Comparison of gas generation and coal-fired power generation from electricity generation cost and environmental protection

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Abstract. It is to guide the natural gas power generation capacity reaching 110 million kw in 2020 according to "Natural gas development "thirteen five" plan", and the natural gas power generation installed ratio from 4.33% in 2015 rises to 5.5% in 2020. Benefiting from the gas and electricity reform policy, the natural gas power generation will be in the golden period of development during the 13th Five-Year time. In order to further study the impact of electricity generation cost and environmental protection on natural gas power generation, this paper compares the differences between the two power generation types based on an open data. Compared with coal-fired power generation, the economic cost of natural gas power generation is far higher. However, due to environmental factors and the power supply capacity, natural gas power generation in the eastern China is better.

1. Introduction

It is to guide the natural gas power generation capacity reaching 110 million kw in 2020 according to "Natural gas development "thirteen five" plan", and the natural gas power generation installed ratio from 4.33% in 2015 rises to 5.5% in 2020. Correspondingly, the CAGR of natural gas power installed capacity is 10.63% based on the plan. Thinking about the difference between the two rates, we can find that the natural gas consumption in the power generation growth rate will be slightly higher than the growth rate of natural gas power generation capacity. In other words, the natural gas generation as the clean energy, will give the priority to development[1,2].

Table 1. The capacity and rate of natural gas power generation during "thirteen five" plan

contents	units	2015	2020
power generation capacity	100 million kilowatts	15.3	20
natural gas power generation rate	%	4.33	5.5
natural gas power generation capacity	100 million kilowatts	0.6637	1.1

In order to estimate the scale of natural gas power generation during the 13th Five-Year Plan, the relevant datas of the power installed condition are calculated in this paper. The installed capacity is from the public data of "Eleventh Five-Year Plan" of "Energy Development". The installed capacity of natural gas power generation in 2015 comes from "China Electrical Engineering Society Professional Development Report (2015 - 2016) " and the natural gas power generation capacity in 2020 is from the "natural gas development "thirteen five" plan ".The installed capacity of about 43.63 million kilowatts of the increase.data can be found in the calculation of natural gas during the 13th Five-Year Plan, which scale is more than half of the installed capacity in 2015[3].

According to the CEC statistics, the ratio of the installed capacity of coal-fired power generation accounts for about 57% and correspondingly the rate of the natural gas power generation accounts for about 4% as of the end of 2016. The generation costs of coal-fired power are far lower than the natural gas power generation, and it is economic[4,5]. However, the pollution of coal-fired power generation is very serious, about one-third parts of factors causing the haze in northern China during winter comes from coal-fired power generation based on the public data.coal. In contrast, gas power comes with environmental advantages. The domestic development of natural gas in the eastern region is better with the national government subsidies and clean energy tariffs.

2. Comparison of Gas Generation and Coal-Fired Power Generation from Electricity Generation Cost

Huaneng, Datang, Guodian, Huadian, State Power and other power generation group have their corresponding listed companies. According to the 2015 annual report on the listed companies from the major power generation group, we can extract out cost, income, profit, capacity and the other data of the coal-fired power generation and gas power generation. Then we can calculate the unit cost and unit power revenue of the two forms of power generation. The results show that, compared with China's current mainstream coal-fired power generation, gas power generation is still lacking in economy.

Fig. 1 Comparison between gas-based cost and coal-based cost

Fig. 2 Comparison between gas-based income and coal-based income

Fig. 3 Comparison between gas-based income/cost and coal-based income/cost

Compared with the unit cost and unit income of the coal-fired power generation and gas power generation, it can be concluded that:

1. The costs of gas power generation remain high and it has no obvious advantage compared with coal-fired power generation. This is mainly due to the higher cost of gas supply.
2. Gas power generation revenue is high, but this is based on the policy of protection for the gas power generation.
3. Coal-fired power generation revenue can cover the cost, and there is no loss.
4. The unit cost of gas power generation maybe be higher than the unit income. In another word, gas-based power plant may make a loss, but it is impossible to the coal-fired power plant in current time.

3. Comparison of Gas Generation and Coal-Fired Power Generation from Environmental Protection

We compare the pollutant emissions under the same calorie. The calorific value of 1 ton Chinese traditional coal (calorific value of 21.2MJ / kg) is equal to the value of 588.78 m³ West-East Gas (calorific value by 36MJ / m³). The pollutant emission rates for natural gas and coal calculated for the same calorific value are shown in the table below.

Table 2 The pollutant emission rates for natural gas and coal

pollution	units	SO ₂	NO _x	CO ₂	CO	fly ash	bottom ash
coal-based emission(1t)	kg/t	18	8	1730.97	0.26	110	30
gas-based emission(588.78m ³)	kg/(588.78m ³)	0.00683	3.65	1183.45	0	0	0
ratio	/	0.04%	45.63%	68.37%	0.00%	0.00%	0.00%

Around the environmental protection, gas power generation has obvious advantages. SO₂ emissions are very low, and there is no fly ash and bottom ash. NO_x production is only less than half of coal-fired power plants.

Because of environmental factors forcing natural gas power generation, the geographical distribution of natural gas power generation is evident. China's natural gas power generation is mainly distributed in the Yangtze River Delta, the southeast coast and other economically developed provinces and cities. As of the end of 2013, the installed capacity of gas power plants in Guangdong, Fujian and Hainan provinces is 17.5 million kW, which accounts for 34% of all gas power plants in China. The proportion of the plants in Jiangsu, Zhejiang and Shanghai provinces is about 32%. In recent years, with China's more severe environmental protection, Shanxi, Ningxia, Chongqing and other regions also make a choice of gas power plants and thier distribution is more extensive.

4. Summary

Although the gas-fired power generation is at a disadvantage in terms of cost, the units of carbon emissions are relatively low and the power generation efficiency is relatively high, which is in line with the energy conservation and pollution emission reduction in China. Due to environmental factors and the power supply capacity, natural gas power generation in the eastern China is better. With the development of more severe environmental pressure, gas power generation has accelerated the potential for alternative coal.

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