

Evaluation of the Status of the Power Structure Based on SO₂ Emissions Responsibility

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Abstract. In recent years, increasing and significant emissions of SO₂ is a major contributor to acid rain pollution, the reasons are manifold. Wherein, SO₂ generated during the thermal power accounts for a large part. This paper selects China's total power generation, thermal power generation and emissions of SO₂ and the current situation of China's energy structure and other related data for analysis, the relationship between power generation and fire power generation and SO₂ emissions and primary energy will be discussed and concluded: from an environmental point of view, the status of China's power structure is unreasonable, the amount of thermal power generation accounted for the total share is too large, it is urgent need to improve this situation, the power status of the irrational structure of the problems to be solved.

Introduction

On the environment, in recent years acid rain, the greenhouse effect and destruction of the ozone layer are outstanding performance in air pollution, and acid rain is one of the most serious environmental problems, health hazards, corrosive materials, destruction of ecosystems, it cause huge economic losses and is one of the important factors of modern social and economic development. The main causes of acid rain is due to excessive emissions of SO₂ in the air, SO₂ emissions are the main factors affecting the development trend of acid rain pollution, which is still one of the key of air pollution prevention and control work of the coming period. According to relevant statistics, China's annual coal for power generation, account for 44.8% of the total consumption of coal industry, SO₂ emissions in thermal power industry account for about half of the total SO₂ emissions. Coal-based energy structure results in serious pollution of the atmosphere SO₂ and cause tremendous pressure on the environment. Thus, thermal power industry caused a large number of SO₂ emissions, so coal combustion can not be ignored. Therefore, this contemporary power structure of China is totally unreasonable, the proportion of the total thermal power generation accounted for too much, but according to China's current energy situation, the total coal accounted for 67.67% of China's total primary energy in 2013, it even accounted for 66.03% in 2014. From energy structure, the status of power structure is inevitable, so this regard, it is reasonable.

About SO₂

SO₂ is a colorless, poisonous gas with a strong pungent odor, is one of the main pollutants in the atmosphere, many industrial processes generate SO₂, SO₂ in the atmosphere can cause respiratory inflammation and other diseases. SO₂ is further oxidized in the catalyzed, and will directly generate sulfuric acid, have serious economic impact and damage on the global environment and human society. Acid rain have caused serious harm to soil, water, forests, buildings, monuments, etc. cultural landscape, not only caused great economic losses, but also endanger human survival and development. It is estimated that direct economic losses caused by metal corrosion accounts for 2% to 4% of national economic output in industrial countries every year.

Present Situation of SO₂ Emissions

SO₂ Emissions and the Status of Power Structure. SO₂ caused serious environmental pollution and huge economic losses. It is thermal power industry that use the most coal and cause the most SO₂ emissions. In recent years, the data view, SO₂ emissions from thermal power industry accounted for about half of the national total SO₂ emissions.

Table 1 Emissions of SO₂

Year	SO ₂ emissions (tons)	Thermal Power Industry SO ₂ emissions (tons)	Proportion
1997	1378.4	739.5	53.65%
1998	1239.6	696.8	56.21%
1999	1230.4	687.4	55.87%
2000	1379.8	720.0	52.18%
2001	1449.3	725.5	50.06%
2002	1459.6	750.1	51.39%
2003	1729.9	862.0	49.83%
2004	2254.9	994.9	44.12%
2005	2249.4	1167.2	51.59%
2006	2588.8	1204.1	46.51%
2007	2468.1	1147.1	46.48%
2008	2321.2	1150.3	49.56%
2009	2214.4	1043.1	47.11%
2010	2185.1	982.6	44.97%
2011	2217.9	1026.8	46.30%
2012	2118.0	957.4	45.20%
2013	2043.9	932.7	45.63%

As can be seen from the table, the emission of SO₂ has been maintained at a high level, it has been more than 20 million tons after 2004, though in recent years, with the increase the intensity of emissions decline, but the effect is not obvious. Secondly, SO₂ emissions in the electricity generation account for a large share in the total SO₂ emissions. In recent years, as the country to increase environmental protection efforts, SO₂ emissions decreased, but still occupy a large share, but also about 45%, it is apparent that it is difficult to control SO₂ emissions generated by thermal power.

We can see power generation capacity was increasing year by year and thermal power generating capacity is also increasing, even faster. Secondly, the amount of thermal power share of total power generation is quite high, basically above 80%.

Relationship with SO₂ Emission of Thermal Power. In order to understand the relationship between thermal power and SO₂ emissions in the development process, according to related data of China thermal power generation and SO₂ emissions to analyze from 1997 to 2006 and 2006 to 2013 in two stages, and set up the regression equation and to analyze the relationship between electricity generation based on emissions intensity (emissions from electricity generation intensity = SO₂ emissions / thermal capacity) indicators.

As can be seen from the scatter diagram approximating a parabola, it can be approximated by quadratic regression, quadratic polynomial regression statistical relationship follows:

$$Y = -0.000001X^2 + 0.00064X + 577.54$$

$$R^2=0.951973 \quad F=69.37521 \quad DW=1.627327$$

Table 2 The related data of China's power generation

Year	Power generation (one hundred million kwh)	Thermal power generation (one hundred million kwh)	Proportion
1997	11345.2	9240.7	81.45%
1998	11663.7	9441.0	80.94%
1999	12045.3	10205.4	84.73%
2000	13556.0	11141.9	82.19%
2001	14808.0	11834.3	79.92%
2002	16540.0	13381.4	80.90%
2003	19105.8	15803.6	82.72%
2004	22033.1	17955.9	81.50%
2005	25002.6	20473.4	81.89%
2006	28657.3	23696.0	82.69%
2007	32815.5	27229.3	82.98%
2008	34668.8	27900.8	80.48%
2009	37146.5	29827.8	80.30%
2010	42071.6	33319.3	79.20%
2011	47130.2	38337.0	81.34%
2012	49377.7	38554.5	78.08%
2013	54316.4	42470.1	78.19%

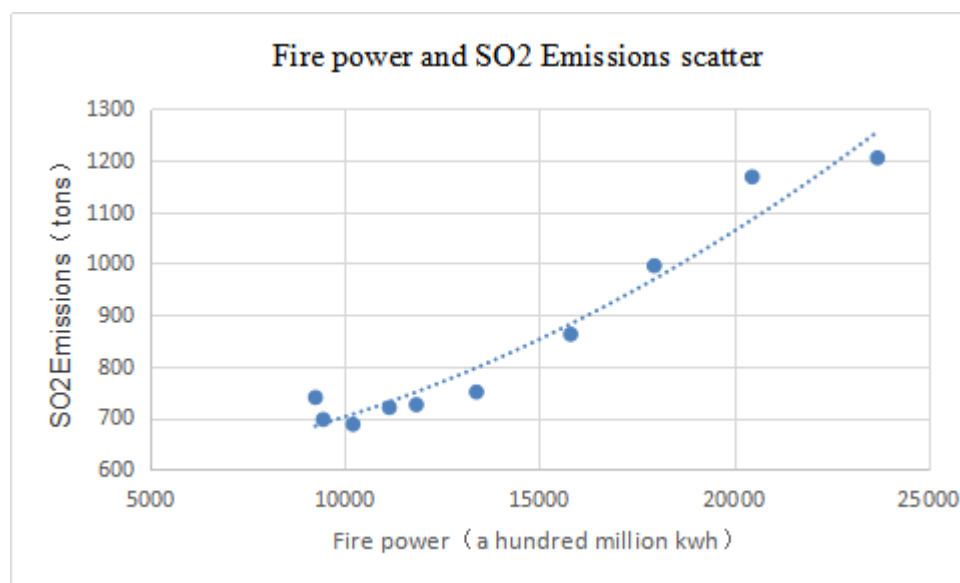


Figure 1. 1997-2006 fire power and SO2 emissions scatter diagram

As can be seen from the regression equation during 1997-2006, the relationship between the amount of SO2 emissions from thermal power and increase of the amount of thermal power generation is conic relationship, SO2 emissions was gradually increasing trend, but remained at a relatively high year-round the level.

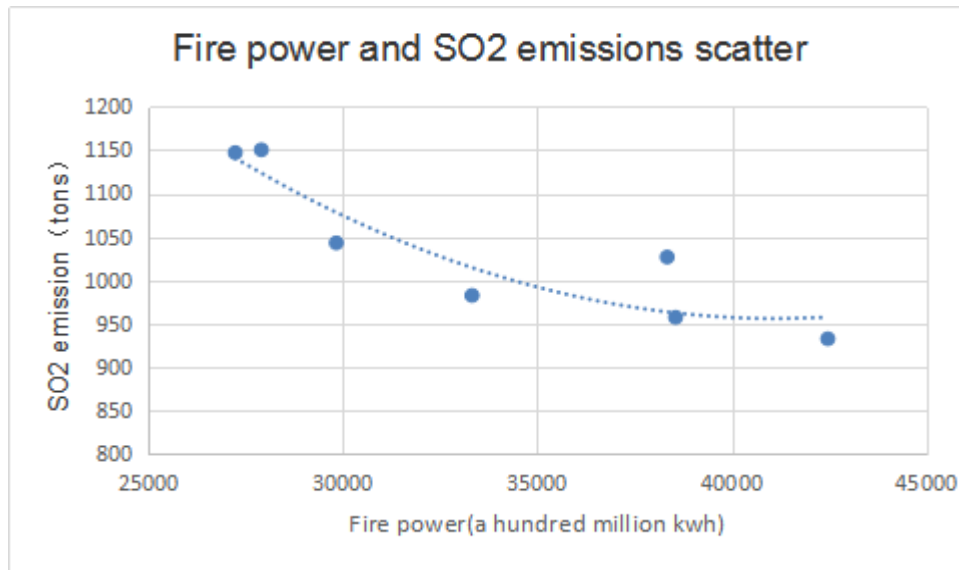


Figure 2. 2007-2013 fire power and SO2 emissions scatter diagram

As can be seen from Fig. 2, SO2 emissions with increasing generating capacity but declined after 2007. One reason of the phenomenon is because of the implementation of relevant policies, on the other hand, it is due to advances in technology, with increasing amounts of thermal coefficient of elasticity, SO2 emissions will be significantly reduced.

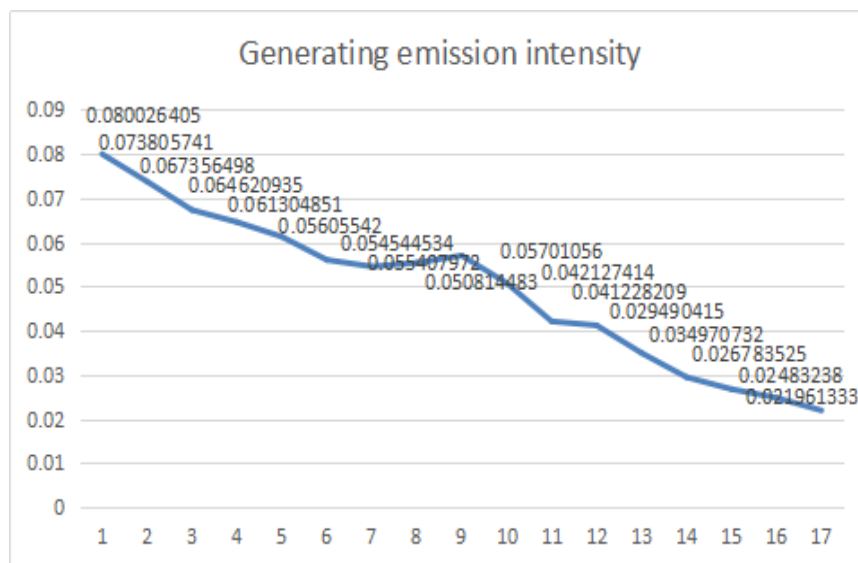


Figure 3. SO2 emissions from electricity generation intensity change map

The Fig. 3 shows the change trend of SO2 emissions from coal-fired power intensity from 1997 to 2013, it can be seen from the figure, changes in China's coal-fired power SO2 emissions intensity declined overall, generating SO2 emission intensity decreased year by year. But the intensity of emissions from electricity generation appears a downward trend, remained at a high level.

Conclusions

At present, China has formed a power structure dominated by thermal power, supplemented by other power generation pattern. The moment it is the largest share of thermal power in the whole power structure, it is a energy crisis and worsening environmental pollution society today, this power structure does not meet the requirements of sustainable development, from this point of view, such a structure is obviously unreasonable.

In China, the primary energy consumption structure is still dominated by coal, the proportion of coal accounted for 70.40%, the current power structure is reasonable. Although the power structure is very tangled, but we try to adjust the power structure, and to develop low-carbon power, in order to achieve sustainable development, we must develop new energy, try to reduce the proportion of thermal power, but just try not to be.

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