The characteristics and enlightenment of famous energy and power enterprises’ environmental management

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Abstract. This study compares and analyzes the environmental management cases of well-known foreign energy and power companies, and investigates their environmental management operation modes, environmental protection measures and environmental management performance. Based on the survey data, this paper puts forward the main problems existing in the environmental management of China’s energy and power enterprises. The results show that the world-famous energy and power companies have clear environmental protection strategic goals, first-class environmental protection talents and continuous environmental protection technology. Innovative environment protection abilities include extending the pollution prevention chain, innovation waste recycling and reusing methods, carrying out the research of carbon capture and storage technology, and focusing on protecting biodiversity. In contrast, the environmental management systems of some domestic power enterprises are not compatible with the rapid development of productivity, therefore, an innovative environmental management model is needed.

1. Introduction
Since the 20th century, strengthening environmental management has become the inevitable choice for internationally renowned energy and power companies to achieve the sustainable development. With the scarcity of environmental resources, internationally famous energy and power enterprises such as British National Grid Corporation, Korea Electric Power Corporation, and French Electric Power Corporation, etc., put more and more attention to their own environmental protection work, which is mainly the establishment of environmental protection organizations, development the standards of environmental protection business and the disclosure of environmental performance indicators. Through continuous improvement of the environmental management system, environmental performance of enterprises met the social and public requirements for environmental protection. With the continuous improvement of the environmental governance model in developed countries, foreign well-known energy and power companies have taken the lead in realizing the transformation of environmental protection development concepts and environmental protection practices, and setting a model for green energy development for China’s energy companies, which is worthy of reference.

At present, China's energy development faces many problems, such as relatively insufficient per capita resources, poor resource endowments, limited environmental capacity, and low energy use efficiency. As the main responsibility of China's ecological civilization construction, the energy and power enterprises directly affect the realization of China's environmental protection goals. The green development management level of energy and power enterprises needs to adapt to national policies, innovate environmental management models continuously, promote energy-saving and emission
reduction on both the production and consumption side, guide the public to green consumption, save resources, and serve the implementation of the national energy revolution strategy. As a major source of pollution source emissions and energy consumption, the energy and power enterprises are the main responsibility of China's ecological civilization construction.

2. Analysis of the characteristics of environmental management of world-renowned energy and power enterprises

2.1. From the point of view of environmental protection management mode, world-renowned energy and power enterprises are gradually transforming and upgrading from the end-management and prevention-oriented green management era of 1.0 to the initiative-led green development era of 2.0. With the transformation of ecological environment governance mode in developed countries from pollution first and treatment later to pollution reduction and treatment earlier, well-known foreign energy and power enterprises have also gradually shifted to a comprehensive green management mode, reflecting the characteristics of full link, all-round and collaborative. First of all, the green management of the whole life cycle of assets should be implemented. In the enterprise development strategy, during the project planning and design, construction, production and operation, customer service, waste recovery and other business operations, the energy conservation, emission reduction and ecological impact should be considered. For example, in the practice of environmental management, E.ON, a German company, practices the concept of all-link, all-direction clean and green, and promotes the comprehensive green development of concept - technology - management, pre-production - production - post-production, employee-supplier-user. Secondly, a green ecosystem should be built by cooperating with upstream and downstream. For example, national grid evaluates the low-carbon options of suppliers and subcontractors during the tender process, and helps suppliers and users develop energy efficiency plans and provide energy-saving products and services to users.

2.2. From the perspective of key areas of environmental protection, we should actively extend the chain of pollution prevention and control, innovate the ways of waste recycling, carry out research and development of carbon capture and storage technology, and pay attention to the protection of biological diversity.

The typical practices of foreign energy and power enterprises in the key areas of pollution prevention, recycling, low-carbon development and ecological diversity protection are as follows. First of all, recycling methods should be expanding and waste recycling with environmental protection and public welfare should be combined. For example, the Italian Electric Power Corporation (ENEL Group) has launched a circular economy initiative called "social recycling"[1][2], which provided waste wood materials (such as cable drums, accessories, etc.) to local foundations for furniture production, and then sold these furniture to low-income families at a low price. Secondly, the low-carbon development should be driven by technological innovation. For example, the ENEL Group invested nearly 1 billion euros in innovation and demonstration of carbon capture and storage technology in the period 2009-2013. Thirdly, the biodiversity should be protected by taking preventive measures [3]. For example, the French Electric Power Corporation funded laboratories to conduct ecological and hydro biological research, and continuously monitored and tracked changes in the quality of water, grass and milk products around the power plant. Fourthly, the chain of pollution prevention and control should be extended. For example, Exelon Company of the United States attached importance to the sustainable use of water resources in enterprises, formulated and implemented a special watershed strategy and maintenance management plan, used information technology to carry out remote sensing monitoring of watershed water quality, and cooperated with stakeholders in watershed to strengthen watershed management [4].
2.3. From the point of view of environmental protection management system, it has clear strategic objectives of environmental protection, first-class environmental protection talents and sustained ability of environmental protection science and technology innovation, etc.

The management characteristics of internationally renowned electric power enterprises in environmental protection are mainly manifested as follows. First of all, they have an efficient internal management system, which includes a clear environmental vision and strategic objectives, establishment of a standard environmental management system, improvement of the incentive and restraint mechanism, perfect environmental risk management system, and high level of environmental management information. Secondly, they have the extensive influence of green brands. By actively participating in public welfare programs, developing clean energy and carrying out green product certification, the green brand building has achieved remarkable results [5]. Thirdly, they have continuous environmental protection innovation ability. With continuous innovation in environmental protection technology, environmental protection strategy and environmental protection management, the company and industry were driven to save energy and reduce emissions. At last, they have first-class environmental protection personnel, which include a lean and efficient, reasonable structure of environmental protection personnel, and a large number of environmental protection technology backbone and management elite. For example, Italian electric power company has set up environmental protection responsibilities at headquarters, departments, regions, subsidiaries and other levels. The group has nearly 500 full-time employees related to environmental protection [6]. From the perspective of organizational settings, most foreign energy and power companies have specialized environmental protection committees or working groups, and environmental experts are invited to form an environmental policy advisory committee, that provide third-party consultation for the company's environmental protection work. At present, most of the typical enterprises with strategic management type have established a sustainable development committee composed of internal and external experts. For example, the French Power Company's Sustainability Committee is composed of professors and experts and scholars from universities and environmental protection foundations, and is responsible for constructive comments on the company's environmental development strategy.

2.4. In terms of environmental management performance, resource recovery rate, pollutant emission reduction rate, green procurement rate and other indicators have reached the world-class level, with high third-party evaluation satisfaction.

Through measures such as improving technological process, improving equipment utilization efficiency, providing comprehensive energy services and carrying out environmental assessment, the well-known foreign energy and power enterprises have achieved remarkable environmental protection performance in the following aspects. Firstly, the emission level of pollutants is low. For example, the $SO_2$ and $NO_x$ emission intensities of thermal power plants of the world's top 500 energy and power enterprises are 0.03~1.9g/kWh and 0.07~1.5g/kWh in Figure 1. ($SO_2$ and $NO_x$ emission intensities of Central Japan Electric Power Company are only 0.03g/kWh and 0.07g/kWh)[7][8][9], which are far lower than the emission level of China's thermal power industry; $SF_6$ recycling rate reaches 99.4% and ranks the first in the world. Secondly, the waste recycling rate is high. For example, the solid waste treatment rate of electric power in central Japan reaches 99%, and the effective utilization rate of limestone reaches 100%. National grid recycles 96% of its waste. Thirdly, the green purchasing in the whole process is implemented. For example, Central Japan Electric Power Company purchased office supplies, power production equipment, power transmission and distribution devices with the lowest environmental impact, and the overall green purchasing rate reached 94.9%[7].
3. Shortcomings in environmental management of domestic energy and power enterprises

With the urbanization of China, the pollutant emission standards for thermal power plants have become increasingly strict. In addition, the resources of substation sites and transmission line corridors are more and more scarce. At present, air pollution, noise, landscape effects, and electromagnetic, etc., have become prominent environmental issues, which power companies are facing with. As the main responsibility of environmental protection, the domestic energy and power enterprises need to innovate the environmental management mode to meet the requirements of ecological civilization construction. From the perspective of environmental protection management of most domestic energy and power enterprises, the prominent problems are mainly manifested in the following aspects.

3.1. The enterprise environmental management system does not adapt to the rapid development of productivity, so it needs to innovate the environmental management mode.

At present, most domestic energy and power enterprises still adopt the decentralized management mode dominated by end-governance. The overall planning and decision-making ability of the environmental protection management department is not strong, so it is difficult to play a leading role in the overall situation. In some enterprises, the environmental protection goal has not been incorporated into the enterprise development strategy system, and the environmental protection management system has not been improved in step with the rapid development of enterprise productivity. The status of corporate environmental information disclosure can reflect the level of enterprise environmental management. The status of corporate environmental information disclosure can reflect the level of enterprise environmental management to a certain extent. As of 2018, the total number of companies that disclosed social responsibility reports is less than 900, of which only 468 enterprises exposed environmental information in Figure 2. The less disclosure of corporate environmental information reflects the lack of environmental management to some extent [8].

3.2. The construction of environmental protection talent team and investment in environmental protection scientific research are not enough to support the environmental protection work of enterprises.

Some enterprises are short of environmental protection management personnel with low professional quality. There is a big gap between the basic quality and vision of environmental protection management personnel and the strategic development goals of enterprises. Enterprises lack theoretical and applied research in environmental protection management, research on laws and regulations, and standard formulation, as well as opportunities for international cooperation and exchange. Input in technical intelligence collection and analysis is insufficient. Enterprises do not invest enough in environmental protection technology, so it is difficult to ensure the systematization and continuity of
environmental protection research work and form long-term and overall scientific and technological support capacity [10].

![Graph](image)

**Figure 2.** Corporate social responsibility report (CSR) and environmental information (ECSR) disclosure.

At present, most domestic enterprises still regard environmental protection as a simple cost investment, that environmental protection investment is mainly driven by external pressure[11][12]. Therefore, corporate environmental management staff is insufficient, that environment managers are sometimes part-time, and the changes are frequent. There is the certain gap in professional quality, resulting in the lack of continuity and stability in environmental protection work. Take Hubei Electric Power Company as an example, where a part-time environmental protection personnel of its local city company is responsible for a lot of daily work such as environmental assessment, water conservation, approval and special acceptance of the construction project, environmental monitoring, environmental treatment, hazardous waste disposal, environmental protection publicity and communication, and handling environmental dispute, etc. The problem of insufficient allocation of environmental protection personnel became more and more prominent. It is difficult to adapt to the current situation of decentralization of environmental protection administrative examination and approval. There are certain risks in the future.

3.3. Environmental protection work is still focused on results management, in the procurement of equipment, construction, equipment decommissioning and other links exist environmental protection blind spots.

In order to fulfill the environmental protection procedures of the project, the majority of energy and power enterprises' environmental protection work is still mainly focused on environmental impact assessment and acceptance, and mainly on results management[13]. In engineering design, equipment procurement, equipment decommissioning and other links, there are problems such as process control and non-standard bidding qualification examination. An ecological industrial chain has not been established to extend upstream and downstream suppliers and users with energy and power enterprises as the core[14].

For example, the environmental protection work of the power grid runs through the whole process of planning, feasibility study, design, construction, operation, decommissioning and other power grid construction projects. The environmental protection business involves development, construction,
transportation inspection, materials, law, and outreach. During the Twelfth Five-Year Plan period, the environmental disputes of power transmission and transformation projects in the State Grid Corporation’s operating area were about 1,305[15]. The complaint disputes were mainly concentrated in developed areas such as Shanghai, Jiangsu, Anhui, and Fujian. The main reason was that some residents who lacked understanding of power transformation facilities believed that power transformation facilities can produce electromagnetic radiation in Figure 3, which is harmful to the health of the body.

![Figure 3](image)

**Figure 3.** Statistics on environmental complaints and disputes of various voltage level projects in the State Grid Corporation business area.

4. The conclusion and suggestions
The green development of the enterprise is based on several factors, which include to have a comprehensive understanding of the impact of the construction and operation of the enterprise on the environment, to adhere to the requirements of environmental protection and resource conservation in the whole process of business development such as development strategy, planning and design, construction, production and operation, and customer service, to implement the concept of environmental protection and resource conservation, to fully participate in green management, to adhere to the implementation of green management of asset life cycle, to implement resource conservation and environmental friendliness requirements throughout the life cycle, to adhere to cooperation with stakeholders to jointly promote environmental protection, and to establish the comprehensive green management system with standardized management and continuous improvement.

It is suggested to take the lead in promoting producer extension system and consumer sharing mechanism in the energy and power industry, introduce policies and schemes to encourage enterprises to innovate in environmental management mode, and promote the construction of green industrial chain or ecological circle. We recommend industries and enterprises to set green standards for procurement, subcontracting and distribution, and address the environmental protection blind spots existing in the procurement and decommissioning of equipment by domestic enterprises. We recommend enterprises to explore new models of waste recycling, disposal and utilization, and explore new models of combining environmental protection with public welfare.

We regularly carry out peer benchmarking of environmental performance of large energy and power enterprises at home and abroad, and use market and government means to encourage and
restrain enterprises to continuously improve their environmental management performance. In the performance appraisal system for the heads of central enterprises, the weight of environmental performance indicators should be increased or improved to promote the fundamental change of enterprise development philosophy. We recommend enterprises to increase investment in environmental protection and upgrade energy-saving technologies through taxation, special funds, credit support and emission rights trading. The guidance and training opportunities for enterprises in environmental protection management, research on laws and regulations and formulation of environmental protection standards could be helpful to improve the environmental management of China's energy and power enterprises.

Acknowledgement
This research was funded by the State Grid Corporation's science and technology project “Research on Strategic Planning Technology and Evaluation Method of Green Power Development Based on Ecological Civilization Thought”.

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