



## Study on Energy Saving and Emissions Reduction of Thermal Plants in China

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### Abstract

China is in the process of industrialization and electricity is indispensable for rapid growth. At the same time, the “coal-based” energy structure in China will not change perennially, which means, the development of power industry will be subject to the constraints of resources and environment for a long period of time. Therefore, according to the development of electric power industry, energy saving and emission reduction will be an eternal theme. The first part of this essay is the presentation of current situation and achievements. The second part, we summarize five most significant problems existed in current situation. According to the deficiency, we provide improvement measures and suggestions from seven aspects including structure adjustment, internal management, market means and legal system, etc, in order to promote the energy saving and reduce emission smoothly and successfully in the thermal plants in China.

**Keywords:** Thermal plants, Energy, Energy saving and emissions reduction

Nowadays, the energy situation in China is fairly severe. Contradictions between energy supply and demand will last for a long time. The sustainable development of energy will support the sustainable development of economic and social, and is also a long-term strategic task in China's modernization process. Looking into the future, China is still in the process of industrialization and electricity is indispensable for rapid growth. At the same time, the “coal-based” energy structure in China will not change perennially as we discussed before. Therefore, according to the development of electric power industrial, energy saving and emission reduction will be the key topic.

### 1. The present situation and achievements

#### *1.1 The coal consumption and line loss rate decreased greatly*

From 1980 to 2007, China's standard coal consumption for power supply had totally reduced to 91g / (kw•h). 2007 is the year of the largest drop since 1980. The coal consumption for power supply declined by 10g/(kw•h), the auxiliary power ratio dropped from 7% in 1992 to 5.92%, and the line loss rate fell from 8.93% to 6.97% ,with a decrease of 1.96%. Figure 1 below shows the standard coal consumption for power supply and auxiliary power ratio from 2000 to 2007; figure 2 shows the line loss rate from 2000 to 2007 in China.

Insert Figure 1 here

Insert Figure 2 here

#### *1.2 Emission of air pollutants has been controlled effectively*

Emission of sulfur dioxide has achieved a historic turning point. At the end of 2006, the capacity of flue gas desulfurization units in national wide had reached to 160GW, and the operation scale was expanding further more. At the end of 2007, the capacity of flue gas desulfurization units in nationwide scope has already reached 270 GW, exceeding by 50% of the coal-fired units. The capacity of flue gas desulfurization units of the thermal plants increased by approximately 53 times compared with that in 2000. Figure 3 shows the development of flue gas desulfurization units in coal-fired power plants in national scale.

Insert Figure 3 here

The level of dust control is rising yearly. The average efficiency of dust removing in new coal-fired power plants is above 99%, and the electrostatic precipitators, which designed with the standard of dust emission concentration of

150mg/m<sup>3</sup> or below, have already reached the international advanced level. At the same time, bag filters are widely adopted by a number of units. Since China introduced the reform and opening up policies, the installed capacity of thermal power plants has been growing significantly, therefore, it is worth mentioning that the decline of dust emissions is inconspicuous.

The emission of nitrogen oxides has been initially controlled. In accordance with national laws and regulations, the combustion mode controlling of low NOX is still the main means to control nitrogen oxides emissions. Since the "Tenth Five-Year Plan" of China, most new coal-fired units have adopted the low nitrogen oxide combustion mode as required simultaneously, and a number of technical transformation of existing units have installed low nitrogen oxide burners. In the influence of new situation of energy saving and emission reduction and the strict requirements of the government, the control level of nitrogen oxides of the thermal plants has already far exceeded the legal requirements and emission standards to enable the plants to launch new projects. According to the statistics published by China Electricity Council, at the end of 2007, about 10GW with single capacity of more than 300MW or 600MW gas commercialization denitration devices were put into operation, and the 40GW denitrifications of flue gas devices were under construction. Most denitrification devices are utilizing "selective catalytic reduction" (SCR) technology, which ensures the level of desulfurization efficiency to be 85% or higher.

### *1.3 Water-intaking quantity for specific generated energy and discharged volume of industrial waste water are decreasing year by year*

In the past years, the new units had obtained obvious achievements in water-saving. Since the "direct air cooling" technology came into commercial operation stage, an increasing number of power plants utilized epigenetic city water as fresh water source, and achieved the implementation aim of "zero emissions" through optimal design. As the increasing momentum of water-saving transformation of the existing units, the amount of ash water and emissions of waste water were significantly declined. In 2007, repeating utilization rate of waste water in the nation was larger than 70%.

### *1.4 The comprehensive utilization rate of fly ash is above 60%*

Comprehensive utilization of fly ash has gained more and more attention by electric power enterprises and generating enterprises. Since the "Eleventh Five-Year Plan", the comprehensive utilization rate of fly ash has been maintained around 60%, and the capacity of utilization has increased yearly. In 2007, fly ash discharged by coal fired power plants is about 380 million tons nationwide, which increased about 3% comparing with that in 2006. The comprehensive utilization rate of fly ash by the coal-fired power plants is 69%, which increased by 3%; the comprehensive utilization of fly ash is 260 million tons, with the rising amplitude of 13%.

## **2. Main existing problems**

With the sustained and rapid development of the power industry and the promotion of the government and the enterprises themselves, remarkable achievements have been made in the field of energy saving and emission reduction, but there are still some problems as below:

### *2.1 Both construction quality and operational effectiveness of desulfurization facilities need to be improved*

Recently, the desulfurization facilities in thermal power plants are processing "explosive" development in China. From the year 2006 to 2007, the capacity of desulfurization facilities had increased from 53 million kilowatts to 266 million kilowatts, with the annual increase of 100 million kilowatts, the ratio of homemade facilities have exceeded 90%. Because of poor sense of environmental protection, low quality of construction, inadequate awareness of regulations and lack of operating experiences, the effectiveness of desulfurization is far away from prominent.

### *2.2 Decline in the quality of the fired coal results in the low efficiency of energy saving and emission reduction*

As a result of price increase and supply shortage, the electricity heat decreased and ash raised sharply. On one hand, it leads to serious wear to the equipment and reduces the efficiency of electricity generation; on the other, it causes serious overload to desulfurization devices, or even damage the equipments, which greatly influences the effectiveness of desulfurization.

### *2.3 The effort of energy saving and emissions reduction in small and self-supply plants needs to be ameliorated*

The proportion of small thermal units is still very large. At present, the whole capacity of small thermal units is about 100 million KW; the proportion is particularly high in the northeast and northwest region of China, which results in high coal consumption for power supply. The development momentum of a few high energy-consuming and self-supply power plants in some areas has not been effectively controlled. These plants are of small capacities, inadequate environmental protection facilities and non-standard management. Moreover the energy sent into grid is instability and not good for energy saving.

#### *2.4 The statistical work of energy reduction in some enterprises is far away from perfect*

Despite the statistical indicator system of energy saving and emission reduction is relatively perfect; some enterprises do not understand the importance of the statistical work sufficiently. Currently, the statistical data of energy saving and emission reduction mainly relies on self-declaration by enterprises and compiled analysis from concerned departments of government. Statistical information lacks accuracy and timeliness, causing a definite affect on the correctness of energy saving and emission reduction.

#### *2.5 The diversity of market means of promoting energy-saving emission reduction is inadequate*

Energy saving and emission reduction in China are promoted by the rule of law, executive orders and market incentives, among which the leading role is government executive orders. The effectiveness of the market in resource allocation is inadequate. The cost of environmental governance has not been reflected in reasonable price system which brings in series influences on the promotion of energy saving and emission reduction.

### **3. Improvement measures and suggestions**

For the thermal power enterprises, energy saving and emission reduction is a long-term and arduous work, making great sense to the realization of China's resource saving and environmental protection. In order to promote the "Eleventh Five-Year Plan" smoothly, we make the following observations and recommendations:

#### *3.1 Continue to promote the structure adjustment of electricity vigorously*

Strengthen the exploitation of renewable energy. Accelerating the construction of regional and provincial power grids and improving the efficiency of comprehensive utilization. In the meantime, optimizing the construction of urban and rural power grids and trying to make a harmony situation between power supply and power network and between transmission and distribution. On the guarantee of power supply, the plants should support the development of "distributed energy systems"-this system owns the characteristics of flexible, low investment, high reliability and low power transmission losses, which ensure the electricity supply for important customers and improve energy efficiency.

#### *3.2 Improving the internal management and enhancing the construction quality and operation effect*

Strengthen the tender management of desulfurization equipments to avoid the successful low-cost regardless of quality; carry out the study on the reliability for the desulfurization device to enhance the reliability of equipment management; standardize the operation management of desulfurization installations, induction training and technical exchanges of operation staff; establish the internal supervision and management system, strengthen the internal assessment, improve the adaptability of poor quality coal to meet environmental protection requirements and enhance the quality of the management of electricity coal.

#### *3.3 Strengthen the statistical work according to the law, and scientifically monitor the effectiveness of emission*

Thermal power plants should strengthen the statistical work of energy saving and emission reduction, provide the statistical information accurately according to the requirements of statistical plans ,and prevent from making false reports , failed reports and delayed reports of the statistics.

Moreover, the thermal power plants should continue to pay attention to the construction, operation and maintenance of the "fume online monitoring system" so that monitoring data can be a true reflection to the actual situation. Strengthen the scientific analysis of energy saving effectiveness, in order to provide the real and reliable data.

#### *3.4 Further strengthen the intensity of closing down small thermal power units*

One of the most crucial ways to reduce emissions is to close down small thermal plants, and timely solve the problems concerned during this process. Combined with practical, the plants should formulate practical programs for the "closing down". Providing various conveniences from every aspects, establishing relevant policies to accelerate the whole process and resolving the problems appeared in time are also important.

The supervision organization should strengthen the monitor and management of small thermal power units, establish monitoring information systems, and refuse to award licenses to those plants which have not meet the requirements of regulations.

#### *3.5 Improve the legal system and strengthen supervision*

Establish the legal system for energy saving and emission reduction, timely combine the existing laws and regulations which are not in conformity with the provisions of energy saving and emission reduction policies, and ensure coordination between the relevant laws and energy saving and emission reduction.

The electric power guild organization should improve the research on laws, regulations and policies, collect information and analyze the existed situation, and clearly review the evaluation of new energy saving and emission reduction project by the government-commissioned. Improve the relevant standards, establish the energy monitoring service system, promote the energy conservation technology and clean production evaluation, establish self-regulatory mechanism,

training, consulting and other services to save energy and reduce emission.

### 3.6 Consummate the market means of energy saving and emission reduction

First, keep implementing the existing price policies related to energy saving and emission reduction. For example, make difference prices according to kinds of high energy consumption enterprises and provide supervision and inspection to the small thermal power plants and self-supply power plants to ensure the implementation of policies. Furthermore, improve the coal price policies; accelerate the establishment of forming mechanism of power price for the clean energy and renewable sources. Establish a competitive electricity market to encourage the active participations of large industrial users and enable the generation cost sharing by the industrial users in kinds of forms

Positively carry out and promote energy saving and emission reduction to improve the economic policy. Improve the compensation policy such as assets verification , personnel placement, debt treatment, project authorization,etc.

Promote the trading policy of sulfur dioxide emissions in electricity industry, handle the relationship between emissions trading and existing regulations correctly to fully embody the market economy principle, and guide and encourage the enterprises to participate actively.

### 3.7 Strengthen the research on the technology of energy saving and emission reduction

Energy saving and emission reduction is a huge systematic project; scientific research is solid foundation. Nowadays, power system, industry energy saving management system of emission reduction, monitoring and supervisory system were reconstituted, classified as related research institutions of the power grid and power generation. To some extent, this reform brings in increase of research capability for some enterprises, but as a whole, the comprehensive, systematic, timely research ability for the development of power industry is severely weakened. For example, the macro-policy research for the sustainable development and strategic planning. Therefore, we must spare no effort to promote the comprehensive study on the development of electric power, especially on the perceptiveness and tracking work of the international power development.

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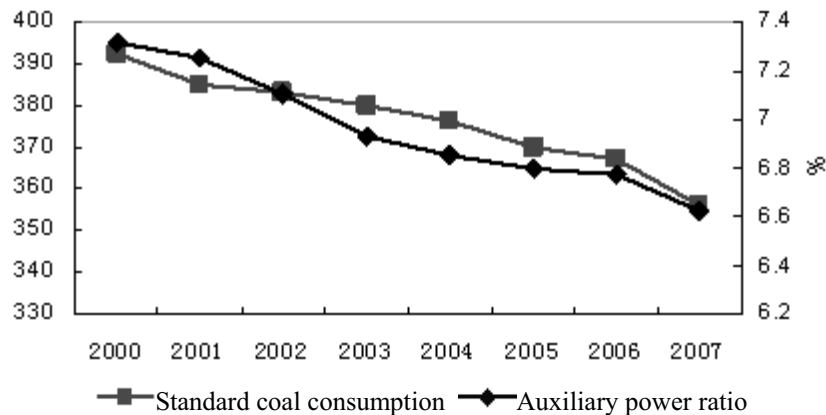


Figure 1. Standard coal consumption for power supply and auxiliary power ratio from 2000 to 2007

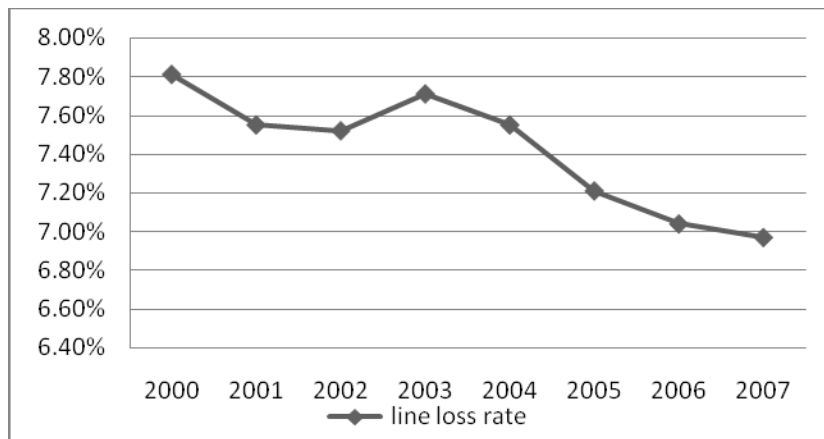


Figure 2. The trend of line loss rate from 2000 to 2007

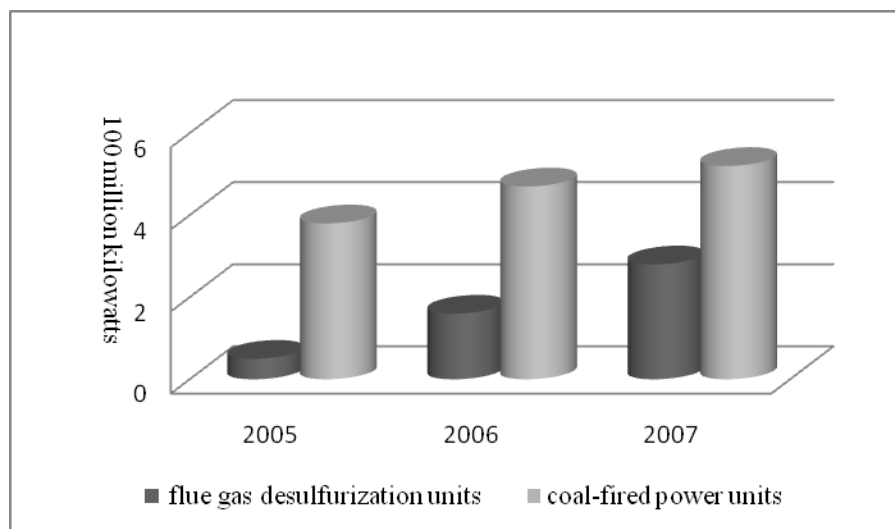


Figure 3. The development of flue gas desulfurization units in coal-fired power units in nation scope