Research on the Impact of the "Coal to Gas" and "Coal to Electricity" Policies on Urban Air Quality

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Abstract. Heating in winter in the north has a significant negative impact on the quality of the atmospheric environment. The coal used for heating emits substances such as PM2.5, PM10, sulfur dioxide, carbon dioxide, etc., exacerbating atmospheric environmental pollution. Air pollution seriously affects the physical health and safety of residents, reduces their sense of happiness, brings about significant environmental pollution costs, and increases the actual level of economic inequality. In response to this situation, this article aims to improve urban air quality through the policies of "coal to gas" and "coal to electricity", and further studies the impact of this policy. To provide empirical evidence and decision-making reference for deepening the "coal to gas, electricity" policy, and to reduce atmospheric environmental pollution, it is necessary to actively adjust the heating plan, increase the central heating area, and construct different heating scales according to different needs. It is necessary to vigorously develop clean coal technology, reduce pollutant emissions, actively explore clean energy, and fundamentally change the problem of air pollution. Therefore, the policies of "coal to gas" and "coal to electricity" can effectively improve the pollution of coal on urban air quality.

Keywords: The policy of "coal to gas" and "coal to electricity" affects urban air quality

1. Introduction

Protecting the ecological environment is an important measure to implement the development concept of "Lucid waters and lush mountains are invaluable assets". Over the past 40 years of reform and opening-up, with the rapid economic growth in China, the environmental pollution caused by extensive economic's growth model has become more and more prominent. With the improvement of residents' income and living standards, the requirements for heating have also increased, and the characteristics of low price and easy access of coal have naturally become the preferred energy source for residents' heating [1]. In the heating of northern cities in China, there are still some deficiencies in heat sources and heating networks, which have aggravated air pollution to some extent. In terms of heat source, there are still many scattered small boiler rooms, and the total number of boiler rooms is too large. Too many boiler rooms lead to the waste of energy and too many sources of pollutants, which are difficult to control. This has caused such a large amount of coal burning in the whole northern region. In addition, there are many supply channels for bulk coal, which brings difficulties to statistical work, which may be the main reason for statistical errors. The combustion of loose coal in rural areas is an important factor causing air pollution, especially the regional haze caused by a large number of subsequent combustion has brought serious harm to people's health [2]. At the same time, air pollution seriously affects residents' health and life safety, reduces residents' happiness, brings greater environmental pollution costs and increases the actual economic inequality. Although technological innovation and industrial revolution are the core driving forces of "changing coal into gas" in essence, ensuring the supply of natural gas at this stage and promoting the rationalization of terminal gas prices should become the focus of China's natural gas market reform. In addition, compared with the "coal-to-gas" promoted by government subsidies and the substitution of energy driven by the market, technological innovation will go more steadily, which in turn requires the continuous progress of technology and the improvement of economy and efficiency. Therefore, in the process of economic development, how to balance the relationship between economic development and environmental pollution and realize the intensive, green and efficient development of China's economy has become an important issue that needs to be solved urgently [3]. In this regard, this paper has improved the urban air quality through the policy of "coal to gas" and "coal to electricity". This paper mainly studies the impact of the policy of "coal to gas" and "coal to electricity" on urban air quality. This paper discusses the air pollution control, green development and economic benefits of the policy of "coal to gas and electricity", and lacks of microscopic and exquisite data to analyze the air pollution control effect of the policy of "coal to gas and electricity" [4]. Therefore, this paper will

use the daily micro-panel data of cities to analyze this problem, and provide empirical evidence and decision-making reference for deepening the policy of "changing coal to gas and electricity". Theoretically, strict policy implementation can effectively reduce air pollution, but because the policy of "changing coal to gas and electricity" needs to be based on subsidies, government implementation and residents' cooperation, if one or more of the factors such as subsidies deviating from costs, inadequate government implementation and low residents' cooperation exist, it will lead to policy "failure" [5]. Therefore, it is very necessary to deeply analyze the air pollution control effect of the policy of "changing coal to gas and electricity".

2. The Development Status of "Coal to Gas" and "Coal to Electricity"

Coal burning is one of the main pollution sources in the northern region. In order to improve the atmospheric environment, the replacement field of "coal to gas and electricity" is the industry that consumes a lot of coal and produces a lot of pollutants. There are many users who use loose coal in life and production, which is difficult to monitor and manage in a unified way, and the pollution control is difficult and the utilization efficiency is low [6]. Therefore, in order to reduce the pollution caused by coal burning in winter and improve the quality of life of residents, many governments began to substantially promote the project of "changing coal into electricity and electricity", that is, appropriate gas means gas, and appropriate electricity means electricity. The main components of smog are sulfur dioxide, nitrogen oxides and inhalable particles. At present, the main pollutants emitted by coal combustion recognized by the national environmental protection agency are inhalable particles, sulfur oxides, nitrogen oxides and carbon monoxide.During the heating period in winter, a large amount of loose coal in Beijing, Tianjin and Hebei is directly discharged after burning, and the contribution rate of pollutant concentration accounts for about 50% of the whole year. Therefore, in the process of "changing coal into gas and electricity", we should increase the substitution of users who burn loose coal. In recent years, coal-fired power plants have strengthened their efforts in desulfurization and denitrification, but their emission level is still higher than that of gas-fired power plants. From the perspective of the influence mechanism of policy implementation on energy consumption, "coal to gas and electricity" will reduce coal burning, and at the same time, it will generate more demand for natural gas and electricity. The gap of natural gas supply and the source of electricity will become the main challenges for the implementation of "coal to gas and electricity" policy. Although the energy consumption structure dominated by coal will not be fundamentally changed in China in the short term, it is an important issue to be considered in the implementation of the policy of "changing coal to gas and electricity" that how to make up for the reduction of energy consumption caused by the reduction of coal consumption with natural gas and electricity[7]. At the same time, due to inadequate environmental supervision measures, there are still problems such as excessive emissions in a short period of time. It also has certain application in the transformation of steam boilers and gas turbines of coal-fired power plants. The policy of "changing coal to gas and electricity" has no significant negative impact on the population of artificial gas and natural gas. The possible reason is that the policy of "changing coal to gas and electricity" in urban areas may focus on the energy fields for non-residents to live in, such as industrial fields. The policy of "changing coal to electricity" makes rural electricity consumption decline, which may be due to the fact that the policy of "changing coal to electricity" has not been effectively implemented, or the high cost relative to coal-fired heating has triggered rural energy-saving behavior. In response to air pollution, some cities began to promote the "coal to gas, electricity" project. "Promoting clean heating in winter in the northern region is related to the warm winter of the masses in the northern region and whether the smoggy days can be reduced. It is an important part of the energy production and consumption revolution and the rural lifestyle revolution. It is necessary to follow the policy of giving priority to enterprises, promoting by the government, and being affordable to residents. It is necessary to use clean energy as much as possible and accelerate the increase of the proportion of clean heating [8]." Therefore, the implementation of "changing coal into gas and electricity" has practical significance for reducing the burning of loose coal in rural areas in northern China, improving air quality and protecting human body from haze. In "coal to gas and electricity", users of loose coal are replaced by natural gas, and then industries with large coal consumption are replaced. Finally, power generation methods are selected according to the development of different regions. While replacing boilers with coal gas, small-scale equipment such as gas-fired wall-hung boilers and heat pumps also play an important role in the "coal to gas" project as effective supplementary means [9].

3. Influence of "coal to gas" and "coal to electricity" policies on urban air quality

3.1 Improve the quality of atmospheric environment.

The research shows that under the same energy consumption, the ash powder released by coal combustion is 148 times that of natural gas, the carbon dioxide emission is 700 times that of natural gas and the nitrogen oxide emission is 29 times that of natural gas. If natural gas can completely replace coal burning, China's smog dilemma will be broken. However, China's energy resources are mainly coal, and natural gas resources are very few. Coupled with the limitations of development technology, the price of natural gas is relatively high and the heating cost is very high. Winter heating in the north is an inevitable demand in the cold weather in the north, and the protection of atmospheric environment should be taken into account on the premise of meeting the living

requirements of northern residents [10]. Most coal-fired boilers have not been desulfurized, and the miniaturization of coal-fired boilers and even some coal-fired boilers have not reached the national standard, which has also aggravated the air pollution during the heating period. Therefore, this paper puts forward a research hypothesis: under the condition of other factors unchanged, compared with non-heating period, coal-fired central heating significantly increases air pollution. According to the descriptive statistical analysis results of all sample variables in Table 1, the average value of AQI index is 89.1242, and the average value of PM10 is 99.2546 μ g/m3, and the standard deviation of the three indexes is relatively large, indicating that the average air quality during the sample period is good, but there are great differences among cities. Taking AQI as a measure, the air quality of 22.12% days is excellent, 53.16% days are good, 17.24% days are lightly polluted, and the proportion of moderately and severely polluted days is 5.01% and 3.56% respectively, while the proportion of severely polluted days is only 1.18%.

Table 1 Descriptive statistical analysis results of variables

Variable	Meaning	Unit	Average value	Standard deviation
AQI	Air Quality Index	-	89.1242	52.1362
PM10	Inhalable particulate matter	Micrograms/cubic meter	99.2546	88.4256
WINDH	Maximum wind force	level	2.7511	1.2856
WINDL	Minimum wind force	level	1.8523	1.0753

In order to reduce atmospheric environmental pollution, it is necessary to actively adjust the heating plan, increase the central heating area, and construct different heating scales according to different needs. It is necessary to vigorously develop clean coal technology, reduce pollutant emissions, actively explore clean energy, and fundamentally change the problem of atmospheric pollution. Therefore, the policies of "coal to gas" and "coal to electricity" can effectively improve the pollution of coal to the atmospheric environment.

3.2 Improving energy efficiency

Reducing pollutant emissions, research shows that under the same heating scale, if energy-saving technology is fully utilized, the fuel consumption will be reduced by two-thirds. On the one hand, according to the heating object and demand, the corresponding heating plan should be made, and different heating scales should be adopted for industrial enterprises with large demand and residents with small demand to reduce energy waste; On the other hand, we should actively upgrade the technology, reduce the heat loss of pipelines and equipment, vigorously develop clean coal technology, use high-quality coal, and reduce pollutant emissions. In view of this situation, this paper intervened in it through the policy of "coal to gas" and "coal to electricity". Before the implementation of the policy, there should be no significant difference between the pilot cities and non-pilot cities of the policy of "changing coal to gas and electricity". In this paper, the data of two years before, two years after and five years after the implementation of the policy are selected for parallel trend test. It can be seen from 2 that after controlling the time effect and urban effect, before the implementation of the policy of "changing coal to gas and electricity", the gap between AQI and PM10 of the pilot cities and non-pilot cities with the policy of "changing coal to gas and electricity" is not significant, so the self-selection problem of the samples of the pilot cities with the policy of "changing coal to gas and electricity" is ruled out through the parallel trend test.

Table 2 Parallel trend test results of the effect of "coal to gas and electricity" policy on air pollution

Variable	AQI	PM10
time	-28.1245***(5.4123)	-35.4587(8.2102)
Before2	-1.5214(6.7542)	-9.5241(10.0214)
Before1	-6.4521(8.5634)	-19.4215(12.8523)
Gurrent	-15.5824(9.1123)	-27.4251(13.1801)

At the same time, theoretically speaking, "coal to gas, electricity" can effectively reduce pollutant emissions. But policy implementation is a process of multi-agent game, with the central government as the policy maker, local governments as the policy pusher, and the public, especially rural residents in key areas of transformation, as the policy recipients. There are biases among the three parties in their interest demands. The policy of "replacing coal with gas and electricity" has significantly reduced rural electricity consumption, possibly due to the higher cost of "electric heating" compared to "coal-fired heating", which has prompted rural residents to form the habit of saving electricity. On the other hand, the coefficient of urbanization rate is significantly negative at the 10% significance level, and its impact on rural electricity consumption is much greater than that of the "coal to gas, electricity" policy. This means that the "coal to gas, electricity" policy has not fundamentally enabled the widespread application of electric heating, and the policy effect is not ideal enough. The interests and demands of the central government are mainly reflected in three aspects: improving environmental quality, meeting people's needs for a better life, and organically integrating economic and social benefits; Under the official promotion championship, the interests of local governments are more reflected in their pursuit of GDP growth rate; The interests and demands of rural residents are reflected in lower costs and higher heating quality. The use of air and electric heating will increase heating costs.

4. Conclusions

Winter heating in northern China has a significant contribution to air pollution. During the heating period, the concentration of pollutants in the air is significantly higher than that during the non-heating period. These studies have proved that heating in winter in the north has obvious negative effects on the quality of the atmospheric

environment. The coal used for heating will emit substances such as PM2.5, PM10, sulfur dioxide and carbon dioxide, which will aggravate the atmospheric environmental pollution. In view of this situation, this paper improves urban air quality through the policy of "coal to gas" and "coal to electricity", and further studies the impact of this policy. "Changing coal into gas and electricity" is actually a form of internal substitution of traditional fossil energy. This substitution should not only be reflected in the green development, but also require the improvement of energy efficiency, that is, according to the structural characteristics of energy consumption in various places, the appropriate promotion route and scale of "coal to gas and electricity" should be adopted to ensure that the policy of "coal to gas and electricity" can play a great role in urban air quality, and natural gas and electricity can replace coal, continuously optimize the heating energy structure, and reduce the atmosphere to a certain extent. Therefore, it is suggested to encourage the general public to use natural gas, increase its supply, and achieve the combination of supply and demand of natural gas; And improve infrastructure, strengthen government supervision and policy step by step.

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