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Financial Accounting and Information Disclosure of Corporate Green Development from a Carbon Accounting Perspective

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Abstract: From a carbon accounting perspective, the financial accounting of corporate green development focuses on carbon emission trading, carbon footprint tracking, and cost–benefit analysis of emission reduction. Data quantification is achieved through tools such as the emission factor method and the mass balance method. Information disclosure relies on international standards (such as GRI and TCFD) and is implemented through independent sustainability reports, integration into annual reports, and digital platforms, providing comprehensive disclosure of carbon emissions, emission reduction costs, and carbon trading data. These practices help enterprises optimize carbon management, meet regulatory requirements, and enhance market competitiveness and investor confidence.

Keywords: Carbon accounting perspective; corporate green development; financial accounting; information disclosure

Introduction

Driven by global "dual carbon" goals, corporate green development has become an inevitable pathway for addressing climate change. Carbon accounting, as a bridge connecting environmental responsibility and economic benefits, provides critical decision-making support for corporate low-carbon transformation by quantifying the financial impacts of carbon emission activities. However, challenges such as inconsistent carbon accounting standards, high costs of data acquisition, and insufficient incentives for information disclosure currently constrain the transparency and sustainability of corporate green development. Based on the theoretical framework of carbon accounting, this paper systematically explores financial accounting methods and information disclosure mechanisms, offering practical references for enterprises to achieve coordinated management of environmental and economic benefits.

1. Theoretical Foundations of Carbon Accounting and the Financial Accounting Framework

1.1 Connotation and Extension of Carbon Accounting

(1) Definition:

Carbon accounting is an interdisciplinary field

integrating environmental science, accounting, and management science. Its core lies in quantifying the financial impacts and environmental benefits generated by carbon emission activities in the process of corporate production and operation through specific accounting methods and procedures, thereby providing accurate accounting information support for corporate carbon emission management and stakeholder decision-making. In essence, carbon accounting transforms environmental responsibilities related to carbon emissions into measurable and reportable accounting elements, enabling the coordinated management of environmental benefits and economic benefits.

(2) Extension:

The application scope of carbon accounting is extensive and mainly encompasses three core areas. First, carbon emission allowance trading accounting, which includes the full accounting process of recognition, measurement, subsequent measurement, and disposal of carbon emission allowances. Second, carbon footprint management accounting, which focuses on tracking and quantifying carbon emissions throughout the entire life cycle of corporate products, from raw material procurement, production and processing, and logistics and transportation to final consumption and end-of-life disposal. Third, cost–benefit analysis of carbon emission reduction measures, which involves comprehensive accounting and evaluation of investment costs, energy-saving benefits, and carbon reduction effects of corporate energy conservation and emission reduction projects, providing data support for the optimization of emission reduction schemes.

1.2 Core Principles of Financial Accounting

(1) Comprehensiveness:

Carbon accounting should comprehensively cover all stages of corporate carbon emissions. This includes not only direct emissions, such as carbon emissions generated from fuel combustion during production processes and industrial manufacturing activities, but also indirect emissions, particularly those arising from upstream and downstream supply chain activities, such as raw material production, purchased energy consumption, and product transportation. This ensures that the accounting scope is complete and presents a holistic picture of corporate carbon emissions.

(2) Accuracy:

The principle of accuracy requires that the quantification of carbon emission data be based on scientifically sound and authoritative methods and standards. In practice, lifecycle assessment (LCA) methods should be applied to map the entire carbon emission chain, while international standards such as ISO 14064 should be strictly followed to regulate data collection and calculation procedures. This ensures that accounting data are truthful and reliable, avoiding distortions caused by improper methodologies or inconsistent standards.

(3) Comparability:

To enable comparisons of carbon emission data across enterprises and industries, carbon accounting must adhere to the principle of comparability. Enterprises should unify accounting boundaries and clearly define the scope and criteria of carbon emission statistics. At the same time, industry-recognized emission factors and accounting methods should be adopted to ensure horizontal and longitudinal comparability of carbon emission data across different entities and periods, thereby providing reference support for industry-level carbon management and policy formulation [1].

(4) Timeliness:

Carbon emission data are characterized by dynamic changes. The principle of timeliness requires enterprises to establish routine mechanisms for tracking and updating carbon emission data, enabling real-time collection of carbon emission information across all stages of production and operation. This allows enterprises to promptly reflect trends in carbon emissions and the effectiveness of emission reduction measures, facilitates timely adjustments to emission reduction strategies, and meets the real-time information needs of regulators, investors, and other stakeholders.

1.3 Accounting Methods and Tools

(1) Emission Factor Method:

As the most commonly used accounting approach, the emission factor method calculates carbon emissions by multiplying activity data by corresponding emission factors, that is, total carbon emissions = activity data (such as electricity consumption or fuel consumption) × emission factors. This method is easy to operate

and involves relatively low data acquisition costs, making it suitable for the rapid calculation of routine corporate carbon emissions. It is widely applied to the quantification of conventional emission sources such as energy consumption and fuel combustion.

(2) Mass Balance Method:

Based on the principle of material conservation, the mass balance method determines carbon emissions in specific production processes by calculating the difference in carbon content between raw materials and final products. This method offers relatively high accuracy and is particularly suitable for industrial production scenarios in which the carbon content of inputs and outputs is clearly defined. It effectively compensates for the limitations of the emission factor method in accounting for carbon emissions in certain production processes.

(3) Carbon Footprint Certification:

As a third-party accounting tool, carbon footprint certification involves independent verification and certification of carbon emissions throughout the entire life cycle of corporate products by professional third-party institutions in accordance with international standards. Its core value lies in enhancing the credibility of carbon emission data, providing authoritative support for low-carbon product certification and market competitiveness, while also helping enterprises identify emission reduction potential across the entire value chain and optimize supply chain carbon management.

2. Information Disclosure Mechanisms for Corporate Green Development from a Carbon Accounting Perspective

2.1 Theoretical Basis of Information Disclosure

(1) Information Asymmetry Theory:

In the context of carbon accounting, enterprises, as the primary actors of carbon emission activities, possess comprehensive information on carbon emissions and emission reduction costs, whereas stakeholders such as investors and consumers often lack full access to such information, resulting in information asymmetry. Through standardized disclosure of carbon accounting information, information disclosure mechanisms can effectively bridge this gap, reduce stakeholders'decision-making uncertainty, lower investment risks and market inefficiencies caused by information asymmetry, and promote the rational allocation of market resources toward low-carbon enterprises.

(2) Stakeholder Theory:

Corporate green development depends on the support and supervision of diverse stakeholders. Investors focus on the impact of carbon emissions on long-term corporate profitability, consumers emphasize the low-carbon attributes of products, and regulatory authorities rely on carbon information to enforce environmental regulations. Based on this theory, enterprises can meet the ESG data needs of different stakeholders more precisely through the disclosure of carbon accounting information, establish constructive interaction mechanisms, and enhance stakeholders'recognition of and trust in corporate green development [2].

(3) Corporate Social Responsibility Theory:

Environmental responsibility constitutes a core component of corporate social responsibility. Under the background of the “dual carbon” goals, enterprises bear increasingly prominent responsibilities for emission reduction and decarbonization. Carbon accounting information disclosure serves as an important vehicle for fulfilling environmental responsibilities. By systematically disclosing carbon reduction targets, implementation processes, and outcomes, enterprises can convey their proactive commitment to green development, demonstrate social accountability, and help build a low-carbon corporate image.

2.2 Disclosure Content and Framework

(1) Quantitative Information:

As the core component of carbon accounting information disclosure, quantitative information should be based on accurate carbon accounting data and mainly includes four categories. First, core carbon emission data, such as total carbon emissions, carbon emission intensity per unit of output, and detailed data on direct and indirect emissions. Second, emission reduction cost data, referring to capital investments in energy-saving retrofits, clean energy substitution, and other emission reduction measures. Third, carbon trading data, including the quantity of carbon emission allowances held, transaction prices, and gains or losses from carbon trading. Fourth, emission reduction performance data, such as the achievement of annual emission reduction targets and cumulative emission reductions.

(2) Qualitative Information:

Complementing quantitative information, qualitative information focuses on corporate carbon management strategies and planning. This includes medium- and long-term carbon reduction strategic objectives and phased implementation plans; the selection of emission reduction technology pathways, such as the application of new energy technologies and optimization of production processes; policy response mechanisms, namely measures adopted by enterprises to align with national carbon peaking and carbon neutrality policies and industry environmental standards; and risk management mechanisms addressing risks such as extreme climate events and carbon price fluctuations.

(3) Reference to International Standards:

To enhance the standardization and comparability of information disclosure, enterprises should draw on authoritative international standards to construct disclosure frameworks. The GRI Sustainability Reporting Guidelines provide a general framework for carbon information disclosure, clarifying disclosure scope, content boundaries, and reporting norms. The TCFD climate-related disclosure framework focuses on climate-related risks and opportunities and guides enterprises in disclosing the impacts of carbon reduction activities on financial position and operating performance. The combined application of these standards facilitates standardized and professional disclosure of carbon accounting information.

2.3 Disclosure Forms and Channels

(1) Independent Reports:

Publishing dedicated *Carbon Footprint Reports* or *ESG Reports* has become the mainstream form of disclosure. Such reports focus specifically on carbon accounting–related information by systematically organizing carbon emission data, emission reduction measures, performance outcomes, and future plans. This enables centralized and professional presentation of information, facilitates stakeholders'rapid access to key data, and enhances the relevance and readability of disclosures.

(2) Integration into Annual Reports:

Enterprises may incorporate carbon accounting information into the notes to their annual financial reports by adding specific items such as “carbon emission allowance assets” and “carbon emission allowance liabilities.” This approach organically integrates carbon accounting information with traditional financial data. Leveraging the authority and wide dissemination of financial reports, it ensures timely disclosure of carbon information and allows investors to comprehensively assess corporate green development capabilities in conjunction with financial performance.

(3) Digital Platforms:

By leveraging blockchain technology, enterprises can establish digital platforms for carbon information disclosure that enable real-time traceability, tamper resistance, and online verification of carbon emission data. This channel enhances the credibility and timeliness of carbon information. Stakeholders can access dynamic carbon emission data in real time through the platform, while regulatory authorities can employ technological tools for precise supervision, thereby further strengthening disclosure transparency and regulatory effectiveness [3].

3. Challenges and Countermeasures for Corporate Green Development from a Carbon Accounting Perspective

3.1 Existing Challenges

(1) Lack of Unified Accounting Standards:

At present, carbon accounting lacks unified national and industry-wide standards. Significant variations exist in emission factors adopted across different industries and regions, and some sub-sectors even lack clearly defined emission factor references. This results in inconsistent accounting bases for corporate carbon emission data, distorted cross-industry and cross-regional comparisons, and an inability to accurately reflect enterprises'actual emission reduction performance, thereby constraining the orderly operation of carbon markets.

(2) High Data Acquisition Costs:

Carbon accounting requires coverage of the entire production chain and the establishment of comprehensive carbon emission monitoring systems. However, small and medium-sized enterprises are constrained by limited financial resources, technological capabilities, and professional talent, making it difficult for them to bear the costs of monitoring equipment procurement and personnel training. As a result, they are often unable to accurately collect carbon

emission data across production stages, causing carbon accounting practices to become superficial and limiting their practical effectiveness.

(3) Insufficient Incentives for Disclosure:

Implementing carbon accounting information disclosure entails additional investments in labor and resources for data organization and report preparation, increasing short-term operational costs. Meanwhile, long-term benefits such as brand enhancement and improved financing access derived from emission reduction and information disclosure are uncertain. This imbalance between "short-term costs and long-term benefits" significantly weakens enterprises'motivation to proactively disclose carbon accounting information.

(4) Weak Policy Coordination:

Currently, policies related to carbon market trading, carbon taxation, and green financial support are regulated by different authorities, with insufficient coordination mechanisms among them. For example, the allocation of carbon allowances is inadequately aligned with green credit policies, and carbon tax implementation has not effectively complemented emission reduction outcomes in carbon markets. As a result, policy effectiveness is substantially diminished, making it difficult to form a synergistic force to promote corporate green development.

3.2 Optimization Strategies

(1) Establishing a Unified Data Platform:

Led by the government, public data resources from environmental protection, energy, taxation, and other relevant departments should be integrated to build a nationally unified carbon accounting data-sharing platform. The platform would centrally release industry-specific emission factors and accounting standards, and provide one-stop services for data collection, accounting, and analysis. This would significantly reduce enterprises'data acquisition and accounting costs while ensuring consistency in data definitions and accounting calibers.

(2) Improving Incentive Mechanisms:

Differentiated incentive policies should be established. Enterprises that proactively disclose carbon information and achieve significant emission reduction results may be granted preferential measures such as tax reductions and additional rewards for excess carbon allowances. Moreover, the quality of corporate carbon information disclosure should be linked to green credit access and government subsidies, thereby enhancing enterprises'perception of short-term benefits from green development and stimulating their willingness to actively participate in carbon management.

(3) Strengthening Third-Party Certification:

Efforts should be accelerated to cultivate professional carbon auditing and certification institutions, with clear qualification requirements and service standards. A carbon information disclosure quality rating system should be established, under which third-party institutions verify and rate the authenticity and completeness of disclosed data. The rating results should be publicly disclosed to enhance the credibility of carbon accounting information and compel enterprises to standardize their disclosure practices [4].

(4) Promoting International Mutual Recognition:

Active participation in the formulation and revision of international carbon accounting standards, such as those issued by ISO, should be encouraged to align China's carbon accounting standards with international norms. A mutual recognition mechanism for domestic and international carbon information disclosure standards should be established to reduce carbon compliance costs for Chinese enterprises engaged in cross-border operations and enhance their competitiveness in the global green supply chain.

Conclusion

As an important tool for corporate green transformation, carbon accounting supports enterprises in balancing environmental and economic benefits through the accurate accounting of carbon emission costs and systematic disclosure of carbon management information, while also contributing to the improvement of low-carbon market mechanisms. In response to challenges such as inconsistent accounting standards and high data costs, coordinated efforts among government, enterprises, and society are required to establish unified data platforms, improve incentive mechanisms, and strengthen third-party certification. Only through such collaborative actions can the endogenous momentum of corporate green development be fully stimulated and China's wisdom and practical solutions be contributed to global climate governance.

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