

Innovation and Challenges in Carbon Accounting

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Abstract: Carbon accounting provides technical support for establishing a unified national carbon emission trading market. Carbon accounting is a pivotal economic management tool for China's carbon peaking and carbon neutrality goals. Enterprises implement carbon accounting systems and management practices to control carbon emissions while balancing economic interests, ecological rights, and public welfare. China should refine existing laws and regulations, and enhance regulatory mechanisms for carbon accounting to advance this initiative. China should promptly establish carbon accounting standards compatible with carbon trading systems. Additionally, China should cultivate high-caliber interdisciplinary carbon accounting professionals and actively participate in international standard-setting processes. It will significantly boost China's global influence and voice in carbon accounting.

1. Introduction

The Chinese government has made a pivotal strategic decision to achieve carbon peaking and carbon neutrality. This strategic decision addresses critical resource and environmental constraints while ensuring sustainable development for the Chinese nation. Carbon peaking and carbon neutrality embodying China's solemn commitment to building a global community with a shared future. Accounting practices should comprehensively measure corporate resource inputs and consumption to achieve the carbon peaking and carbon neutrality goals. Carbon accounting facilitates effective resource allocation and equitable benefit distribution, while actively engaging in global environmental and climate governance efforts [1]. A policy tool of carbon emission trading has gained increasing adoption across nations and regions with the development of low-carbon economies. It is a policy utilizing market mechanisms to curb greenhouse gas emissions. Carbon emission rights of enterprises become a vital production factor in business operations. Carbon accounting practices are inevitably introduced to corporate accounting systems.

2. Innovative Accounting under the Carbon Peaking and Carbon Neutrality Goals

2.1. Financial Accounting

2.1.1. Carbon Accounting

Carbon accounting constitutes a vital component of corporate financial reporting at the micro level. It encompasses the recognition and measurement of carbon emission rights, carbon costs, carbon benefits, and carbon liability. The outcomes of carbon accounting provide strategic foundations for enterprises to formulate future carbon asset management objectives. Carbon accounting also supplies critical data for establishing stable national carbon trading markets and supports the development of climate policies and legal frameworks [2]. Enterprises must effectively manage carbon costs, budgets, and trading activities as they are primary emitters of carbon dioxide. Enterprises can dynamically adjust their strategic development goals and make informed operational decisions by leveraging carbon accounting. Carbon accounting laying the groundwork for achieving low-carbon transformation to ensures alignment between corporate growth objectives

and societal development priorities.

2.1.2. Carbon Disclosure

Enterprises has the responsibility to disclose effective carbon information as they are primary implementers to achieve carbon peaking and carbon neutrality goals. Carbon disclosure includes emission volumes, carbon intensity, carbon finance operations, emission reduction measures, and their effectiveness. Carbon disclosure primarily focuses on assets information related to carbon emission. The recognition and measurement of carbon assets differ from traditional accounting practices. Carbon disclosure process encompasses both financial and non-financial carbon accounting information. Nowadays, carbon disclosure reports include corporate development strategies, carbon asset management plans, and analyses of carbon asset risks and opportunities. Carbon disclosure provides a foundation for the stable operation of carbon trading markets. It serves as a crucial bridge connecting governments, businesses, and the public in addressing climate change challenges.

2.2. Management Accounting

2.2.1. Carbon Cost Accounting

Carbon cost is generated by the carbon emissions of enterprise during its production and operational activities. Enterprises acquire carbon assets by purchasing carbon emission allowances on the market and form their carbon costs. Enterprises must purchase additional allowances when they exceed emission quotas. Those below standards can sell surplus allowances to other enterprises. Carbon cost accounting is the corporate-level control to mitigate carbon emission. Comparative analysis and trend analysis of carbon emission costs help identify key areas for emission reduction strategies. Enterprises should adopt product life-cycle theory in managing carbon costs, prioritize proactive control measures, and avoid environmental costs arising from reactive measures. Enterprises should adopt effective carbon cost management measures during production. For example, they can select non-toxic low-carbon materials, adopt eco-friendly processing equipment, and minimizing resource waste in packaging.

2.2.2. Carbon Asset Management

Carbon asset management is a comprehensive set of corporate activities around carbon assets. It encompasses planning, utilization, and innovation of carbon assets. Enterprises can unlock greater value and benefits from implementing effective carbon asset management strategies. Corporate carbon asset management should be conducted in a timely manner based on their development needs. These management practices includes conduct carbon inventories, establish carbon budgets, disclose carbon-related information, and perform carbon monitoring. It provides a solid foundation for informed decision-making and enables businesses to optimize carbon resource allocation, enhance operational efficiency, and mitigate carbon trading risks.

3. Challenges in Accounting under the Dual Carbon Goals

3.1. Inadequate Carbon Accounting Standards

Carbon assets of a enterprise refer to carbon emission rights and other forms of energy conservation resources. These assets are formed through daily operations, controlled or owned by the company, and expected to generate economic benefits. Carbon assets include carbon emission rights and emission reduction credits specifically. Carbon emission rights are not assets before they can meet the recognition and measurement standards of current accounting standards. They can be reflected in financial statements only after fulfilling all requirements [3]. Enterprises need to further clarify the value of carbon emission rights and quantify measure them under the carbon trading system. It poses challenges to traditional accounting methods. Many issues persist in corporate accounting processes due to the lack of comprehensive accounting standards for carbon emission trading. The Ministry of Finance issued the "Interim Provisions on Accounting Treatment for

Carbon Emission Trading" in 2019 to standardize accounting treatment for carbon emission trading. It simplifies accounting procedures for key emission enterprises. However, it fails to effectively recognize and measure the essence of carbon emission rights in practice. It creates hidden risks for carbon market management. The lack penalties of current laws for carbon accounting violations, resulting in weak legal constraints and ineffective prevention of such misconduct.

3.2. Regulatory Mechanisms for Carbon Disclosure are insufficient

Carbon disclosure is the practice of enterprises publicly disclosing carbon emission information to external stakeholders of the public, government, and investors. The carbon emission information was disclosed through periodic reports and interim disclosures. Voluntary disclosure remains the predominant approach in China for most companies lacking mandatory requirements. Carbon disclosure significantly impacts corporate performance, value, and financing. But, current policy frameworks lack unified regulations and strict oversight mechanisms for disclosure formats and content. This resulting in slow progress in corporate low-carbon development. Carbon accounting implementation lacks regulatory oversight for it has not been incorporated into the Accounting Law. The Interim Provisions on Accounting Treatment for Carbon Emission Trading currently serves as an effective regulatory mechanism for carbon accounting. Though it faces challenges including weak internal supervision within organizations, insufficient coordination between social and governmental oversight, and fragmented regulatory efforts. Accounting personnel's supervisory functions are often compromised due to organizational management internally. The reliance on certified public accountants externally for audits proves problematic. As economic conflicts of interest between auditors and audited entities place accounting firms in a vulnerable position. Government oversight managed by the Ministry of Finance faces issues of overlapping jurisdictions and unclear accountability, significantly undermining regulatory effectiveness.

3.3. Multidisciplinary Carbon Accounting Professionals are Short

Carbon accounting is an emerging interdisciplinary field in accounting. It integrates accounting principles, environmental ecology, and sustainable development theories. The practical implementation of carbon accounting requires cross-disciplinary methodologies. While most Chinese professionals lack comprehensive knowledge and practical experience in carbon accounting. Enterprises have insufficient commitment to cultivating specialized talent in this area. Consequently, the field of carbon accounting lacks professional guidance and faces talent shortages. Carbon accounting professionals with interdisciplinary expertise and strong practical skills cannot meet the need of industry development. Currently, China's accounting education of universities and institutions lacks carbon accounting programs has impeded the development of high-end professionals [4]. Chief accountants lack channels to develop carbon accounting competencies lead to the slowing progress toward cultivating top-tier interdisciplinary talents.

3.4. The National Carbon Accounting Standards Needs to be Improved

3.4.1. China's Carbon Accounting Development Lags Behind International Standards

The international convergence of carbon accounting standards is imminent. China must deepen its international exchanges and cooperation in carbon accounting to adapt to the global low-carbon economic development. The global warming caused by greenhouse gas emissions makes the formulation and application of unified, high-quality global carbon accounting standards an urgent necessity. China is the world's second-largest economy and an emerging market economy. China needs to continuously enhance international exchanges and cooperation in carbon accounting to align with global trends and safeguard national interests. Thereby China has the responsibility to contribute to the establishment of unified, high-quality carbon accounting standards worldwide. China's economic interdependence with other nations has grown stronger and stronger. However, China's carbon accounting development lags behind economic growth. The low-quality disclosures and accounting methods lacking international recognition is the obstacle of China's low carbon economy.

3.4.2. China's Carbon Accounting Standards Lag Behind

Low carbon economic development need the establishing of high-quality carbon accounting standards. It serve as a crucial bridge between economic growth and environmental protection. Carbon accounting standards enables enterprises to identify green investment opportunities while enhancing the quality of carbon accounting information. However, China's carbon accounting standards lags behind its economic progress hindering its economic transformation. Moreover, China's incomplete carbon accounting framework weakens market supervision and compromises transparency in capital market operations. The climate change mitigation and prevention requires global collaboration as economic globalization intensifying. China must contribute to refining global low-carbon economic regulations and safeguarding ecological environments worldwide for it is a key emerging market participant. China struggles to exert meaningful international impact due to its insufficient institutional influence in carbon accounting. China should improve its global discourse power in carbon accounting standard-setting. This will safeguards China's interests and grasp its international cooperation and exchange opportunities [5].

4. Strategies and Recommendations

4.1. Strengthen Legal Frameworks for Carbon Accounting

High quality development of carbon accounting requires strategic planning at the policy level. The legal framework for carbon accounting should align with market economy principles to ensure compliance in corporate operations. It also should safeguard the legitimate rights of carbon market participants. China's carbon accounting legislation must be grounded in national realities and compatible with low-carbon development models. Specifically, China's Accounting Law and Certified Public Accountants Law should incorporate carbon accounting provisions. These laws should clarify the concept, scope, and application of carbon accounting. Also the accounting framework should define corporate and stakeholder responsibilities, and create robust legal mechanisms for addressing violations through penalties.

4.2. Standardize Carbon Accounting Disclosure Mechanism

The carbon disclosure mechanism can be standardized through disclosure entities, content, and methods dimensions. First, it is disclosure entities. China's "Carbon Emission Trading Management Measures" currently stipulates that key emission entities with annual greenhouse gas emissions reaching 26,000 tons of CO₂ equivalent must disclose carbon information. Listed companies only disclose carbon data after being held legally accountable for ecological violations. All key industries should be included as disclosure entities to better achieve the carbon peaking and carbon neutrality goals. Second, it is disclosure content. Carbon information should encompass both financial and non-financial data. Non-financial information typically includes textual descriptions of corporate low-carbon management practices and internal implementation of low-carbon regulations. Third, it is disclosure methods. Future disclosure methods should be based on carbon information characteristics. Carbon assets and revenues meeting recognition criteria should be disclosed in annual reports. Uncertain carbon resources, revenues, and other trading information may be consolidated in ESG reports. A dedicated carbon information section should be added to the environmental component of ESG reports for specialized disclosure.

4.3. Cultivate High-quality Interdisciplinary Carbon Accounting Professionals

Professionals in carbon accounting often work with businesses, governments, and non-profit organizations to develop strategies for reducing emissions and transitioning to cleaner energy sources. China's relevant regulatory authorities should establish and improve the mechanism for cultivating high-end talents in the carbon accounting industry. They should also improve the special professional competence assessment system for carbon accounting treatment. Government departments should improve the examination syllabus under the guidance of the competency framework for carbon accounting personnel, and promote its nationwide application. Higher

education institutions and enterprises should prioritize the cultivation of professional ethics for carbon accounting practitioners through standardized regulations. Education institutions bring together carbon accounting professionals who measure and report carbon emissions, which includes software companies, consultancies, auditors, in-house sustainability managers, standards bodies and independent professionals. Enterprises collaborate on solving challenges faced by their industry, share best practice and promote the development of robust standards. Government departments should establish a carbon accounting integrity registry system, enhancing accounting personnel information management systems through digital transformation. Fortunately, today, carbon accounting professionals have comprehensive sustainability software and management systems like Workiva Carbon to drastically simplify the process. A talent development strategy should be implemented through service-oriented development, talent prioritization, application-driven approaches, and high-level leadership in carbon accounting.

4.4. Actively Participate in the Formulation of International Carbon Accounting Standards

Climate change is a common challenge for all humanity, and one that demands widespread participation and collective action to address. China is now charting a new course for the development of international carbon accounting standards and actively participate in projects such as the conceptual framework and content disclosure of international carbon accounting standards. China has actively participated in the standard-setting bodies in a constructive manner and made historic contributions to the conclusion, signing, effecting and implementation of the revision and formulation of international standards, thereby enhancing the level of international technical exchanges and cooperation in carbon accounting and fully leveraging the role of China as a representative in the standard-setting bodies of international carbon accounting. The accounting industry should balance the relationship with international carbon accounting standards while maintaining China's unique characteristics, learning from international experiences while upholding and promoting its own distinctive features. The accounting industry should make full use of international exchange and cooperation mechanisms in carbon accounting to create an environment conducive to the development of China's carbon accounting standards and their alignment with international norms. As regulatory pressures and societal expectations intensify, measurement alone is no longer enough. Analytical carbon accounting is becoming an essential standard for effectively managing corporate decarbonization trajectories.

5. Conclusion

The development of accounting under the "dual carbon" goals faces both challenges and opportunities for innovation. We must adhere to the guiding principles of ecological civilization and fully implement the new development philosophy. Within this framework, accounting should fully leverage its measurement, value assessment, information disclosure, supervision, property rights protection, and management functions to provide foundational data, valuable references, and evaluation criteria for achieving the dual carbon objectives.

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