

10.2 Analysis of world experience in state regulation and reform of the thermal power industry

In the context of increasingly harsh global social environment, energy conservation, emission reduction and environmental protection has become an important issue of global green development. As an important sector in the field of energy, the heating industry's high energy consumption, high pollution, low efficiency and other problems have become one of the outstanding problems that need to be solved globally. Therefore, governments have taken measures to regulate the heating industry in order to reduce energy consumption, reduce pollution and protect the ecological environment.

It is of great purpose and significance for the government to regulate the heating industry. On the one hand, it can protect the environment, reduce energy consumption, improve resource utilization and promote sustainable economic development. On the other hand, government regulation can guide social and market behavior, regulate the development of the industry, improve the development level of the industry, and promote the sustainable development of the country and the industry.

10.2.1.1 Regulation reform and development of heating industry in European countries

1.1.1 Germany

The German government attaches great importance to how to collect heat cost and how to formulate price system. As early as 1981, on the basis of the energy Conservation Law established by the state in 1976, Germany promulgated the provisions on heating charging. The law extended the requirement of installing household heat metering devices to all new and existing apartments of multi-storey buildings. Residents paid according to the measured heat consumption, but limited to the technical conditions at that time, the law did not stipulate the compulsory heat metering technology. After reunification, the law was revised to require that high-rise residential buildings in Germany be fitted with heat-metering devices by 1995. So far,

about 98 percent of apartment residents have installed heat metering devices and pay heat fees based on the metering[519].

The system reform of heating industry in the former East Germany went through difficulties and finally established the heating system based on heat metering and charging. In the early days, urban heating in East Germany was charged by area, and the indoor heating system was a single pipe vertical sequential system under government control. In order to implement the charge by calorimeter in the whole country, residents' original indoor heating single pipe vertical sequential system must be reformed[520].

The main factors affecting the amount of fixed cost are the heat transfer loss of hot and non-hot walls in public buildings, the investment in heat network construction, the location of each floor and the orientation of the house, and so on. This part of the cost is rigid.

Here, for the fixed cost of heat cost, European countries have no uniform regulations on the above proportion, usually between 30% and 50% to choose. But began to implement heat metering charges, fixed charges charged a higher proportion, but generally not more than 50%. Up to now, the measurement of heat charge in the German heating industry has achieved the goal of accurately measuring the actual heat used by residents under the impetus of the innovation of heat metering technology. The measurement of heat charge still adopts two heat production charges, and the fixed charges have been subsidized by the government. The fixed heat charges actually paid by residents account for less than 20% of the whole heat charges.

1.1.2 France

Before the oil crisis, energy in France was very cheap. The heating cost of heating enterprises is relatively low, and the heating cost for consumers is almost negligible. So for the whole heating related industry, there is no awareness of energy conservation. Both housing design units and heating construction units are trying to use the cheapest heating equipment, heating enterprises do not pay attention to improving heating efficiency, and do not consider the use of energy-saving equipment.

After the outbreak of the oil crisis, heating costs and heating costs rose sharply, which prompted the French government, heating industry, consumers and other stakeholders to adopt a series of methods to reduce heating costs and reduce heating energy consumption. To this end, the French government set up the "Energy Conservation Bureau", specializing in the study of energy-saving measures, and through legislation to ensure the implementation of these measures, at the same time to widely publicize the awareness of energy conservation and adopt a lot of energy-saving measures: first, set up a high insulation standard for building materials, to provide financial help for building insulation improvement projects; Second, in order to ensure the normal use of heat for residents, the mandatory installation of temperature control equipment for all new and old buildings, so that the heat supply is stable.

In France, at present, only about 1/3 of the households use the household heat meter and evaporation dispenser to calculate the heat fee, and about 2/3 of the residents are based on the overall heat meter reading at the thermal entrance of the building, according to the user's living area to share the heat fee. Although the French government introduced this metering charge model from the original point of view is an energy-saving measure caused by the energy crisis and forced to take, but in the implementation process of this measure, the French Energy Conservation Bureau has done many tests to verify the energy-saving effect, the fact shows that the energy-saving effect is obvious, effectively improve the heating efficiency of the heating industry. The Energy Administration has conducted experiments that show energy savings of 15 to 25 percent in the two years since metered heating was fully implemented. The French government officially puts the figure at 15% and uses that as the basis for its economic return on investment[521].

The characteristics of district heating in French cities (take Paris as an example) can be summarized into the following three aspects: First, the distribution characteristics of main heat sources. Paris pays attention to energy conservation, environmental protection and efficiency in heating. Under the premise of constantly improving the efficiency of heating industry, Paris constantly develops a series of scientific research activities such as new energy and regenerated heat source, and

transfers heating energy to gas, natural gas and waste incineration. Second, the charging profile of central heating. There are two main modes of charging for district heating in Paris, which are recognized by heating enterprises and consumers. The two charging modes are: one is fixed charging mode, and the other is proportional charging mode. Third, the heating method. The main way of central heating in Paris, France is steam central heating. Making full use of renewable energy and cogeneration is also a major feature of Paris heat supply.

1.1.3 Ukraine

As an important part of the Ukrainian economy, the Ukrainian heat supply industry is of great importance to the economic development and social stability of the country. However, the heating industry in Ukraine faces a series of challenges, such as low efficiency, high energy consumption, high maintenance costs and high heating prices, due to long-standing regulatory regulations and problems with the operation mode of heating enterprises.

The main problems in Ukraine's heating industry lie in its market structure and regulatory system. In the traditional sense, the heat supply industry is monopolized by state-owned heat supply enterprises, while the government implements a package of price and quality supervision, resulting in the actual price of heat supply service can not reflect the real supply cost, which leads to the waste of energy and resources in thermal power plants. The resulting economic losses and environmental pollution also make the economic sustainability of the heating industry in Ukraine unguaranteed.

The Ukrainian heating industry is facing major challenges in regulatory reform and development as the Ukrainian government works to strengthen energy independence and sustainable development. The following are the main aspects of regulation reform and development of the heating industry in Ukraine:

First, separate electricity and heat markets. The government plans to separate the electricity and heat markets and introduce market reforms in each. In the heat market, the government will promote market regulation and standardized operation, strengthen supervision and supervision, establish a legal competition mechanism, protect consumers' rights and interests, and encourage more private investment.

Second, improve energy efficiency. The Government of Ukraine has adopted a series of policy measures to encourage and support heating enterprises to implement energy-saving and energy efficiency improvement measures in order to reduce energy waste and environmental pollution and reduce heating costs.

Third, promote the use of renewable energy. The Ukrainian government is also pursuing a renewable energy development policy, encouraging heating companies to switch to renewable energy sources, such as solar energy and geothermal energy, through national energy policies, regulations and financial support.

Fourth, strengthen supervision and safety management. The Ukrainian government has strengthened the supervision and safety management requirements of heating enterprises, and strengthened the safety standards and maintenance requirements of heating facilities to ensure the safety and reliability of heating operations.

The reform and development of Ukrainian heating regulations is an important way to transform Ukrainian heating industry into a green and sustainable development. The government shall, in light of the actual situation, formulate reasonable policies and measures to gradually guide and encourage the Ukrainian heat supply industry to achieve sustainable development and improve its business level, so as to make its own contribution to the sustainable economic development and social stability of the country.

1.1.4 Russia

Russia's heating mode is mainly based on central heating. As a world power, Russia occupies an extremely important position in the world from the aspects of comprehensive heating technology.

Since the 1930s, the Soviet Union has regarded heating industry as a major national policy in a series of major conferences as an important agenda. Therefore, over the past decades, a number of professionals and scientific and technical teams engaged in hot power engineering have been trained and established. After World War II, the Soviet Union's energy production skyrocketed, quickly becoming the largest in Europe and second in the world, after the United States[522]. Electricity production and

consumption double every 12 to 13 years, and heat production and consumption double every 15 to 18 years. 80% of the country's heat consumption is supplied by central heating sources, more than half of which rely on thermal power plants[523].

Although Russia is rich in energy resources, with the development of economy, Russia's heating industry consumes a lot of energy, and Russia attaches more and more importance to energy conservation. In general, the characteristics of the development of district heating in Russia are as follows:

First, Russia considers cogeneration to be the highest and most perfect form of district heating. Taking the thermal power plant as the main heat source for central heating and the thermal power plant as an important part of the power industry, various measures have been taken to improve the economy and reduce the consumption of specific fuel for power generation.

Second, the research solves the design, economic operation, optimization and adjustment of the heat network when a variety of loads, especially the heating and hot water supply loads coexist, the connection form between the heat network households and the heat network and the water conservancy conditions and other problems.

Third, developed and applied a series of central heating technology and equipment. Energy conservation and environmental protection are closely linked. The research on nuclear heating technology and high energy fuel has also achieved results.

10.2.1.2 Reform and development of heating industry regulation in Asian countries

1.2.1 China

With the increasing shortage of energy and the enhancement of environmental awareness, the heating industry has gradually become the focus of social attention. In China, the heating industry has always been in the predicament of high pollution, high energy consumption and low efficiency. Therefore, the reform and development of industry supervision have become the necessary measures and important means for China to save energy and reduce emissions and build a beautiful China. The heating

industry generally includes boiler fuel, radiator and pipe parts[524]. In the past, there were the following problems in the regulation of China's heating industry:

First, the lack of regulations is not perfect. Although there are relevant policies and regulations, such as "boiler room management Measures", "heat dissipation equipment energy-saving evaluation code", but the current legal system is not complete, need to be further improved[525].

Second, the standards are not uniform. Due to the different conditions of the heating industry in China, the industry standards lack of uniformity and consistency, which makes it difficult to achieve standardized and standardized management.

Third, supervision lacks strength. Management departments lack professional skills, supervision is not strong enough, and enterprise self-discipline is not strict, leading to the existence of safety risks in some enterprises and serious confusion in environmental standards[526].

In response to these regulatory issues, China has adopted the following measures:

First, establish sound regulations and standards. Government departments should actively promote industry-related regulations and standards, adhere to the "system first, then practice" when formulating standards and management methods, adopt the way of multi-party communication and widely solicit public opinion, so that every industry participant can jointly abide by.

Second, we need to strengthen oversight. Governments at all levels should strengthen industry supervision in accordance with the law, increase the punishment of enterprises and producers for violations of laws and regulations, and at the same time, strengthen relevant supporting policies to encourage good enterprises and market access.

Third, promote smart and clean energy equipment. New technologies, such as intelligent heating technology, gas-fired boilers, wind and solar energy, can greatly reduce energy consumption and pollution, and their popularization and application will promote the adjustment of energy structure and promote the sustainable development of green economy in the whole society.

The development of China's heating industry regulatory reform needs the cooperation of the government, enterprises and the market to form a multi-dimensional force such as deleveraging, subtraction quantification and regulation institutionalization. On the basis of strengthening supervision, we should actively introduce new technology, establish a comprehensive mechanism and complete legal system, promote the standardization and professional development of heating industry, benefit the society and protect the ecological environment[527].

1.2.2 South Korea

The development time of South Korea's heating industry is the same as that of China. Its rapid development in just a few decades is inseparable from their scientific regulation. South Korean law stipulates that heating energy consumption must be measured by hot water flowmeter. South Korea initially used household heat meters, and later passed a law allowing the use of hot water meters for household metering. In South Korea, about 600,000 customers are heated and supplied with domestic hot water by district heating systems throughout the year. The District heating Company is responsible for the installation of the heat exchange stations and heat meters, and is responsible for the monthly heating and domestic hot water fees to the housing company, which is responsible for the operation and maintenance of the heat exchange stations and the collection of monthly heat fees from the users. Each heat bill consists of a fixed part and a variable part. In the case of household distribution, the variation is equal to the heat supplier's heat price multiplied by the heat meter reading plus 10%, which takes into account the network loss between the heat exchange station and the points of consumption.

South Korea has its own unique way of measuring heat. South Korea is the only country with a law requiring the use of hot water flowmeters to measure heating energy consumption. In the beginning, South Korea stipulated that centralized heating buildings must use household metering, and then switched to hot water meters for household metering. The main reason for this change is that the performance of the heat meter developed at that time is poor, and because of the poor heating water quality to accelerate the wear of the flow metering components, so the heat meter must be

repaired frequently. And the battery in the meter has a life expectancy of only five years. At present, the heating method in South Korea is mainly using low-temperature hot water floor radiation heating. The flow rate of circulating water is large and the temperature difference is small, so the accuracy of heat consumption allocation calculation of hot water meter is greatly improved, and the cost of this hot water meter is low.

1.2.3 Japan

The development of district heating system in Japan is fast, and the development is different in different regions. Japan's heating industry uses a quota system and a two-step charging system. The reform of heating supply in Japan mainly focuses on the reform of charging system. For different heating properties of users almost all use two - step charging system. For some customers with small differences in the amount of heating, the use of a single quota charging system. Heating expenses are determined by the following expenses, that is, on the premise of appropriate heat supply and demand planning, from the total calculated manufacturing expenses, selling expenses, general administrative expenses and non-operating expenses, minus the balance of the amount to be deducted, plus a reasonable amount of profit.

In Japan, a large number of customers are the most basic force to decide the charging system. Whether to establish a charging system that residents think is fair and reasonable is the main purpose of the Japanese government to control the price of heating industry. At present, there are two kinds of charging in the heating industry in Japan: the quota system and the two-part charging system (the fixed fee plus the actual heat metering fee). The characteristics of the quota system are: mainly applicable to some users with small differences in the amount of heating, eliminate the cost of the calculation of complex heating amount and heating fees, only need to be simple for the price is cheap, the use of a single quota system, and the regional heating almost all use two charging system. The main feature of the two-part system is that a fixed portion is used as the basic cost of heat, while a variable portion is charged according to how much heat the household actually uses. The basic price of heating is based on the proper

heat supply and demand market, the normal operation of heating enterprises and the consumption level of consumers.

Generally speaking, the heating condition in Japan has the following characteristics:

First, the rapid development of the district heating system, especially in the Kanto region with Tokyo as the center, currently accounts for 60% of the country's district heating area.

Second, the district heating system in Japan is mostly small-scale and mostly used in office buildings and other business facilities, with a small proportion used in residential buildings.

Third, Japan's heating system attaches great importance to energy conservation and environmental protection. Japan is one of the industrialized developed countries with the most scarce energy resources in the world, but its comprehensive energy utilization efficiency is also one of the highest in the world. The Japanese government has invested heavily in the development of a number of energy-saving and environmental technologies, such as thermoelectric supply systems, heat storage tanks and the use of urban waste heat as energy sources, to improve energy efficiency.

10.2.1.3 Experience of government regulation of heating industry in foreign countries

In foreign theoretical circles, the research scope of heating industry is mainly limited to the industry that directly provides heat energy for cities that need heating in winter. It is believed that the main heating modes include: combined heating, coal-fired boiler heating, electric heating, heat pump unit heating, cogeneration of heat and power, large heat source central heating, etc. It can be divided into coal heating, oil heating, natural gas heating, electric energy heating, nuclear heating, geothermal heating, solar heating and so on. Central heating includes cogeneration, central boiler house, industrial waste heat, geothermal, nuclear, etc. Urban central heating system consists of three parts: heat source, heat network and heat user. Heating facilities in cold northern regions is one of the very important infrastructure, is an important part of public utilities, is the basic needs of urban residents, it plays a pivotal role in the

comprehensive development of urban economy and society. It is precisely because the heating service has the characteristics of low substitutability, non-exclusivity, public welfare and publicity, so it has the characteristics of quasi-public goods.

Heat is a commodity, and heat prices consist of costs and profits and taxes. The calculation method of heating costs is generally the same in different countries, and the difference is in the value of profits and taxes. The European district heating industry does not aim at profit, but operates according to commercial behavior. All its profits are used to repay loans, invest or reduce heat charges of heat users, and to improve the investment of heating system, improve the efficiency of heating and transmission, reduce heat consumption and reduce costs.

In foreign countries, France, Germany, Russia and other countries have successfully reformed the heating industry system. From the development of heat meters, the formulation of standards, the detection and use of instruments, the collection of heat charges and the regulation of heating prices, the development of the heating industry and the government regulation system in these countries have been quite mature. The system reform of heating industry involves a wide range of areas and a complex system. Some foreign countries have also gone through a tortuous course in the system reform. For example, Germany, South Korea, Japan and other countries mainly reform the heating charging system and charging methods. While carrying out the above reforms, they have successfully explored the transformation of the investment and financing system of the heating industry[528]. The development of heating industry in European countries is very successful, which is worth our reference.

These current heating countries have taken measures suitable for their national conditions to stimulate users to use heat according to demand, and have achieved obvious energy-saving effects and social justice. The implementation of household metering of electricity, gas, heating and water, household heat metering charges are relatively advanced countries, such as Germany through the law to enforce the introduction of heat metering charges, formulate basic provisions for heat metering, implement preferential policies to encourage heat metering charges.

For the natural monopoly industry, especially the reform of public utilities in various countries, the overall goal of local government regulation should also be to realize the optimal allocation of resources and maximize social welfare, and the methods and approaches to achieve this are to combine the competitive market mechanism with government regulation and make it operate effectively. Under the conditions of market competition and on the basis of government regulation, The government regulation system should be established to form and maintain an effective competitive market, and the balance of government regulation should be constantly adjusted and realized by using the two forces of market and government.

The content of government regulation in foreign heat supply industry is extensive, including: market entry (exit) regulation, price regulation, legal regulation, quality regulation, environmental regulation, etc. As a special commodity, heat can not be measured by the performance, life, reliability, safety, economy and other standards of industrial products, which also increases the operational space of regulating the heating market government regulations, but also leaves room for institutional innovation for government intervention in the heating industry[529].

Through the practice of government regulation of heating industry in typical Eurasian countries, several enlightenments can be drawn:

First, we will improve the pricing system for heat supply. Heating price is the most sensitive topic for residents and heating enterprises. Perfect heating price system is the key to promote the stable and healthy development of heating industry. In order to make heat really become a commodity, we must change the phenomenon of heat cost and heat disconnection, really can realize how much heat, pay how much money, this must do the household control of heat, the use of heat meter for household measurement. From the process of the international heating reform, the heat charge collection method basically goes through two stages, one is according to the building area charge, the other is according to the use of heat charge, that is, metering charge. And in the metering charge, the composition structure of the heat price is clearly proposed, that is, the components of the heat price are fixed cost and floating cost[530]. It can be seen that for China, which is charging by area, heat metering charge is the

only choice, and it is imperative to carry out heat metering charge. The reform practice of two-part heat charging system will be further deepened, opening up a way for the establishment of a perfect heating price system.

Second, strengthen the heat supply industry technological innovation. Many European countries have done a lot of scientific research in the field of district heating, and the government's strong support has enabled the heating technology and products to be transported overseas. For example, Ivo Group of Finland is a multinational group engaged in environmental protection and energy conservation research. Its main task is to provide detailed consulting services on electricity generation and transportation, operation and maintenance, project development and investment, so as to improve its brand image. While developing technology, developed countries attach importance to the product quality of heating equipment, so as to ensure the reliability of heating system. Most of their heating equipment manufacturers have obtained the ISO quality system certification, with very good experimental equipment, so that the product can be constantly updated and reformed. In the process of product production, we have carried out comprehensive quality management for each process to ensure 100% qualified rate of factory products[531].

Third, the proper introduction of competition mechanism. Introducing regional competition mechanism is a good way to reform heat supply industry under the market economy system. For a long time, the heat supply industry has been monopolized by the central or local governments. Due to the lack of competition, enterprises relax internal management and technological innovation, resulting in low production efficiency and low allocation efficiency. The government should take the heat supply industry as the focus of regulation, establish a management mechanism simulating competition mechanism, so that the heat supply and heat source are operated by many enterprises competitively, give full play to the role of competition mechanism, and generally make the whole heat supply industry in an effective competition state compatible with scale economy and competitive vitality[532].

Fourth, social regulation is particularly necessary. In order to realize heating energy saving and build a conservation-oriented society, the government plays a crucial

role. The first thing to do is to improve the consciousness of energy conservation of the whole society, for the joint construction of a conservation-oriented society and efforts. The government can make extensive use of television, the Internet, newspapers and other media to strengthen the publicity of energy conservation, and carry out energy conservation activities in enterprises, public institutions, communities and other places to raise residents' awareness of energy conservation, and turn resource conservation into a conscious action of everyone. In order to improve the energy efficiency of heating, the government should publicize the advantages of central heating in energy saving and environmental protection, and at the same time implement corresponding policy subsidies to the users of central heating, so as to reflect the economic superiority of central heating and make more users choose the central heating. Central heating is one of the important symbols of modern city construction. The main goal is to make full use of energy, save energy and protect the environment. In order to effectively solve the problem of energy reserve shortage in China, local governments should actively develop and utilize a variety of renewable resources and clean energy, and gradually explore the use of nuclear energy, geothermal energy, garbage, solar energy, biogas, biogas and other energy sources as heating sources. While making full use of existing resources, European countries have also made great efforts in the utilization of waste resources such as garbage and wood chips, which has provided valuable experience for China in the development and utilization of waste resources. In view of China's current economic and technological conditions, garbage is a feasible heating energy with good social and environmental benefits. The recycling and utilization of various industrial and household wastes can generate heat energy for production and living use, which not only saves the problem of energy shortage, but also is conducive to environmental protection and can get better economic benefits. So the national energy sector should adopt corresponding policies.

10.2.1.4 Suggestions on improving the efficiency of government regulation in the heating industry

With climate change and increasing energy consumption, the regulation of the heating industry is getting more and more attention. As a regulatory department, the

government bears the important responsibility of maintaining the stability and healthy development of the heating industry. However, due to various reasons, there are still some deficiencies in the regulatory efficiency of the current government on the heating industry. The following are suggestions to improve the efficiency of government regulation of the heating industry:

First, establish a sound regulatory system. The government should formulate stricter laws and regulations and establish a sound regulatory system and mechanism, including policies and measures, regulatory agencies and regulatory processes. Especially in the quality supervision of heating enterprises and products, the government should provide more human, material and financial support for the regulatory authorities, so as to make the regulatory authorities more accurate, strict and effective in quality supervision.

Second, improve the quality of supervision personnel. The professional quality and supervision ability of supervisors directly affect the efficiency of supervision. Therefore, the government should strengthen the training and education of regulators, improve their professional quality, build a high-quality team, and ensure that the regulatory work has a wide coverage, strict standards and strong execution.

Third, strengthen communication and coordination with heating enterprises. The government should strengthen communication and coordination with heating enterprises and related industries, understand the actual situation and needs of enterprises, and provide them with better regulatory services. This can not only fully protect the interests of enterprises, but also standardize the management of the heating industry and achieve common development.

Fourth, establish a public supervision mechanism. The government should establish a public supervision mechanism so that the public can participate in the supervision work, improve the transparency and fairness of the supervision work, and speed up the efficiency of the supervision. Public supervision will enable regulators to pay more attention to the public interest and help the government find and solve problems.

These are some suggestions to improve the efficiency of government regulation of the heating industry. Through these suggestions, the government can improve the efficiency of supervision from many aspects and more effectively maintain the healthy and orderly development of the industry.

Conclusion

Heating industry is one of the important components of public utilities, its development directly affects the development of national economy. Heat supply not only involves the interests of thousands of households, but also affects the development of heat supply enterprises and social stability. Therefore, perfect government regulation plays a pivotal role in the future of heat supply industry. As the system reform of heating industry is a complex system project, it involves the interests of residents, and involves the interests of units and enterprises, and is related to a number of related policies such as finance, price, social security, and at the same time, there are metering charges and technology and other issues, so the reform of heating industry is very difficult. The reform of heating industry not only needs to be old and new, but also needs to combine several systems, provide comprehensive support, and promote together. In addition, it also faces many technical difficulties, so it is necessary to vigorously develop technological innovation, which is the prerequisite for ensuring sustainable development. In the process of innovation, constant comparison and revision are needed. Be prepared for the long haul. It will be a long and complicated process. Each country has its own characteristics, so it needs to adapt to local conditions, select the essence and discard the dregs, and formulate appropriate government regulations based on the current situation of the country.