ESG Disclosure in China's Thermal Power Industry: Status, Challenges, and Analysis of Listed Companies

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Abstract. Against the backdrop of tightening global ESG regulations, the deepening of China's "dual carbon" goals, and the green development requirements of the 15th Five-Year Plan, the thermal power industry—as a key sector for carbon emissions—relies on high-quality ESG disclosure as an important lever for balancing energy security with low-carbon transition. This research takes the ESG and annual reports of 24 non-ST A-share listed thermal power enterprises in 2024 as the key samples for analysis and then systematically examines the current situation of ESG disclosure and the structural bottlenecks in the domestic thermal power industry by means of the combination of content analysis and descriptive statistics. This study discovers that there are deficiencies in the core aspects within this industry, including inconsistent disclosure standards, complicated preparation bases, extremely low third - party certification rates, insufficient substantial disclosure in the environmental dimension, and unbalanced disclosure among various dimensions. Based on these results, this study puts forward a series of targeted optimization strategies, for example, improving the mandatory information disclosure system, formulating specific disclosure regulations for the thermal power industry, strengthening comprehensive certification, and so on. By doing so, a powerful and evidence-based reference is provided, which is used to enhance the quality of environmental, social, and governance information disclosure and to enable the sustainable development of China's thermal power industry.

Keywords: ESG Disclosure, Thermal Power Industry, Dual Carbon Goals, Content Analysis, Chinese Listed Companies

1 Introduction

1.1 Research Background and Policy Imperative

Given that there are an increasing number of geopolitical, environmental, and technological upheavals, high-quality ESG disclosure has become a vital standard for corporate resilience, which is of great significance. In response, governments all over the world, together with China, are increasing ESG conformance and disclosure norms. This situation can be shown by recent regulatory actions in China such as the

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Corporate Sustainability Disclosure Standard No. 1-Climate in Trial (2025), the Sustainable Information Assurance Practice Standard No. 6101 in Trial (2026), and the green development mandate in the 15th Five-Year Plan Outline (2026), all of which are to make the disclosure regular and to push forward the "carbon peaking" goal. Moreover, many countries around the world have already started to compulsorily demand ESG disclosures, which have played a good role in the capital market [1]. It is quite obvious that ESG disclosures have become a key driving factor for the development of enterprises in the new era and have also become a consensus of the times.

1.2 Industry Context: The Urgency of ESG Disclosure in China's Thermal Power Sector

By the year 2025, the Chinese power industry, which accounts for approximately 41% of the country's total carbon emissions, will have become the biggest industrial carbon emission source in China [2]. In this domain, coal-fired power generation, which is the main form of thermal power generation, constitutes 51.1% of China's total power generation and is also the core driving force behind carbon emissions in the power industry. Additionally, a large number of pollution problems are also brought about by thermal power generation, like sulfur dioxide, nitrogen oxides, and particulate matter, and so on [3]. However, electricity is a thing that is lacking in elasticity and is very important; it is expected that the electricity consumption across China in 2026 will grow at a rate of 5% to 6% per year. With the rapid development of artificial intelligence, the demand for electricity in data centers is also growing at the same time, which will drive the generation of electricity. It is estimated that by the year 2030, the power demand of global data centers will double, reaching 945 terawatt-hours. Moreover, the policies made by China to promote the development of high - tech industries have stimulated the development of the domestic artificial intelligence field. In such a situation, it will cause a further rise in coal - fired power generation and then will bring about a very severe ecological pressure. Finally, even if China focuses on the development of renewable energy, there will still be a considerable amount of expenditure related to the stranded coal resources [4]. Under such a background, the thermal power industry is in the core position of China's efforts to achieve the "dual carbon" goal, and the enterprises in this industry are in a critical and increasingly tense situation. On the one hand, they have to ensure a stable power supply to meet the rapidly growing electricity demand of the country; on the other hand, they have to promote low-carbon transformation under the increasing policy and market pressures.

1.3 Literature Review and Research Gap

Since the 1990s, ESG disclosures have been developing greatly, becoming a core governance tool that was previously an edge concern of CSR [5]. This evolution generally includes the voluntary reporting stage, the international standardization stage, and increasingly involves the mandatory implementation stage [6]. In this developmental process, the international disclosure frameworks, which consist of the

Global Reporting Initiative (GRI), the Task Force on Climate-related Financial Disclosures (TCFD), and the ISO 6000 standards, gradually come into being, and their requirements are increasingly tending to be consistent. However, because of the fragmented regulation and the diverse needs of different stakeholders, the coordinated advancement of the reporting standards is indeed rather slow [7]. In developing countries, this challenge is especially prominent, where the disclosure systems are often backward, highly dependent on voluntary reporting, and have always been of poor comparability as well [8]. In addition, in developing countries, improving corporate governance rules and tightening regulatory disclosure requirements are the main ways to enhance ESG standards rather than relying on a very comprehensive environmental system or national-level ecological commitments [9]. Some scholars point out that at present, the ESG disclosure levels of most emerging market countries are positively related to national-level economic, institutional, and cultural characteristics, as well as company-level factors like company size, profitability, and R & D investment [10]. Other scholars have also pointed out that the ESG disclosure level of Asian companies is determined by the combined factors of the economic strength of enterprises, their financial conditions, and the social attention [11]. Regarding the impact of corporate ESG disclosure, a great number of studies show that there are remarkable positive effects it has in enhancing business performance, promoting green innovation, and furthering sustainable development [12,13]. Moreover, the powerful ESG disclosure can reduce the probability of the sharp drop of the stock price of listed companies and also reduce the risks related to accounting practices and market returns [14,15]. Some scholars also point out that effective ESG disclosure can enhance the market value of the company, reduce the cost of debt financing, and also improve the investment efficiency [16]. Moreover, a fairly strong ESG disclosure performance can also bring about the improvement of corporate reputation by enhancing investor attention [17]. However, some literature also points out that the current ESG disclosure, which is troubled with data inconsistencies, serious distortions in data estimation, and a lack of unified disclosure standards, results in extremely poor comparability [18]. Moreover, the differences in information disclosure can result in such situations as excessive divergence in ESG ratings, widespread “green washing”, insufficient institutional constraints, and excessive formalism [19].

Generally speaking, although a great deal of literature elaborates on the driving factors, impacts, and key challenges of ESG disclosure, it is indeed rather deficient at the industry - specific level. The absence of customized research that takes such differences into account is the result, with macro and cross - industry research frequently ignoring the specific operational characteristics, regulatory forces, and actual problems of high - impact industries such as thermal power generation, as mentioned in [16].

1.4 Research Objectives and Contributions

This paper takes into account the background of the constantly changing ESG regulatory environment in China, as well as its “double carbon” and industrial policy goals, and the different pressures that the thermal power industry faces (including the

demand growth driven by artificial intelligence and so on), and then selects 24 listed thermal power companies for analysis. By analyzing their annual reports and ESG reports—concentrating on quantity, format, preparation basis, certification situation, and content—this paper diagnoses present deficiencies and puts forward targeted optimization suggestions. The purpose is to offer references for the formulation of regulatory standards and guide the industry to move towards higher-quality ESG implementation and sustainable development.

2 Empirical Analysis: Status and Characteristics of ESG Disclosure in China's Thermal Power Industry

2.1 Sample Selection and Data

According to the industry classification of the China Securities Regulatory Commission in 2024, this research first identifies the listed thermal power companies. After excluding ST/*ST companies, a sample composed of 24 A - share listed companies is finally formed for analysis, as shown in Table 1. The study focuses on their 2024 ESG (or equivalent) reports and annual reports, with all data manually collected from disclosures published in 2025.

Table 1. List of selected companies in the thermal power industry

No.	Firm Name	No.	Firm Name	No.	Firm Name	No.	Firm Name
1	Huaneng Power International, Inc.	7	Zhejiang Zheneng Electric Power Co., Ltd.	13	Anhui Wanneng Power Co., Ltd.	19	Luenmei Holding Co., Ltd.
2	Huadian Power International Corporation Limited	8	Beijing Jingneng Power Co., Ltd.	14	Jointo Energy Investment Co., Ltd. of Hebei	20	Guangzhou Hengyun Enterprises Holding Co., Ltd.
3	Datang International Power Generation Co., Ltd.	9	Shenzhen Energy Group Co., Ltd.	15	Jiangxi Ganneng Co., Ltd.	21	Guangdong Baolihua New Energy Stock Co., Ltd.
4	Guodian Power Development Co., Ltd.	10	Inner Mongolia Mengdian Huaneng Thermal Power Co., Ltd.	16	Fujian Funeng Co., Ltd.	22	Yongtai Energy Co., Ltd.

5	Shanghai Electric Power Co., Ltd.	11	Henan Yudong Electric Power Holding Co., Ltd.	17	Ningbo Energy Group Co., Ltd.	23	GCL Energy Technology Co., Ltd.
6	Jilin Electric Power Co., Ltd.	12	Jinneng Holding Electric Power Co., Ltd.	18	Zhejiang Fuchun Environmental Protection Co., Ltd.	24	Baichuan Energy Industry Co., Ltd.

2.2 Disclosure Format and Proliferation

Chinese stock exchanges mandate ESG disclosure for certain listed companies (e.g., constituents of major indices and dual-listed firms), requiring reports within four months of the fiscal year-end. Of the five companies that this study selected, five fall under voluntary disclosure: Huaneng Power International, Inc., Huadian Power International Corporation Limited, Datang International Power Generation Co., Ltd., Guodian Power Development Co., Ltd., and Zhejiang Zheneng Electric Power Co., Ltd. Of the other 20 companies, 19 are voluntary disclosures. All of them voluntarily disclosed their 2024 reports (79.17% of the total). In general, the thermal power industry is quite willing to share ESG information. However, as seen in Table 2, a more careful reading of companies' ESG report titles shows that while 50% of companies have standardized the term "ESG Report", around 30% still use "Sustainability Report" as a title. Moreover, three companies do not give ESG reports themselves; instead, they only include a brief mention in Section 5 of their annual reports without professional or detailed disclosures. Thus, there is considerable variation in the reports' titles and formats of the companies, which is a loss in comparability and indicates a lack of unified, industry-specific requirements. This heterogeneity in reports titles as well as formats reflects a late stage, transition of the industry's ESG disclosure journey in which companies are trying different solutions with no single authoritative, industry-specific requirements standard available.

Table 2. Forms and quantity of ESG disclosure

Disclosure Form	Number	Percentage
Section 5 of the Annual Report	3	12.50%
Social Responsibility Report	2	8.33%
Sustainability Report	7	29.17%
Environmental, Social, and Governance (ESG) Report	12	50.00%
Total	24	100.00%

2.3 Reporting Frameworks and Third-Party Assurance

An analysis of the preparation basis disclosed in reports shows that 87.5% of the sample companies gave this information (as opposed to 3 companies that reported ESG content in their annual reports). By covering an ESG basis, the ESG reporting helps us to report more ESG information, more reported content, and, thereby, to make the report more reliable and complete, helping external contributors in decision-making, with more guidelines and references than references [20]. As a result, reports are often too short and not comprehensive enough (with a significant gap in information). The authors found that, out of 24 listed companies, three companies reported 9 bases for financial statement preparation and 3 reported none, while most (75%) reported 4 to 5 bases. Overall, the number of bases selected for the thermal power industry is acceptable, but the problem of excessive or insufficient disclosure remains, and the considerable difference in the number of base disclosures remains to be established. As shown in the figures illustrating the proportion of different reference sources (Figures 1-3).

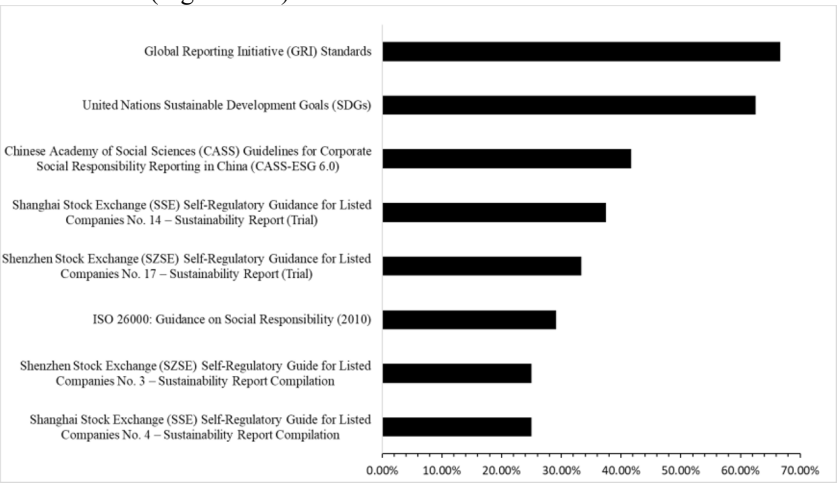


Fig. 1. Proportion of High-Proportion Preparation Bases for ESG Disclosure of Listed Companies in the Thermal Power Industry (Proportion ≥ 20%)

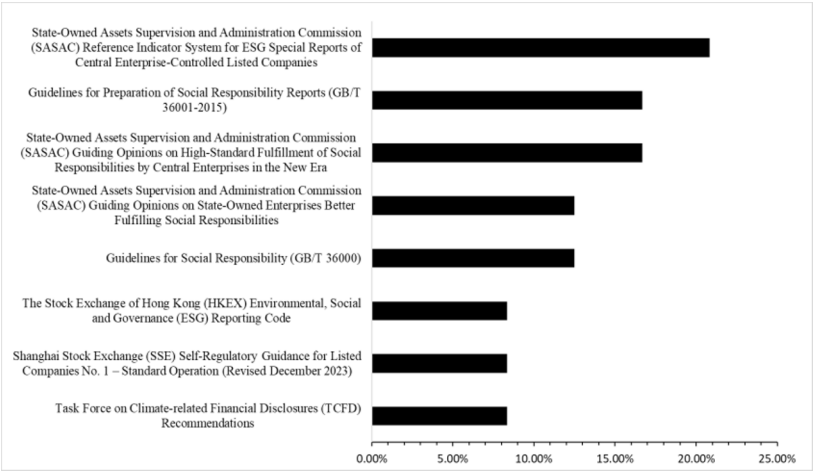


Fig. 2. Proportion of Mid-Proportion Preparation Bases for ESG Disclosure of Listed Companies in the Thermal Power Industry (10% ≤ Proportion < 20%)

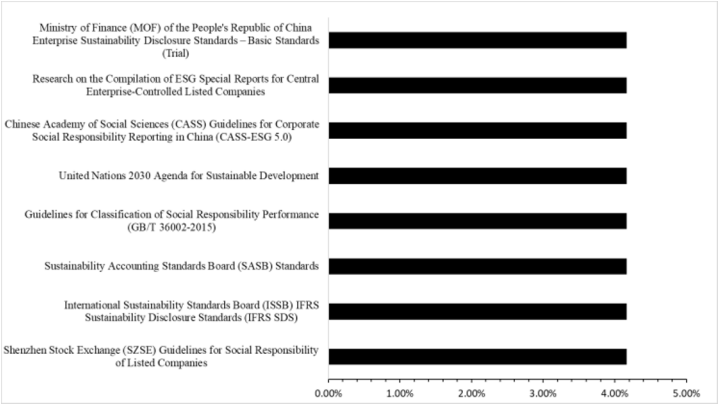


Fig. 3. Proportion of Low-Proportion Preparation Bases for ESG Disclosure of Listed Companies in the Thermal Power Industry (Proportion < 10%)

The most commonly used guidelines currently are internationally recognized ESG disclosure frameworks and policy guidance documents issued by Chinese stock exchanges and the Chinese Academy of Sciences, such as the GRI and SDGs. Among the 24 companies, over 60% used these as guidance. In addition, the Guidelines for Corporate Social Responsibility Reporting in China (CASS-ESG 6.0), published by the Chinese Academy of Social Sciences (CASS), is widely adopted by companies. Documents such as the Self-Regulatory Guidelines for Listed Companies issued by the Shanghai and Shenzhen Stock Exchanges are also cited by a large number of companies, accounting for over 70% combined. In contrast, documents that are too macro-level or excessively specialized are cited by fewer companies as a basis for preparation, for example, the United Nations 2030 Agenda for Sustainable

Development and the Sustainability Accounting Standards Board (SASB) Standards, each of which accounts for a mere 4.17%. Consequently, while mainstream Chinese and international frameworks dominate, companies frequently cite a wide array of additional standards, resulting in a fragmented reference landscape and high preparer autonomy. Consequently, there is still no unified standard or system for ESG disclosure in the thermal power sector, and listed companies retain a high degree of autonomy. This hinders the standardization of ESG disclosure, reduces the comparability of reports among different companies, and makes it more difficult for investors to understand the information.

In terms of third-party verification, listed companies in China's thermal power sector perform poorly, with a very low verification rate, as shown in Table 3.

Table 3. Third-party assurance status of ESG reports

Third-Party Assurance Status	Number	Percentage
With Third-Party Assurance	1	4.17%
Without Third-Party Assurance	23	95.83%
Total	24	100%

Among the 24 listed companies, only GCL Energy Technology Co., Ltd. included disclosures of standard third-party independent verification information in its ESG report, accounting for just 4.17%. For the remaining 23 companies, only Shanghai Electric Power Co., Ltd. provided its rating and 2 expert evaluations, which are not a kind of third-party verification, while for the other 22 companies, there is no third-party content at all, and only internal company evaluations. Third-party assurance rate remains quite low (4.17%) (Table 3) with no independent validation, which is huge since in the literature it provides good report verifications, reduces greenwashing attacks, and has a positive impact on investor perception [20–22].

2.4 Content Analysis: Completeness and Comparability Across E, S, and G Dimensions

This study used 18 material indicators (Table 4) based on policy documents, industry features, international standards (e.g., GRI), and research from industry. This paper classified indicators as qualitative or quantitative, and the main disclosures are discussed in the sample.

Table 4. Material issues of ESG information disclosure of listed companies in the thermal power industry

Dimension	Topic	Topic types
Environment (E)	Greenhouse Gas (GHG) Emission Intensity	Quantitative
	Total Energy Consumption Intensity	Quantitative
	Solid Waste Discharge Intensity	Quantitative
	Renewable Energy Utilization Intensity	Quantitative
	Biodiversity Conservation	Qualitative
	Climate Risks and Mitigation Measures	Qualitative

Social (S)	Employee Compensation and Benefits	Qualitative
	Safety Production Management	Qualitative/Quantitative
	Occupational Safety and Health	Qualitative
	Research and Development (R&D) Investment	Quantitative
	Supply Chain Management	Qualitative
	Customer Service	Qualitative
Governance (G)	Debt-to-Asset Ratio	Quantitative
	Cash Flow to Current Liabilities Ratio	Quantitative
	Integration of ESG into Corporate Strategy	Qualitative
	Risk Management	Qualitative
	Compliance Management	Qualitative
	General Meeting of Shareholders	Qualitative/Quantitative

Environmental (E) Disclosure: Gaps in Critical Metrics. The selected environmental indicators correspond to China's dual-carbon strategy and energy development plans. For the high-pollution, high-emission thermal power sector, relevant disclosures drive energy-saving, carbon reduction, green transformation, and high-quality development, while tackling biodiversity conservation needs.

Table 5. Disclosure Practices of Material Environmental Issues

Dimension	Topic	Disclosed	Undisclosed	Undisclosed Proportion
Environment (E)	Greenhouse Gas (GHG) Emission Intensity	18	6	25.00%
	Comprehensive Energy Consumption Intensity	16	8	33.33%
	Solid Waste Discharge Intensity	13	11	45.83%
	Renewable Energy Utilization Intensity	13	11	45.83%
	Biodiversity Conservation	15	9	37.50%
	Climate Risks and Mitigation Measures	18	6	25.00%

As detailed in Table 5, despite the disclosure of each environmental indicator by most sample firms, the corresponding non-disclosure rates remain persistently substantial, falling within a range of 25.00% to 45.83%. For a sector central to emissions, this indicates significant gaps in environmental transparency. At the same time, the author found that the non-disclosure rates were highest for the "Solid Waste

Discharge Intensity" and "Renewable Energy Utilization Intensity" indicators. Nearly 50% of the 24 thermal power companies did not disclose these two indicators, suggesting that the thermal power industry places less emphasis on solid waste emissions and renewable energy use in ESG disclosure reports. In contrast, the industry places greater emphasis on disclosures regarding greenhouse gas emissions and climate risk management. This suggests that the environmental part of the thermal power industry faces the disadvantage of 'selective disclosure', which excludes sensitive and core indicators.

Social (S) Disclosure: Prevalence with Divergent Quality. The selection of social dimension indicators for thermal power enterprises' ESG disclosure is closely correlated with the industry's high-risk attributes and dual-carbon policy, ensuring power supply security and operating stability, and embodying humanistic values.

Table 6. Disclosure practices of material social issues

Dimension	**Topic**	**Disclosed**	**Undisclosed**	**Undisclosed Proportion**
Social (S)	Employee Compensation and Benefits	24	0	0.00%
	Safety Production Management	24	0	0.00%
	Occupational Safety and Health	21	3	12.50%
	Research and Development (R&D) Investment	22	2	8.33%
	Supply Chain Management	24	0	0.00%
	Customer Service	20	4	16.67%

Table 6 presents the disclosure status of various social indicators for the 24 selected companies. Overall, companies generally performed well in disclosing these indicators; in fact, all companies disclosed three indicators. Even for indicators where some companies failed to disclose information, the number of non-disclosing companies did not exceed five. Among these, the disclosure of "Customer Service" was the poorest, with four companies failing to disclose any customer-related information. However, upon studying the specific content of the disclosures, the author found that due to the lack of a uniform evaluation system and framework, companies exercise substantial autonomy in their disclosures. Consequently, there are considerable variations in both the quantity and quality of information disclosed for the same indicator. For example, Baolihua, Jiangxi Gannan Energy, Guodian Power, Beijing Jingneng, and Zhejiang Energy Power—all five companies disclosed information concerning employee compensation and benefits, but the disclosures were extremely inadequate. Most content consists of only one or a pair of sentences, lacking detailed measures and policies. Huadian International and Suidehengyun fully

disclose this indicator, which is much longer than in cases of insufficient disclosure. There are customer service problems. Some companies have separate sections to explain in the report, while others are not listed separately but mentioned in the stakeholders section. There are relatively large differences in customer service disclosure among various companies. For example, the customer service of Ningbo Energy said that the customer's information is confidential and did not mention other content. Also, for some reports of Inner Mongolia Huadian, the disclosure in the social aspect is relatively simple, and the number is small. Consequently, although social disclosure is widespread, marked variations in depth, specificity, and presentation greatly undermine comparability, with many reports prioritizing form instead of substantive content.

Governance (G) Disclosure: Structural Flaws Amid Formalism. The selection of indicators in the governance section primarily considers whether they fully reflect corporate governance, risk control, and the ability regarding sustainable development, and whether they respond to the core demands of stakeholders.

Table 7. Disclosure practices of material governance issues

Dimension	**Topic**	**Disclosed**	**Undisclosed**	**Undisclosed Proportion**
Governance (G)	Debt-to-Asset Ratio	24	0	0.00%
	Cash Flow to Current Liabilities Ratio	24	0	0.00%
	Integration of ESG into Corporate Strategy	21	3	12.50%
	Risk Management	24	0	0.00%
	Compliance Management	22	2	8.33%
	General Meeting of Shareholders	23	1	4.17%

As shown in Table 7, the 24 thermal power companies also demonstrate relatively good disclosure practices regarding governance. Most companies disclose the aforementioned indicators. Although the Debt-to-Asset Ratio and Cash Flow to Current Liabilities Ratio are not disclosed in their ESG reports, they are mentioned in the companies' annual reports and can be calculated, so they are also considered disclosed. However, as these metrics are commonly used across multiple disclosure frameworks and are considered high-priority indicators by the China Energy Research Society, the author believes they should also be disclosed in ESG reports. Therefore, the completeness of information disclosure in the thermal power industry still needs improvement. Furthermore, comparability within the social sector remains poor, with companies demonstrating strong autonomy and disclosure formats that remain inconsistent and disorganized. For example, Jiangxi Gannan Energy and Inner Mongolia Huadian have not fully disclosed their risk management sections, merely

mentioning the topic and the company's vision, or providing a brief summary. In contrast, Suihengyun A has detailed its risk management section, specifically covering risk identification, risk analysis, and the establishment of a risk response framework. This demonstrates that, even when addressing the same indicators, disclosure practices vary considerably across companies. Furthermore, the issue of "disclosing for the sake of disclosure"—prioritizing form over substance—also persists. For instance, China Datang merely mentioned risk and compliance management in its report without giving detailed elaboration, remaining at a superficial level. This makes it difficult for investors to truly understand the company's specific management methods and philosophy, indicating that both the extent and quality of disclosure need improvement.

Synthesis: Overall Patterns and Structural Deficiencies. Generally speaking, the information disclosure of listed companies in China's thermal power industry is relatively comprehensive in terms of social and governance disclosure, yet it is lacking in environmental disclosure. Moreover, the author also discovers that the interpretations of the indicators by the companies are different, and they also name each part according to their internal regulations and the like. Some indicators are positioned in different sections, and the titles of the environment (E), social (S), and governance (G) disclosure sections are rather weakly related to their corresponding themes, thereby creating a great obstacle for investors to read and understand the report. For example, China Datang changes social innovation and distributed network issues into two separate chapters rather than integrating them into the part of corporate social responsibility. Moreover, the part of corporate governance named "Value Creation" fails to clearly convey the key points of disclosure. On the contrary, companies such as Guodian Power and Jingneng Power organize their reports in line with three distinct parts of environment, society, and governance, thus making the content clear, the structure good, and the readability and comparability relatively strong. This indicates that within China's thermal power industry, there should be unified standards and a series of regulations for preparing the information disclosure reports, which are used to address the flaws of the ad hoc disclosure practices and thus enhance the ESG disclosure quality.

3 Strategic Recommendations for Systemic Enhancement of ESG Disclosure

3.1 Strengthening the Regulatory and Standardization Foundation

Leading regulators—including the Ministry of Finance, the National Energy Administration, the CSRC, stock exchanges, and industry associations—must spearhead efforts to advance ESG disclosure and report comparability by expanding and enforcing mandatory disclosure policies. First, the scope of mandatory disclosure should be expanded. Beyond current index constituents, policymakers ought to concentrate on extending mandates to all major emitters and high-pollution thermal

power enterprises. Second, report titles and structures must be standardized. Authorities should mandate the uniform use of "ESG Report" as the title and require a core "Environment-Social-Governance" tripartite structure, with flexibility for company-specific highlights. Finally, a core set of material topics must be defined. Regulators should issue Guidelines on Material ESG Disclosure Topics for the Thermal Power Industry, mandating disclosure of currently underdeveloped areas such as solid waste management and renewable energy utilization. Consequently, listed companies should be required to disclose using detailed quantitative indicators, the statistical criteria, calculation methodologies, and units of measurement, which must be uniformly prescribed in the sector-specific guideline.

3.2 Developing a Sector-Specific and Dynamic Disclosure Guideline

China should formulate disclosure guidelines for the thermal power industry that integrate national conditions, reference both domestic policy and mainstream international frameworks (e.g., GRI, ISSB), and are customized to the sector's particular operational profile. Second, while conforming to national standards, China should benchmark against, or consult, specific guidelines from mainstream international frameworks (such as GRI and ISSB) to promote the internationalization of the framework and boost its global recognition. Finally, during the drafting process, the company should also take into account the unique characteristics of the thermal power industry—such as its large installed capacity, high coal demand, and slow transition to low-carbon operations—to develop customized, sector-specific disclosure guidelines that can act as effective guidance. A dynamic revision mechanism should be established to ensure that the guidelines change in reaction to market developments, technological innovations, policy changes, and public and expert feedback. Enterprises should be required to use this sector-specific guideline as the primary framework, with a strict cap (e.g., two or three) on the number of additional standards they may reference, to curb the current problem of excessive and disorganized citations.

3.3 Instituting a Strong Third-Party Assurance and Oversight Ecosystem

Robust third-party assurance and oversight are instrumental to ensuring the quality, reliability, and genuineness of ESG disclosures. Building on policies like the 'Sustainable Information Verification Practice Standard No. 6101,' explicit regulations must be established to standardize third-party assurance by defining verifier qualifications, verification scopes, and methodologies. At the same time, China should encourage listed companies in the thermal power industry to actively seek third-party verification and incorporate their willingness to undergo verification and verification results into evaluation criteria for business access and ESG ratings, thereby stimulating the companies' intrinsic motivation [24]. Finally, China should also formulate preferential policies to promote the development of diverse domestic verification institutions, strengthen the cultivation and professional training of verification professionals, break the industry monopoly held by a single dominant overseas verification institution, and enhance the comparability and genuineness of

results [24]. On this basis, China can rely on standardized verification policies and diverse verification institutions to first implement mandatory ESG reporting verification for large state-owned enterprises, industry leaders, and companies subject to mandatory disclosure requirements. A transition period should be established, with the scope gradually expanded to cover all listed thermal power companies, thereby advancing the development of third-party verification in the sector.

Complementing third-party assurance, a solid regulatory framework must be strengthened, incorporating clear incentives for strong performance and tough penalties for noncompliance or fraudulent disclosure. Furthermore, effective regulation has to leverage the different roles of stakeholders and social media. Companies should be encouraged to conduct surveys and solicit feedback, enabling multi-stakeholder oversight and standardization of the authenticity, completeness, and timeliness of corporate ESG disclosures. This approach will help prevent violations such as "greenwashing" and fraud within the thermal power sector.

3.4 Elevating Substantive Disclosure and Purposeful Communication

Listed thermal power companies must provide comprehensive and planned environmental disclosures. This entails not only reporting quantitative indicators (e.g., emission intensity, renewable energy use) in accordance with relevant standards, but also clarifying the underlying transition narrative—how they plan to reconcile growing energy demand with decarbonization goals through efficiency gains, clean energy investment, and technologies such as CCS. On the other hand, thermal power companies must actively disclose key metrics aligned with green transition goals, including detailed emission-reduction roadmaps, the installed capacity of clean energy projects, recycling rates for various types of waste, and investments in and applications of carbon capture and storage (CCS) technology. They should also account for the significant electricity demand driven by AI and translate this demand growth into disclosures explaining "how energy efficiency improvements and technological innovations can reduce carbon intensity while meeting demand".

First of all, it is necessary to require thermal power enterprises to put forward a disclosure framework when disclosing core social and governance indicators, clearly defining the specific form and content of the disclosure. His system needs to specifically embody the substantial content and key numerical indicators. For example, when disclosing risk management information, the enterprise has to specifically work out its risk management frameworks, processes, training, and other arrangements related to the company's risk management, and so forth. Meanwhile, it is necessary to disclose quantitative indicators like the number of risk reports and risk warning letters; this is done to check that kind of superficial disclosure situation and solve the problem of insufficient disclosure depth. Secondly, thermal power enterprises need to additionally place the emphasis on the detailed disclosure of the indicators related to the green transformation at the social and governance levels, so as to address the various concerns at present.

3.5 Applying Digital Technologies for Heightened Transparency and Performance

Significant opportunities have been brought about for thermal power enterprises in the aspect of enhancing the quality and efficiency of environmental, social, and governance information disclosure through artificial intelligence technologies. On the one hand, the company has to take the initiative to develop such a comprehensive platform which combines artificial intelligence technologies such as machine learning, industrial 4.0 innovation, and decision support systems DSS and so on, with ESG reports. By using artificial intelligence to intelligently recognize, extract, classify, and standardize the measurement of financial and non-financial data, and at the same time ensuring real-time support, the company may be able to enhance the accuracy, consistency, and transparency of the disclosure of each part of the report as well [25,26]. In addition, artificial intelligence models can be deployed to verify the internal consistency and can also cross-validate the disclosure content according to the operational data. Such an approach then promotes self-regulation, prevents the phenomenon of "greenwashing" and finally inspires more genuine and comprehensive reports [27].

4 Conclusion

Through a systematic analysis of the 2024 ESG reports of 24 listed thermal power enterprises in China, this research finds that there are several systemic deficiencies in the disclosure practices of this industry. Analysis indicates that the disclosed situation is plagued by the lack of a common framework, inconsistent formats, excessive reliance on different preparation standards, and almost complete absence of third - party assurance. At this moment, coupled with the vague and unbalanced disclosure contents in the environmental, social, and governance dimensions, the comparability, reliability, and overall practicality of the report are severely impaired. Based on the above - mentioned problems, this paper puts forward to imple-ment mandatory disclosure requirements as well as standardized disclosure guidelines; to develop an industry - specific disclosure framework; to limit the quantity and content of the cited compilation bases; to establish a strong third - party verifi-cation and disclosure supervision mechanism; to balance and improve the disclosure contents of all parts of the report; and also to put forward suggestions focusing on artificial intelligence and green transformation. This research, through conducting the specific domain analysis targeting the thermal power generation industry, aims to address a key research gap. These research findings provide practical guidance for companies that are under the dual pressures of accelerating the 'double carbon' goal and the growing artificial intelligence-driven energy demand and need to respond to stricter disclosure requirements, thus facilitating the sustainable transformation of the industry, and also provide meaningful references for relevant policymakers, industry associations, and investors. However, this research has a relatively small sample size, a very short time span, and also relatively limited representativeness. Moreover, it does not conduct heterogeneous analysis or empirical research on enterprises of different regions and

different types. Therefore, the subsequent research may need to be expanded to incorporate long-term and multi-dimensional samples, optimize research methods, establish an industry-specific disclosure quality assessment system, and also deeply study the relationship between ESG disclosure and the green and low-carbon transformation of the thermal power industry.

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