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MANAGING THE SOCIAL RESPONSIBILITY OF CHINA'S RENEWABLE ENERGY DEVELOPMENT

УПРАВЛІННЯ СОЦІАЛЬНОЮ ВІДПОВІДАЛЬНІСТЮ РОЗВИТКУ ВІДНОВЛЮВАНОЇ ЕНЕРГЕТИКИ КИТАЮ

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In this article, the issue of social responsibility management in the development of renewable energy in China is becoming increasingly salient. Regarding the policy environment, the Chinese government has introduced a series of strategies and regulations to support the development of renewable energy, yielding certain results. However, policy implementation and the coordination and cooperation mechanisms of local authorities still require further strengthening to ensure effective policy realization. Enhancing policy transparency and predictability is also crucial for attracting more investors and enterprises to participate in the renewable energy sector. From the perspective of corporate social responsibility management practices, an increasing number of Chinese companies in the renewable energy domain are integrating it into their business strategies. Through technological innovation and management optimization, some enterprises have achieved significant progress in renewable energy consumption. Nevertheless, disparities persist in the level of corporate social responsibility management, particularly among small and medium-sized enterprises.

Keywords: management, renewable energy, energy shortage, energy efficiency, sustainable development, CSR.

У даній статті здійснена спроба розглянути сучасний стан відновлювальної енергетики Китаю, який продовжує залишатися світовим лідером у встановленні нових потужностей з відновлюваної енергії, особливо сонячної та вітрової. Країна демонструє вражаючі темпи зростання у цій галузі, значно випереджаючи інші країни. Загальна потужність сонячних і вітрових станцій, що будуються в Китаї, становить 339 ГВт. У цій статті розглядається це питання та пропонується низка пропозицій і контрзаходів на основі теоретичних досліджень і практичного досвіду. Ми провели поглиблені обговорення з трьох аспектів: політичне середовище, практики управління корпоративною соціальною відповідальністю та комплексний вплив на економіку та навколишнє середовище. Враховуючи глобальну реакцію на зміну клімату, питання управління соціальною відповідальністю у розвитку відновлюваної енергетики в Китаї стає все більш актуальним. Що стосується політичного середовища, уряд Китаю запровадив низку стратегій і правил для підтримки розвитку відновлюваної енергетики та досяг певних результатів. Проте впровадження політики та механізми координації та співпраці місцевих органів влади все ще потребують подальшого зміцнення для забезпечення ефективної реалізації політики. Підвищення прозорості та передбачуваності політики також має ключове значення для залучення більшої кількості інвесторів і підприємств до участі в галузі відновлюваної енергетики. З точки зору практики управління корпоративною соціальною відповідальністю, все більше китайських компаній визнають соціальну відповідальність у сфері відновлюваної енергетики та інтегрують її у свої бізнес-стратегії. Завдяки технологічним інноваціям та оптимізації управління деякі підприємства досягли значного прогресу у споживанні відновлюваної енергії. Проте все ще існують відмінності в рівні управління корпоративною соціальною відповідальністю, і, зокрема, малі та середні підприємства стикаються з обмеженнями в ресурсах, технологіях та можливостях управління. Тому дуже важливо заохочувати малі та середні підприємства до посилення їхньої участі та підзвітності, а також сприяти інноваціям у моделях управління корпоративною соціальною відповідальністю.

Ключові слова: менеджмент, відновлювана енергетика, енергодефіцит, енергоефективність, сталий розвиток, корпоративна соціальна відповідальність.

The formulation of a scientific problem. Corporate Social Responsibility (CSR) refers to the proactive responsibility that a company should take towards the environment, society, and stakeholders while pursuing economic benefits. In the energy sector, the concept of corporate social responsibility focuses more on promoting sustainable development and the social benefits of energy supply. As an industry with high emissions and resource consumption, the energy sector's corporate social responsibility is particularly important in addressing environmental issues and resource utilization. The development of renewable energy provides an opportunity for the energy industry to implement environmental responsibility management. Renewable energy technologies such as wind power and photovoltaics have significant advantages in reducing carbon emissions. According to the International Energy Agency (IEA), global wind and solar power generation has helped avoid over 500 million tons and 350 million tons of carbon dioxide emissions, and renewable energy based energy supply plays an important role in achieving low-carbon economic transformation. Therefore, energy sector enterprises need to pay special attention to sustainable development and environmental protection when implementing social responsibility, in order to promote green and low-carbon energy transformation.

Analysis of the latest research and publications. Research into the development of renewable energy in China is undertaken by the Chinese Academy of Sciences in conjunction with Tsinghua University, Shanghai Jiao Tong University, and the University of Science and Technology of China, encompassing a broad spectrum of topics related to solar, wind, hydro, and bioenergy. The justification and analysis of the costs and benefits associated with the implementation of renewable energy sources, along with investigations into the impact of policy on the development of the renewable energy market, are conducted by contemporary scholars, including but not limited to: Zheng, C. Y., Hou, J. D., Wang, J., Zhang, Y., Jiang, Y., Xu, D., Liang, J., Zhang, X., You, S. N., and Chen, X. Y..

Highlighting previously unresolved parts of the general problem. Undoubtedly, the scientific achievements of scientists on the topic of the article are of great recognition and high value. At the same time, it should be noted that the significant variability of theoretical and practical scientific approaches to studying the essence of the problem of corporate social responsibility in the process of implementing renewable energy requires transparency and appropriate coordination of actions both among local authorities and support from the state.

Statement of the task. This paper systematically analyzes the current situation, challenges and future path of China's renewable energy development, and puts forward policy suggestions to promote the high-quality development of China's renewable energy based on the latest research results at home and abroad. It provides theoretical support and practical reference for China's renewable energy policy-making and industrial practice, and promotes the optimization of energy structure and the realization of sustainable development goals.

Summary of the main material. The following researchers' research in the field of renewable energy not only discussed the current situation of China's development, but also put forward forward-looking views and policy suggestions. Their research provides important theoretical support and practical guidance for the future development of renewable energy in China.

Zheng Chunyang (2024) proposed a "dual track" model for the development of renewable energy in China, emphasizing the synergy of policy incentives and market mechanisms. This paper analyzes the technological innovation path of photovoltaic and wind power industries, and points out China's global leading position in the field of photovoltaic manufacturing. The paper puts forward the Trinity development framework of "policy market technology", and believes that the policy should pay more attention to the establishment of long-term market mechanism rather than short-term subsidies. It emphasizes the key role of local governments in the promotion of renewable energy, and suggests encouraging local enthusiasm through fiscal decentralization and performance appraisal [1].

Hou Jinduo, Wang, J. (2023) discussed the role of renewable energy in reducing carbon emissions, and believed that China is expected to achieve the goal of carbon peak by 2030. Based on provincial data, the regional distribution of wind and solar energy and their contribution to the optimization of energy structure are evaluated. The "regional coordinated development" mode is proposed, and it is suggested to solve the problem of uneven resource distribution through cross regional power trading and UHV transmission technology. It emphasizes the synergistic effect of renewable energy and ecological protection, and suggests that priority should be given to the

development of distributed energy in ecologically fragile areas [2–3].

Zhang Yao(2023) emphasized the key role of energy storage technology in the large-scale application of renewable energy, and proposed the development mode of "integration of wind, solar and energy storage". This paper analyzes the current situation and challenges of energy storage technology in China, and points out that battery energy storage and pumped storage are the main technology paths at present. The solution of "distributed energy storage+ smart grid" is proposed, which is considered to be an effective way to improve the capacity of power grid. It is suggested to increase R&D investment in new energy storage technologies (such as hydrogen energy storage and compressed air energy storage) to meet future energy demand [4].

Jiang Yan (2023) emphasized the role of social capital in the development of renewable energy and proposed the "green finance" support mode. The supporting effects of green bonds, carbon finance and ESG investment on renewable energy projects are analyzed. The financing mode of "government guidance+market leading" is proposed, and it is suggested to attract more social capital to participate through policy incentives. Emphasize the importance of risk management and control, and propose to establish a risk assessment system for renewable energy projects [5].

Xu Dan (2023) believes that digital technology is a new engine for the development of renewable energy, and puts forward the concept of "digital energy". The application potential of big data, artificial intelligence and blockchain technology in the field of renewable energy is analyzed. The "digital energy platform" mode is proposed, and it is suggested to optimize the energy allocation through data sharing and intelligent algorithm. Emphasize the importance of data security and privacy protection, and propose to formulate relevant regulations and standards [6].

Liang Ji (2023) believes that rural areas are the new growth point of renewable energy development, and recommends the promotion of distributed energy systems. They studied the utilization potential of biomass energy and solar energy in rural areas and put forward the policy framework of "energy poverty alleviation". It emphasizes the supporting role of rural renewable energy development for Rural Revitalization Strategy, and proposes to combine energy infrastructure construction with rural economic development. The business model of "farmers+cooperatives+enterprises" is proposed to solve the problem of insufficient funds and technology in rural areas [7].

Zhang Xia (2023) pointed out that the main obstacles to the development of renewable energy in China are the lack of grid capacity and regional coordination. The solutions of cross regional electricity trading and smart grid construction are proposed, which are considered to be the key to improve the efficiency of renewable energy utilization. It emphasizes the importance of electricity market reform, and proposes to guide the rational allocation of renewable energy through the price mechanism. The "multi energy complementary" mode is proposed, and it is suggested to combine renewable energy with traditional energy system to improve the stability and flexibility of energy system [8].

Chen Xiangyu (2023) stressed the importance of international cooperation for China's renewable energy technology upgrading, and proposed to strengthen energy cooperation among countries along the "belt and road". This paper analyzes the cooperation cases between China and Europe in the field of wind power technology, and puts forward the optimization path of technology transfer. Put forward the Trinity international cooperation mode of "technology capital market", and believed that China should enhance its global influence through foreign investment and technology export [9]. It emphasizes the importance of international standard formulation and suggests that China actively participate in the formulation of global renewable energy technology standards.

From 2015 to 2024, the public sector has been an important driving force in China's renewable energy sector, accounting for an important share. State owned enterprises play the role of "ballast stone" in the field of renewable energy. They have strong advantages in capital, technology and resources in the investment, construction and operation of hydropower, large-scale wind power bases, centralized photovoltaic power generation and other projects, ensuring the national energy security and the stable supply of renewable energy. In some projects requiring large-scale capital investment and policy support, such as large-scale offshore wind power projects, state-owned enterprises bear the main responsibility. While the share of the private sector is in a rapid upward trend, and has occupied a considerable proportion in some sub sectors. Tables 1–4 present the latest data on the share of renewable energy from hydro power, wind energy, photovoltaic electricity generation, and biomass energy.

Table 1

Proportion of renewable energy (Hydro power) in China from 2015 to 2024

Year	Installed capacity(Gwh)	Proportion in total installed capacity of renewable energy	Power generation(Twh)	Proportion in total renewable energy generation
2015	3.00	62.50%	1.10	80.62%
2016	3.32	55.33%	1.19	68.44%
2017	3.41	52.46%	1.19	70.35%
2018	3.52	48.30%	1.23	65.9%
2019	3.56	44.84%	1.30	63.73%
2020	3.70	39.61%	1.36	61.17%
2021	3.91	36.78%	1.34	54.08%
2022	4.13	34.05%	1.35	50.00%
2023	4.22	27.83%	1.28	43.39%
2024	4.36	23.10%	1.42	41.15%

Source: [11–12]

Table 2

Proportion of renewable energy (Wind power) in China from 2015 to 2024

Year	Installed capacity(Gwh)	Proportion in total installed capacity of renewable energy	Power generation(Twh)	Proportion in total renewable energy generation
2015	1.29	26.88%	0.19	13.68%
2016	1.49	24.83%	0.24	13.82%
2017	1.64	25.23%	0.31	18.01%
2018	1.84	25.20%	0.37	19.80%
2019	2.10	26.45%	0.41	19.99%
2020	2.81	30.09%	0.47	21.06%
2021	3.28	30.86%	0.66	26.38%
2022	3.65	30.10%	0.76	28.25%
2023	4.41	29.09%	0.89	30.17%
2024	5.21	27.58%	0.99	28.66%

Source: [11–12]

Table 3

Proportion of renewable energy (Photovoltaic power generation) in China from 2015 to 2024

Year	Installed capacity(Gwh)	Proportion in total installed capacity of renewable energy	Power generation(Twh)	Proportion in total renewable energy generation
2015	0.43	9.00%	0.04	2.88%
2016	0.77	12.83%	0.06	3.45%
2017	1.30	20.00%	0.12	6.96%
2018	1.74	23.90%	0.18	9.60%
2019	2.04	25.70%	0.22	11.00%
2020	2.53	27.09%	0.26	11.76%
2021	3.06	28.79%	0.33	13.10%
2022	3.93	32.40%	0.43	15.83%
2023	6.09	40.17%	0.58	19.63%
2024	8.87	46.94%	0.83	24.11%

Source: [11–12]

Table 4

Proportion of renewable energy (Biomass power) in China from 2015 to 2024

Year	Installed capacity(Gwh)	Proportion in total installed capacity of renewable energy	Power generation(Twh)	Proportion in total renewable energy generation
2015	0.10	2.15%	0.05	3.88%
2016	0.13	2.17%	0.08	4.60%
2017	0.15	2.30%	0.08	4.68%
2018	0.18	2.60%	0.09	4.70%
2019	0.23	2.84%	0.11	5.45%
2020	0.30	3.16%	0.13	5.99%
2021	0.38	3.57%	0.16	6.54%
2022	0.41	3.41%	0.18	6.76%
2023	0.44	2.90%	0.20	6.78%
2024	0.46	2.44%	0.21	6.02%

Source: [11–12]

With the progress of technology and the optimization of the market environment, the participation and market share of private enterprises in the renewable energy field continue to increase. In the field of distributed photovoltaic power generation, the participation of private enterprises and residential users is high, and the installed scale of distributed photovoltaic power generation is growing rapidly. Many private enterprises are active in the investment, construction and operation of distributed photovoltaic power generation. In the field of wind power, some private enterprises also occupy a certain market share in small-scale wind power projects and supporting links of the wind power industry chain, such as wind power parts manufacturing. At the same time, many private enterprises are also involved in biomass power generation and other fields. Both promote the rapid development of China's renewable energy industry.

As the world's largest developing country, China has not only achieved significant development in the field of renewable energy, but its largest companies have also carried out extensive activities in this field. Taking State Grid Corporation of China as an example, as one of the world's largest utility companies, it has made significant investments in the field of renewable energy and achieved remarkable results. According to the latest data, as of the end of 2022, State Grid Corporation of China's installed capacity of renewable energy nationwide has reached 387.62 gigawatts, accounting for 23% of the company's total installed capacity. This indicates that State Grid Corporation of China has made significant progress in the development and utilization of renewable energy. State Grid Corporation of China is particularly active in promoting the development of wind and solar energy, especially in the northwest and north China regions, which have become important bases for wind and solar power generation due to their abundant wind and solar energy resources. State Grid Corporation of China has also improved the consumption capacity of renewable energy by constructing ultra-high voltage transmission lines, effectively solving the transmission bottleneck problem between renewable energy bases and consumption centers. In addition to State Grid Corporation of China, China Three Gorges Corporation also plays an important role in the field of renewable energy. As a leading enterprise in the field of hydropower in China, Three Gorges Corporation has been widely involved in the development of hydropower projects worldwide and has actively expanded its wind and solar energy businesses in recent years. According to reports, as of early 2023, the installed capacity of renewable energy in Three Gorges Group has exceeded 100 gigawatts. Three Gorges Group has also laid out renewable energy projects in countries such as Brazil, Pakistan, and Argentina, making positive contributions to the development and utilization of green energy in the local areas. As one of the major power generation companies in China, Huaneng Group has also demonstrated impressive strength in the development of renewable energy. Huaneng Group has accelerated the promotion of wind energy, solar energy, biomass energy and other projects,

Table 5

Overview of private and public share development of renewable energy in China from 2015 to 2024

Year	Public share	Private share
2015	The hydropower sector is dominated by large state-owned energy enterprises. State owned energy enterprises and large power groups in the wind power sector account for a large market share. The public sector and state-owned enterprises in the field of photovoltaic power generation are dominant in the construction of large-scale photovoltaic power stations.	Private enterprises are more involved in the middle and lower reaches of the renewable energy industry chain, such as the installation of small PV modules, operation and maintenance services, and the overall proportion is relatively small.
2016-2018	The public sector continues to make efforts in large-scale hydropower, wind power bases and centralized photovoltaic projects, leading the construction of large-scale energy projects.	Private enterprises' participation in distributed photovoltaic power generation, wind power component manufacturing and other fields has increased, but the overall share is still relatively small.
2019-2021	The public sector plays a key role in emerging fields such as offshore wind power and large-scale energy projects, ensuring energy supply and stable project progress.	Private enterprises have developed rapidly in the distributed photovoltaic market, accounting for a relatively high proportion of the installed capacity of distributed photovoltaic in some regions, and their participation in biomass power generation and other fields has also increased.
2022-2024	State owned enterprises maintain advantages in hydropower, large-scale wind power, centralized photovoltaic and other projects, and also occupy an important position in the construction of new energy storage and other supporting projects.	Private enterprises continue to maintain high growth in the field of distributed photovoltaic power generation, and are active in technological innovation and market expansion in the fields of wind power and biomass energy, and their market share is further improved.

Source: [11–12]

especially during the 14th Five Year Plan period, planning to increase the installed capacity of renewable energy by no less than 15 gigawatts per year. By the end of 2023, Huaneng Group's total installed capacity of renewable energy has approached 90 gigawatts, with plans to achieve a renewable energy installed capacity ratio of over 30% by mid-2025. While actively expanding into the nuclear energy sector, China General Nuclear Power Group is also accelerating the expansion of new energy fields such as wind and solar energy. CGN Group has established multiple wind and photovoltaic power generation demonstration bases nationwide and plays an important role in promoting the green transformation of the power system. CGN Group has also gained a foothold in overseas markets such as Pakistan and South Africa. By delivering advanced technology and concepts, CGN Group has driven the development of the local new energy market. The active layout of these top Chinese enterprises in the field of renewable energy not only demonstrates their competitiveness and innovation capabilities, but also reflects China's important position in the global renewable energy market. The successful experiences of these enterprises provide reference for other developing countries and inject new vitality into the development of renewable energy worldwide. However, despite significant achievements in their activities in the renewable energy sector, these companies still face some challenges. For example, how to achieve more breakthrough development in technological innovation, how to cope with the uncertainty brought by changes in the international market, and how to further enhance one's environmental image and responsibility positioning in the macro context of global energy conservation and emission reduction. Therefore, in future development, these enterprises need to make comprehensive efforts in technological

innovation, market expansion, international cooperation, and other aspects to cope with the rapidly changing global renewable energy market.

Conclusions. Research shows that the development of renewable energy in China has had a positive impact on the economy and environment. Renewable energy reduces dependence on fossil fuels, lowers carbon emissions, and provides new impetus for economic growth. The renewable energy industry continues to expand and plays an important role in creating employment opportunities. It is estimated that by 2025, the number of renewable energy related jobs will exceed 10 million. By implementing energy-saving and emission reduction measures, China's carbon dioxide emissions have decreased by about 20% compared to 2010, making a positive contribution to environmental protection. The social responsibility management of China's renewable energy development is a multidimensional issue that needs to be optimized and improved from policy support, corporate social responsibility fulfillment, and comprehensive benefits. Therefore, we propose suggestions to strengthen the supervision and evaluation of policy implementation, promote innovation in corporate social responsibility management models, and deepen market-oriented reforms. Through these efforts, China will better achieve its long-term development goals for renewable energy and make greater contributions to the global energy transition.

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