

A Discussion on the Crisis Management of Small Scale Thermal Power Plant Basing on Sustainable Development

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Abstract

The strategy of sustainable development is one of the two important strategies for Chinese economic development. The present small scale thermal power plants cause much pollution, and consume too much energy, so they are being confronted with the crises of existence and management. Accordingly, it is urgent for small scale thermal power plants to carry out study on the crisis management about their own existence and development. Starting with the deficiencies of small scale thermal power plants, this paper found out the reasons for the difficulties in small scale thermal power plant management and put forward corresponding countermeasures.

Keywords: Sustainable development, Small scale thermal power plant, Crisis management

In 1987, the United Nations Conference on Environment and Development put forward the concept of sustainable development of human society; briefly speaking, sustainable development means the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The economic development of China depends on the strategy of prospering the nation with science and education and sustainable development, in the process of vigorously advancing "Two fundamental changes", the small scale thermal power plants meet lots of difficulties. The electric elasticity coefficient is increased owing to the macro-control of Chinese economy, so electric power supply no longer falls short of demand, but balances demand even exceeds demand. Now, more and more large-scale power generation units are being used, the small scale thermal power plants are being confronted with great existence crisis, because of their low efficiency, high energy consumption and the severe environmental pollution.

1. Small scale thermal power plants are being confronted with existence crisis

In 2006, Chinese National Development and Reform Commission delivered the Notice of Doing Well the Investigation about Closing down the Small Thermal Power Generation Units. The notice required that local government should inspect the situation of shutdown of small scale thermal power plants since 1999, and the notice listed 700 small scale thermal power plants that should be closed down during 1999 and 2010, the total capacity is up to 16.01256 million kilowatt, which accounts for 3.2% of the national gross power generation capacity. Besides, more small scale thermal power plants will be closed down because Chinese government has decided to put things straight about the small scale thermal power plants.

On August 15th, 2005, Chinese National Development and Reform Commission issued the fiftieth bulletin of 2005, and publicized the first group of small scale thermal power plants that should be closed down. The content of the bulletin is as follows:

According to the demand of National Development and Reform Commission, the small scale thermal power plants that should have been closed down should be shut down immediately, the newly studied out 64 small scale thermal power plants will be shut down at different stages. The capacity of small scale thermal power plants closed down in 2005 would be 286.5 thousand kilowatt, and that of 2006, 2007, 2008, 2009 and 2010 will be 1.003 million kilowatt, 1.921 million kilowatt, 1.1 million kilowatt, 530 thousand kilowatt, 505 thousand kilowatt respectively (Figure 1). The purpose of closing down the small scale thermal power plants is to save energy, promote the regulation of power supply structure, and transform the economic growth mode, and it is important to solve the problems of high

energy consumption, low efficiency and severe pollution in the present small scale thermal power plants.

In the beginning of 2007, National Development and Reform Commission began to make more effort in closing down the small scale thermal power plants.

After the State Council approved the Several Opinions on Accelerating Closing down the Small Thermal Power Generation Units of National Development and Reform Commission and National Energy Office, the National Meeting of Electric Power Industry, on January 29th, 2007, which mainly focused on encouraging the big ones and controlling the small ones, energy conservation and emission reduction, put forward the following objectives: during the Eleventh Five Year Plan, the power of small scale thermal power plants closed down will be more than 50 million kilowatt, 50 million tons of standard coal will be saved, and over 160 tons of sulfur dioxide will be reduced. Accordingly, large scale and efficient power plants that can save energy, and use reproducible and clean energy should be constructed.

In the following four years, small scale thermal power plants, whose power is over 50 million kilowatt, will be closed down, and no more small scale thermal power plants will be constructed. The newly planned thermal power plants should adopt electrical machines that are over 600 thousand kilowatt. Specifically, the following small scale thermal power plants will be closed: the general thermal electrical machines in which the capacity of a single unit is less than 50 thousand kilowatt; regular power generation units that are used for 20 years, in which the capacity of a single unit is less than 100 thousand kilowatt, electrical machines whose life-span has expired, and in which the capacity of a single unit is less than 200 thousand kilowatt; and the electrical machines that consume too much coal and don't measure up to environmental protection standard.

According to statistics, when kilowatt-hour of electricity is generated, the difference of coal consumption between large scale electrical machine that is 600 thousand kilowatt and small scale electrical machine that is lower than 100 thousand kilowatt is 100 to 150 gram. In 2005, the total capacity of small scale electrical machines that are lower than 100 thousand kilowatt is up to 0.115 billion kilowatt, so more than 0.4 billion tons of coal are consumed every year, and 5.4 million tons of the sulfur dioxide are discharged. If all the present small scale electrical machines are replaced by large scale ones, 90 million tons of standard coal will be saved, accordingly, 2.2 million tons of sulfur dioxide will be reduced, and 2.2 hundred million tons of carbon dioxide will be reduced, accounting for 16.6% and 10% of the total discharge of power industry in 2005 respectively. The trends of the capacity of the small scale thermal power plant that will be closed down in the future four years are shown in figure 2.

At present, the supply of electric power exceeds demand, that's why the small scale thermal power plants should be closed down. Chinese government is strengthening the macro-control on small scale thermal power plants, so small scale thermal power plants should take up some measures and accelerate the technological reform to face up to the existence crisis. It is urgent for small scale thermal power plants to thoroughly bring the function of old power generation units into play, fully utilize the present assets, and distribute the staff, so as to meet the need of market economy.

2. Problems in small scale thermal power plants

2.1 The energy consumption of small scale thermal power plants is high

The capacity of a single power generation unit in small-scale thermal power plant is small, and the energy consumption of small scale thermal power plant is high, usually, the energy consumption accounts for 70% of the total cost. The Chinese average coal consumption is 370 gram per kilowatt-hour, while the world average coal consumption is 335 gram per kilowatt-hour. If the difference of coal consumption between small scale power generation units and large scale ones is 100 gram, 60 million tons of stand coal will be excessively consumed when generating 6000 hundred million kilowatt-hours if the small scale electrical machines that are lower than 100 thousand kilowatt are used. It can be seen that the small scale power generation units will increase the coal consumption of China. So Chinese National Development and Reform Commission pays much attention to energy saving and emission reduction in power industry.

2.2 Small scale thermal power plants severely polluted the environment

Thermal power plant is one of the major air pollution sources. The three main air pollution problems are acid rain, greenhouse effect, and the damage of ozonosphere, and two problems have close relationship with thermal power plant. The smoke discharge from the chimney of coal-fired thermal power plant includes power, sulfur dioxide, carbon monoxide, carbon dioxide, nitrogen oxide and few heavy mental particulates. Owing to that small scale thermal power plants have no good equipment for dust removing, and it consumes much coal, more smoke and dust will be discharged into the air when the same amount of electricity is generated. A 35ton/hour spreader stoker will discharge 400 tons of power and dust every year even when the dust removing efficiency is over 95%. The

discharged dust severely influenced the quality of air.

Sulfur dioxide and nitrogen oxide are also important air pollution sources. The amount of sulfur dioxide discharged is in proportion to the gross coal consumption in the situation of rated evaporation, and the gross coal consumption is in proportion to the coal consumption in power generation. The amount of sulfur dioxide discharged into the air by small scale thermal power plant is large because of the large amount of coal consumption in electricity generation. So it is urgent to restrict the emission of dust and control the area of acid rain. But in a long period of time, coal will still be the most important one-off energy, only in large-size or oversize boilers (over 1000t/h), can coal be burnt completely, that is to say, 99% of the sulfur, nitrogen will be removed. But it is difficult for small and media scale thermal power plants to do so (less than 1000t/h).

It can not be neglected that the sewage will also pollute the environment. Large amount of sulfur dioxide in the water from dust catcher, and the acid and alkaline liquid used to regenerate the water treatment equipment will destroy the environment to a great extent.

2.3 It is difficult for small scale thermal power plants to solve the problem of low exergy efficiency

According to the Second Law of Thermodynamics, in order to improve the exergy efficiency, the steam parameter should be increased, which can reduce the energy cost introduced by temperature difference inside the boiler. Another important approach to improve the exergy efficiency is thermoelectricity generation. Insufficient thermal load will impede the energy saving effect of heat supply machines.

3. Countermeasures for small scale power plant to face up to the existence crisis

Small scale thermal power plants used to play important roles at certain historical period. In the present time, the combined heat and power generation unit still has strong life-force. The laws and regulations for public utility management in the United States prescribe that thermoelectricity factory is entitled to sell the superfluous power to the Power Company, and Power Company should unconditionally buy the power with avoidable cost. As a developing country, China should save resources and energy, for the sake of the welfare of the offspring.

3.1 The boiler of spreader-stoker consume too much is the fundamental reason for environmental pollution

The granule of raw coal is small, and the sulfur content is high. At present, most boiler users, including the small scale thermal power plants, pay much attention to the reconstruction of equipment, for example, the coal hopper is changed to layered coal feeder, the hearth and dust separator are also reconstructed, but all these changes don't lead to obvious effect. The correct way is that additive should be added into the coal to get briquettes. Further more, calcareousness should be added to briquettes to absorb the sulfide because the sulfur dioxide discharged will directly influence the production, data showed that, the above method will decrease 50% to 90% sulfur dioxide and 50% to 70% nitrogen oxide. The use of briquettes will not only be good for the decrease of dust, but also is good for the aeration of coal bed, so the coal will be burnt thoroughly, which will improve the thermal efficiency of boiler. In addition, the proportion of coal preparation should be increased. Thermal power plants use pulverized-fuel boiler, the comminution will cost much electricity, while the layer combustion boiler will waste too much coal because the granules of coal don't measure up to standard.

3.2 Developing thermoelectricity generation is an important way for small scale thermal power plant to exist and develop

Thermoelectricity generation will save more energy. The theoretical thermal efficiency of thermal power plant is 41%, but the practical thermal efficiency is only 36% to 39%. The thermal efficiency of thermoelectricity generation is over 45%, and the practical efficiency is about 60%. The efficiency of gas-steam combined cycle power plant is 50% to 52%, but the thermal efficiency of the whole gas-steam combined cycle power plant can reach 70% or more. In thermoelectricity generation, heat-electricity ratio is increased, and the thermal efficiency can reach 80%, which can lead to good economic benefit and social benefit. Chinese government established preferential policy in this aspect; using the central heating system and closing down some small boilers will save energy and reduce pollution. Data showed that the ratio of thermoelectricity generation machines to thermal power plants units with the same capacity is over 60% in German, England, Denmark and Holland.

The thermoelectricity generation should accord with two basic indexes; on the one hand, the average thermal efficiency per year should be over 45%, on the other hand, average heat-electricity ratio of thermoelectricity unit that is lower than 50 thousand kilowatt should be over 100%, the average heat-electricity ratio of thermoelectricity unit that is between 50 and 200 thousand kilowatt should be over 50%, and heat-electricity ratio of thermoelectricity unit that is larger than 200 thousand kilowatt should be over 50% in the heating period.

Small thermal power plants make great contributions to central heating and the development of power industry in China. The concept of small thermal power plant should be distinguished from the small heat & power plant,

because the small thermal power plants will be closed down while the heat & power plant, not matter it is large or small, are encouraged by Chinese government.

In recent year, Japan, the United States, European countries and Taiwan of China established a series of policies to encourage the thermoelectricity generation, so thermoelectricity generation develops at great speed recently. China has established some preferential tax policies, for example, the investment regulation tax is exempted, and products that make full use of ash are exempted from value added tax.

Considering of the preferential policies, small thermal power plants should carry out study on how to reconstruct themselves to become heat & power plants. And there are some advantages to do so, firstly, the capacity of power generation unit is relatively low, which doesn't measure up to the demand of power industry development in China if it only generates electricity; secondly, these small power plants are also providing heat, so they have advantages to be reconstructed as heat & power plants.

3.3 Small thermal power plants should be changed through biological way, which accords with the policy of China.

Bio-energy means the energy produced by photosynthesis; bio-energy exists in surplusages of agriculture and industry, such as rice hull, straw, bagasse, sawdust and urban garbage. These things are called clean energy because they produce less harmful gases when burned. Bio-energy has been widely used by European and American countries, for example, there are more than 350 bio-energy power plants in the United States.

China is a big agricultural country, more than 5 billion tons of bio-energy is produced every year, which equals to the energy of 2 billion tons of oil. But the bio-energy used only accounts for 0.5% of the primary energy; it has such large potential that China put forward some preferential policies for power generation using bio-energy.

Firstly, the Eleventh Five Year Plan put forward that we should build a resource-preserving and environment-friendly society, energetically develop renewable energy, accelerate developing bio-energy, support and develop straw-fired power generation, build a batch of straw-fired power plants, and realize power capacity of 5.5 million kilowatt.

Secondly, Chinese government encourages and supports the renewable sources connected to power (thirteenth article of Law of People's Republic of China on Regenerable Energy).

Thirdly, power generated by renewable sources will be totally purchased (fourteenth article of Law of People's Republic of China on Regenerable Energy).

Fourthly, it will be provided with preferential loan with financial discount interest (twenty fifth article of Law of People's Republic of China on Regenerable Energy)

Fifthly, preferential revenue (twenty sixth article of Law of People's Republic of China on Regenerable Energy)

Sixthly, electrovalence allowance. 0.25 Yuan per kilowatt will be subsidized on the basis of the electrovalence of desulfured-coal fired power generation machines (seventh article of Tentative Management Measures for Price and Sharing of Expenses for Electricity Generation from Renewable Energy).

Seventhly, Chinese government encourages the technological reconstruction of adding biological substances to regular thermal power generation (Notice Regarding Strengthening Evaluation and Management on the Influence of Electricity Generation from Biological Substances)

The national policies on regenerable energy pointed out a way for the small thermal power plant; it will be encouraged to change the small thermal power plant to bio-energy power plant.

It will be more advantageous to change the small thermal power plant to bio-energy power plant than to build a new bio-energy power plant. Firstly, it will be easy to raise money because less money is needed to reconstruct a power plant; secondly, the stocked assets will be fully utilized, which will save resources and energy; thirdly, the newly built bio-energy power plant is not allowed to burn any regular fuel, but the reconstructed power plants are allowed to use 20% or less regular fuel, it will be easier to carry out regulation; fourthly, the procedure of reconstruction will be much easier than that of building a new power plant.

3.4 Actively carry out the policy of "encourage big ones and control small ones"

"Encourage big ones and control small ones" means that the construction of new power plants should be linked with the closing down of small thermal power plants. When building the power plants that have large capacity, high parameter, low consumption and low emission, some small thermal power plants should be closed down. The construction of big ones will create market conditions for closing down the small ones, while closing down the small ones will vacate capacity spaces for the construction of big ones, so the two of them supplement each other and are cause and effect of each other. To mobilize the enthusiasm of local area and enterprises, conversion according to

proportion is allowed, i.e. if 300 thousand kilowatt power plants will be built, 240 thousand kilowatt small power plants should be closed down, if 600 thousand kilowatt power plants will be built, 420 thousand kilowatt small power plants should be closed down. And if 1 million kilowatt power plants will be built, 600 thousand small power plants should be closed down. It can also be counted according to the amount of coal consumed.

The construction of large capacity power generation system is the development trend of power industry. However, Chinese government established some policies that are propitious to the development of small thermal power plants, so, the small thermal power plants should actively carry out the policy of “encourage big ones and control small ones”, increase the capacity of themselves, gradually digest the previous human resources and social resources, and realize sustainable development.

3.5 Other methods

Firstly, if there is natural gas, the small thermal power plant can be changed to heat & power plant or combined heating, cooling and power supply system, in that way, there will be no pollution. Secondly, small coal-fired power plant can be changed to garbage fired power plant. Thirdly, if the equipment is still in good condition, the small thermal power plants can be sealed up for keeping, and it can be used again when in emergency, but countermeasures should be taken to avoid pollution. Fourthly, under the guidance of government, the power amount of the small low-efficiency power generation units can be transferred to large high-efficiency power generation units, so as to realize mutual benefits.

In a word, according to the theory of circular economy, the small power plant should be used thoroughly unless the equipment is too old to be used. Power industry is capital intensive industry, unlike the small coal mine, small paper mill, small glass factory and cement industry, a 50 thousand kilowatt small thermal power generation unit needs 200 to 300 million Yuan, so it must be reconstructed and used thoroughly.

4. Conclusion

The small thermal power plant is facing up to two main tasks; on the one hand, it should try to make itself survive in the disadvantageous environment, on the other hand, it should reduce environmental pollution, improve efficiency and realize sustainable development. So the small thermal power plants are being confronted with existence crisis and development crisis now, they should enhance the consciousness of crisis management, actively look for the methods to solve problems, and try to find their way to exist and develop in accordance with their own deficiency, accordingly improve the crisis management on the basis of sustainable development.

References

- Chen, Zunli. (1997). A discussion on sustainable development and countermeasures for small thermal power plants. *Energy Conservation Technology*. 6:20-22.
- Fang, Junshi. Shang, Quanhong and Li, Qionghui. (2006). Investigation and analysis on the Chinese small thermal power plants and some suggestions. *China Power Enterprise Management*. 9:49-50.
- He, Haiyan. (2006). *Crisis management*. Capital University of Economics and Business Press.
- Huang, Hongxiang, Lu, Dehong. (2006). Feasibility study on the reconstruction of small thermal power plants. *Energy Conservation*. 3:44-46.
- Tang, Xiaohui. (2001). Develop thermoelectricity generation, reconstruct the small thermal power plant. *Anhui Electric power*. 18 (1) 59-60.
- Yang, Xiaoli and Guo, Jianbin. (2005). Analysis and countermeasure on the problems of small power plants connected to network. *Hebei Electric Power*. 24 (3):22-24.
- Zhou, Chunsheng. (2007). *Enterprise risk and crisis management*. Beijing University Press.
- Zhong, Lin and Zhang, Zhixue. (1999). Eliminate the small thermal power plants through annexation. *Energy Conservation*. 10:10-12.

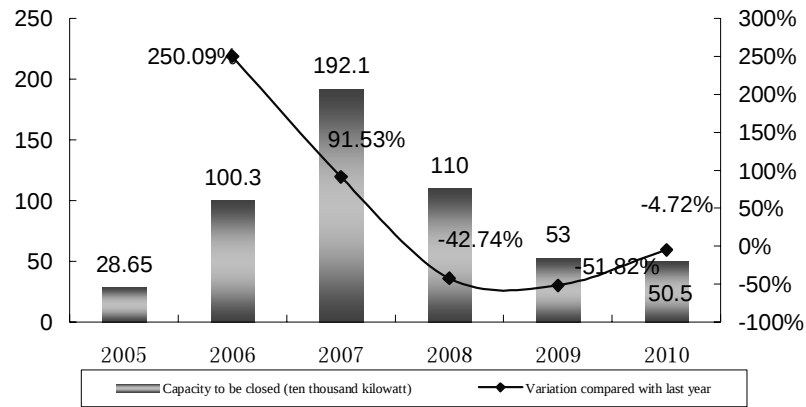


Figure 1. The power capacity of small thermal power plants that are to be closed down every year from 2005 to 2010 in China.

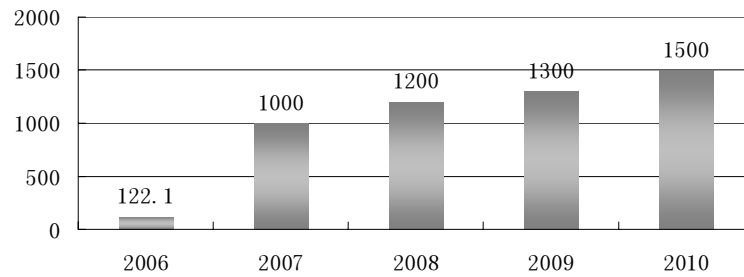


Figure 2. The power capacity of small thermal power plants that are to be closed down every year from 2006 to 2010 in China.