately measure, this article chooses the reduction in operating costs as an alternative indicator. In recent years, BYD's operating costs have been on an upward trend year by year, and its high operating expenses have also led to a surge in BYD's operating revenue from 2021 to 2023, increasing by approximately 386.2 billion yuan. However, its net profit has only increased by 26.996 billion yuan. As an emerging industry, the industrial structure of new energy vehicles is still being adjusted and improved. At the same time, due to the relatively high cost of batteries, reducing operating costs has become a challenge. This situation has led to a widespread phenomenon

of high income but low profit in the new energy vehicle industry. Therefore, although technological research and innovation have significantly driven a significant increase in corporate revenue, the time, investment, and even potential sunk costs involved in this process are enormous [7]. To ensure sustained profit growth, enterprises must constantly adhere to the research and innovation of new technologies, while striving to reduce costs and improve efficiency on the premise of environmental protection.

4. The impact of green innovation on BYD's financial performance

4.1. Expand the industry layout and add new profit points

In the field of new energy passenger vehicles, BYD, relying on continuous innovation in core technologies and precise and efficient market strategies, will continue to rank first in passenger vehicle sales among Chinese automakers in 2023. BYD is guided by the needs of car owners and driven by technological innovation. It has taken the lead in using lithium iron phosphate starter batteries instead of lead-acid batteries in the industry, achieving lead-free vehicles [8]. On the basis of promoting the application of existing green technologies, the group has successively released globally leading forward-looking and disruptive technologies such as the "Yi Si Fang" architecture, the "Yun Nian" intelligent vehicle control system, the "Tian Shen Zhi Yan" advanced intelligent driving assistance system, and the "DMO" super hybrid off-road platform, further enhancing the group's comprehensive competitiveness and helping business development move towards higher levels [9]. Despite more intense industry competition, the company has achieved significant improvements in profitability through the continuous improvement of its brand power, rapid growth in overseas sales, continued expansion of scale advantages, and strong cost-control capabilities in the industry chain. Its net profit increased by 445.86% year-on-year in 2021–2022 and 80.72% year-on-year in 2022–2023, demonstrating strong resilience.

In terms of new intelligent product business, BYD actively improves the layout of AI servers and other high growth tracks, continuously deepens close cooperation with industry leaders in various sectors, and enables the continuous and stable development of business sectors such as drones, smart homes, and gaming hardware, with market share continuously increasing [10]. Overall, through green technology innovation, BYD has found new profit growth points in the industries of new energy vehicles, mobile phone components and assembly, and new intelligent products, and also has high growth potential in these areas.

4.2. Reduce costs and improve efficiency

Effective cost control is a necessary factor for the long-term healthy development of enterprises. Proper cost control can enhance the competitive advantage of enterprises and improve their profitability. Although BYD's total operating costs have shown an upward trend in the past three years, its core innovative technologies and products, as well as excellent marketing strategies, have led to rapid growth in the new energy vehicle and new intelligent product businesses. While revenue and profits have increased significantly, cost management has also been within a controllable range, and the cost-profit margin has steadily increased year by year from 2021 to 2023. This indicates that the company has integrated its industrial chain, achieved sustained independent innovation and development in the supply chain, strengthened the management of raw material procurement and use, reduced the production cost of components through economies of scale, and improved the overall operational efficiency and profitability of the company [11]. At the same time, green innovation has also helped BYD optimize its production process, and reduce energy consumption and raw material waste; After adopting energy-saving technologies and environmentally friendly materials, the production efficiency of the enterprise has been significantly improved, reducing production costs and improving efficiency, achieving lean production. In the daily operation process, BYD has established an efficient and professional green

collaborative work system, leading the upstream and downstream of the industry chain to jointly adopt new green technologies, forming a green management process from supply to production to sales, thereby improving the green management standards of the entire industry [12].

4.3. Shaping a green corporate image and enhancing brand competitiveness

Currently, with the increasing global emphasis on environmental protection, governments around the world have established strict environmental regulations. If enterprises want to maintain competitiveness in the future market, they must incorporate sustainable development into their strategic planning [13]. BYD continues to comply with environmental regulations, strive for sustainable development, and shape a green image by implementing green innovation measures.

In recent years, BYD's performance in the ESG field of the automotive industry has shown a positive upward trend, thanks to its outstanding performance in environmental governance, fulfilling social responsibilities, and strengthening corporate governance. Adhering to the core concept of "green, development, and sustainability," BYD announced in August 2021 the construction of China's first zero carbon emission park headquarters in the automotive industry. The park will comprehensively apply a series of environmentally innovative solutions such as new energy vehicles, photovoltaics, energy storage, and cloud rail and bus [14]. After efforts, the park obtained the "ISO14064 certification" and "PAS 2060 carbon neutrality certification" in 2022, marking the successful creation of China's first zero-carbon park for automotive brands. Although BYD disclosed in its latest ESG report that its power battery business and automotive manufacturing inevitably face challenges in greenhouse gas emissions, it actively takes measures to save energy and reduce emissions, and practices green responsibility. In 2023 alone, it added 93 energy-saving renovation projects, achieving a greenhouse gas reduction of 132,500 tons.

BYD's green innovation measures demonstrate the company's social responsibility and environmental awareness, shape a good corporate image, and win market recognition. In the ESG rating of the automotive industry, BYD's performance and rating results also rank among the top [15]. These fruitful achievements fully reflect the important significance of green innovation for the green transformation and development of the enterprise.

5. Conclusion and suggestions

In the context of "dual carbon," BYD Group's green innovation practices have had a positive impact on its financial performance. This is not only reflected in the improvement of product quality and the enhancement of market competitiveness but also the reduction of production costs and the shaping of corporate image. Therefore, it is recommended that other enterprises also attach great importance to the role of green innovation in their development process, in order to achieve a win-win situation between economic benefits and environmental protection. At the same time, the development of enterprises is closely linked to the internal and external environment. In terms of the internal environment, enterprises should continuously strive to ensure technological advantages, promote product innovation, and actively expand product market share. For the external environment, enterprises should grasp the role of policies in promoting the integration of industry resources, actively respond to national policy calls, establish good cooperative relationships with government departments, and jointly promote the healthy development of the industry. In this process, enterprises should not forget the original intention of green innovation, adhere to the concept of harmonious coexistence between humans and nature, closely follow the direction of national policies, bear in mind the social responsibility of enterprises, and contribute their own strength to ecological environment protection.

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