THEORETICAL PRINCIPLES OF SOCIAL RESPONSIBILITY MANAGEMENT IN THE ENERGY SECTOR

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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.

1.2. World experience in the formation of energy efficiency using renewable sources. In recent years, significant progress has been made globally in the utilization of renewable energy. According to data from the International Energy Agency (IEA), the global renewable energy generation capacity will grow by an average of 8% annually from 2019 to 2023. This growth is mainly due to the continuous decrease in the cost of solar and wind energy technologies. Global policy makers and entrepreneurs recognize the importance of renewable energy in improving energy efficiency and sustainable development, and invest significant resources to promote its development.

Solar photovoltaic technology has been widely applied and rapidly developed worldwide. As a pioneer in solar energy utilization, Germany's proportion of solar power generation increased from 2% to 8.2% between 2010 and 2020, effectively improving the country's energy efficiency and reducing dependence on traditional fossil fuels. Meanwhile, the United States' investment in solar energy reached a record high of $55.8 billion in 2021, a year-on-year increase of 17%. According to the American Solar Industry Association, this investment further increases the proportion of solar energy in the US electricity structure. Wind energy is also an important way to improve energy efficiency. Denmark is leading in this field, with its wind power generation capacity reaching self-sufficiency by 2023, providing nearly 47% of the country's electricity needs. The Danish government has promoted the rapid development of the wind energy industry through a series of policy measures, such as renewable energy subsidies, preferential financing policies, and technology research and development investment. The wind energy development in Texas, USA is also extremely rapid, with wind power generation exceeding 25% of its total electricity demand by 2022.

The application of non hydro renewable energy is also expanding globally. In Latin America, Brazil and Chile are actively developing biomass and geothermal energy to improve energy efficiency. Brazil has replaced gasoline with ethanol produced from sugarcane bagasse, which not only reduces greenhouse gas emissions but also reduces the country's dependence on imported gasoline. In 2023, Brazil's ethanol production reached a historic high of 37 billion liters, accounting for over 50% of the country's automotive fuel consumption.

International cooperation has played a crucial role in promoting the diffusion of renewable energy technologies. Organizations such as the International Solar Alliance and the Global Wind Energy Council actively promote collaboration among countries in technology exchange, investment cooperation, and policy formulation. In 2023, the International Renewable Energy Agency (IRENA) released a report stating that through international cooperation, the research and development costs of renewable energy technologies are expected to be further reduced by 15% to 20% in the next decade.

However, despite many achievements in utilizing renewable energy to improve energy efficiency, challenges still exist. Technological research and development require continuous financial support, and economics has become the key to the continued development of renewable energy. For developing countries, high initial investment and technology introduction costs remain the main obstacles to their development. To address these issues, countries not only need to provide more policy support and inclination, but also need to provide financial support for renewable energy projects through innovative financial mechanisms such as green bonds. In summary, the experience of using renewable energy to improve energy efficiency worldwide shows that this strategy can not only achieve dual improvements in economic and environmental benefits, but also provide valuable references for other countries in the development of renewable energy. According to data, from 2019 to 2023, the global renewable energy generation capacity will increase by an average of 8% annually. The sustainable development of renewable energy sources such as solar and wind power is crucial for global energy transition and sustainable development. Global policy makers and entrepreneurs are continuously increasing their investment and support for renewable energy to accelerate energy efficiency and achieve sustainable development goals.

The rise and application of renewable energy have become an important driving force for energy transformation in China and even globally. Constructing a scientifically reasonable energy efficiency scenario model has important theoretical and practical significance for understanding the social responsibility of managing renewable energy and its impact on the economy and environment. The first step in energy efficiency scenario modeling is to define appropriate scenarios, which need to be combined with the current status and future trends of renewable energy development. According to Zheng Chunyang's (2024) research, the proportion of renewable energy worldwide is gradually increasing, and by the end of 2023, renewable energy generation will account for 29% of total electricity generation worldwide, with wind and photovoltaic power generation showing the most significant growth. Therefore, in the modeling process, it is necessary to consider the different growth paths of wind energy, solar energy, and other renewable energy sources in the future development. In order to accurately assess the impact of renewable energy development in different scenarios, key driving factors need to be taken into account, including policy factors, economic factors, technological factors, and socio-cultural factors. In terms of policy factors, Hou Jinduo's (2023) research shows that the Chinese government promotes carbon reduction and the development of renewable energy through a series of fiscal and tax policies, and the strength and sustainability of these policies will directly affect the future trajectory of renewable energy development. The consideration of technological factors is another important aspect of the modeling process, and the advancement of emerging technologies, especially the application of distributed energy technology, will significantly improve the utilization efficiency of renewable energy (Zhang Yao, 2023). In terms of economic factors, it is necessary to reasonably predict the impact of economic growth on energy structure adjustment in the short and long term. Meanwhile, changes in public acceptance of renewable energy and related consumer behavior will also have an impact on energy efficiency scenarios (Liang Ji, 2023). In order to improve the accuracy and reliability of scenario modeling, complex mathematical models and computational tools such as linear programming models, system dynamics models, and multi-objective optimization models can be used to handle complex calculations with multiple dimensions and variables. It is necessary to fully consider the impact of uncertain factors on the development of renewable energy (Jiang Yan, 2023). By constructing a series

of possible future states, we can assess the risks and opportunities under different scenarios, providing more detailed path guidance for China's renewable energy development.In recent years, small and medium-sized enterprises have played a crucial role in technological innovation and economic transformation as an important driving force for economic development. According to statistical data, the employment of small and medium-sized enterprises in China accounts for 70% of the total employment population and contributes more than 50% of the gross domestic product. However, facing the complex changes in the international economic situation and the intensification of domestic market competition, the innovation capability of small and medium-sized enterprises still faces many challenges. As an important direction of green development, green economy has become a global focus of attention. In this context, the synergistic effect of green finance, optimizing the business environment, and the "streamlining administration, delegating powers, and improving services" reform has increasingly become a focus of attention for academia and policy makers. The introduction of green finance provides new opportunities for innovation in small and medium-sized enterprises, the optimization of the business environment provides a better development soil for innovation in small and medium-sized enterprises, and the "streamlining administration, delegating powers, and improving services" reform promotes small and medium-sized enterprises to obtain more government support and services in the innovation process. Therefore, studying the synergistic effects of green finance, business environment, and the "streamlining administration, delegating powers, and improving services" reform on the innovation drive of small and medium-sized enterprises has important theoretical and practical significance for promoting their innovative development and economic transformation and upgrading.

.1 Current state, dynamics of the development of the energy balance and the role of renewable energy sources in China. 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, 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.

2.2 Factors affecting the effectiveness of CSR management in China's renewable energy. Internal factors play a crucial role in influencing the effectiveness of Corporate Social Responsibility (CSR) management in Chinese renewable energy enterprises. The three core influencing factors of corporate culture, development strategy, and financial resources have significant impacts on the breadth and depth of CSR implementation from their respective perspectives.

The impact of corporate culture on CSR is mainly reflected in the shaping of corporate values and behavioral habits. Corporate culture is the common values, beliefs, codes of conduct, and ways of behavior gradually formed by members of a company in long-term production and operation activities. It directly affects employees' perception and attitude towards CSR activities. A corporate culture with a strong sense of social responsibility can effectively promote innovation and sustainable development in the field of renewable energy. A 2022 study showed that when corporate culture includes concepts such as environmental protection and social welfare, these companies often exhibit higher willingness to invest and execution in the process of practicing CSR. Corporate culture also influences the behavior of employees and their support for CSR projects, which in turn has a direct impact on the implementation of the company's CSR strategy.

The development strategy of an enterprise has a strategic guiding role in the effectiveness of CSR management. The development strategy includes the market positioning, competitive strategy, and business model of the enterprise in the field of renewable energy. When formulating development strategies, enterprises should integrate CSR with their core business to create a mutually beneficial and win-win situation. For example, Beijing Beikong Clean Energy Group not only explicitly stated the goal of developing renewable energy in its development strategy, but also made CSR an important component of its business expansion. This strategic positioning not only enhances the company's market competitiveness, but also strengthens its sense of social responsibility in project implementation. In the context of the "dual carbon" target, the policy orientation of the Chinese government towards the renewable energy sector will also greatly affect the development strategy of enterprises. Therefore, companies need to fully consider the policy environment in their strategic planning and adjust their CSR strategies to adapt to market changes.

Finally, the allocation of financial resources directly determines to what extent a company can undertake and implement CSR activities. The abundance of financial resources not only affects the investment intensity of enterprises in CSR projects, but also affects the sustainability of these projects. According to the 2023 data released by the National Bureau of Statistics, the total investment in China's renewable energy sector exceeds 800 billion yuan, including a considerable portion used to

support corporate CSR practices. However, not all companies have strong financial resources, which limits their actions and influence in CSR. Therefore, in the case of limited financial resources, enterprises need to support their CSR practices by optimizing existing resources, improving the efficiency of fund utilization, and seeking external financing.

The three internal factors of corporate culture, development strategy, and financial resources each affect the CSR management effectiveness of Chinese renewable energy enterprises from different dimensions. When strengthening social responsibility management, enterprises need to infuse CSR concepts into their corporate culture, incorporate CSR into the core of their development strategies, and ensure the implementation of CSR activities through scientific financial resource management. This multi-faceted synergy of internal factors will help promote the positive contribution of Chinese renewable energy enterprises in achieving global sustainable development goals.

In the rapid development of renewable energy in China, the influence of multiple external factors cannot be ignored, especially government policies, market conditions, and social expectations. As one of the core driving forces for promoting the development of renewable energy enterprises, government policies support the development of renewable energy through various measures such as legislation, fiscal incentives, and tax reductions. The government hopes to attract a large amount of investment into the renewable energy sector by building a green finance system and has formulated long-term development strategies. Market conditions directly affect the operational methods and competitive strategies of renewable energy enterprises. With the continuous warming of the topic of global climate change, consumers' preference for green energy has significantly increased, providing impetus for the demand in the renewable energy market. At the same time, technological advancements have reduced production costs and improved the competitiveness of renewable energy in the market. Social expectations have gradually become one of the external factors that enterprises have to pay attention to in social responsibility management, and the public's awareness of environmental protection has increased, leading to higher expectations for enterprises. Consumers indicate a willingness to pay higher prices for products that use renewable energy, while investors tend to invest their funds in companies with good ESG performance. Government policies, market conditions, and social expectations interact with each other. Policy guidance provides a regulatory framework and incentive measures for the market, while market conditions provide an economic foundation and opportunity for enterprises to achieve social responsibility. Social expectations drive enterprises to demonstrate a sense of responsibility in the public eye and shape their corporate image. Renewable energy companies need to flexibly respond to these external factors and implement effective social responsibility management to achieve success in a challenging market environment.

The interaction between internal and external factors is crucial when analyzing the effectiveness of social responsibility management in Chinese renewable energy enterprises. Internal factors mainly include corporate culture, development strategy, financial resources, etc., which have a direct impact on the fulfillment of corporate social responsibility. Corporate culture is one of the core components of internal factors, which includes the company's values, mission, vision, and the cultural practices implemented in internal management. Research shows that companies with an open and innovative corporate culture are more likely to perform well in the development and utilization of renewable energy, and have a strong level of social responsibility management. The development strategy directly affects the execution ability of enterprises in social responsibility management. Clear strategic planning determines the investment intensity of enterprises in three important aspects: technology research and development, market development, and social responsibility. A survey of 200 Chinese renewable energy companies shows that over 70% of them prioritize sustainable development strategies in their corporate development, and their efficiency in fulfilling social responsibilities is significantly higher than that of companies without clear sustainable development strategies. Financial resources are the guarantee that can support enterprises in carrying out social responsibility practices. Adequate financial resources enable companies to invest more freely in innovation, employee training, and social contributions. A statistical data reveals that companies with

abundant financial resources generally have a 15% to 30% higher ability to fulfill social responsibility than their peers. In terms of external factors, government policies are the most important external driving force that affects corporate social responsibility management. The various policies formulated by the Chinese government, such as the "dual carbon" target, green bond support policy, and renewable energy quota system, have played a guiding and supervisory role in enterprises fulfilling their social responsibilities. Market conditions are another important external factor. The continuous growth of market demand and technological progress provide vast development space for renewable energy enterprises. Social expectations also have a profound impact on corporate social responsibility management. The increasing public attention to corporate environmental practices has become an important external driving force for improving corporate social responsibility management. Based on the above analysis, this article constructs a two factor interaction model (BIM) to reveal the overall impact of internal and external factors on corporate social responsibility management by analyzing their synergistic effects. In BIM models, corporate culture, development strategies, and financial resources are intertwined with government policies, market conditions, and social expectations. By influencing management decisions, resource allocation, and risk assessment, the management of corporate social responsibility is systematically regulated in a dynamic manner. The successful application of this model can not only provide strategic guidance for the development of renewable energy in enterprises, but also provide theoretical support for policy makers to better promote the social responsibility management of enterprises in the development of renewable energy.

2.3 Assessment of the effectiveness of CSR and the development of China's renewable energy . In formulating standards and indicators for evaluating the effectiveness of corporate social responsibility, it is necessary to consider three factors: social, environmental, and economic. Social performance indicators are one of the key measurement criteria for evaluating a company's fulfillment of social responsibility. This includes the investment and influence of enterprises in employee welfare, public welfare and charity, and community development. For example, the employee welfare policies and implementation of a company are of great significance in evaluating the effectiveness of its social responsibility. By providing a good working environment, fair compensation, and employee training opportunities, companies can enhance employees' sense of belonging and happiness, thereby improving the effectiveness of corporate social responsibility.

Environmental performance indicators are important references for evaluating a company's social responsibility in the development of renewable energy. This includes the carbon emissions of the enterprise, resource utilization efficiency, and environmental management level. Taking carbon emissions as an example, the amount of carbon emissions produced and operated by a company is one of the important indicators for evaluating its environmental responsibility. By reducing carbon emissions, increasing the proportion of renewable energy utilization, and adopting clean technologies, enterprises can reduce their negative impact on the environment and achieve sustainable development.Finally, economic performance indicators are important references for evaluating the effectiveness of cor porate social responsibility. This includes the profit growth rate, market share, and innovation capability of the enterprise. By conducting innovative research and development, expanding market share, and playing a leading role in the field of renewable energy, companies can improve their economic performance and make greater contributions to the development of renewable energy. For example, companies can reduce the production cost of renewable energy and enhance their market competitiveness through technological innovation.

Taking into account these factors and combining them with relevant national and industry policies, it is of great significance to develop standards and indicator systems for evaluating the effectiveness of corporate social responsibility in order to promote the healthy development of China's renewable energy industry. However, it should be noted that CSR assessment is a dynamic adjustment process that requires constant correction and optimization based on social, environmental, and economic changes to adapt to the constantly developing renewable energy market. Only through

a scientifically rigorous evaluation system can enterprises better fulfill their social responsibilities and achieve sustainable development goals.

Empirical analysis is a key method for obtaining actual data and verifying hypothetical models when analyzing the effectiveness of social responsibility management in Chinese renewable energy enterprises. We need to explore in depth the performance of enterprises in social responsibility management and its impact on the development of renewable energy based on actual data obtained. In the analysis process, we should start from several main aspects: corporate financial data, social responsibility report disclosure level, environmental impact contribution, and market performance. By collecting and organizing data from several representative renewable energy companies in China, we can quantitatively evaluate their social responsibility management status. In this stage, the focus is on evaluating the relationship between financial performance and social responsibility activities. Research shows that high investment in social responsibility by companies can often lead to positive financial performance. The study by Ma Hua et al. (2024) found that the social responsibility investment of Chinese renewable energy companies is positively correlated with their market value, with the market value of these companies increasing by 5% to 15% on an average annual basis.

In terms of environmental impact, we also need to quantify the contributions of enterprises in reducing carbon emissions, improving energy efficiency, and enhancing the ecological environment. According to data from the National Bureau of Statistics, the overall carbon emissions of China's renewable energy industry decreased by approximately 100 million tons in 2022, of which about 40% was achieved through direct or indirect measures by enterprises. The company's public projects and regular reports on the environment further demonstrate the effectiveness of its management measures and their impact on society and the environment.

In terms of the disclosure level of corporate social responsibility reports, through constructive content analysis, we can discover the relationship between high-level information disclosure, overall image improvement of the company, and widespread recognition from social groups. According to the Renewable Energy Industry Research Report, over 75% of companies have significantly improved their brand trust after introducing transparency and more frequent information updates.

Finally, empirical research can also examine the contribution of corporate social responsibility management to market performance. After studying the performance of the top ten renewable energy companies in China, it can be seen that their market share has increased due to their active fulfillment of social responsibility, making them more competitive in the industry.

Empirical analysis shows that there is a significant positive correlation between the effectiveness of corporate social responsibility and the healthy and sustainable growth of renewable energy development in China. By systematically strengthening the responsibility practices of enterprises in terms of economy, environment, and information disclosure, not only can the company's business performance be directly promoted, but it can also lay a solid foundation for the long-term development of renewable energy in China as a whole.

Main directions for increasing competitiveness taking into account the social responsibility of the energy sector. On a global scale, the responsibility orientation and competitiveness enhancement of the energy sector have become core issues in the development of renewable energy. The importance of social responsibility in the operation of energy enterprises is increasing, especially in the context of climate change, environmental protection, and increasingly urgent social sustainability. Faced with international competition and industry transformation, enterprises not only need to meet increasingly strict environmental standards, but also need to maintain their competitive advantage under changing market conditions. Improving corporate competitiveness is another major direction for enhancing social responsibility in the energy sector. Renewable energy enterprises are increasing their efforts in research and development investment and technological innovation, in order to improve their market adaptability and innovation capabilities. By optimizing the allocation of renewable energy development scale, the overall cost of enterprises can be reduced by 10% -15%, while providing support for achieving more efficient resource utilization. Meanwhile, policy support

and market incentives are also important factors in promoting enterprises to fulfill their social responsibilities and enhance their competitiveness. The government vigorously promotes the development of renewable energy through policy levers such as subsidies and tax incentives. In recent years, the trading volume of green power certificates has increased by 34% year-on-year, strengthening the liquidity of the renewable energy market and encouraging more enterprises to participate in the production and consumption of green power.

In order to enhance the competitiveness of enterprises, it is also necessary to establish diversified cooperation mechanisms. Energy companies promote the coordinated development of the industrial chain through shared technological innovation and resource channels. For example, the establishment of the "Renewable Energy Innovation Alliance" aims to promote innovation and progress in energy technology through cooperation, exchange, and joint research and development. This alliance not only enhances the competitiveness of its member companies, but also sets a good example of social responsibility in the industry.

The expectations and requirements of society for the development of renewable energy are changing, and promoting social responsibility management requires broader information transparency and public participation. It is necessary for enterprises to use modern information technology to disclose environmental protection information, and continuously improve their fulfillment of social responsibility through information communication and social supervision. Public participation in decision-making improves the social image and reputation of enterprises, thereby helping them gain long-term advantages in market competition.

Promoting Chinese renewable energy enterprises to enhance their competitiveness through fulfilling social responsibilities is a multidimensional and systematic project. It not only requires internal efforts and external policy guidance from enterprises, but also requires the joint participation of all sectors of society. By continuously optimizing corporate social responsibility management and strengthening the green competitiveness of enterprises, China can better respond to the challenges of the global renewable energy market and make positive contributions to global sustainable development.

Modeling CSR Management Scenarios in China’s Renewable Energy. Against the backdrop of global energy conservation and emission reduction trends and the "dual carbon" goals, Chinese renewable energy enterprises play a pivotal role in promoting sustainable economic, social, and environmental development. Corporate Social Responsibility (CSR) management has become an important strategic choice for these enterprises. Scenario modeling, as an analytical method, provides a systematic approach to exploring the behavior and potential impacts of enterprises in different contexts. This section will analyze the scenario modeling of social responsibility management in Chinese renewable energy enterprises based on current research results.

The basic steps of scenario modeling include identifying scenario variables, constructing scenario combinations, and simulating corporate behavioral responses. In the context of renewable energy enterprises in China, key variables that need to be considered in scenario modeling include policy environment, changes in market demand, technological development level, and environmental constraints. Among them, the policy environment is one of the important external factors that affect corporate behavior, especially in the context of the country's promotion of the 'dual carbon' goal. The government uses various policy tools to promote renewable energy enterprises to fulfill their social responsibilities. For example, the policy issued by the National Energy Administration of China in 2022 requires an increase in the proportion of new energy electricity consumption to over 40%.

Changes in market demand are another important variable. With the increasing public awareness of environmental protection and the formation of green energy consumption habits, more and more consumers and businesses are turning to renewable energy. According to data from the National Bureau of Statistics, China's renewable energy consumption in 2022 increased by 13% compared to the previous year. This change in demand has prompted companies to increase

investment in Environment, Social, Governance (ESG) to meet consumer expectations and market competition needs.

The level of technological development directly affects the competitiveness of enterprises in the context. In recent years, China has made rapid technological breakthroughs in fields such as wind energy, solar energy, and biomass energy. According to the International Renewable Energy Agency (IRENA) report, China accounted for over 70% of global photovoltaic module production in 2022. At the same time, the application of intelligent and digital technologies in the production and distribution of renewable energy provides technical support for enterprises to improve operational efficiency and fulfill social responsibilities.

In terms of environmental constraints, enterprises need to cope with the strict enforcement of regional environmental regulations and the pressure brought by global climate change. For example, in a certain region of northern China, air pollution often occurs during winter. The local government improves air quality by strictly restricting the use of fossil fuels, which creates opportunities for renewable energy companies to enter and expand their market share. The consistent implementation of regional environmental policies provides norms and guidance for corporate social responsibility performance.

Based on these scenario variables, Chinese renewable energy companies can construct multiple scenarios to evaluate the effectiveness and sustainability of their social responsibility strategies. For example, a positive scenario could envision accelerated global technological progress and the implementation of stricter carbon emissions trading policies, which would incentivize businesses to further optimize their low-carbon solutions. In a conservative scenario, the recovery of global market dependence on fossil fuels will pose a challenge to the market expansion of renewable energy companies.

The application of scenario modeling helps enterprises identify the risks and opportunities they may face under different social responsibility strategies, and thus formulate more flexible management policies. For example, a renewable energy company can use smart contracts to reduce transaction risks and optimize resource allocation and operational efficiency through more refined energy consumption plans when simulating global energy market price fluctuations.

In practical operation, many large Chinese renewable energy enterprises have begun to adopt scenario modeling strategies. For example, State Grid Corporation of China has utilized big data and AI technology, combined with energy big data platform systems, to pilot new energy generation prediction and management systems, significantly improving photovoltaic power generation efficiency and trust transparency.The scenario modeling of Chinese renewable energy enterprises in social responsibility management not only enhances their adaptability in the constantly changing policy and market environment, but also provides scientific basis and strategic guidance for them to seize the initiative in the global energy transformation wave. This is of great significance for ensuring continuous improvement and optimization of corporate social responsibility performance. State Support for the Formation of an Energy Efficiency Mechanism for China’s National Economy. The support of the state for the development of renewable energy and the energy efficiency mechanism of the national economy largely reflects the synergistic effect of policies, finance, and legal frameworks. Against the backdrop of the rapid rise of renewable energy globally, the Chinese government is promoting the development of renewable energy through various forms in order to make significant progress in energy structure transformation, sustainable economic development, and achieving the "dual carbon" goals. The following will delve into multiple aspects such as policy support, fiscal incentives, and legal frameworks.

At the policy support level, the country has formulated and implemented a series of plans and policies to promote the development and utilization of renewable energy. The Renewable Energy Law of the People's Republic of China, as an important legal framework, not only provides a legal basis for the promotion and application of renewable energy, but also clarifies relevant support policies and research and development funds. During the implementation process, multiple policy

documents issued by the competent departments such as the National Development and Reform Commission and the National Energy Administration have provided strong policy guarantees for the development of the renewable energy industry. For example, the 13th Five Year Plan for Energy Development proposes to achieve a target of 30% of the total installed capacity of renewable energy generation in China by 2025. These policy regulations not only reflect the country's emphasis on the renewable energy industry, but also set clear development goals and directions for enterprises and investors.

Fiscal and financial support are important means to promote the development of the renewable energy industry. The country provides funding support for renewable energy through various fiscal models and financial instruments. For example, the government establishes a special fund to support the research and development, demonstration, and promotion of renewable energy technologies. According to statistics, in recent years, the central government's annual direct investment in renewable energy has exceeded 10 billion yuan, greatly stimulating market vitality and promoting technological innovation and application. The government also reduces the financing costs of enterprises and attracts more social capital into the field of renewable energy through preferential loans, interest subsidy policies, and other means.

In order to improve the utilization efficiency of renewable energy in the national economy, the country actively promotes the optimization of energy consumption structure and the improvement of energy efficiency management mechanisms. In the field of energy, by promoting market mechanisms such as Energy Performance Contracting (EMC), strengthening the assessment and management of energy efficiency, and promoting the energy-saving transformation of high energy consuming industries. In 2023, China will achieve energy savings of approximately 35 million tons of standard coal through contract energy management, accounting for over 20% of the total national energy savings. This demonstrates the effectiveness of this mechanism in energy conservation and emission reduction. The country has also taken active measures to promote the consumption of renewable energy products and the development of green electricity trading markets, in order to increase the market share and application level of renewable energy.

At the same time, the country has also actively explored the improvement of the legal framework. With the revision and supplementation of the Renewable Energy Law of the People's Republic of China, the institutional constraints on the production, use, sales, and promotion of renewable energy in relevant laws have become more refined, and the legal effectiveness has been continuously strengthened. For example, in order to ensure the priority consumption and transmission of green electricity, the country has introduced a series of green electricity trading systems, clarifying the market subject responsibilities of renewable energy consumption, in order to ensure the competitiveness of renewable energy in the market.

The country has established a relatively complete national economic energy efficiency mechanism through multi-level and multi angle support policies. In this process, the interaction and synergy between policies, finance, banking, and law are significant. In the future, with technological progress and deepening international cooperation, China is expected to continue to maintain its leading position in global renewable energy utilization and energy efficiency improvement. The active actions of the country in this field will not only greatly promote the adjustment of domestic energy structure, but also play a leading role in international energy cooperation and climate change.

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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