International Journal of Finance and Investment
ISSN: 3078-6002 (Print), ISSN: 3078-2295 (Online) | Vol. 3, No. 3, 2025

Research on Strategies and Practices of Carbon Asset Management in Liquor Enterprises

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Abstract: This study focuses on carbon asset management in liquor enterprises and systematically explores the carbon emission challenges and management strategies faced by the liquor industry under the context of the "dual carbon" goals. First, the paper analyzes the main sources of carbon emissions throughout the full lifecycle of liquor production, examining the characteristics and influencing factors of carbon emissions in processes such as raw material cultivation, fermentation and distillation, packaging, and logistics. Next, it constructs a theoretical framework for carbon asset management in liquor enterprises and elaborates on implementation pathways, covering key aspects such as carbon inventory methodology, emission reduction technology systems, and participation in carbon trading mechanisms. Through comparative case studies, the research comprehensively presents innovative practices and results in carbon asset management from leading liquor companies. Finally, systematic recommendations are proposed from the perspectives of policy and regulations, technological innovation, market mechanisms, and management optimization, while also projecting future development trends for the industry. This study provides theoretical guidance and practical reference for the low-carbon transformation of the liquor industry and holds significant importance for promoting green and sustainable development in traditional industries.

Keywords: Liquor enterprises, carbon asset management, carbon emission accounting, low-carbon technology, carbon trading market, sustainable development.

1. Analysis of the Carbon Emission Characteristics of Yibin Distillery Co., Ltd.

1.1. Carbon Emission Composition of the Full Lifecycle of Baijiu Production at Yibin Distillery Co., Ltd.

In the process of Baijiu production, Yibin Distillery Co., Ltd. exhibits significant full lifecycle carbon emission characteristics. By establishing a "from farm to table" carbon footprint analysis model [1], five core carbon emission links can be clearly identified: raw material agriculture, production and processing, packaging, logistics, and waste treatment. In the raw material agriculture stage, for every ton of Baijiu produced, the cultivation of grains such as sorghum and wheat leads to the generation of approximately 150-200 $kgCO_2e$ due to activities such as fertilizer application and agricultural machinery operations [1, 4]. It is especially important to note that raw materials from different producing regions vary significantly in carbon emissions, a difference closely related to local cultivation methods and climatic conditions. Since Yibin Distillery Co., Ltd. sources raw materials from multiple regions, special attention must be paid to the impact of these differences.

The production and processing stage is the most carbon-intensive phase for Yibin Distillery Co., Ltd., accounting for 55%-65% of the company's total emissions [1]. Among these, energy consumption in the distillation process is particularly significant. The company currently uses traditional coal-fired boilers, which require 0.15 tons of standard coal to produce the steam needed for each ton of Baijiu, corresponding to approximately 400 $kgCO_2e$ emissions [3]. Although the fermentation process has relatively low direct energy consumption, it releases a large amount of carbon dioxide, accounting for approximately 20% of total emissions in the production and processing stage [2]. In addition, the company's auxiliary production facilities, such as water treatment systems and refrigeration equipment, also generate indirect carbon emissions during operation, which should not be overlooked [10].

1.2. Impact of Regional Factors on Carbon Emissions of Yibin Distillery Co., Ltd.

The registered office and production base of Yibin Distillery Co., Ltd. are both located in Yibin City, Sichuan Province, and the geographical location affects the company's carbon emission characteristics in multiple ways. First, climatic conditions directly influence the energy consumption for temperature control during fermentation. Summer temperatures in Yibin are relatively high, and to ensure the stability of the fermentation process, the company must invest more energy in cooling during the summer, undoubtedly increasing energy consumption and carbon emissions [1]. Second, regional differences in energy structure provide certain emission reduction advantages. Sichuan Province has abundant hydropower resources, so the carbon emission factor of electricity used by Yibin Distillery Co., Ltd. is significantly lower than that in northern regions where coal-fired power dominates [3]. Finally, the distance of raw material transportation is also an important factor affecting carbon emissions. By sourcing sorghum, wheat, and other raw materials locally and from nearby areas, Yibin Distillery Co., Ltd. effectively shortens transportation distances, thereby

reducing carbon emissions in the logistics stage [6].

2. The Theoretical Framework and Implementation Path of Carbon Asset Management for Yibin Liquor Industry Co., Ltd.

2.1. Construction of Carbon Inventory and Accounting System for Yibin Liquor Industry Co., Ltd.

Conducting a comprehensive carbon inventory is the primary step for a company to implement carbon asset management [5]. When performing a carbon inventory, Yibin Liquor Industry Co., Ltd. must first clearly define organizational boundaries and operational boundaries, accurately identify various carbon emission sources in the production and operation processes, and on this basis establish a complete data collection system, focusing on key areas such as stationary combustion sources (e.g., boilers), process emission sources (e.g., fermentation processes), purchased electricity and heat, and waste treatment [10]. In terms of selection of accounting methods, it is recommended to adopt a combination of process emission accounting based on mass balance and emission factor methods based on activity data, in order to improve the accuracy of carbon emission accounting results [1, 10].

Establishing a dynamic carbon accounting information system is of great significance for the carbon asset management of Yibin Liquor Industry Co., Ltd. Referring to the practices of leading companies in the industry, Yibin Liquor Industry Co., Ltd. can develop a dedicated carbon emission management platform that enables real-time monitoring, automatic calculation, and visual display of the company's carbon emission data. According to industry estimates, the use of such a platform can increase the accuracy of the company's carbon emission data by 40% and improve management efficiency by 35% [5]. In addition, this system can automatically generate carbon emission reports that comply with various standards, meeting the informational needs of different stakeholders such as government regulators, investors, and customers.

2.2. Carbon Reduction Technology System and Application for Yibin Liquor Industry Co., Ltd.

The carbon reduction technology system of Yibin Liquor Industry Co., Ltd. can be divided into three major categories: process optimization technologies, energy substitution technologies, and recycling technologies [2, 3]. In terms of process optimization, by applying advanced technologies such as low-temperature fermentation, multi-effect distillation, and thermal energy cascading utilization, the company can reduce energy consumption by 15%-25% [3]; in terms of energy substitution, converting traditional coal-fired boilers to biomass can reduce carbon emissions by 40% [7], and combined with the solar radiation conditions in Yibin, the application of solar steam systems in production also has significant potential.

Recycling technologies are not only distinctive in the industry but also highly compatible with the actual production of Yibin Liquor Industry Co., Ltd. [6]. Among them, the vinasse biogas project can convert the vinasse generated in the production process into energy. According to the operational data of typical industry projects, if Yibin Liquor Industry Co., Ltd. implements this project, the annual power generation is expected to reach 5 million kilowatt-hours [8]; carbon dioxide recovery technologies can purify the CO_2emitted during fermentation into food-grade CO_2, achieving "turning waste into treasure" [2]. In addition, Yibin Liquor Industry Co., Ltd. can also try to implement the "vinasse-biogas-organic fertilizer" recycling model. This model not only effectively addresses the company's waste disposal issues but could also bring the company annual economic benefits of tens of millions of yuan [6, 8].

3. Case Analysis of Carbon Asset Management at Yibin Distillery Co., Ltd.

3.1. Comprehensive Carbon Management Practices of Leading Enterprises (Benchmark Reference)

Leading enterprises in the industry, represented by Moutai Group, have established a complete path for carbon management through "top-level design - system construction - project implementation" [8]. At the organizational level, Moutai Group has established a Carbon Asset Management Committee led by the general manager, with a dedicated carbon management office responsible for the daily advancement of carbon management work. At the institutional level, the company has formulated 12 regulatory documents, including the "Carbon Asset Management Measures," providing institutional support for carbon management. At the project implementation level, four major types of projects are prioritized: energy structure adjustment projects, process energy-saving retrofit projects, circular economy projects, and green logistics projects. Through these measures, Moutai Group has successfully reduced total carbon emissions while increasing production, with carbon emissions per unit of product decreasing by 28% compared to the 2015 baseline. Notably, Moutai Group's distributed energy projects, which utilize distillery residue biomass energy, meet 60% of the plant's steam demand and reduce CO_2 emissions by 120,000 tons annually. Additionally, Moutai Group has actively participated in the carbon market pilot program in Guizhou Province, achieving a cumulative carbon trading volume of over 20 million yuan [8]. Yibin Distillery Co., Ltd. can draw on Moutai Group's experience in organizational structure and project implementation and carry out carbon management based on its own conditions.

3.2. Exploration of Yibin Distillery Co., Ltd.'s Specialized Emission Reduction Path

Compared with leading enterprises, Yibin Distillery Co., Ltd. faces certain financial and technical constraints in carbon asset management [9]. However, it can leverage its own advantages to explore specialized emission reduction paths. For example, in product packaging, Yibin Distillery Co., Ltd. can develop lightweight ceramic bottles. Based on practices of medium-sized enterprises in the industry, the weight of a single ceramic bottle can be reduced by 20%, potentially reducing annual glass-related carbon emissions by 800 tons [6]. At the same time, Yibin region has abundant bamboo resources, which the company can utilize to develop bamboo wine boxes to replace traditional wooden ones. This not only lowers the product's carbon footprint but also creates a

differentiated competitive advantage leveraging regional characteristics [6].

In advancing its specialized emission reduction path, the key for Yibin Distillery Co., Ltd. is to conduct a thorough carbon cost-benefit analysis, prioritizing projects with short payback periods and significant emission reduction effects [5, 9]. Moreover, by leveraging resources from industry associations and other platforms, the company can share emission reduction technologies and practical experiences with other enterprises, thereby reducing innovation costs.

4. Recommendations for Optimizing Carbon Asset Management of Yibin Liquor Co., Ltd.

4.1. Policy and Standards System Development (Adapted to the Development of Yibin Liquor Co., Ltd.)

To support the carbon asset management work of Yibin Liquor Co., Ltd., it is recommended to improve the relevant policy and standards system at the national, local, and industry levels [3, 8]: At the national level, efforts should be made to accelerate the formulation of carbon emission quota standards for the liquor industry and establish differentiated control mechanisms. When setting control indicators, the actual development situation of medium-sized enterprises such as Yibin Liquor Co., Ltd. should be fully considered [8]. At the local level, relevant government departments in Sichuan Province and Yibin City can introduce supportive incentive policies such as subsidies for carbon reduction projects and green credit support, providing financial and policy support for Yibin Liquor Co., Ltd. to carry out emission reduction projects [3].

At the industry level, it is necessary to accelerate the development of unified carbon emission accounting standards and methodologies to ensure that the carbon accounting work of Yibin Liquor Co., Ltd. is carried out in a standardized and orderly manner [1, 10]. In particular, establishing a baseline system for carbon emissions in the liquor industry is especially important. This system should set differentiated carbon emission benchmarks according to different aroma types and enterprise scales, providing a scientific basis for carbon market quota allocation and ensuring that Yibin Liquor Co., Ltd. has a fair environment in carbon market competition [8]. Additionally, it is recommended to include liquor products in the green product certification system to guide consumers to prioritize low-carbon and environmentally friendly liquor products, thereby expanding the market space for Yibin Liquor Co., Ltd.'s low-carbon products [3].

4.2. Technological Innovation and Result Transformation (Focusing on the Needs of Yibin Liquor Co., Ltd.)

It is recommended that the relevant departments establish special research and development projects for low-carbon technology in the liquor industry, focusing on key technologies such as distillation energy-saving and waste heat utilization [3, 7]. Yibin Liquor Co., Ltd. can actively participate in these special R&D initiatives and promptly adopt the latest technological achievements [2]. At the same time, efforts should be made to establish a collaborative innovation platform integrating "production - education - research - application" to accelerate the transformation of low-carbon technological achievements [5]. Yibin Liquor Co., Ltd. can establish cooperative relationships with universities and research institutions to conduct special technical research on carbon emission pain points in their production processes. For example, joint development of modular energy-saving equipment suitable for the liquor production process of Yibin Liquor Co., Ltd. could lower the application threshold for advanced technologies within the enterprise [7]. The application of digital technology in carbon asset management is also crucial. Artificial intelligence and big data technologies can optimize the production process control of Yibin Liquor Co., Ltd., improving energy utilization efficiency, while blockchain technology can enhance the reliability and traceability of carbon emission data [5]. Referring to industry best practices, if Yibin Liquor Co., Ltd. implements an intelligent energy management system to optimize operating parameters of production equipment in real-time, an energy-saving effect of 8% can be expected [5, 7].

4.3. Market Mechanisms and Financial Innovation (Facilitating Yibin Liquor Co., Ltd.'s Participation)

A well-established carbon market mechanism is key to unlocking the value of carbon assets [5, 8]. It is recommended to gradually incorporate the liquor industry into the national carbon market trading system, and to develop emission reduction accounting methodologies that align with the production characteristics of the liquor industry, providing a clear and definite pathway for Yibin Liquor Co., Ltd. to participate in carbon trading [8]. At the same time, financial institutions should be encouraged to develop innovative financial products such as carbon-collateralized loans and carbon insurance, reducing the risks for Yibin Liquor Co., Ltd. in participating in carbon market transactions [5].

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