

ESG and Carbon Neutrality Goals: Literature Review and Investment Strategy Analysis

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Abstract. Against the backdrop of escalating global climate change and the pressing urgency to mitigate environmental impacts, achieving carbon neutrality has become a critical focus in transitioning to a sustainable low-carbon economy on a global scale. Within this context, Environmental, Social, and Governance (ESG) frameworks play an increasingly recognized and essential role in supporting low-carbon economic development across various sectors. This paper systematically reviews the role of ESG in achieving carbon neutrality, exploring its effectiveness not only in selecting low-carbon enterprises but also in facilitating the development of robust low-carbon investment strategies. Through a comprehensive literature review, it reveals how ESG frameworks enable companies to undertake low-carbon transformation initiatives and delves into the application of relevant investment tools, assessing their significant contributions to carbon neutrality goals. Additionally, this paper addresses the persistent challenges faced by ESG frameworks, including issues of standardization, transparency, and accountability, and proposes future research directions alongside actionable suggestions to improve the ESG framework to better support the global pursuit of carbon neutrality and a more sustainable future.

Keywords: ESG, carbon neutrality, green finance, investment strategy.

1. Introduction

With the intensification of global climate change, the transition to a low-carbon economy has become the focus of attention of all countries. International agreements, such as the Paris Agreement, as well as national commitments to reduce emissions, have prompted companies and investors to take more responsibility in the process of achieving carbon neutrality [1].

There has been extensive research on ESG and its relationship with carbon neutrality goals, focusing on the theoretical basis of ESG, investment models, and its role in promoting corporate social responsibility. ESG investment is a very important part of ESG's efforts to promote carbon neutrality. Previous studies have shown that green bond issuance enhances corporate finance accessibility, lowers financing costs, which can effectively direct funds to low-carbon enterprises and projects, thus accelerating the transition to a low-carbon economy [2]. In addition, the literature also points out that Green financial instruments are crucial for advancing green, low-carbon development and facilitating the attainment of carbon neutrality. However, they have faced criticism for the misallocation of green funding by firms for the purpose of "greenwashing" [2].

This article systematically reviews the relationship between ESG and carbon neutrality, uncovering the mechanisms through which ESG investment achieves carbon emission reduction targets by means of corporate screening, investment strategies, green bonds, etc., and analyzing the main challenges therein, such as issues of standardization and transparency. Through a comprehensive review of the role of ESG investment in the transition to a low-carbon economy, this article not only enriches the understanding of this relationship in the existing literature but also focuses on the practical application and case studies of specific investment strategies, particularly their contribution in the process of carbon emission reduction. Compared with previous studies, this article emphasizes the crucial role of investment tools in promoting the low-carbon transition and proposes suggestions for optimizing the ESG framework based on the existing problems, to better cope with the challenges of achieving the goal of carbon neutrality.

2. Background Overview of ESG Investing and Carbon Neutrality Goals

2.1. The Definition of ESG and its Position in Modern Investment Strategies

The concept of ESG (Environment, Society and Governance) originated from a collaboration between the United Nations and the financial community, and was first proposed in the "Who Cares Who Wins" report in 2004. Then-un–Secretary-General Kofi Annan invited the world's leading financial institutions to advocate for the integration of environmental, social and governance considerations into asset management and investment decisions to advance sustainable development. The connotation of ESG is extensive, covering three aspects: environment, society and corporate governance. The environment is mainly concerned with the impact of enterprises on climate change, resource use and ecological protection; Social focus on corporate relationships with employees, communities and supply chains, such as human rights, Labour standards and health and safety; Governance focuses on the transparency of the company's management structure, the independence of the board of directors and the rights and interests of shareholders to ensure that the company has a sense of responsibility and transparency in governance [3].

Today, ESG has become an integral part of global capital markets, In the selection of firms in which to invest, many investors, especially institutional ones, now consider ESG factors as critical components of decision-making [4]. Previous research results show that combining financial risk indicators with corresponding ESG risk indicators can improve the effectiveness of traditional financial indicators in predicting financial assets. Combining the prediction of ESG risk indicators can obtain more accurate investment volatility, so that the investment results are more in line with expectations [5]. What's more, in the face of increasingly stringent global ESG standards and policies, companies are gradually increasing the publication of their ESG reports in response to academic, investor and social concerns about corporate sustainability performance. As a result, ESG has evolved from a niche area into a mainstream investment strategy tool, driving global investments toward more sustainable and socially responsible directions [6].

2.2. The Global Context of Carbon Neutrality Goals, Including International Agreements (Such as the Paris Agreement), National and Regional Policies

Carbon neutrality refers to a state in which CO₂ emissions from human activities are balanced by an equal amount of CO₂ removal over a given period, resulting in "net zero emissions". Achieving carbon neutrality usually involves two efforts: 1. Reducing emissions: Reducing carbon dioxide emissions through energy efficiency, clean energy and other means. 2. Negative emission technologies, such as carbon capture, utilization and storage (CCUS), achieve a balance of emissions by absorbing and fixing carbon dioxide [7].

The global context for carbon neutrality goals stems from the urgency of addressing climate change, with countries around the world increasingly recognizing the importance of reducing greenhouse gas emissions. The Paris Agreement, a key milestone in the international community's efforts to achieve carbon neutrality, was adopted in 2015 with the aim of limiting global temperature increases to well below 2 degrees Celsius and working to limit warming to 1.5 degrees Celsius. The agreement requires countries to submit their "Intended Nationally determined Contributions" (NDCs) to gradually reduce emissions and become carbon neutral [7].

After the Paris Agreement, countries around the world have launched relevant carbon neutral policies. The European Green Deal aims to be carbon neutral by 2050. The agreement includes a full range of policy measures, including the research and development of zero-carbon technologies, green transformation, transportation emission reduction, industrial decarbonization, etc., and comprehensively covers the optimization of the energy system and the promotion of renewable energy. In addition, the EU is pushing companies to reduce their carbon emissions through carbon pricing mechanisms, such as the EU Emissions Trading System (EU ETS). The United States rejoined the Paris Agreement in 2021 and pledged to achieve net zero emissions by 2050. To this end, the United States has promoted clean energy investments in the energy sector and industry, tightened

restrictions on fossil fuels, and established carbon neutrality targets at the federal level. Through a multi-tiered policy approach, the United States encourages state and local governments to take concrete actions to reduce emissions. China has proposed peaking its carbon emissions by 2030 and achieving carbon neutrality by 2060. To achieve this goal, China has vigorously developed clean energy sources such as solar and wind power, accelerated the transformation of the coal sector, and promoted the establishment of a carbon trading market. In addition, the document also mentioned that China has implemented a nationwide carbon market pilot to promote the low-carbon transition of high-emission industries. Countries such as Japan, South Korea and Canada have each set a goal of becoming carbon neutral by 2050. Japan is actively promoting the use of renewable energy and reducing its dependence on nuclear power and fossil fuels. South Korea is committed to green growth and zero-carbon cities; Canada has developed a national carbon pricing scheme covering energy, transport, buildings and other sectors to support its 2050 carbon neutrality commitment [8].

3. How Does ESG Contribute to Achieving Carbon Neutrality

3.1. The Inhibition Effect of ESG Score on Carbon Emission

The ESG scores of enterprises not only significantly inhibit carbon emissions at their own level, but also influence the carbon emission reduction process in a wider geographical scope through regional and spatial spillover effects. The mechanism of this influence is mainly reflected in several aspects: First, enterprises with high ESG scores tend to actively adopt low-carbon production methods and energy-saving emission reduction technologies, which directly reduces the carbon emission level of enterprises and their regions. Second, the good environmental performance of these enterprises has formed a "demonstration effect", which encourages neighboring enterprises and regions to improve their ESG performance in the market competition, thus creating competition-driven pressure to reduce emissions. Third, the presence of companies with high ESG scores facilitates information sharing and technical cooperation between regions, leading to more effective carbon reduction strategies in neighboring regions. In addition, in economically developed areas and densely populated megacities, ESG score has a particularly significant inhibitory effect on carbon emissions, indicating the importance of regional economic development level and city size in ESG's impact on carbon emissions. This finding supports local development of ESG enhancement and carbon reduction policies to achieve regionally coordinated carbon neutrality goals [9].

3.2. Specific Investment Instruments and Strategies

At present, the most popular ESG investment vehicle is green bonds. Studies have shown that by issuing green bonds of \$1,000 per person, countries' emissions subsequently fall by 0.9% to 1.4%. And cross-border data show similar declines. This suggests that green bonds can be effective in promoting the reduction of carbon emissions [10].

In addition to specific investment vehicles, there are several strategies that investors can employ to effectively drive carbon neutrality goals. These strategies include:

Active shareholder engagement involves shareholders working with management to effectively promote improvements in the ESG area. This collaborative approach helps make the company more compliant with ESG standards and enhances its overall compliance. In addition, shareholder participation has contributed to the optimization of corporate governance structures, especially in linking management compensation to ESG targets, increasing transparency and accountability. This participation also helps to enhance the company's reputation, reduce the risks associated with environmental and social issues, and make the company more resilient and competitive in the market in the long term. As a result, ESG active shareholder engagement not only improves short-term performance, but also has a profound impact in terms of sustainability and long-term value [11].

Negative screening strategy is an exclusionary approach aimed at reducing ethical and financial risk in a portfolio by eliminating industries or companies that are considered harmful, unethical, or contrary to an investor's values. Negative screening typically covers industries such as tobacco,

weapons manufacturing, fossil fuels, etc., which are considered by many investors to be not sustainable because of their negative health, social, or environmental impacts. For example, as global concerns about climate change increase, the fossil fuel industry faces increasingly stringent regulations, so eliminating these industries can help investors ethically and financially hedge against future risks. Negative screening strategies not only help investors manage reputational and financial risk, but also make their portfolios more in line with individual or institutional ethical positions. Through this strategy, investors can avoid high-risk and highly controversial areas while ensuring that their investment decisions are aligned with the general direction of sustainability [12].

Positive screening strategy is an active approach to investment selection, where investors allocate funds to businesses that align with sustainability values by screening and supporting companies that excel in environmental, social, and governance (ESG) practices. The goal of the strategy is to promote and empower businesses that have a positive social and environmental impact, such as companies that focus on renewable energy, agribusinesses that adopt environmentally friendly approaches, or businesses that promote diversity and inclusion. Positive screening allows investors to not only achieve financial returns, but also contribute to broader social progress in a way that gives investments higher ethical value and social significance. Investors often rely on assessments from third-party ESG rating agencies, combined with sustainability reports issued by companies, to determine which companies are worth backing and build a portfolio that aligns with their values. This strategy aims to help investors identify companies that are more resilient in the face of future risks and challenges, with a view to achieving both financial and social benefits in the long term [12].

By combining these investment strategies and tools, investors can actively contribute to the achievement of global carbon neutrality goals while achieving financial returns. These strategies can also motivate companies to consider their environmental impact in the long term and promote broader sustainability actions.

3.3. ESG Investment Cases that Have Been Applied So Far and Their Actual Impact on Carbon Neutrality.

Case in China: Under the guidance of the "14th Five-Year Plan", remarkable reform results have been brought about through a series of clean energy investments, carbon offset projects and carbon market incentives. The 14th Five-Year Plan clearly sets carbon peaking and carbon neutrality as priority development goals, calls for accelerating the transition from coal dependence to renewable energy, and increases support for low-carbon projects such as solar and wind energy through green finance, laying a solid foundation for achieving carbon neutrality. Driven by the plan, China has not only accelerated the allocation of investment in renewable energy projects, but also actively carried out carbon offsetting projects such as carbon capture and storage (CCS) and afforestation to help high-emitting industries partially offset their carbon emissions through these measures. In addition, the 14th Five-Year Plan promoted the establishment of a national carbon market and strengthened the use of carbon pricing mechanisms, encouraging enterprises to achieve emissions reduction through carbon quota trading in a more cost-effective way, significantly improving the economic efficiency of enterprises in the low-carbon transition [13].

Case in Italy: Martell uses the internationally recognized Carbon Neutral Protocol framework, which allows it to accurately assess its carbon emissions throughout the production process, including raw material procurement, production and processing, packaging and transportation, thus laying the data foundation for targeted emission reduction measures. In terms of specific emission reduction measures, Martell first adopted lightweight bottles. This adjustment not only reduces the carbon footprint of a single bottle of wine, but also reduces the energy consumed during packaging and transportation. The application of lightweight cylinders effectively reduces the transport weight, thus significantly reducing the use of transport fuel. It is estimated that this measure has reduced Martell's carbon emissions by about 10% [14].

At the same time, Martell has also installed solar panels with an annual capacity of 34,000 KWH to further supplement the energy requirements of its production process. The use of solar energy to

provide clean energy for enterprises not only reduces the dependence on traditional fossil fuels, but also reduces the carbon emissions of the overall operation. The addition of solar panels has enabled Martell to achieve a higher proportion of self-contained clean energy use in its daily operations, significantly reducing indirect carbon emissions. In addition, Martell distillery purchases carbon credits to offset remaining emissions that are difficult to avoid completely. Carbon credits provide an effective means for companies to become carbon neutral in their actual operations, offsetting their carbon footprint by funding other green projects, such as forest conservation or renewable energy projects. In this way, Martell can achieve its goal of net zero emissions and officially achieve its commitment to carbon neutrality [14].

4. Challenges and Future Directions of ESG Investment

4.1. The Main Challenges Regarding ESG Investments in the Process of Carbon Neutrality

There are three main challenges to ESG investing in carbon neutrality.

Standardization issues: The lack of uniform standards for ESG disclosure has led to different metrics and methodologies for reporting ESG performance by different companies. This lack of standardization makes it difficult for investors to effectively compare and evaluate different companies. For example, some companies may disclose only certain environmental indicators, such as carbon emissions, but ignore other key factors such as water use and waste management. Other companies may use inconsistent reporting cycles and calculation methods, making it difficult to directly compare information. The lack of standardization not only limits investors' analysis, but also leaves companies with room for manoeuvre in information disclosure, increasing the risk of incomplete or misleading information [15].

Lack of transparency: Some enterprises often have selective disclosure and exaggerated publicity in ESG information disclosure. Specifically, some companies tout their environmental achievements without disclosing negative environmental impacts or unfulfilled promises. This lack of transparency makes it difficult for investors to obtain complete information when assessing a company's true ESG performance. In addition, the lack of independent auditing of ESG data for many companies, especially in highly polluting industries, may lead to overstatement or misrepresentation of environmental achievements, further undermining the reliability of the data [15].

Greenwashing risk: greenwashing behavior, that is, enterprises through false or exaggerated publicity to create an environmental image behavior. To gain the support of investors, consumers or regulators, some companies will selectively disclose favorable environmental information, exaggerate environmental achievements and even falsify data. For example, some companies may claim to have achieved "carbon neutrality" without taking effective measures to cover up their high emissions by purchasing carbon credits. This "greenwashing" not only misleads investors, allowing them to unknowingly support companies that do not have a genuine environmental commitment, but also undermines the integrity of the market and the credibility of ESG investing. Without effective regulatory and punitive measures, greenwashing will continue to threaten the effectiveness of ESG investments [15].

4.2. Future Research Directions are Proposed to Discuss How to Improve the ESG Framework to Better Support the Achievement of Global Carbon Neutrality Goals

Unified standards: To improve the ESG framework to better support the achievement of global carbon neutrality goals, the first thing is to establish a unified international standards system. At present, the ESG standards of different countries and industries are different, resulting in large inconsistencies in the implementation of carbon reduction by enterprises. Therefore, it is crucial to promote global ESG standards. Establishing such standards would help to create consistency in accounting for carbon emissions, measuring emissions reductions, and standards for green investments. In addition, considering sectoral and regional differences, harmonized standards should be flexible, with more stringent standards for high-carbon industries and appropriate adjustments

between developing and developed countries to suit their respective economic and resource circumstances.

Enhance data transparency: To ensure data transparency, the use of technology is critical. The introduction of digital means such as blockchain can ensure that carbon emission data is open, transparent and immutable. Such technologies can not only provide a true source of data and a complete traceability process, but also help reduce the phenomenon of "greenwashing". At the same time, the establishment of a global or regional ESG data sharing platform can help improve the accessibility of data, so that companies, investors and the public can easily access relevant information, thereby promoting information transparency and increasing society's trust in corporate emissions reduction commitments.

Strict disclosure and third-party audit: Companies should be required to regularly disclose ESG data, including carbon emissions, in accordance with internationally accepted norms, and in particular, complete information in terms of carbon footprint 1, 2 and 3. In addition, an independent and authoritative third-party audit institution is introduced to review the data disclosed by the enterprise to ensure the authenticity and accuracy of the data. Through third-party verification, it can effectively reduce the behavior of data falsification and exaggeration of emission reduction results, combat the phenomenon of "green bleaching", and increase the responsibility of enterprises to disclose information.

Punishment mechanism and green incentive: Combining punishment and incentive means can further promote the real implementation of ESG. For enterprises that have "greenwashing" behavior, measures such as fines or restrictions on financing channels can be adopted to impose strong constraints to curb false environmental claims. At the same time, the government can encourage enterprises to proactively disclose carbon emissions and ESG performance through green incentives such as tax cuts and subsidies, and provide substantial support for enterprises that actively transform. This "combination of rewards and punishments" helps to mobilize the enthusiasm of enterprises in low-carbon development, so that more enterprises can invest in the process of achieving carbon neutrality.

Increase public and investor participation: By raising public and financial market awareness of ESG, we can increase social awareness of companies' carbon emissions and ESG performance. Through education and publicity, the public and investors can be equipped with the ability to identify the real emission reduction results of enterprises, which can effectively monitor and promote the low-carbon transition of enterprises. In addition, institutional investors and public funds, through capital support, can direct more resources to companies with good ESG performance, putting pressure on companies to continue the path to carbon neutrality.

5. Conclusion

ESG investment strategies play a crucial role in driving the transition to low carbon development. By screening companies with good environmental, social responsibility and governance performance and providing financial support, ESG investments accelerate the low-carbon transition of companies. This strategy not only helps enterprises to achieve energy conservation, emission reduction and green production, but also effectively guides the flow of global capital to low-carbon projects, providing important support for achieving the goal of global carbon neutrality. The ESG framework not only focuses on economic benefits, but also reflects the responsibility of capital markets in addressing environmental and social issues, laying a solid foundation for building a sustainable economy.

Green bonds, active shareholder participation and negative screening strategies are highly effective tools in ESG investing. Green bonds channel a large amount of capital to renewable energy and low-carbon projects, effectively reducing carbon emission levels. Active shareholder engagement promotes long-term sustainability by promoting corporate governance reform and transparency to better meet carbon neutral and ESG standards. Negative screening strategies help investors reduce the carbon risk of their portfolios by excluding high-emitting and high-polluting industries, making

them more in line with a low-carbon development direction. The widespread use of these tools shows that ESG investments cannot only deliver financial returns, but also play a positive role in carbon reduction and low-carbon transition.

While ESG investments have been effective in driving the low-carbon transition, there are still some challenges, particularly lack of standardization, transparency issues and green washing. These problems lead to the lack of consistency in information disclosure, which increases the difficulty of investors' decision-making. To address these challenges, the future should promote the establishment of a unified international ESG standard to ensure that the indicators of carbon emissions accounting and green investment are consistent and flexible according to the characteristics of countries and industries. The introduction of technologies such as blockchain can improve data transparency and prevent information tampering, while promoting third-party auditing systems to improve the reliability of ESG disclosures. In addition, the establishment of a reward and punishment mechanism, through the reward and punishment measures to guide enterprises to truly fulfill their low-carbon responsibilities, can not only strengthen the motivation of enterprises to low-carbon transformation, but also provide an effective guarantee for the global realization of carbon neutrality.

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