

## Research Article

# Quality Evaluation of Environmental Accounting Information Disclosure of Y Nonferrous Metal Company Based on AHP-FCE Model

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Environmental accounting information disclosure is an important way to achieve the goal of “carbon peak carbon neutrality”, which plays a role in the link between economic development and environmental protection. Select Y Non-Ferrous Metal Company for case analysis, use the AHP-FCE model for comprehensive evaluation of environmental accounting information quality of the company, which use analytic hierarchy process to determine the evaluation factors and factors of weight value, and then use fuzzy synthesis method for multi-level fuzzy comprehensive evaluation. The results show that as a state-owned enterprise, the quality level of Y company’s environmental accounting information disclosure is in the “general” level in the past 5 years, and the intensity of government environmental regulation will promote the quality of the company’s environmental accounting information disclosure. Non-ferrous metal companies should enhance the concept of environmental protection, strengthen the awareness of environmental accounting information disclosure, promote technological innovation in energy conservation and emission reduction, and reduce carbon emission intensity. The government should also provide a favorable social environment and policy support for the non-ferrous metal industry to implement environmental accounting information disclosure, formulate relevant laws and regulations, and continuously strengthen supervision.

## 1. Introduction

At present, the global energy consumption structure is undergoing a third transformation. The main goal is to establish a low-carbon and sustainable energy supply and consumption system. Renewable energy has been extensively developed and utilized. Environmental accounting information disclosure refers to the disclosure of the company’s management to the outside world in the form of an annual report, social responsibility report, and other ways to explain the company’s environmental strategy in the process of production and operation and the implementation of environmental pollution discharge means and measures [1]. The disclosure of environmental accounting information is beneficial to standardize the environmental treatment of enterprises, optimize the low carbon economic structure,

and guide and accelerate the transformation of the economic industrial structure.

The process of industrialization and urbanization in China has promoted the rapid development of the non-ferrous metal industry. The production process and characteristics of non-ferrous metals determine that the production of various metals is high energy consumption and high emissions. According to statistics from the China non-ferrous metals industry association, carbon emissions from the non-ferrous metals industry reached 660 million tons in 2020, accounting for about 4.7% of the country’s total carbon emissions, making it one of the main sources of carbon emissions in China. China is actively promoting the goal of carbon peak carbon neutrality, and the non-ferrous metal industry, as an industry with high carbon emissions, is naturally the first to carry out reform and upgrading.

Y non-ferrous metal enterprise is the first domestic mining, electricity, and smelting triple production enterprise. Y Company's main business is lead, zinc, and other non-ferrous metals mining, zinc smelting, production and sales of extended products, and hydroelectric power generation. Y Non-Ferrous Metal Company is a state-owned holding company. The special status of state-owned enterprises enables Y Non-Ferrous Metal Company to obtain many preferential policies in its development.

As a listed company in the zinc and lead industry, Y company has serious heavy metal pollution, causing great damage to the local environment. In 2016, the central environmental protection inspection group and the local environmental protection Bureau pointed out that Y company did not treat 10 tons of solid waste according to the standard treatment, and Y company's subsidiary exceeded the emission of exhaust gas. It called for the complete elimination of potential environmental pollution by the end of 2018. In 2018, the central Environmental protection inspection team carried out an environmental inspection again and found that Y company did not solve the internal management chaos and prominent environmental safety problems, but the problem is further aggravated.

Under the background of carbon peak and carbon neutralization, the biggest challenge facing the non-ferrous metal industry is to reduce carbon emissions, increase carbon absorption, and show the effect of energy conservation and emission reduction on the industry enterprises. This requires enterprises to disclose environmental accounting information according to their own industrial characteristics, and to make carbon emissions, pollutant discharge, and related emission reduction scientific research and technology costs transparent. This study takes Y Non-ferrous Metal Company as a case study and selects the company's annual report, interim announcement, social responsibility report, and other data from 2017 to 2021. First, according to the requirements of accounting information quality, the AHP-FCE model is constructed from three aspects of relevance, reliability, and compliance. Then, the comprehensive score of Y company's environmental accounting information quality is decomposed and calculated to explore the problems existing in the disclosure of environmental accounting information in the non-ferrous metal industry and put forward suggestions for improvement.

## 2. Literature Review

*2.1. The Influence of Government Regulation on Enterprise Environmental Accounting Information Disclosure.* Government regulation mainly through promulgation and implementation of environmental protection-related laws and regulations to achieve rigid constraints on enterprises' environmental behavior. Hughes et al. [2] found that in order to cope with FASB and SEC's review, enterprises with poor environmental performance had to disclose their environmental information. Stefan Paul [3] believes that reducing environmental regulations does not necessarily bring better economic efficiency and financial benefits. Enterprises can partially or completely compensate for pollution control

costs caused by environmental regulations from other aspects, and some enterprises can benefit from environmental regulations. Qian [4] found that the introduction of environmental information disclosure system brought enormous environmental pressure to enterprises and effectively improved the quality of corporate environmental information disclosure. The research of Chen and Qian [5] shows that the promulgation of the "new Environmental Protection Law" effectively improves the quality of enterprises' environmental information disclosure, which indicates that it is effective for the government to strengthen enterprises' environmental responsibility from the legislative level. Chai [6] concluded through empirical research that government supervision can increase the value of a company by improving its environmental information disclosure level. Qi et al. [7] found that government incentives have a great influence on guiding enterprises to disclose environmental accounting information.

*2.2. The Influence of Enterprise Nature on Environmental Accounting Information Disclosure.* There is a huge difference between China's political and economic environment and that of western countries. In western countries, the capital market is relatively complete and mainly private enterprises, while a large part of China's enterprises is controlled by the government. Many scholars have found that there is a very close relationship between the nature of enterprises and the quality of accounting information. Liu and Du [8] found that the probability of financial fraud was higher in state-controlled companies. Wang et al. [9] found in their study that no matter what the nature of enterprises, they would have a strong motivation to manipulate accounting information and earnings management. Chen [10] mainly studied the quality of accounting information of enterprises with different properties. Studies have found that when enterprises are state-owned, the quality of accounting information disclosure is high. Liu and Bai [11] found that the quality of monetary environment accounting information disclosure of state-owned enterprises was higher than that of non-state-owned enterprises, and there was a significant negative correlation between environmental supervision and the quality of monetary environment accounting information disclosure.

*2.3. Selection of Environmental Information Disclosure Quality Evaluation Index Content.* The construction of environmental information disclosure index system abroad is an evolving process. Clarkson et al. [12] divided the environmental information disclosure system into two types: hard and soft. Hard disclosure includes corporate governance structure, environmental performance indicators, and environment-related expenditures; Soft disclosure includes environment-related strategic statements, environmental status, and corporate environmental behavior. Beck et al. [13] believed that corporate environmental information disclosure behavior characteristics should be considered and added to the evaluation indicator system, such as environmental strategic arrangement, management system,

employee training programs, etc. Ren and Hong [14] constructed an enterprise environmental accounting information evaluation index system from soft disclosure and hard disclosure, assigned values and scored them, and then summarized the scores for comparative analysis. Li [15] proposed that government regulation, stakeholders, and enterprises' own factors should be fully considered in the construction of the index system.

*2.4. The Scoring Standard of Environmental Information Disclosure Quality Evaluation Index.* The core of the analytic hierarchy process is to establish the judgment matrix. First, the analytic hierarchy process model is established to refine the research questions, and then the importance of indicators is compared, and finally, the weight of each indicator in the model is obtained. Anirut et al. [16] improved the effectiveness of the analytic hierarchy process (AHP) in assessing environmental performance by integrating exploratory factor analysis and confirmatory analysis to validate appropriate criteria and sub-criteria. Research results show that quality policy, quality assurance, and quality control are the three most important factors in environmental performance measurement respectively, while organizational support in innovation is given the lowest priority. Wang and Han [17] used the AHP analysis method to evaluate the quality of environmental accounting information disclosure of listed companies. Yao [18] obtained the environmental performance evaluation results of various functional departments of the enterprise by AHP based on the performance management of the enterprise and analyzed the environmental performance differences of different departments of the enterprise.

The fuzzy comprehensive evaluation method is very effective when some indexes are difficult to be quantified in the evaluation. Based on the membership theory of mathematics, it changes qualitative indexes into quantitative indexes and reduces the influence of supervisor factors in evaluation. Chithambaranathan and other scholars [19] conducted a fuzzy comprehensive evaluation from the perspective of the value supply chain by integrating multiple influencing factors. Kumar et al. [20] used the fuzzy extension method to evaluate the environmental performance of suppliers to facilitate the selection of suppliers. Wang and other scholars [21] also chose this method when studying the environmental performance of the coal industry. Other scholars use the fuzzy comprehensive evaluation method to study the fulfillment of corporate social responsibility. For example, Junhua et al. [22] quantified qualitative indicators with a fuzzy comprehensive evaluation method when studying tanning companies.

### **3. Quality Analysis of Corporate Environmental Accounting Information Disclosure Based on the AHP-FCE Model**

*3.1. AHP-FCE Model.* AHP-FCE model is an evaluation model based on Analytic Hierarchy Process (AHP) and Fuzzy Comprehensive Evaluation (FCE). Analytic hierarchy

process (AHP) is a method proposed by Professor T. L. Saaty in the United States to make scheme decisions by using hierarchical weight. Its core is to split the factors related to decision into multiple levels, such as the target layer, criterion layer and scheme layer, and calculate the weight of each factor in turn to get the appropriate scheme. The fuzzy comprehensive evaluation method is proposed by American professor L.A. Zeh. Its core is to use the concept of the fuzzy set to carry out scientific quantitative analysis of many problems with unclear boundaries in reality, and it can well transform qualitative indicators into quantitative data evaluation methods. The main steps of the AHP-FCE model are as follows: first, a complete evaluation index system is established according to the target layer, criterion layer, and scheme layer; Second, from the evaluation index system, construct each judgment matrix and complete the consistency test. Then determine the fuzzy weight data, calculate the combined weight, and finally calculate the comprehensive score.

The quality of environmental accounting information disclosure is a comprehensive evaluation system. The quality of enterprise environmental accounting information disclosure can be reasonably evaluated only by selecting reasonable evaluation factors, establishing a hierarchical index system, and assigning an appropriate weight value to each evaluation factor. Environmental accounting information disclosure quality evaluation exists lots of fuzzy phenomena and concepts, and needs quantitative index and qualitative index to reflect the current state of the environment information, therefore, the study combined the two methods, using the analytic hierarchy process to determine index weight and the fuzzy synthesis evaluation of environment quality of accounting information, the two complement each other, improve the reliability of evaluation and effectiveness.

*3.2. Establishment of Evaluation Index System.* According to the AHP-FCE model, the AHP evaluation index system needs to be established first. According to between 2015 and 2022, the ecological environment of the People's Republic of China and the China Securities Regulatory Commission released the enterprise environment accounting information disclosure system files, and combining previous research results and the non-ferrous metal industry characteristics, this study builds A set of relevance, reliability, and compliance as the main indicators of the evaluation system, are shown in Table 1 below, from left to right in turn into A target layer, criterion layer B, Secondary criterion layer C and scheme D, form class time relationship. Correlation indicators refer to financial information and non-financial information such as rules and regulations, production and operation, development, and management related to enterprise environmental protection. The reliability index refers to the authentication of enterprise information disclosure, which can be internal authentication or third-party independent authentication. Compliance refers to whether the disclosure methods and contents of enterprises meet the requirements of laws and regulations.

TABLE 1: Environmental accounting information disclosure quality index evaluation system table.

Target layer	Criterion layer	Secondary criterion layer	Scheme layer
Quality of corporate environmental information disclosure A	Correlation B1	Environmental assets C1	Antifouling treatment facilities D1
			Environmental government subsidies, environmental governance awards, etc. D2
			Patented technology for environmental protection D3
		Environmental liabilities C2	Resource tax and environmental protection tax D4
			Environmental protection fees, pollution discharge fees, pollution liability insurance and other environmental protection expenses D5
			Environmental penalty expenditure D6
	Environmental attitude C3	Emergency plans related to the environment D7	
		Environmental system certification and cleaner production D8	
		Environmental protection education and training for staff D9	
	Reliability B2	Environmental performance C4	Carbon emission and pollutant emission D10
			Disposal of pollutants and wastes D11
			Comprehensive utilization rate of mineral resources and environmental rectification measures D12
		Environmental information accuracy C5	Environmental credit evaluation D13
			Environment information internal control settings and operation D14
			Third-party environmental audit verification D15
	Compliance B3	Environmental information compliance C6	Instructions for ensuring the accuracy of environmental information D16
			Whether the form of disclosure complies with laws and regulations D17
			Whether the disclosure related to environmental information is timely D18
Whether the disclosure time of major announcements is timely D19			

3.3. *Determination of Weight of Evaluation Index.* Starting from the index system constructed in Table 1, using the nine-level scoring system in Table 2, experts compare and judge the importance of two elements at the same level, so as to construct a judgment matrix, and then use mathematical methods to calculate the weight of the judgment matrix.

$$\begin{bmatrix} 1 & 5 & 2 \\ \frac{1}{5} & 1 & \frac{1}{5} \\ \frac{1}{2} & 5 & 1 \end{bmatrix} * \begin{pmatrix} 0.5590 \\ 0.0887 \\ 0.3521 \end{pmatrix} = \begin{pmatrix} CW_1 \\ CW_2 \\ CW_3 \end{pmatrix}. \tag{1}$$

3.3.1. *Weight of Environmental Liability Information*

(1) *Weight of Environmental Asset Information.* The weight of each indicator is calculated according to the results of the judgment matrix. The weight calculation process is as follows:

First, multiply the elements of each row of judgment matrix  $C$  to obtain  $\bar{u}_i$ , and calculate  $\bar{u}_1 = 10$ ,  $\bar{u}_2 = 0.04$ ,  $\bar{u}_3 = 2.5$ . Then multiply the product by the  $n$  power to obtain the vector  $u_i$ , and calculate  $u_1 = 2.154$ ,  $u_2 = 0.342$ ,  $u_3 = 1.357$ . Then divide each  $u_i$  by the sum of all the root vector values,  $U$  to get  $W_1 = 0.5590$ ,  $W_2 = 0.0887$ ,  $W_3 = 0.3521$ , Calculate the product of matrix  $C$  and feature vector  $CW$  to get the maximum eigenvalue  $\text{Max}(\lambda)$ .

$$CW_1 = 1 * 0.5590 + 5 * 0.0887 + 2 * 0.3521 = 1.7071$$

By the same token,  $CW_2 = 0.2709$ ,  $CW_3 = 1.0754$ .

$$\begin{aligned} \text{Max}(\lambda) &= \frac{1}{n} \sum_{i=1}^n \frac{(CW)_i}{W_i} \\ &= \frac{1.7071/0.559 + 0.2709/0.0887 + 1.0754/0.3521}{3} \\ &= 3.0536. \end{aligned} \tag{2}$$

In order to judge whether the matrix has satisfactory consistency, a consistency index  $CR$  should be used to detect the consistency degree of the judgment matrix, and the

TABLE 2: Grade 9 grading table.

Factor A vs. factor B	Quantitative values
As important	1
A little important	3
More important	5
Highly important	7
Extremely important	9
The intermediate value of the quantized value	2, 4, 6, 8
Reverse comparison	Reciprocal of each of the above numbers

consistency degree should be modified by using the index of average random consistency  $RI$ . The fixed values of  $RI$  are shown in Table 3. When  $CR = 0$ , it indicates that the judgment matrix has a good consistency. When  $CR < 0.1$ , it indicates that the consistency is good; otherwise, it indicates that the consistency of the judgment matrix is not good. It is necessary to modify the values of the matrix until  $CR < 0.1$ .

$$CI = \frac{\max(\lambda) - n}{n - 1} = \frac{3.0536 - 3}{2} = 0.0268, \quad (3)$$

$$CR = \frac{CI}{RI} = \frac{0.0268}{0.52} = 0.05155. \quad (4)$$

(2) *Weight of Environmental Liability Information.* According to the previous calculation ideas, the judgment matrix, weight allocation, and consistency test of environmental liability information are obtained, as shown in Table 4 below.

(3) *Weight of Environmental Attitude Information.* Similarly, the judgment matrix, weight distribution, and consistency test of environmental attitude information are obtained, as shown in Table 5 below.

(4) *Weight of Environmental Performance Information.* Similarly, the judgment matrix, weight distribution, and consistency test of environmental performance information are obtained, as shown in Table 6 below.

3.3.2. *Determination of Weight of Environmental Reliability Index.* Similarly, the judgment matrix, weight distribution, and consistency test of environmental information accuracy are obtained, as shown in Table 7 below.

3.3.3. *Determination of Weight of Environmental Compliance Index.* Similarly, the judgment matrix, weight distribution, and consistency test of environmental information compliance are obtained, as shown in Table 8 below.

3.3.4. *Determination of Weights for Total Model Indicators*

(1) *Determination of the Weight of Information Index in the Sub-criterion Layer.* Similarly, the judgment matrix, weight distribution, and consistency test of sub-criteria layer information are obtained, as shown in Table 9 below.

TABLE 3: RI values corresponding to the order.

Order	1	2	3	4	5	6	7	8	9
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46

TABLE 4: Judgment matrix, weight allocation, and consistency test of environmental liability information.

	D4	D5	D6	Weight	CI	CR
D4	1	1/5	1/4	0.0936		
D5	5	1	3	0.6267	0.4288	0.0825
D6	4	1/3	1	0.2797		

TABLE 5: Judgment matrix, weight allocation, and consistency test of environmental attitude information.

	D7	D8	D9	Weight	CI	CR
D7	1	2	1/2	0.3108		
D8	1/2	1	1/2	0.1958	0.0268	0.0516
D9	2	2	1	0.4933		

(2) *Determination of Information Index Weight of Criterion Layer.* Similarly, the judgment matrix, weight distribution, and consistency test of criterion layer information are obtained, as shown in Table 10 below.

The fuzzy weight and combined weight of indicators at each level are obtained by summary calculation, as shown in Table 11.

3.4. *Comprehensive Results of Environmental Information Assessment.* After determining the quality evaluation index system of environmental accounting information disclosure and the weight value of each index, the evaluation standard and grade evaluation of the index should be clarified. The evaluation index system includes a qualitative index and a quantitative index. This study mainly adopts the method of combining qualitative statements, monetary quantitative statements, and non-monetary quantitative statements to evaluate 19 environmental information disclosure indicators, with the highest score of 6 and the lowest score of 0. The specific scoring criteria are shown in Table 12.

Analyze the annual report, interim announcement, and social responsibility report of Y Non-ferrous Metal Company from 2017 to 2021. According to the evaluation score of each index and the combined weight, the comprehensive score of environmental accounting information quality of Y Company in recent 5 years is calculated, as shown in Table 13 below.

According to the score grade of comprehensive evaluation in Table 14, it can be seen from Figure 1 that the quality level of environmental information disclosure of Y Non-ferrous Metal Company is generally in the “general” level, and the evaluation level reached the “good” level in 2018. It indicates that there is a large room for improvement in the environmental accounting information disclosure of Y Company. According to the index disclosure score of each layer in Table 13, Y company has problems such as a

TABLE 6: Judgment matrix, weight allocation, and consistency test of environmental performance information.

	D10	D11	D12	D13	Weight	CI	CR
D10	1	3	1	1	0.2832	0.0201	0.0226
D11	1/2	1	1/2	1/2	0.1416		
D12	1	2	1	1/2	0.2382		
D13	1	2	2	1	0.3369		

TABLE 7: Judgment matrix, weight distribution, and consistency test of environmental information accuracy.

	D14	D15	D16	Weight	CI	CR
D14	1	1	2	0.3874	0.0091	0.0176
D15	1	1	3	0.4434		
D16	1/2	1/3	1	0.1692		

TABLE 8: Judgment matrix, weight distribution, and consistency test of environmental information compliance.

	D17	D18	D19	Weight	CI	CR
D17	1	1	1	0.3275	0.0268	0.0516
D18	1	1	1/2	0.2599		
D19	1	2	1	0.4126		

TABLE 9: Judgment matrix, weight distribution, and consistency test of environmental correlation information.

	C1	C2	C3	C4	Weight	CI	CR
C1	1	1	1/2	1/3	0.1411	0.0035	0.0039
C2	1	1	1/2	1/3	0.1411		
C3	2	2	1	1/2	0.2627		
C4	3	3	2	1	0.4550		

relatively single way of environmental accounting information disclosure, incomplete disclosure content, and non-standard disclosure.

#### 4. Cause Analysis of Y Company's Environmental Accounting Information Disclosure

*4.1. The Intensity of Government Environmental Supervision Will Promote the Quality of Environmental Accounting Information Disclosure.* According to the score of information quality level of Y Company, the quality of information disclosure is improved only when the government supervision is strengthened. Y company had serious environmental pollution problems in 2016 and 2017. The central environmental inspector clearly pointed out that the Y non-ferrous metal company had serious potential environmental pollution problems, but did not punish it or demand rectification. The company did not disclose environmental information that year. Until 2018, the central environmental inspector carried out an environmental inspection again and criticized the environmental problems of Y company, so the

company increased the disclosure of environmental information.

*4.2. The Responsibility Consciousness of Enterprises to Implement Environmental Accounting Information Disclosure Needs to Be Improved.* Kong and Tang [23] found that compared with non-state-owned enterprises, state-owned enterprises were sheltered by local governments, which interfered in their economic behavior and social responsibility fulfillment, thus covering up their inadequate performance of environmental responsibility and reducing the quality of environmental information disclosure. Y Non-ferrous Metal Company is a listed company controlled by The State-owned Assets Supervision and Administration Commission (SASAC), making great contributions to the local economy. Central environmental inspectors have pointed out that one of the reasons for Y non-ferrous metal company's serious environmental pollution problems is the lax environmental supervision of the relevant local government departments.

Y enterprise as heavy pollution of nonferrous metals enterprise, daily production process of "three wastes" pollution to the ecological environment is larger, but Y enterprise in selecting environmental information disclosure forms still choose the lower cost of the annual report and disclosure of the interim report, has such problems as environmental information content is not complete, repetitive, or selective description, avoidance or not to disclose negative news. Although criticized by the regulatory authorities, Y company did not improve the form and content of environmental information disclosure, indicating its low awareness of environmental protection.

*4.3. Lack of Professional Environmental Accounting Talents.* Fang et al. [24] found that the industry work experience and knowledge update degree of financial directors had a significant positive effect on the quality of accounting information of companies. It can be seen from Table 13 that the company has not disclosed "environmental protection education and training for employees" in the past 5 years, which indicates that the management of the company has not paid enough attention to environmental protection and has not provided regular environmental protection training for employees. Xiong et al. [25] believed that the education level of the CFO would have a positive impact on the quality of accounting information. As shown in Table 15, in the past 5 years, the proportion of people with a bachelor's degree or above is on the rise, but the overall proportion is less than 20%, indicating that enterprise Y is short of comprehensive professionals in environmental accounting, and its environmental protection training for employees is seriously insufficient, resulting in a low level of environmental information disclosure.

*4.4. Company Environmental Accounting Information Disclosure System Is Not Perfect.* For the disclosure of enterprise environmental information, China's law currently provides

TABLE 10: Judgment matrix, weight distribution, and consistency test of the total model.

	B1	B2	B3	Weight	CI	CR
B1	1	1	1	0.3275		
B2	1	1	2	0.4126	0.0268	0.0516
B3	1	1/2	1	0.2599		

TABLE 11: Weight table of environmental accounting information disclosure quality index evaluation.

Target layer	Criterion layer	Secondary criterion layer	Scheme layer	Combination weight	
Quality of corporate environmental information disclosure A	Correlation B1 (0.3275)	Environmental assets C1(0.1411)	Antifouling treatment facilities D1(0.5590)	0.0258	
			Environmental government subsidies, environmental governance awards, etc. D2(0.0887)	0.0041	
			Patented technology for environmental protection D3(0.3521)	0.0163	
		Environmental liabilities C2 (0.1411)	Resource tax and environmental protection tax D4(0.0936)	0.0043	
			Environmental protection fees, pollution discharge fees, pollution liability insurance, and other environmental protection expenses D5 (0.6267)	0.0290	
			Environmental penalty expenditure D6(0.2797)	0.0129	
		Environmental attitude C3 (0.2627)	Emergency plans related to the environment D7(0.3108)	0.0267	
			Environmental system certification and cleaner production D8(0.1958)	0.0168	
			Environmental protection education and training for staff D9(0.4933)	0.0424	
		Reliability B2 (0.4126)	Environmental information accuracy C5(1)	Carbon emission and pollutant emission D10(0.2832)	0.0422
				Disposal of pollutants and wastes D11(0.1416)	0.0211
				Comprehensive utilization rate of mineral resources and environmental rectification measures D12(0.2382)	0.0355
		Compliance B3 (0.2599)	Environmental information compliance C6(1)	Environmental credit evaluation D13(0.3369)	0.0502
				Environment information internal control settings and operation D14(0.3874)	0.1598
				Third-party environmental audit verification D15(0.4434)	0.1829
				Instructions for ensuring the accuracy of environmental information D16(0.1692)	0.0698
				Whether the form of disclosure complies with laws and regulations D17(0.3275)	0.0851
				Whether the disclosure related to environmental information is timely D18(0.2599)	0.0675
				Whether the disclosure time of major announcements is timely D19(0.4126)	0.1072

a combination of compulsory disclosure and voluntary disclosure. For example, the Standards for Disclosure format of Enterprise Environmental Information in accordance with the law standardize the disclosure format of enterprise environmental information but does not adopt mandatory requirements. The environmental information disclosure of Y company is more arbitrary and subjective, with a single form of disclosure and incomplete disclosure content.

### 5. Suggestions on Optimization of Environmental Accounting Information Disclosure in the Nonferrous Metal Industry

5.1. To Formulate Laws and Regulations, Continue to Intensify Supervision. Disclosure of environmental information in accordance with the law is an important enterprise environmental management system and the basic content of the

TABLE 12: Scoring criteria.

0	1 point	2 points	3 points	4 points	5 points	6 points
No description	Simple qualitative description (1-5 sentences)	Detailed qualitative description (more than 5 sentences)	Simple non-monetary quantitative description (1-5 sentences)	Detailed non-monetary quantitative statements (more than 5 sentences)	Simple monetary quantitative description (1-5 sentences)	Detailed monetization quantitative description (more than 5 sentences)

TABLE 13: Comprehensive score table of Y Company’s environmental accounting information quality from 2017 to 2021.

Scheme layer	2017	2018	2019	2020	2021
Antifouling treatment facilities	0.1548	0.1548	0.1548	0.1548	0.1548
Environmental government subsidies, environmental governance awards, etc.	0.0246	0.0205	0.0328	0.0328	0.0328
Patented technology for environmental protection	0.0652	0.0652	0	0.0652	0.0652
Resource tax and environmental protection tax	0.0215	0.0215	0.0215	0.0215	0.0215
Environmental protection fees, pollution discharge fees, pollution liability insurance, and other environmental protection expenses	0.174	0.174	0.174	0.174	0.174
Environmental penalty expenditure	0	0.129	0	0	0.129
Emergency plans related to the environment	0.0267	0.0267	0.0267	0.0267	0.0267
Environmental system certification and cleaner production	0.0168	0.0168	0.0168	0.0168	0.0168
Environmental protection education and training for staff	0	0	0	0	0
Carbon emission and pollutant emission	0.2532	0.2532	0.2532	0.2532	0.2532
Disposal of pollutants and wastes	0.0844	0.1899	0.0844	0.0844	0.0844
Comprehensive utilization rate of mineral resources and environmental rectification measures	0.213	0.213	0.213	0.213	0.213
Environmental credit evaluation	0	0	0	0	0
Environment information internal control settings and operation	0	0.799	0	0	0
Third-party environmental audit verification	0	0	0	0	0
Instructions for ensuring the accuracy of environmental information	0.0698	0.0698	0.0698	0.0698	0.0698
Whether the form of disclosure complies with laws and regulations	0.0851	0.0851	0.0851	0.0851	0.0851
Whether the disclosure related to environmental information is timely	0.0676	0.0676	0.0676	0.0676	0.0676
Whether the disclosure time of major announcements is timely	0.1072	0.1072	0.1072	0.1072	0.1072
Total	1.3639	2.3933	1.3069	1.3721	1.5011

Data source: According to the 2017–2021 annual report, interim announcement, and social responsibility report of Y Nonferrous Metals Company.

TABLE 14: Grade table of comprehensive evaluation score.

Grade	Excellent	Good	General	Bad	Very bad
Composite scores	$2.5 \leq X \leq 3$	$2 \leq X < 2.5$	$1.5 \leq X < 2$	$0.5 \leq X < 1.5$	$0 \leq X < 0.5$

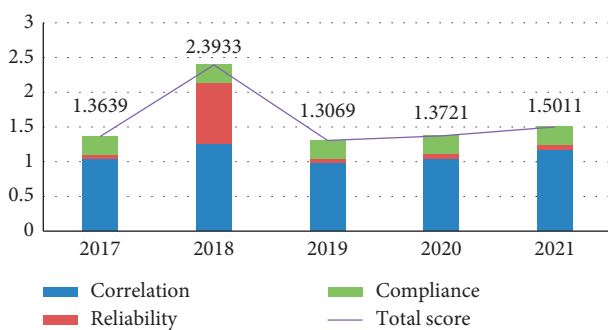


FIGURE 1: Comprehensive score of environmental accounting information quality. of Y Company from 2017 to 2021.

system of ecological civilization. Relevant departments in China should issue relevant laws and regulations, provide detailed implementation measures, and strengthen the compulsory disclosure of environmental accounting information in the non-ferrous metal industry. Environmental

accounting standards for pollution control in the non-ferrous metal industry were issued, requiring industry enterprises to strengthen the clean management of production technology and encouraging enterprises to carry out technological reform and innovation in production. At the same time, guidelines on pollutants that can be discharged will be formulated to control the discharge of high-risk pollutants.

5.2. Enhance Environmental Awareness and Integrate Environmental Protection into Corporate Culture. Lin et al. [26] found that large companies and companies with strong profitability lack environmental protection awareness, and management generally ignores corporate environmental responsibilities when expanding the company scale and improving economic benefits. As can be seen from the annual report and interim report of Y Non-ferrous Metal Company, most of the company’s disclosures are mandatory requirements of the government, while there is little disclosure of environmental information, even less negative environmental information disclosure. With the gradual



TABLE 15: Educational background of employees in Y enterprise.

Education level	2017		2018		2019		2020		2021	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
Graduate	6	0.37	6	0.37	5	0.30	5	0.29	6	0.33
Undergraduate	189	11.68	202	12.32	214	12.87	218	12.85	283	15.40
Junior college	453	28.00	453	27.64	459	27.60	453	26.71	602	32.75
High school and below	970	59.95	978	59.67	985	59.23	1020	60.15	947	51.52
Total	1618	100	1639	100	1663	100	1696	100	1838	100.00

establishment of a carbon emission trading market, non-ferrous metal companies should link environmental protection and energy saving with corporate culture, actively promote environmental protection culture, strengthen environmental protection publicity and education and training, edify employees with corporate culture and practice environmental protection concepts. Through annual reports, social responsibility reports, and other forms, the company discloses environmental accounting information such as resource consumption, carbon emissions, pollutant production, and recycling utilization through multiple channels.

*5.3. Promote Scientific and Technological Innovation, and Reduce the Carbon Intensity.* Carbon peak carbon neutralization action brings new opportunities and challenges to the development of the non-ferrous metal industry. On the one hand, promote industrial enterprises to accelerate green transformation, strengthen technological innovation, actively promote and apply advanced energy-saving and low-carbon technologies, reduce indirect emissions in energy consumption, continuously optimize process control, reduce energy consumption and material consumption, and further reduce industrial carbon emission intensity. On the other hand, while promoting carbon peak, industrial enterprises will also rapidly reduce the carbon peak level, and make contributions to carbon peak and carbon neutrality.

*5.4. Strengthen the Training of Environmental Accounting Personnel.* Environmental accounting personnel is the discloser of environmental accounting information, which plays an important role in the process of environmental accounting information disclosure. The training expenditure of enterprise Y’s environmental accounting personnel is zero, which leads to the accounting personnel’s slackness on environmental accounting information and affects the disclosure of environmental accounting information. Environmental accounting includes accounting, economics, management, and other disciplines, which means that environmental accounting requires higher professional quality and higher comprehensive ability of accounting personnel. Enterprises need to strengthen the training of environmental accounting personnel and cultivate excellent environmental accounting personnel.

**6. Conclusions**

The construction of ecological civilization has been included in the overall layout of China’s “five-in-one,” and the

proposal of “carbon peak and carbon neutrality” both emphasizes the change in the energy industry pattern. It is a prerequisite for environmental governance that the environmental information can be fully disclosed by high-polluting enterprises [11]. Environmental accounting information disclosure is an important way to achieve the goal of “carbon peak carbon neutrality.”

This study takes Y non-ferrous metal company as a case study, introduces the AHP-FCE model to comprehensively evaluate the quality of environmental accounting information of Y Company, which uses an analytic hierarchy process to determine the evaluation factors and factors of weight value, and then use fuzzy synthesis method for multi-level fuzzy comprehensive evaluation. The results show that: as a state-owned enterprise, the quality level of Y Company’s environmental accounting information disclosure is in the “general” level in the past 5 years, and the intensity of government environmental regulation will promote the quality of the company’s environmental accounting information disclosure. Y Non-Ferrous Metal Company, as a state-owned listed company, should enhance the concept of environmental protection, strengthen the awareness of environmental accounting information disclosure, promote technological innovation of energy conservation and emission reduction, reduce carbon emission intensity, and strengthen the training of environmental accounting personnel. The government should also provide a favorable social environment and policy support for the non-ferrous metal industry to implement environmental information disclosure research, formulate relevant laws and regulations, and strengthen supervision.

Although a large number of domestic and foreign literature were used for reference to establish the quality evaluation index system of environmental accounting information disclosure of Y Non-ferrous metal Company, due to the particularity of Y non-ferrous metal Company’s industry, the existing index may not fully cover the environmental accounting information of Y Company. In the future, it is necessary to continue to improve and optimize the indicators. The conclusion of this study hopes to provide new ideas for improving the information disclosure of environmental accounting in the non-ferrous metal industry through targeted case analysis.

**Data Availability**

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this paper.

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