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Quality Evaluation of Environmental Accounting Information Disclosure of China's Thermal Power Listed Companies

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Abstract*:* With the increasingly serious pollution caused by the production and operation of many industrial enterprises, the state and the international community have paid more and more attention to environmental protection, especially for some heavily polluting industrial enterprises. However, the theoretical research and institutional norms of environmental accounting information in China are still not perfect, and the quality of environmental accounting information disclosed by enterprises is uneven. How to evaluate the quality of environmental accounting information disclosed by enterprises is an urgent problem to be solved. Therefore, this paper selects the listed companies whose main business is heavy polluting thermal power generation as a sample, collects the annual report, prospectus and social responsibility report of the case enterprise for 2013-2017, and establishes reasonable environmental accounting by using the analytic hierarchy process and fuzzy comprehensive evaluation method. The information disclosure quality evaluation system evaluates the environmental accounting information disclosed by the case enterprises. The evaluation results show that the environmental accounting disclosure quality of China's thermal power listed companies is generally poor.

Keywords Environmental accounting, Information disclosure quality, Thermal power listed companies

INTRODUCTION

In order to meet the growing needs of society, enterprises are growing faster and faster, and the problem of environmental degradation is also increasing. When environmental pollution has affected people's daily lives and even threatened people's lives and health, people realized that blindly at the expense of the environment to achieve temporary development is tantamount to self-restraint. Today, whether it is the public or government regulatory agencies, there is a growing expectation of corporate environmental responsibility. In the just-concluded "Nineteenth National Congress" report, General Secretary Xi Jinping proposed that we should establish a legal system for green production, establish and improve an economic system for the development of a green and low-carbon cycle, and strengthen the energy conservation and environmental protection industry, the clean production industry, and the clean energy industry. Promote energy production, build a clean, low-carbon, safe and efficient energy system, and promote comprehensive resource conservation and recycling. As an important role in social and economic activities, enterprises have an important impact on the environment. The Ministry of Environmental Protection issued the "Guidelines for the Preparation of Corporate Environmental Reports" on October 1, 2011 and July 13, 2015,"the Notice on Strengthening the Environmental Protection Verification Management System of Listed Companies" and "Strengthening the Supervision of Environmental Protection of Listed Companies" requires provincial-level environmental protection departments to urge listed companies within their jurisdiction to conscientiously implement the relevant provisions of the Ministry of Environmental Protection on corporate environmental information disclosure, and urge enterprises to disclose environmental information in a timely, complete and accurate manner and issue annual environmental reports. This has played a key role in promoting the disclosure of environmental information in Chinese enterprises. Under the promotion of these standards, more and more enterprises have begun to publish relevant environmental responsibility reports, such as "CSR" and "Enterprise Environment". Report (CER) and so on. However, due to the current lack of supervision system for corporate environmental accounting information content, the disclosure of relevant information of enterprises is relatively arbitrary. For example, enterprises will be forced by social supervision and investor pressure to disclose the environmental investment of enterprises and Results, but for that "negative" information, it is reported as a negative avoidance attitude. Therefore, this paper selects the statistics of Ruisi database, and eliminates the listing of thermal power listed companies in one of the 39 heavily polluting industries of ST* enterprises. It adopts AHP and fuzzy comprehensive evaluation method to establish a reasonable quality evaluation system for environmental accounting information disclosure. Evaluate the case enterprises and make reasonable suggestions on the evaluation results, so as to improve the quality of environmental accounting information disclosure of thermal power enterprises.

The academic research on environmental accounting originated from developed countries in

the West. In 1990, Rob Gray wrote "Green Accounting: Accounting Professionals Behind Pearce" was recognized as the pioneering work of environmental accounting research(Zhou Shouhua,2012). Wiseman attempts to evaluate the quality of relevant information of corporate environmental accounting information through content analysis. in order to evaluate the quality of relevant information. The evaluation includes four categories: corporate pollution, corporate environmental investment, and corporate environmental litigation. A total of eighteen indicators(Wiseman,1992).R.H Graybelieves that the company's environmental accounting information should contain three aspects, namely: the policy adopted by the enterprise in terms of the environment, the environmental protection plan formulated by the enterprise, and the impact of relevant environmental activities on the financial status of the enterprise(R.H Gray,1993). Jerry Kreuze and Gale Newell further refine the main contents of corporate environmental accounting information into environmental protection laws and regulations, corporate environmental protection responsibilities, corporate environmental problems, corporate production and sales, environmental impact, and waste recycling. Disposal policy, implementation status of energy conservation and emission reduction policies, environmental related expenses and penalties, and environmental incentives for enterprises(Gale Newell,1996). Based on the Global Reporting Initiative (GRI), Clarkson divides corporate environmental information evaluation into hard environment information evaluation and soft environment information evaluation. Hard environment information is a specified amount of environmental accounting information, while soft environment information refers to non-quantization. Descriptive environmental accounting information(Clarkson,2007) . Gulati and Barnali believe that the disclosure of the environmental system at the location of the enterprise, the disclosure of the environmental governance strategy formulated by the enterprise, the disclosure of the environmental cost and cost of the enterprise, the disclosure of the specific environmental protection plan of the enterprise, and the rewards related to the enterprise and the environment Or the disclosure of punishments, the five aspects of the evaluation of corporate environmental accounting information(Barnali ,2015).

Domestic research on environmental accounting started late, and it is generally believed that Ge Jialu and Li Ruoshan published in the "Accounting Research" in 1992, "A New Trend of Western Accounting Theory in the 1990s - Green Accounting Theory" is a domestic environmental accounting research. The beginning（Ge Jialu,1992). After more than ten years of continuous exploration, Chinese scholars have had some theoretical results in recent years. Yimeng and Ye Yinyin proposed that in the evaluation of corporate environmental accounting information, both the positive and negative aspects of the environment should be considered at the same time, and the two major factors of environmental cost and environmental performance in the environmental accounting theory should be simplified. Establish an environmental performance evaluation system. The environmental cost reflects the impact of the company on the environment, and the environmental performance reflects the contribution of the company to the environment(Yimeng,2001). Shen Hongtao put forward the quality evaluation of corporate environmental accounting information disclosure from the three levels of pollution discharge, environmental management and social impact when exploring corporate environmental accounting information disclosure and environmental performance(Shen Hongtao,2014). Li Yongchen believes that environmental accounting information evaluation can start from six aspects, including environmental protection equipment and environmental protection projects, environmental protection income, environmental protection expenditures, environmental liabilities, corporate environmental protection policies, and corporate environmental protection commitments)Li Yongchen ,2015). Song Junliang, Lu Yi, and Zhang Benyuefrom the perspective of financial accounting, set environmental assets, environmental liabilities, environmental rights, environmental income, environmental costs and environmental benefits to evaluate the quality of environmental accounting information of enterprises(Song Junliang,2016). Zhou Yarong and Zhang Lifang sort out the research results of existing scholars, and believe that corporate environmental accounting information disclosure often lacks integrity. Enterprises usually prefer to disclose positive information that is beneficial to enterprises, but there is little mention of negative information that has an impact on enterprises. For information users, the "undisclosed" negative information is more valuable (Zhou Yarong,2016).

Through literature review, it is known that current scholars generally use content analysis method to evaluate the quality of environmental accounting information disclosure of enterprises when evaluating the quality of enterprise environmental accounting information. Although the operation process is cumbersome, it also provides clear research for related research. The idea. Scholars generally use the content analysis method to evaluate the quality of environmental accounting information disclosure. It is generally divided into three steps. First, the evaluation content and the scoring standard are formulated for the evaluation object. Secondly, use the developed evaluation criteria to analyze and rate the enterprise information disclosure carrier such as the company's annual report, social responsibility report and prospectus. Finally, the quality of the final environmental accounting information disclosure of the enterprise is evaluated by summarizing the scores of the various evaluation contents. In addition, the

researchers also put forward their own requirements for environmental accounting information disclosure from multiple perspectives. After inductive analysis, the author believes that environmental accounting information disclosure should include information such as environmental performance, environmental finance and environmental policies of the enterprise, and also meet the quality, reliability and comparability of accounting information in terms of information quality characteristics. Feature requirements.

THE DESIGN OF INDICATORS

Principle of indicator design

This paper draws on the requirements of the IASB and FASB accounting information quality characteristics framework, and classifies the environmental accounting information disclosure quality evaluation indicators from the two levels of "correlation" and "reliability". Among them, "relevance" means that the environmental accounting information disclosed by the enterprise should be related to the performance of the information user's evaluation of the environmental responsibility of the enterprise, and help the information user to evaluate and predict the past, present and future environmental behavior of the enterprise. "Reliability" means that the process of preparing and disclosing the enterprise's environmental accounting information should comply with relevant regulations, ensure the integrity and neutrality of the information and there is no material misstatement.

Selection and description of specific indicators

Design of "relevance" level indicators

This paper selects three representative indicators of corporate environmental policy and responsibility information, enterprise environmental performance information and corporate environmental financial information in the "relevance" level indicators.

(1)Corporate Environmental Policy and Responsibility Information

The corporate environmental policy and responsibility information mainly refers to the relevant environmental protection rules and regulations, environmental protection measures and the implementation of relevant national mandatory laws and regulations for the purpose of achieving the intended environmental protection. The specific indicators include: whether there are social responsibility reports; corporate environmental protection principles, objectives and systems; disclosure and implementation of environmental laws and regulations; environmental protection plans and environmental problems prepared by enterprises; environmental management certification system obtained by enterprises; And the status quo; the evaluation and supervision of the environmental issues of the stakeholders; the impact of production and sales activities on the environment; the promotion and education of the company's environmental protection concept.

Table1 Enterprise Environmental Policy and Responsibility Information Indicators

	Indicator name	Comment
Corporate Environmental Policy and Responsibility Information	Whether there is a social responsibility report	--
	Corporate environmental principles, goals and systems	The specific norms formed by the senior management of the enterprise on the strategic summary of the environmental protection work of the enterprise have guiding significance for the environmental protection of the enterprise.
	Disclosure and enforcement of environmental laws and regulations	Except for environmental laws and regulations disclosed in the company's internal environmental regulations, and the implementation of the company (generally referred to by the relevant state departments).
	Environmental plan and environmental problem plan formulated by the enterprise	--
	Environmental management system certification obtained by the company	Professional certification in the current environmental field, such as the ISO14000 series of standards introduced by the International Organization for Standardization (ISO) and the OHSAS18000 series of standards introduced by the British Standards Institute (BSI).
	Enterprise Environmental Management Structure and Status	Including whether the company has set up an environmental protection department or whether there is a person engaged in environmental protection work.

Evaluation and supervision of environmental issues of stakeholders	Stakeholders mainly include creditors, debtors, investors and investors of enterprises, and upstream and downstream enterprises of enterprises.
Environmental impact of production and sales activities	This includes the extent of resource consumption and the degree of pollution to the environment.
Enterprise propaganda and education on environmental protection concepts	Enterprises to promote environmental protection concepts and related activities organized by environmental education.
Environmental policy risk	Refers to the negative impact of current or new laws on the current state of environmental protection of enterprises.

(2)Corporate environmental performance information

The enterprise environmental performance information refers to the environmental impact of the production and operation activities of the enterprise and the governance of the negative impact.The specific indicators include: “three wastes” emissions; “three simultaneous” implementation; energy consumption and use efficiency; and recycling.

Table2 Enterprise Environmental Performance Information Indicators

	Indicator name	Comment
Corporate environmental performance information	"Three Wastes" emissions	The “three wastes” are derived from the “Trial Standards for Industrial “Three Wastes” Emissions”.
	"Three simultaneous" implementation	“Three simultaneous” refers to the provisions of Article 41 of the “Environmental Protection Law”, that is, in the process of project construction, the facilities for pollution prevention and control of the project shall be designed, constructed and put into operation simultaneously with the main project.
	Energy consumption and efficiency	--
	Recycling	Refers to the recycling and reuse of production residues, wastes and pollutants by enterprises.

(3)Corporate environmental financial information

Corporate environmental financial information refers to the accounting and supervision of environmental accounting elements based on financial accounting. Specifically include: environmental assets; environmental liabilities; environmental rights; environmental costs.

Table3 Corporate Environmental Financial Information

	Indicator name	Comment
Corporate environmental financial information	Environmental assets	Refers to environmentally related assets, including resource environmental assets and non-resource environmental assets.
	Environmental liability	Mainly refers to negative expenses caused by the environment, including sewage charges and purification fees levied due to violations of environmental laws and regulations; fines and compensation obligations arising from environmental damage; liabilities formed to repair the environment; or environmental liabilities .
	Environmental rights	Refers to the relevant rights and interests of the enterprise due to environmental protection, including the environmental rights and interests formed when the environmental assets are acquired; the state supports and rewards the environmental protection of the enterprise; and the retained earnings formed by the gains and losses resulting from the environmental protection income and expenses.

	Environmental cost	Refers to the active expenditures caused by environmental protection, including pollution damage fees; environmental protection fees; pollution control funds; environmental protection business fees.
	Environmental income	Refers to the economic inflows caused by environmental protection activities, including direct income (receiving the income of three wastes, selling environmental protection by-products, tax relief for the development of environmentally friendly products, incentives for other institutions to promote environmental protection activities, etc.) and indirect income (the company has environmental protection) Signs or the establishment of environmental image and other reasons for the increase in sales of the company's revenue, etc.).

Design of "reliability" level indicators

(1)Environmental information preparation process

The process of preparing environmental information is mainly evaluated from the production process of enterprise environmental accounting. Whether it meets the principle of reliability in the process of forming environmental accounting information, it is reflected in various internal control descriptions and information reliability levels of the company in its related reports. Description. Specifically, it includes: internal control of environmental work; description of environmental compliance by enterprises; and other explanations for confirming the reliability of environmental information.

Table4 Environmental information preparation process

	Indicator name	Comment
Environmental information preparation process	Internal control of environmental work	For enterprises that establish environmental management regulations or establish separate environmental management departments, they shall disclose the development of relevant systems and supervision work during the reporting period, such as the implementation of environmental management systems by various departments of the enterprise, and whether there are violations.
	Enterprise's description of environmental information compliance	The enterprise shall explain in detail the principles for the preparation of environmental accounting information, such as whether the measurement of environmental expenditures and capitalized environmental expenditures meet the corresponding confirmation criteria, and whether the measurement of various environmental subsidies received by enterprises follows the recognition of income. Guidelines and more.
	Other explanations confirming the reliability of environmental information	--

(2)Environmental information disclosure process

The environmental information disclosure process mainly examines the relevant quality assurance provided by internal management and external independent third-party organizations on the environmental accounting information that has been disclosed by the company to ensure the reliability of the final information. The specific indicators are: the government's audit situation; the third-party audit situation; the internal audit situation.

Table 5 Environmental Information Disclosure Process

	Indicator name	Comment
Environmental information disclosure process	Government audit	--
	Third party audit	Mainly refers to the auditor's audit of the company and issued an unqualified audit report.
	Internal audit of the company	The management and management of the enterprise as the actors of the various work of the enterprise shall be responsible

for the public information disclosed by the enterprise. Therefore, the evaluation and guarantee of the enterprise's environmental accounting information by the management is an important basis for reflecting the true and reliable information.

(3)Environmental information disclosure integrity

The integrity of corporate environmental accounting information content mainly investigates the disclosure of negative information related to the corporate environment. The specific indicators are: major environmental accidents; environmental litigation; public media negative reports on the corporate environment.

Table 6 Environmental Information Disclosure Integrity

	Indicator name	Comment
Environmental information disclosure integrity	Major environmental accident	Refers to a serious environmental accident in which the company has not filed a lawsuit.
	Environmental litigation	Refers to a serious environmental accident of the company that violates the law and is brought to court.
	Public media reports on the negative aspects of the corporate environment	--

Through the above design of the evaluation indicators, the environmental accounting information disclosure quality evaluation system is obtained, as shown in the table.

Table 7 Environmental Accounting Information Disclosure Quality Evaluation System

Target layer A	Criteria layer B	Sub-criteria layer C	Indicator layer D	
Environmental Accounting Information Disclosure Quality Evaluation	Correlation B_1	Corporate Environmental Policy and Responsibility	Whether there is a social responsibility report	D_1
			Corporate environmental principles, goals and systems	D_2
			Disclosure and enforcement of environmental laws and regulations	D_3
			Environmental plan and environmental problem plan formulated by the enterprise	D_4
			Environmental management system certification obtained by the company	D_5
			Enterprise Environmental Management Structure and Status	D_6
			Evaluation and supervision of environmental issues of stakeholders	D_7
			Environmental impact of production and sales activities	D_8
			Enterprise propaganda and education on environmental protection concepts	D_9
			Environmental policy risk	D_{10}
		Corporate environmental	"Three Wastes" emissions	D_{11}

	performance information	"Three simultaneous" implementation	D_{12}
		Energy consumption and efficiency	D_{13}
		Recycling	D_{14}
	Corporate environmental financial information	Environmental assets	D_{15}
		Environmental liability	D_{16}
		Environmental rights	D_{17}
		Environmental cost	D_{18}
		Environmental income	D_{19}
reliability B_2	Environmental information preparation process	Internal vacancy situation for environmental work	D_{20}
		Description of enterprise-to-business information compliance	D_{21}
		Other explanations confirming the reliability of environmental information	D_{22}
	Environmental information disclosure process	Government audit	D_{23}
		Third party audit	D_{24}
		Internal audit of the enterprise	D_{25}
	Environmental information disclosure integrity	Major environmental accident	D_{26}
		Environmental litigation	D_{27}
		Public media and other negative reports about the corporate environment	D_{28}

Determination of indicator weight

After confirming the environmental accounting information evaluation indicators, it is necessary to assign weights to the importance of each evaluation index to ensure the accuracy of the final evaluation results. Combined with the evaluation index system constructed above, this paper attempts to use the Analytic Hierarchy Process (AHP) to assign weights to evaluation indicators. Analytic Hierarchy Process (AHP) is a hierarchical weighting method proposed by American operations researcher T. L. Saaty in the 1970s. It is often used in multi-objective, multi-criteria and multi-factor strategic decision-making problems.

Referring to the above method, this paper uses questionnaires to issue questionnaires to scholars in the field of economic management and workers engaged in financial auditing. A 9th-order evaluation level is set in the questionnaire for the respondents to rank the importance of each indicator in the evaluation system. Through the statistical analysis of the 10 valid questionnaires collected, preliminary statistics on the importance of each indicator are obtained. Then, after referring to the relevant literature, the preliminary ranking is adjusted to ensure consistency of importance ordering. Finally, the analytic hierarchy process (AHP) is used to calculate the weights of the evaluation indicators at each level, and the consistency test is carried out. The specific operation process is as follows.

Determination of the weight of the criteria layer

Building a comparison matrix, $A-B=\begin{bmatrix} 1 & \frac{4}{3} \\ \frac{3}{4} & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_1=(0.5333,0.4667)^T$,Maximum eigenvalue $\lambda_{\max}=2.0000$; Test consistency, CI=0.0000, CR=0.0000, CR<0.1, passed the consistency test.

Determination of sub-criteria layer weight

(1)Weight assignment for the "correlation" sub-criteria layer:

Building a comparison matrix $B_1 - C = \begin{bmatrix} 1 & \frac{3}{7} & \frac{3}{5} \\ \frac{7}{3} & 1 & \frac{6}{5} \\ \frac{5}{3} & \frac{5}{6} & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_7 = (0.2013, 0.4458, 0.3530)^{\mathrm{T}}$,Maximum eigenvalue $\lambda_{\max} = 3.0026$; Test consistency, CI = 0.0013, CR = 0.0023, CR < 0.1, passed the consistency test.

(2)Weight assignment of the "reliability" sub-criteria layer

Building a comparison matrix $B_2 - C = \begin{bmatrix} 1 & \frac{5}{3} & \frac{5}{4} \\ \frac{3}{5} & 1 & 1 \\ \frac{4}{5} & 1 & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_8 = (0.1980, 0.3984, 0.4037)^{\mathrm{T}}$,Maximum eigenvalue $\lambda_{\max} = 3.0183$; Test consistency, CI = 0.0193, CR = 0.0332, CR < 0.1, passed the consistency test.

Weight assignment at the "correlation" level in the sub-criteria layer

(1)The weight distribution of each indicator of C1 in the enterprise environmental policy information:

Constructing a comparison matrix, $C_1 - D = \begin{bmatrix} 1 & \frac{1}{2} & \frac{4}{3} & \frac{6}{5} & \frac{7}{3} & \frac{3}{2} & 3 & \frac{2}{3} & \frac{3}{4} & \frac{5}{2} \\ 2 & 1 & \frac{3}{4} & \frac{7}{3} & 3 & \frac{5}{2} & \frac{7}{2} & \frac{3}{2} & \frac{7}{3} & \frac{7}{2} \\ \frac{3}{4} & \frac{3}{4} & 1 & \frac{4}{3} & 3 & \frac{6}{5} & \frac{5}{2} & \frac{3}{4} & \frac{3}{2} & 3 \\ \frac{5}{6} & \frac{3}{7} & \frac{3}{4} & 1 & \frac{3}{2} & \frac{4}{3} & \frac{7}{3} & \frac{3}{4} & \frac{6}{5} & \frac{5}{2} \\ \frac{3}{7} & \frac{1}{3} & \frac{1}{3} & \frac{2}{3} & 1 & \frac{5}{6} & \frac{6}{5} & \frac{1}{3} & \frac{5}{5} & \frac{1}{6} \\ \frac{2}{3} & \frac{2}{5} & \frac{5}{6} & \frac{3}{4} & \frac{6}{5} & 1 & \frac{7}{3} & \frac{1}{2} & 1 & 2 \\ \frac{1}{3} & \frac{2}{7} & \frac{2}{5} & \frac{3}{7} & \frac{5}{6} & \frac{3}{7} & 1 & \frac{2}{7} & \frac{2}{7} & 1 \\ \frac{3}{2} & \frac{2}{3} & \frac{4}{3} & \frac{4}{3} & 3 & 2 & \frac{7}{2} & 1 & \frac{7}{2} & \frac{7}{2} \\ \frac{4}{3} & \frac{3}{7} & \frac{2}{3} & \frac{5}{6} & \frac{6}{5} & 1 & \frac{3}{2} & \frac{3}{7} & 1 & \frac{4}{3} \\ \frac{2}{5} & \frac{2}{7} & \frac{1}{3} & \frac{2}{5} & \frac{6}{5} & \frac{1}{2} & 1 & \frac{2}{7} & \frac{3}{4} & 1 \end{bmatrix}$

Calculate the weight vector by MATLAB W_2 =(0.1151,0.1912,0.1229,0.0988,0.0564,0.0828,0.0452,0.1578,0.0817,0.0481 $)^T$, Maximum eigenvalue $\lambda_{\max} = 10.1774$; Test consistency, CI = 0.0197, CR = 0.0132, CR < 0.1, passed the consistency test.

(2)The weight distribution of each indicator in the enterprise environmental performance information C2:

Constructing a comparison matrix, $C_2 - D = \begin{bmatrix} 1 & \frac{4}{3} & \frac{6}{5} & \frac{3}{2} \\ \frac{3}{4} & 1 & \frac{5}{6} & \frac{6}{5} \\ \frac{5}{6} & \frac{6}{5} & 1 & \frac{4}{3} \\ \frac{3}{2} & \frac{5}{6} & \frac{3}{4} & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_3 = (0.2893, 0.2173, 0.2503, 0.2432)^{\mathrm{T}}$,Maximum eigenvalue $\lambda_{\max} = 4.2218$; Test consistency, CI = 0.0739, CR = 0.0821, CR < 0.1, passed the consistency test.

(3)The weight distribution of each indicator in the enterprise environmental financial information C3:

Constructing a comparison matrix $C_3 - D = \begin{bmatrix} 1 & \frac{5}{3} & \frac{5}{6} & \frac{5}{4} & \frac{5}{3} \\ \frac{3}{5} & 1 & \frac{1}{2} & \frac{3}{4} & \frac{3}{4} \\ \frac{6}{5} & 2 & 1 & \frac{5}{3} & 2 \\ \frac{4}{5} & \frac{4}{3} & \frac{3}{5} & 1 & \frac{4}{3} \\ \frac{3}{5} & \frac{4}{3} & \frac{1}{2} & \frac{3}{4} & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_4 = (0.2372, 0.1348, 0.2908, 0.1859, 0.1513)^{\mathrm{T}}$,Maximum eigenvalue $\lambda_{\max} = 5.0113$;

Test consistency, CI=0.0000, CR=0.0000, CR<0.1, passed the consistency test.

Weight assignment at the "reliability" level in the sub-criteria layer

(1)The weight distribution of each indicator in the environmental information preparation process C4:

Constructing a comparison matrix C_4 - $D = \begin{bmatrix} 1 & \frac{2}{3} & \frac{5}{6} \\ \frac{3}{2} & 1 & \frac{4}{3} \\ \frac{6}{5} & \frac{3}{4} & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_4 = (0.2698, 0.4134, 0.3168)^T$,Maximum eigenvalue $\lambda_{max} = 3.0005$; Test consistency, CI=0.0002, CR=0.0003, CR<0.1, passed the consistency test.

(2)The weight distribution of each indicator in the environmental information disclosure process C5:

Constructing a comparison matrix $C_5 - D = \begin{bmatrix} 1 & \frac{4}{5} & \frac{4}{3} \\ \frac{5}{4} & 1 & \frac{5}{2} \\ \frac{3}{4} & \frac{2}{5} & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_5 = (0.3240, 0.4637, 0.2123)^T$,Maximum eigenvalue $\lambda_{max} = 3.0183$; Test consistency, CI = 0.0090, CR = 0.0156, CR < 0.1, passed the consistency test.

(3)Environmental Information Disclosure Integrity The weight distribution of each indicator in C6:

Environmental Information Disclosure Integrity The weight distribution of each indicator in C6: $C_6 - D = \begin{bmatrix} 1 & \frac{4}{5} & 1 \\ \frac{5}{4} & 1 & \frac{5}{3} \\ 1 & \frac{3}{5} & 1 \end{bmatrix}$,

Calculate the weight vector by MATLAB $W_6 = (0.3430, 0.3939, 0.2631)^T$,Maximum eigenvalue $\lambda_{max} = 3.0163$; Test consistency, CI = 0.0081, CR = 0.0267, CR < 0.1, passed the consistency test.

Combination weight of each indicator to the target layer

The weight of the criterion layer B to the criterion layer A is $W_1 = (0.5333, 0.4667)^T$, CI=0.0000, CR=0.0000, CR<0.1, passed the consistency test.

The sub-criteria layer C checks the combined weights of the criterion layer A: CR = 0.5333 * 0.0132 + 0.4667 * 0.0821 = < 0.1, passing the consistency test.

The consistency weight test of the index layer D on the criterion layer A: CR=0.2013*0.0132+0.4458*0.0821+0.3530*0.0000+0.1980*0.0003+0.3984*0.0156+0.4037*0.0267<0.1, passed the consistency check.

In summary, the environmental information disclosure quality evaluation index system constructed in this paper is as follows:

Table 8 Combination weight of each indicator to the target layer

Target layerA	Criteria layerB	Sub-criteria layerC		Indicator layerD	
Environmental Accounting Information Disclosure Quality Evaluation	Correlation B_1 0.5333	Corporate Environmental Policy and Responsibility	C_1 0.2013	Whether there is a social responsibility report	D_1 0.1151
				Corporate environmental principles, goals and systems	D_2 0.1912
				Disclosure and enforcement of environmental laws and regulations	D_3 0.1229
				Environmental plan and environmental problem plan formulated by the enterprise	D_4 0.0988
				Environmental management system certification obtained by the company	D_5 0.0564
				Enterprise Environmental Management Structure and Status	D_6 0.0828
				Evaluation and supervision of environmental issues of stakeholders	D_7 0.0452
				Environmental impact of production and sales activities	D_8 0.1578
				Enterprise propaganda and education on environmental protection concepts	D_9 0.0817

			Environmental policy risk	D_{10} 0.0481
	Corporate environmental performance information	C_2 0.4458	"Three Wastes" emissions	D_{11} 0.28973
			"Three simultaneous" implementation	D_{12} 0.2173
			Energy consumption and efficiency	D_{13} 0.2503
			Recycling	D_{14} 0.2432
	Corporate environmental financial information	C_3 0.3530	Environmental assets	D_{15} 0.2372
			Environmental liability	D_{16} 0.1348
			Environmental rights	D_{17} 0.2908
			Environmental cost	D_{18} 0.1859
			Environmental income	D_{19} 0.1513
reliability B_2 0.4667	Environmental information preparation process	C_4 0.1980	Internal vacancy situation for environmental work	D_{20} 0.2698
			Description of enterprise-to-business information compliance	D_{21} 0.4134
			Other explanations confirming the reliability of environmental information	D_{22} 0.3168
	Environmental information disclosure process	C_5 0.3984	Government audit	D_{23} 0.3240
			Third party audit	D_{24} 0.4637
			Internal audit of the enterprise	D_{25} 0.2123
	Environmental information disclosure integrity	C_6 0.4037	Major environmental accident	D_{26} 0.3430
			Environmental litigation	D_{27} 0.3939
			Public media and other negative reports about the corporate environment	D_{28} 0.2631

QUALITY EVALUATION

Evaluation process

This paper collects the annual report, social responsibility report and prospectus of 34 listed companies with thermal power generation as their main business for 2013-2017, and sorts and extracts according to the above-mentioned index system. Both qualitative and quantitative methods are used. The environmental information it discloses is scored. In the sub-criteria level, the enterprise environmental performance information and the enterprise financial information involve the level of detail of the disclosure. Therefore, the fuzzy evaluation method is used to score the three aspects of significance, quantitative and temporal, respectively, and other indicators adopt the method of quantitative scoring (That is, the information includes the indicator score of 1 point, otherwise it is 0 points).

The fuzzy comprehensive evaluation method used in this paper was firstly proposed by the American automatic control expert L.A.Zadeh in 1965. It is a comprehensive evaluation method based on fuzzy mathematics. The comprehensive evaluation method transforms the qualitative evaluation into quantitative evaluation according to the membership theory of fuzzy mathematics. It has the characteristics of clear results and strong system, which can solve fuzzy and difficult to quantify problems, and is suitable for solving various non-deterministic problems.

Therefore, this paper uses the comprehensive evaluation method to evaluate the enterprise environmental performance information and corporate financial information from three perspectives, that is, the significance refers to the location of corporate environmental information disclosure, including annual report, social responsibility report and prospectus (individual enterprises have independent environment) Report); Quantitative refers to the level of detail of environmental information disclosed by enterprises; time refers to the comprehensiveness of environmental information disclosed by enterprises in the time dimension. In this case, 28 indicators in the three-point system (3-1 corresponding to excellent, general, and poor) are used to score, and the final evaluation results are obtained by calculating the evaluation index to the “excellent” membership degree, and the membership evaluation is compared. The standard table analyzes the disclosure of evaluation information.

Table 9 Membership evaluation criteria

	excellent	general	Poor
Membership	0.8<W≤1.0	0.4<W≤0.8	0≤W≤0.4

According to the above evaluation criteria, 34 thermal power companies were scored and the results are as table 10:

Table 10 Scores of quality evaluation of environmental accounting information disclosure for thermal power listed companies

Evaluation results

It can be seen from the table that the best quality of environmental accounting information disclosure is that “Guodian Power” and “Yoneng Holdings” have a membership of 0.45, and the worst quality disclosures are “Huadian International” and “Sheneng Shares”. For 0.1, in the three ratings of “excellent”, “general” and “poor”, the evaluation of all cases is “poor”, and the average degree of membership is 0.27, indicating the disclosure of environmental accounting information of China’s thermal power listed companies. The overall quality is relatively poor and needs to be improved and improved.

The average membership degree of the "correlation" of the criterion layer B1 is 0.26, and the rating is evaluated as "poor". The average membership degree of the criterion layer B2 "reliability" is also 0.26, and the rating is evaluated as "poor".

The average membership degree of the sub-criteria level C1 “Corporate Environmental Policy and Responsibility” is 0.38, and the rating is “poor”. Among them, the average subordinate degree of D1 “Independent Social Responsibility Report” is less than 0.1. Only ten companies have independent social responsibility reports, and in detail disclose the contents of environmental responsibility. There are two enterprises “Shenzhen Energy” and “Sui Hengyun A” not only has an independent social responsibility report, but also an independent environmental report. The environmental information of other enterprises is concentrated in the chapter of social responsibility of the annual report. This shows the company’s awareness of environmental accounting information disclosure. Not high, and the visibility of information disclosure is poor. Indicator D2 “Corporate Environmental Goals, Principles and Institutions” and Indicator D3 “Disclosure and Implementation of Environmental Laws and Regulations” have a good evaluation result, with an average membership degree of around 0.3. Due to pressure from law and public opinion, more and more Eyes began to pay attention to the environmental protection of enterprises. In order to maintain their image and improve their competitiveness in environmental protection, enterprises have to actively demonstrate their environmental awareness on the basis of complying with environmental laws and regulations. The evaluation results of indicator D4 “Environmental plan and environmental problem plan formulated by the enterprise” and indicator D10 “Environmental policy risk” are similar, and there is a positive correlation between the two indicators. When the enterprise has environmental policy risks, it will be targeted for one hundred years. Risk development of targeted environmental plans and environmental issues. Some companies such as “Huayin Power” and “Chuantou Energy” have not disclosed the risks related to environmental policies, but they have also formulated corresponding plans and plans. These companies have strong environmental awareness. Indicators D5 “Environmental Management System Certification for Enterprises”, D6 “Corporate Environmental Management Structure and Status” and D7 “Evaluation and Supervision of Stakeholders' Environmental Issues” have an average membership degree of 0.00, and the disclosure is extremely poor. Only three companies in the D5 index were disclosed, namely “National Investment Power”, “Yueng Holdings” and “Changyuan Power”. It can be seen that these three companies have outstanding performance in environmental protection and have obtained environmental protection certification. Indicator D6 has been disclosed by four companies, namely “SDIC”, “Shanghai Power”, “Guodian Power” and “Yoneng Holdings”. Most of the disclosures of these indicators in the four companies are in the status of environmental management. However, there is almost no description of its environmental management structure, which indicates that although the company is committed to environmental protection, it does not form a separate or specialized environmental management structure. For indicator D7, all case companies have not disclosed, thermal power enterprises themselves are heavily polluting enterprises, and their upstream and downstream enterprises also involve environmental pollution to a certain extent, so the disclosure of this part should be strengthened to meet the interests of investors and other stakeholders. The complete right to know about corporate environmental accounting information. Indicator D8 “The impact of production and sales activities on the environment” was disclosed by eight companies. The thermal power industry was defined as one of the heavily polluting industries. The impact of its production and operation activities on thermal environment as a thermal power company is self-evident. The disclosure of negative environmental accounting information by enterprises is very passive, and most enterprises try to avoid them. However, the disclosure of this indicator can enable stakeholders and the public to understand the environmental pollution of the production and operation of the enterprise, and also have the right to understand. The disclosure of indicator D9 “Promotion and education of enterprises on environmental protection concepts” is also rare. Only individual companies organize environmental

Table 10 Scores of quality evaluation of environmental accounting information disclosure for thermal power listed companies

	C1	C2	C3	C4	C5	C6	B1	B2	A
Huaneng International	1.29	0.02	0.04	0.32	0.07	0.00	0.29	0.09	0.20
Shanghai Electric Power	0.66	0.02	0.04	0.29	0.08	0.00	0.16	0.09	0.13
Huadian International	1.73	0.00	0.02	0.06	0.00	0.00	0.36	0.01	0.20
Guangzhou Development	1.23	0.00	0.02	0.09	0.00	0.00	0.26	0.02	0.14
Jingneng Power	1.62	0.06	0.03	0.43	0.10	0.00	0.36	0.12	0.25
Shenergy	0.00	0.00	0.01	0.06	0.00	0.00	0.00	0.01	0.01
Sichuan Investment Energy	1.23	0.08	0.04	0.48	0.20	0.00	0.30	0.18	0.24
Huadian Energy	1.63	0.03	0.02	0.22	0.04	0.00	0.35	0.06	0.22
Huayin Power	0.78	0.06	0.03	0.31	0.09	0.00	0.19	0.10	0.15
Guodian Power	1.34	0.06	0.04	0.47	0.12	0.00	0.31	0.14	0.23
Inner Mongolia Huadian	0.39	0.06	0.02	0.33	0.08	0.00	0.11	0.10	0.11
SDIC Power	1.70	0.06	0.02	0.31	0.08	0.00	0.38	0.09	0.24
Datang Power Generation	0.39	0.03	0.03	0.27	0.04	0.00	0.10	0.07	0.09
Hongyang Energy	1.40	0.03	0.01	0.18	0.04	0.00	0.30	0.05	0.18
Ningbo Thermal Power	1.00	0.06	0.02	0.38	0.10	0.00	0.23	0.11	0.18
Fu Neng shares	0.05	0.08	0.02	0.49	0.13	0.00	0.05	0.15	0.10
Jinshan Shares	0.62	0.03	0.02	0.19	0.04	0.00	0.15	0.05	0.10
Tianfu Energy	1.28	0.06	0.02	0.33	0.08	0.00	0.29	0.10	0.20
Tongbao Energy	1.35	0.06	0.05	0.35	0.15	0.00	0.32	0.13	0.23
Huitian Thermal Power	1.39	0.03	0.01	0.19	0.04	0.00	0.30	0.06	0.18
Shenzhen Energy	1.61	0.08	0.03	0.54	0.13	0.00	0.37	0.16	0.27
Binhai Energy	1.00	0.06	0.01	0.33	0.10	0.00	0.23	0.10	0.17
Sui Hengyun A	1.32	0.03	0.04	0.36	0.11	0.00	0.30	0.11	0.21
WanNeng Power	1.00	0.08	0.01	0.47	0.13	0.00	0.24	0.14	0.20
Jiantou Energy	0.21	0.06	0.01	0.38	0.12	0.00	0.07	0.12	0.10
ShaoNeng Company	0.70	0.03	0.02	0.30	0.09	0.00	0.16	0.09	0.13
Baoxin Energy	1.28	0.06	0.03	0.46	0.12	0.00	0.30	0.14	0.22
Takizawa Electric Power	0.54	0.06	0.01	0.31	0.08	0.00	0.14	0.09	0.12
Hubei Energy	0.05	0.06	0.02	0.34	0.08	0.00	0.04	0.10	0.07
Jidian shares	0.66	0.06	0.01	0.28	0.08	0.00	0.16	0.09	0.13
GanNeng Company	1.58	0.06	0.01	0.30	0.08	0.00	0.35	0.09	0.23
Eastern Energy	1.00	0.06	0.02	0.32	0.08	0.00	0.23	0.10	0.17
Yueneng Holdings	1.44	0.06	0.05	0.43	0.10	0.00	0.33	0.13	0.24
Changyuan Power	0.05	0.06	0.01	0.28	0.08	0.00	0.04	0.09	0.06

knowledge contests and environmental lectures for employees from time to time, which hinders the improvement of the overall environmental awareness of enterprises.

The sub-criteria level C2 "enterprise environmental performance information" has an average membership degree of 0.25 and a rating of "poor". The four indicators included are evaluated in terms of significance, quantification and time. Because the evaluation criteria in the evaluation system designed in this paper are strict, the evaluation results are not high, but the environmental performance information is almost every Enterprises have disclosed relevant content, but most of them are

still subject to the requirements of laws and regulations and are symbolically disclosed in the annual report. The environmental accounting information in this part requires a lot of manpower and material resources in accounting. To calculate accurate quantitative data, it must be calculated by a special person. Therefore, in order to save costs, the company will not violate laws and regulations and disclose the indicator. Staying in a qualitative report in a single report (annual report or prospectus or social responsibility report) is not significant. The average degree of membership of indicator D11 is 0.45, which indicates that the disclosure of “three wastes” is more significant and quantitative disclosure. Only a few companies have disclosed the data comparison in recent years, and the overall data disclosure lacks comparability.

The average membership degree of the sub-criteria level C3 "enterprise environmental financial information" is 0.21, and the rating is evaluated as "poor". Environmental financial information is difficult to obtain and account for relative to environmental performance information. It requires enterprises to separately calculate accounting and financial information about the environment according to accounting standards. It is no longer a simple measurement and statistical problem. It requires professional accounting personnel to conduct accounting and disclosure. . Since most companies do not have separate environmental management agencies, they do not have a separate accounting for environmental financial information. Among the five indicators in C3, the highest average membership is D15 “environmental assets”, and the lowest is D1 “environmental liabilities” and D19 “environmental income”. That is to say, enterprises generally take the initiative to disclose their investment in environmental protection, and prefer to conceal environmental liabilities including fines. Environmental accounting is difficult, so few companies disclose. The disclosure of environmental equity indicators varies according to the situation of the local government, and is generally subsidized by the government for environmental protection projects.

The average membership degree of the sub-criteria level C4 "environmental information preparation process" is 0.11, and the rank evaluation is "poor". Since there is no authoritative environmental information disclosure system in China, and most of the case enterprises have not formulated relevant systems in light of the actual situation of enterprises, enterprises have no rules to follow in the process of disclosing environmental information, and they are more random. The information that leads to disclosure by different companies is not comparable.

The sub-criteria layer C5 "disclosure process of environmental information" has an average membership degree of 0.05 and a rating of "poor". First, the average subordination degree of the government audit situation of indicator D23 is at least 0.00. The accounting information of no enterprise has been audited by the government, and the information lacks reliability. Secondly, the average subordinates of the indicators D24 “third-party audit situation” and D25 “enterprise internal audit situation” The degree is high, third-party audits are mostly audited by certified public accountants, but the content of third-party audits is financial accounting information such as financial statements in annual reports. The audit of some qualitative non-financial accounting information is not comprehensive, so the results of audits are lacking. reliability.

The average membership degree of the sub-criteria level C6 "Environmental Information Disclosure Integrity" is 0.54, and the rating is rated as "general". Among them, D26 “major environmental accident” has the best disclosure status, and the disclosure position is one of the major accidents in the annual report. If the enterprise is in a major environmental accident, the disclosure content is “no major environmental accident”. The D27 “Environmental Litigation” and “Public Reports on Negative Reports Related to the Enterprise Environment” are poorly disclosed. Only one company of “Huayin Power” disclosed negative reports from the media. The reason is that both of them involve Negative environmental information affects corporate image, which reduces the integrity of corporate environmental information disclosure.

It can be seen from the evaluation of environmental accounting information of the case enterprises in this paper that the overall performance of environmental accounting information disclosure of China's thermal power listed companies is poor. There are many problems that cannot be ignored, such as weak corporate environmental responsibility awareness, non-standard disclosure of environmental information, and lack of reliability and comparability of disclosed environmental information. Enterprises can, in light of their specific circumstances, focus on improving the links with lower evaluation scores and improve the quality of corporate environmental accounting information disclosure. At the same time, enterprises should disclose more detailed content with higher combined weights, such as “enterprise environmental performance information”, “enterprise environmental financial information” and “integrity of environmental information compilation”, etc., to strengthen the disclosure quality of such information. It is essential to improve the quality of corporate environmental information disclosure.

CONCLUSIONS

With the development of China's economic level and the diversification of economic activities, environmental issues have become more than just the issues of concern in the natural sciences. Nowadays, more and more scholars in the field of economic management have begun to conduct in-depth research

on environmental issues in their profession. At the same time, the regulatory authorities and the community are increasingly demanding environmental information from enterprises, especially environmental accounting information for heavily polluting enterprises. At present, the theoretical and practical research on environmental accounting in China is still in the development stage. Based on the existing research results, this paper first analyzes the status quo of environmental accounting information disclosure of China's thermal power listed companies, and then attempts to establish a quality evaluation index system for corporate environmental accounting information disclosure, and applies the evaluation system to heavily polluting enterprises in Jiangxi Province. The quality of environmental accounting information disclosure was evaluated, and it was found that the quality of environmental accounting information disclosure of heavily polluting listed companies in Jiangxi Province is generally poor. Finally, combined with the evaluation results, the factors affecting the quality of environmental accounting information disclosure of heavily polluting listed companies in Jiangxi Province were analyzed and corresponding reasonable suggestions were put forward.

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