Research on Low Carbon Development of Enterprises Based on Carbon Managemen

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Abstract. The current atmospheric pollution and global warming have aroused widespread concern, and have become an urgent problem in the global economic and social development. As the world carbon trading market is becoming more and more mature, China's carbon trading is also booming. Under the framework of carbon trading, carbon emission right becomes a special commodity that can be traded, and also has financial and asset properties. The creation of carbon assets provides an important way to develop a low-carbon economy and promote sustainable economic development. The development of carbon asset management will also change the existing production mode and status of enterprises, and improve their low-carbon competitiveness. This paper describes the relevant theories of carbon economics, calculates the carbon emissions of enterprises, accounts for carbon quotas, describes the carbon management business process and the main costs, and also puts forward suggestions for the low-carbon development of enterprises, and briefly organizes the carbon emission work.

Keywords: carbon management, low carbon, carbon emissions, carbon accounting

1 INTRODUCTION

As we all know, climate change is a major challenge facing mankind nowadays. In order to cope with the challenge of climate change, in recent years, the state has introduced a series of regulations and policies to manage carbon emissions. Problems in the research and practice of carbon asset management need to be further solved, therefore, this paper attempts to further enrich the content of the carbon management framework from the theoretical aspect by introducing the basic process of carbon management, in order to increase the understanding of carbon asset management by enterprises and to provide theoretical support for carbon management by enterprises in the future.

At present, there are no systematic results on enterprise carbon management at home and abroad, and most of the existing studies focus on enterprise supply chain low-carbon management, enterprise product carbon footprint calculation, and enterprise carbon information disclosure. Dunn et al. [1] pointed out that different enter-

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prises in different industries have different implementation of carbon management strategies, and summarized five carbon management measures: improving energy efficiency, fuel conversion, application of new technologies, emission trading, and investment in carbon offset projects. Kolk et al. [2] divided enterprise carbon management measures into six aspects: process improvement, product improvement, new market/product mix, internal transfer of emission reduction, supply chain measures, and purchase of emission quotas. Schultz [3] et al. believe that in the process of carbon management transformation, enterprises need to carry out a series of reform measures, Weinhofer et al. [4] proposed a conceptual framework for enterprise carbon management measures based on enterprise carbon strategy, and divided enterprise carbon management measures into three types: carbon compensation, carbon reduction and carbon complete independence. Jones et al. [5] disclosed that many enterprises did not include the carbon emissions generated by the upstream and downstream of the supply chain in the enterprise emission report, Linton[6] et al. proposed to transfer the local optimization of environmental operation management to the entire supply chain from product production, consumption, customer service.Butner [7] et al. proposed to achieve the balance of carbon emissions of the entire supply chain by coordinating products, processes, information and funds. In addition, Australian scholar Ratnatunga [8] et al proposed that the information provided by the strategic cost management system should be applied to the assessment of the life cycle of products and services.

Domestic research on enterprise carbon management started late and has not yet formed a systematic research. The research on enterprise carbon management strategy mainly focuses on the low-carbon supply chain of enterprises and the carbon footprint measurement of enterprise products. For example, Bei Junqiu [9] established a carbon emission reduction model and integrated all factors in the supply chain to solve the carbon management, carbon energy consumption and other environmental problems of enterprises in the supply chain. Bao Lei [10] qualitatively analyzed the implementation of carbon factor, carbon process and carbon asset management in supply chain management.

2 Theories related to carbon economics

2.1 Carbon emissions accounting

At present, China has used two carbon quota methods, namely the baseline method and the historical intensity method. If the product attributes in the industry are basically the same, the benchmark method is used, which can calculate and statistics the carbon dioxide emissions of the products with the same attributes in the industry, and the benchmark can be set to a higher value.

Carbon emission calculation methods include emission factor method (also known as emission factor method), measurement method and mass balance method. The emission factor method is the first C02 emission accounting method highlighted in the guidelines published by the International Panel on Climate Change (IPCC) in 2006. Through the comparison of the above three accounting methods, the emission coeffi-

cient method is more widely used than the other two methods. China's statistical institutions and statistical yearbooks do not publish carbon emission data, combined with the National Bureau of Statistics website has published the relevant data to estimate the total carbon dioxide emissions of the power industry over the years (2000-2017), the specific calculation formula is as follows:

$$CO_2 = \sum_{i=1}^{8} CO_{2,i} = \sum_{i=1}^{8} E_i \times NCV_i \times CEF_i \times COF_i \times 44/22 \tag{1}$$

Where CO_2 represents the estimated carbon emissions, the unit is 10,000 tons; i = 1,2, ⋯8 represents energy type, and E represents energy consumption; NCV indicates the low average heating value. CEF stands for carbon emission coefficient; COF stands for carbon oxidation rate.

China is rich in coal resources, oil, natural gas is relatively scarce, such resource structure determines that China's electricity production mainly relies on coal. Globally, China has a higher share of thermal power generation than developed countries. Moreover, the electricity demand of the power industry, infrastructure expansion, and economic development speed are closely related to carbon emissions.

2.2 Carbon management performance evaluation model

Rough set theory, proposed by Polish mathematician Pavlak in 1982, is a mathematical method and tool for analyzing and processing uncertain information. It has the characteristics of expressing and processing incomplete information without prior knowledge, and is widely used in decision analysis, data mining and other fields.

Using rough set theory can determine the index weight, and has the advantages of not requiring prior knowledge, completely driven by the data itself, and mining information characteristics. There are two main methods to determine weights in rough set theory: algebraic view and information view. In algebraic view, the weight of conditional attribute of rough set is calculated based on the partition of conditional attribute set to the domain of discourse. This method can calculate the weight of the set that can be clearly divided into the domain of discourse, but for the set that can not be clearly divided, the weight will be zero. The main relevant definitions of the conditional entropy of rough sets are as follows:

Definition 1 $X = \{X1, X2, \ldots, Xn\}$ is a partition rule over the domain U, $p(X_i) = \dfrac{Card(X_i)}{Card(U)}$, Then the information entropy of X is:

$$H(X) = \sum_{i=1}^{n} ((p(X_i))(1 - p(X_i))) = 1 - \sum_{i=1}^{n} p^2(X_i) \tag{2}$$

Definition 2 Let $P = \{P1, P2, \ldots, Pn\}$ and $Q = \{Q1, Q2, \ldots, Qn\}$ are two partitions on the domain U, then the conditional information entropy of P under Q is:

$$H(P|Q)=\sum_{j=1}^{n} p(\mathrm{Q_i})\sum_{i=1}^{\mathrm{n}} p(P_i|Q_i)(1-p(P_i|Q_i)) \tag{3}$$

Definition 3 In a decision table information system, a set of decision attributes $D(U|D=\{D_1,D_2,.....D_n\})$, Relative to the conditional attribute set $C(U|C=\{C_1,C_2,...C_{\mathrm{m}}\})$ Conditional information entropy is defined as:

$$I(D|C)=\sum_{i=1}^{\mathrm{m}}\frac{(Card(\mathrm{Ci}))^2}{(Card(U))^2}\sum_{j=1}^{n}(\frac{Card(C_i\cap D_i)}{Card(C_i)}(1-\frac{Card(C_i\cap D_i)}{Card(C_i)})) \tag{4}$$

Whether the index weight is determined scientifically or not will directly affect the reliability of carbon management performance evaluation results. In the existing research, there are many methods to determine the index weight, which can be divided into three categories: subjective weighting method, objective weighting method and combination weighting method.

3 Enterprise carbon management framework

3.1 Carbon management business process

Carbon inventory preparation: First, the organization needs to prepare a carbon inventory, that is, to identify its carbon in the course of operations and indirect emissions

Carbon Footprint Assessment: Based on the carbon inventory, organizations can conduct a carbon footprint assessment to understand their carbon emissions across the value chain.

Set emission reduction targets: Organizations need to set clear emission reduction targets, that is, how much carbon emissions will be reduced over a certain period of time in the future.

Emission reduction strategy development: Based on carbon footprint assessment and emission reduction targets, organizations can develop emission reduction strategies.

Implement emission reduction measures: The organization needs to implement established emission reduction measures and monitor their effects.

Carbon Disclosure and reporting: Organizations are required to regularly disclose and report on their carbon emissions and progress in reducing them.

Carbon offsets and carbon trading: In some cases, organizations may choose to engage in carbon offsets or participate in carbon trading markets.

Continuous improvement and monitoring: Carbon management is an ongoing process, and organizations need to continuously improve their emission reduction measures and monitor their emission reduction effects.

Please note that specific carbon management business processes may vary depending on the size, industry, and geographic location of the organization. The above is a

general overview, the specific process can be adjusted and customized according to the actual situation.

3.2 Main costs of carbon management

Cost of data collection and monitoring: The compilation of carbon inventories and the assessment of carbon footprints requires the collection and monitoring of a large amount of data, including energy consumption, material use, transportation, etc.

Technology and equipment investment costs: Implementing emission reduction measures may require investment in new technologies and equipment.

Increased operating costs: Some mitigation measures may result in increased operating costs, such as purchasing more expensive renewable energy, changing production processes to reduce carbon emissions, etc.

Training and education costs: In order to implement effective carbon management strategies, organizations may need to train employees to increase their awareness and knowledge of energy efficiency and carbon reduction. This may require the investment of training and educational resources.

Carbon offsetting and carbon trading costs: If an organization chooses to undertake carbon offsetting or participate in a carbon trading market, there will be associated costs, such as purchasing carbon reduction projects, participating in carbon market trading, etc.

Carbon management systems and certification costs: Some organizations may choose to implement a carbon management system and certify their carbon reduction results through certification. This may require investment in the development and implementation of the system and payment of the certification body's fees.

Specific figure 1

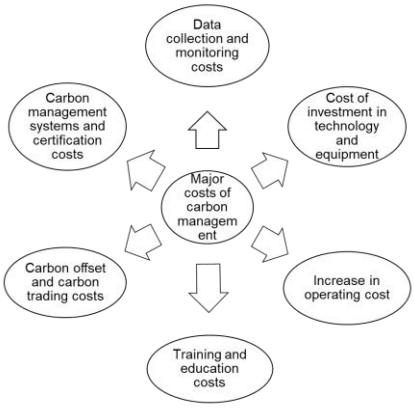

Fig. 1. Main costs of carbon management

It is important to note that although carbon management may involve some costs, it can also bring some potential economic benefits, such as energy cost savings, brand image enhancement, and competitive advantage in the market.

4 Suggestions for low-carbon development of enterprises

Setting clear carbon reduction targets: Setting specific, measurable and traceable carbon reduction targets is an important first step in implementing carbon management.

Conduct a carbon footprint assessment: Conducting a carbon footprint assessment can help an organization understand its carbon emissions across the value chain and identify key sources and hotspots of carbon emissions.

Development of emission reduction strategies: Based on carbon footprint assessment and emission reduction targets, the development of emission reduction strategies is a key step.

Adoption of clean energy and low-carbon technologies: Shifting to clean energy and low-carbon technologies is an important way to reduce carbon emissions.

Optimize the supply chain: Every link in the supply chain may involve carbon emissions. Organizations can work with suppliers to promote carbon reduction in the supply chain.

5 Conclusion

The generation of carbon assets provides an important way to develop low-carbon economy and promote sustainable economic development. The development of carbon asset management will also change the existing production mode and state of enterprises and improve the low-carbon competitiveness of enterprises. Carbon management business processes can vary depending on an organization's size, industry, and geographic location. The development of low-carbon economy has formed an inevitable trend.

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