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Pathways and Reflections on ESG and Carbon Neutral Realization

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Abstract: With the acceleration of industrialization, the massive use of fossil fuels has led to a sharp increase in the emission of greenhouse gases (GHGs) such as carbon dioxide, triggering a series of environmental problems such as rising global temperatures, the frequency of extreme weather events and the degradation of ecosystems, which have had far-reaching impacts on the health of human societies, economic development, and natural ecosystems. To cope with this global problem, the international community has been actively seeking solutions. The 1997 Kyoto Protocol and the 2015 Paris Agreement have made clear the international commitment to reduce greenhouse gas emissions and emphasized the importance of controlling the rise in global average temperature. Carbon neutrality has become one of the key strategies to achieve the goals of these agreements, meaning reaching a net-zero goal for carbon emissions through emissions reduction and carbon offset activities. ESG (Environmental, Social, and Governance) practices reflect the social responsibility of corporations and governments, and by integrating ESG principles, all parties can reduce their carbon footprints more efficiently, improve resource efficiency, and achieve sustainable development. This paper will explore the intersection of ESG and carbon-neutral strategies, analyze the effectiveness of their implementation in different subjects, and put forward specific recommendations for achieving the global carbon-neutral goal.

Keywords: ESG; carbon neutrality; pathway

Introduction

Carbon neutrality refers to a state in which the total CO_2 emissions from the activities of an enterprise, organization, or individual are balanced by the amount of CO_2 absorbed or reduced by planting new forests or using other methods to capture or offset an equivalent amount of CO_2 emissions. Carbon neutrality typically involves calculating an entity's carbon footprint, implementing emission reduction strategies, and neutralizing remaining emissions by supporting carbon offset projects such as forest conservation, reforestation, renewable energy development, and carbon capture technologies. Achieving carbon neutrality is an effective means of combating global climate change and reducing global greenhouse gas concentrations. As the international community's concern over climate change intensifies, carbon neutrality has become an important strategy for many countries and enterprises to achieve long-term environmental sustainability goals. With increased public awareness of environmental protection and the rise of green consumption trends, companies have also begun to adopt carbon neutrality as part of their sustainability strategies to enhance brand image, meet consumer expectations, and reduce operational risks. As a result, carbon neutrality is not only a governmental act but is also becoming one of the ways for companies to participate in global climate action.

1. Types of Carbon Markets

In recent years, against the backdrop of increasing attention to the topic of global climate change, the global carbon market has developed rapidly, with more and more countries and regions participating in the carbon market. However, issues such as inter-market linkage and integration, price

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volatility, and ensuring the actual effects of emission reduction projects remain challenges to the development of carbon markets. The international community is committed to optimizing the structure and efficiency of the carbon market through policy coordination and technological innovation, to reach the long-term goal of global carbon emission reduction.

1.1. Mandatory carbon market

Mandatory carbon markets, also known as compliance markets, are set up by governments or international organizations through laws and regulations, to forcibly restrict carbon emissions in specific industries or regions. The European Union Emissions Trading System (EU ETS) is the largest and most mature mandatory carbon market, which has been in operation since 2005, covering about 40% of carbon emissions within the European Union, including the energy industry, manufacturing industry, and aviation industry, etc. (Zhao et al., 2023). China is also actively promoting the development of the carbon market, which will be launched in 2021, initially covering only the electric power industry, and is planned to be expanded to more industries in the future, through the mechanism of "carbon allowance trading", i.e., the government sets a cap on the total amount of emissions and allocates or sells emission allowances to polluting enterprises, which can then buy and sell these allowances to meet their needs. Enterprises can buy and sell these allowances in the market to meet their own needs.

1.2. Voluntary carbon market

The voluntary carbon market is mainly participated by enterprises or individuals who voluntarily purchase carbon credits to offset their carbon emissions or to achieve their carbon neutrality targets. Compared to the mandatory carbon market, the voluntary market is more flexible in that participants are free to choose the amount and type of carbon credits they want to purchase based on their carbon reduction plans, with credits coming from sources such as forest preservation, renewable energy projects, and even marine and wetland protection projects. The key challenge in the voluntary market is to ensure the quality of the projects and the effectiveness of the emission reductions (Gong, 2023), so third-party certifications and standards, such as the Gold Seal and the Clean Development Mechanism (CDM), can increase market transparency and trust.

2. The Three Core Components of ESG

2.1. Environment

Environment is a company's behavior and responsibility in mitigating environmental impacts, which mainly includes the management of greenhouse gas emissions, efficient use and recycling of resources, as well as ecological protection and maintenance of biodiversity. Greenhouse gas emission control is an important indicator of corporate environmental responsibility, and to reduce greenhouse gas emissions, clean energy can be used, energy use efficiency can be improved, and carbon capture and storage technology can be implemented (An et al., 2022). The efficiency of resource use and recycling capacity reflects the role of enterprises in supporting the circular economy, and strategies such as optimizing production processes, enhancing the recyclability of product design, and promoting waste separation and recycling can be used to reduce reliance on natural resources, as well as to reduce environmental pollution, and to promote the transition of economic activities to a more sustainable direction against the backdrop of increasing global resource pressures. Ecological protection and biodiversity maintenance is another key area for assessing corporate environmental responsibility. Businesses should take steps to minimize damage to natural ecosystems from their operations, protect critical habitats, implement environmental impact assessments, and participate in local and global ecological conservation projects to safeguard the continued provision of ecosystem services.

2.2. Society

The "Social" dimension of the ESG refers to the company's performance and commitment to safeguarding the rights and interests of its employees, fostering community development, and ensuring the social responsibility of its supply chain. In terms of employee relations and welfare, enterprises should establish a fair and inclusive work environment, implement comprehensive employee development programs, and provide competitive welfare policies, which help to enhance employee satisfaction and the

sustainability of human resources, implement flexible work systems, and provide vocational training and health protection measures to enhance the loyalty and productivity of internal talent (An et al., 2022). Community involvement and fair treatment are important indicators of CSR. Enterprises should actively participate in community building by promoting education, supporting local development programs, or participating in activities such as disaster response and recovery, as a way to enhance the relationship between the enterprise and the local community, respect the local culture and social norms, and build up corporate social capital. Supply chain social responsibility requires companies to go beyond direct operations and extend their social responsibility practices downstream to ensure that their supply chain partners also comply with appropriate social and ethical standards, monitor the labor conditions of their supply chain partners to ensure that there is no child labor or forced labor, and promote environmentally friendly and socially fair procurement policies so that companies can reduce operational risks, enhance brand reputation, and also promote the concept of social responsibility in the global supply chain. global supply chain to promote the concept of social responsibility.

2.3. Governance

The "Governance" dimension focuses on the management structure, transparency, compliance, and handling of shareholder rights and corporate responsibilities. A good corporate governance structure should ensure transparency in the decision-making process, which enhances corporate responsibility and the trust of investors and other stakeholders (Shi et al., 2021). In terms of anti-corruption and compliance, firms must comply with national and international laws and regulations, implement effective internal control systems and compliance procedures to monitor and mitigate potential financial and operational risks, set up compliance departments, conduct regular compliance training and audits, and firms can prevent misconduct and maintain the legality and legitimacy of their operations. In addition, ensuring that shareholders' rights are protected and corporate responsibilities are clearly defined is a key aspect of governance. Enterprises should ensure that the rights of all shareholders, especially minority shareholders, are respected and protected by building an inclusive shareholder meeting and decision-making structure, taking responsibility for the environment, employees, and society, and establishing a Corporate Social Responsibility (CSR) committee or a similar body to oversee and implement social responsibility activities (Song, 2021).

3. Carbon Neutral Goals and Strategies

3.1. Target setting

The implementation of carbon neutrality requires companies and government agencies to set science-based reduction targets to ensure that their emission reduction efforts are in line with the need to control global temperatures between 1.5°C and 2°C. Emission reduction targets can be divided into two types: short-term and long-term. Short-term carbon neutrality targets are to implement rapid emission reductions over 5 to 10 years, such as improving energy efficiency, shifting to the use of renewable energy sources, and optimizing the use of resources in operations (Zhan, 2021). The short-term carbon neutrality goal is to rapidly implement emission reductions within 5 to 10 years, such as improving energy efficiency, switching to renewable energy, and optimizing the use of resources in the operation process, so that enterprises can gradually adapt to the low-carbon economy (Zhan, 2021). Long-term carbon neutrality targets are set for more than 10 years, usually aiming for carbon neutrality or negative emissions by 2050, and require more far-reaching strategic planning, investment in research and development of new technologies, modification or restructuring of production and supply chain systems, and broader transformation of industries and markets. business models. Science-based emission reduction targets emphasize quantification and specific pathway settings and require companies to collect and analyze a large amount of data, assess the actual impact of their business activities on the climate, and develop a practical and feasible emission reduction road map.

3.2. Emission reduction strategies

Energy efficiency improvement is a direct way to reduce energy consumption and related GHG emissions, upgrading the energy efficiency of buildings, production equipment, and transportation

tools, adopting high-efficiency equipment and technologies, and implementing energy-saving measures, such as intelligent temperature control systems and LED lighting, etc. Afterward, shifting to the use of renewable energy sources, shifting from traditional fossil fuels to large-scale application of renewable energy sources, such as wind, solar, and water, and establishing or purchasing renewable energy systems to reduce their carbon footprint, while supporting the development of the renewable energy industry and technological innovation.

4. Direct Impact of ESG Strategies on Carbon Neutrality

4.1. Enhancing social awareness and education

Enterprises can enhance the environmental awareness of employees and the public by organizing seminars, launching publicity campaigns, and posting educational content on social media and company websites, which raises the visibility of climate change issues and inspires more individuals and organizations to take practical actions to form a broad social support network, which has a positive impact on promoting policy change and environmental practices (Shen & Li, 2022).

4.2. Improving the decision-making process

Improving corporate decision-making processes to ensure that environmental factors are prioritized in decision-making is key to driving carbon neutrality and sustained sustainable development, integrating environmental responsibility into their core business strategy, establishing or enhancing cross-functional sustainability committees responsible for integrating environmental risks and opportunities into the corporate risk management framework prioritizing carbon reduction and environmental protection objectives in strategic planning, capital investment decisions, and day-to-day operations management. Enterprises should also introduce environmental performance indicators into the performance evaluation of senior management, directly linking environmental responsibility to management and employee incentives, which promotes a sense of environmental responsibility among all employees (Mou & Li, 2022).

4.3. Enhance transparency and accountability

Enterprises should implement high standards of transparency in their operations and reporting processes to ensure that all stakeholders-including investors, customers, and regulators have a clear understanding of the environmental impacts of the enterprise, establish a comprehensive environmental information disclosure system, and regularly release detailed carbon emissions data, the implementation of environmental protection measures, and future This builds public trust and promotes proper pricing and investment decisions in the marketplace so that companies' efforts in environmental performance are fairly evaluated. In addition, the implementation of strict compliance practices ensures that companies continue to reduce environmental risks, comply with domestic and international environmental regulations, implement environmental management system standards such as ISO 14001, as well as conduct regular environmental risk audits to identify and manage potential environmental risks, respond quickly in the event of environmental problems, mitigate possible negative impacts, and enhance their brand value and market competitiveness.

5. The Role of Government and Supervisory Authorities in the Path to Carbon Neutrality of ESG

5.1. Policy formulation

The government formulates strong environmental regulations, such as emission standards and pollution control regulations, which directly affect carbon emissions from industrial activities, mandates the adoption of clean technologies by enterprises, promotes the development and application of green technologies and low-carbon solutions, and provides tax incentives and financial subsidies to incentivize enterprises and individuals to invest in carbon-neutral technologies and projects, which reduces the economic burden of enterprises and individuals, and also accelerates the low-carbon economic transformation process, and thus can guide and adjust the economic structure and promote the transformation towards low-carbon and environmentally sustainable development (Li et al., 2024), and can also strengthen the public's and enterprises' awareness of and commitment to their environmental responsibilities through regulations and economic means, and build a carbon emission

reduction and environmental protection system with the participation of the whole society.

5.2. Regulatory framework

The government and regulatory authorities have formulated strict ESG disclosure rules, established and maintained a comprehensive regulatory framework, regularly monitored and assessed the progress of carbon neutrality of enterprises and other entities, used advanced technologies such as satellite monitoring and environmental data analysis, as well as verified the accuracy and completeness of the disclosed information through the third-party auditing and reporting mechanism, which has enhanced the transparency and credibility of the implementation of carbon neutrality targets, and also strengthened the accountability of enterprises for their accountability for environmental behavior, promoting a fair and efficient market environment, and motivating all economic actors to take positive action to combat climate change, promoting the transition of the entire society to low-carbon and the achievement of long-term environmentally sustainable development goals (Tang & Jin, 2023).

5.3. Public investment

Government investment in green infrastructure, such as renewable energy power generation (wind, solar, etc.), high-efficiency public transportation systems, and energy-efficient buildings, can reduce overall carbon emissions, as well as promote the green transformation of the economy, help create new employment opportunities, and also reduce energy costs and enhance national energy security. In addition, the government's financial support for the research and development of low-carbon technologies is key to promoting scientific and technological innovation and sustained development, funding basic scientific research projects at universities and research institutions, supporting enterprises to develop new energy-saving and emission-reduction technologies, and incentivizing innovation accelerating the commercialization and popularization of low-carbon solutions through tax incentives and direct funding, increasing social acceptance of new technologies and application efficiency, and improving society's sense of environmental responsibility and sustainable development capacity, while also providing the private sector with an exemplary role and market confidence, promoting universal participation and multifaceted cooperation, promoting the country's transition to a low-carbon economy, and realizing the win-win goal of environmental protection and economic development.

6. The Role of Financial Institutions in the Path to Carbon Neutrality of ESG

6.1. Financial support

Financial institutions can provide enterprises with financial products such as green bonds and green loans to finance low-carbon projects and environmental protection innovations, which promotes the development of a green economy, allows enterprises and governments to raise funds to invest in renewable energy projects, energy efficiency improvement measures, pollution reduction technologies, and other sustainable development projects, enables projects to obtain the necessary initial investment, reduces the risks and costs of traditional financing channels, and enhances the economic feasibility and attractiveness of the projects. In addition to this, financial institutions have developed financial products related to carbon credits, such as carbon credit trading and carbon offset projects, whereby enterprises purchase carbon credits to offset their carbon emissions or achieve carbon neutrality by investing in carbon emission reduction projects in other regions and industries, which provides funding for low-carbon technologies (Shi & Gong, 2021), creates new market opportunities for carbon emission reduction, and incentivizes more enterprises to participate in global carbon emission reduction efforts, and it accelerates the development of environmentally sustainable projects and also provides important financial support and market momentum for global climate action.

6.2. Risk management

In managing climate change-related financial risks, financial institutions have incorporated environmental, social, and governance (ESG) factors into the credit and investment decision-making process, assessed ESG indicators in investment projects and loan applications, identified high-risk investments that may hurt the environment, and avoided potential financial losses and reputational risks. Stress testing, climate sensitivity analysis, and

long-term climate risk assessment models, assessing the impact of physical risks (e.g., increase in natural disasters) and transition risks (e.g., changes in carbon pricing policies) that may be triggered by climate change on the value of the assets (Lv et al., 2021), to protect itself from the possible negative impacts of climate change in the future, and also to promote the economic transition to a low-carbon and more environmentally friendly direction globally, and to establish a more robust risk management framework for itself and provides valuable risk assessment knowledge and tools for other industries and market participants to jointly address the challenges posed by climate change.

Conclusion

In summary, ESG strategies have far-reaching implications for achieving carbon neutrality goals. Governments need to continue to develop and implement legal frameworks and policies that support ESG and carbon neutrality, financial institutions should promote low-carbon projects by providing financial support and risk management tools, and corporations must integrate ESG principles into their operations and culture to ensure the sustainability of their business activities. It is only through such multi-party collaboration and joint efforts that we can move towards reducing global greenhouse gas emissions and achieving carbon neutrality by 2030, innovate low-carbon technologies, and raise public awareness of the importance of climate change and carbon neutrality to build a sustainable future together.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

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