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Influence of "Coal-to-Gas" Policy in the Beijing-Tianjin-Hebei Region and Surrounding Area on the Air Quality

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Abstract:

In recent years, extreme weather, such as haze, has occurred frequently; air pollution has been aggravated; and the concentration of inhalable particulate matter in the air has been very high in China, especially in Northern China. The problem of atmospheric environment needs to be solved urgently. Meanwhile, the energy problem pertains to the country's major strategy. Adjusting the energy structure can not only solve the problem of environmental pollution, but also change the energy pattern of our country. Thus, the "Coal-to-Gas" policy has been implemented. This paper examines the influence of the "Coal-to-Gas" policy on the air quality in the Beijing-Tianjin-Hebei Region, which also has important practical significance for further optimization and control of the policy.

Keywords: Coal-to-Gas policy, Green Development, Energy Transition, Policy Effect

1. Introduction

The industrialization has raised production level of China. However, the price of progress at the expense of the environment is serious, with damage incurred to the environment and people's happy living standards influenced. Therefore, China has started to advocate winning the blue sky defense battle and lay emphasis on green development. The "Coal-to-Gas" policy is also one of the environmental protection policies. As for the research on the policy of "Coal-to-Gas", scholars focused on studying the effect of policies, especially on carbon emissions and environmental behaviors of rural housing (Hou Longshu, Ding Hongtao et al., 2022) and rural enterprises (Liu Ling, 2021). Secondly, the economic benefits of the policy (Lu Chuanyi, Lu Yucheng et al., 2022) or green benefits (Ding Yueqing, Hong Zenglin, etc., 2020; Yue Hongfei and Shi Chuan, 2019) were evaluated. Yue Hongfei (2019) used the direction distance function based on slack variables (SBM-DDF) and integrated the economic costs and benefits of implementing the "Coal-to-Gas" policy to calculate and evaluate the green net benefit of "Coal-to-Gas" in the Beijing-Tianjin-Hebei Region and prove that under the difference of energy structure and price cost , the green net benefit of "Coal-to-Gas" engineering in Hebei is the largest, and such green net benefit in Tianjin is weaker than that in Beijing[1]. In addition, scholars have adopted PSM-DID model, ARMA model, etc. and selected the data during the policy implementation period in a specific region for empirical analysis to explore the policy effect of "Coal-to-Gas". This paper deeply explores the actual impact of the "Coal-to-Gas" policy on air quality in the Beijing-Tianjin-Hebei Region and finds that there are problems in the implementation of the Coal-to-Gas policy (such as less clean energy, untimely policy subsidies and policy implementation) by judging the policy effect based on the industrial, economic and meteorological characteristics of each region and observing and comparing the data of coal use and air quality. This paper also summarizes the implementation status and the effect of the policy, providing direct evidence of policy effectiveness and offers suggestions like scientific overall planning, expanding the scope of subsidies and establishing a scientific supervision and evaluation system pursuant to the actual situation.

2. Overview of "Coal-to-Gas" policy

The problem of air pollution is serious, and haze weather happens frequently in autumn and winter in China, especially in northern China. Since 2012, the number of days with haze pollution and heavy air pollution nationwide has increased sharply. The concentration of inhalable particulate matter in the atmosphere has been very high, and environmental problems have become increasingly serious in economically developed areas and regions with rapid economic growth (such as the Circum-Bohai Sea Region, the Yangtze River Delta Region, the Pearl River Delta Region, and northern China), especially in the Bei-

jing-Tianjin-Hebei Region. In this situation, to achieve coordinated and sustainable economic development in the Beijing-Tianjin-Hebei Region, it is urgent to control environmental pollution, and it is imperative to replace the original coal heating with clean energy.

The energy is an important guarantee condition for social activities and the material basis of the national economy. The energy and environmental protection issues have always been in a strategic high-order position in China. High coal and high emission have been the important characteristics of energy consumption structure in China, as a country which is "rich in coal, short of oil and short of gas", for a long time. [2] Different from the energy using structure of other countries, the coal consumption accounts for 64% of China's traditional energy structure which has incurred a lot of impacts and damages to our environment [3]. During the heating season in the Beijing-Tianjin-Hebei Region and its surrounding cities, the scattered coal burning is a major source of air pollution particles. To reduce the hazard caused by coal burning and develop a low-carbon economy, using low-carbon energy to replace high-carbon energy as much as possible to make economic development meet the needs of environmental protection [4] is not only a strategic consideration for environmental pollution control, but also an important decision of the national development strategy.

There are Many factors influence the environmental quality in the Beijing-Tianjin-Hebei Region, and the environmental pollution in the Beijing-Tianjin-Hebei Region is serious due to various unfavorable conditions (such as regional transport, weather conditions, transfer between cities and traffic greening). The "Coal-to-Gas" policy is mainly implemented in "2+26" cities (such as Beijing, Tianjin and Hebei) through the reduction of natural gas prices and gas subsidies. For example, in the Beijing's 2017 government work report, it's planned to continue to vigorously reduce coal burning, complete the conversion of coal into clean energy in 700 villages, make the basic "coal-free" in the six urban districts and the southern plain area, implement 4,000t/h coal-fired boiler clean energy transformation, eliminate coal burning facilities of industrial enterprises, thoroughly obsolete coal-fired boilers of 10t/h or less, ensure the shutdown of Huaneng Beijing Thermal Power Plant coal-fired units for standby application after the heating season ends and reduce fire coal by 30% yearly and total fire coal to less than 7 million tons. For clean heating in rural areas, the principle of government guidance and market operation was followed and clean heating equipment renovation subsidies were granted pursuant to the way of home appliances going to the countryside in 2023.

3. Effect of "Coal-to-Gas" on air quality

Remarkable achievements in the implementation of the policy have been made nationwide. More than 170 million tons of low-quality scattered coal was accumulatively eliminated through "Coal-to-Gas" policy from 2017 to 2019. As of Oct. 2020, "Coal-to-Gas" had been completed for more than 16 million households nationwide.

The implementation of the "Coal-to-Gas" policy has significantly improved air quality in the Beijing-Tianjin-Hebei Region. There were only 175 days with good air quality in 2014 in Tianjin and there were only 209 days with good air quality when the policy was first implemented in 2017. After the implementation of the policy, the number of days with good air quality reached to 245 in 2020; The changes in Hebei Province are more significant: The number of days with good air quality increased from 151 in 2017 to 255 in 2020.

The "Coal-to-Gas" policy has significantly reduced the amount of inhalable particles (such as SO_2, NO_2 and $PM_{2.5}$) in the air. The annual average concentration of SO_2 in Beijing's air decreased from 22mg/m3 (μg/m3) in 2014 to 4μg/m3 in 2020. The annual average concentration of NO_2 in Tianjin also decreased from 0.05μg/m3 in 2017 to 0.039μg/m3 after transformation via the policy for three years.

As reported in 2023, the average annual $PM_{2.5}$ concentration in Beijing, Tianjin and Hebei decreased by 64.2%, 57.3% and 64.3% compared with 2013. In 2023, the number of heavy pollution days in Beijing, Tianjin and Hebei Province was decreased by 50, 37 and 69, respectively in comparison to that in 2013, and the pollution degree was significantly reduced.

The implementation of the policy has also significantly reduced pollutant emissions. The coal consumption in Beijing decreased from 20.37% of total energy consumption in 2014 to 1.5% in 2020, while the natural gas consumption increased from 21.09% of total energy consumption to 37.16%. Beijing residents' natural gas consumption increased from 59.2 cubic meters in 2014 to 93.9 cubic meters in 2022, reflecting the implementation of the "Coal-to-Gas" policy to residents. The total output of primary energy in Hebei Province in 2014 was 68.0101 million tons of standard coal, of which the raw coal accounted for 75.42%, and the total output of primary energy in 2021was 69.4952 million tons of standard coal, of which the raw coal accounted for 51%. This shows that the demand for coal is gradually decreasing while energy productivity is continuously improving, embodying the vigorous promotion of clean energy use.

In all, the "Coal-to-Gas" policy has significantly improved the air quality in the Beijing-Tianjin-Hebei Region and

people's living standards. People couldn't see their hands in front of them, had to wear a mask when going out and couldn't see the ground from the high-rise building before under the hazy weather, while now people can bravely breathe fresh air, showing the effect is obvious.

4. Policy problems and recommendations

4.1 Policy problems

When some results have been achieved by the implementation of the Coal-to-Gas policy in the improvement of energy structure and environmental governance, there are certain obstacles in the implementation of the policy. As a result, the policy effect is not fully reflected.

4.1.1 Whether the clean energy is sustainable?

The coal consumption accounts for 64% in China's traditional energy structure, dominated the China's energy consumption for a long time. To protect the ecological environment and achieve sustainable development, China strongly supports the use of clean energy, and the domestic demand for clean energy (such as natural gas) has risen sharply. However, China's natural gas highly depends on imports from foreign countries, which will be certainly affected by geopolitics and frequent fluctuations in gas prices. The high cost leads to the huge financial pressure on the government in the process of policy promotion, incurring a certain resistance to the promotion of local policies.

In addition to this, it is doubtful whether the environmental problem can be improved by the discharge of natural gas. Carbon dioxide and water will be produced after complete combustion of natural gas. Although some environmental problems (such as excessive SO_2 and NO_2 emissions and extreme haze weather) caused by coal burning can be radically solved, the natural gas combustion still gives rise to greenhouse gases like coal burning, thus aggravating the greenhouse effect and influencing the timely realization of China's carbon peaking and carbon neutrality goals.

4.1.2 Policy subsidy mechanism

Policy subsidies are the biggest driving force for the implementation of Coal-to-Gas policy. The gas subsidy is an incentive policy implemented by the government to improve the enthusiasm of gas companies and reduce the heating pressure of residents. Subsidies are mainly divided into one-time heating equipment installation subsidies and electricity and gas heating operation subsidies.

The cost of natural gas is high, subsidies are not enough to cover residents' demand for coal burning equipment, and the price of gas is too high after the cancellation of subsidies and the heating cost is much higher than that of coal, so the phenomenon that residents are unwilling to bear high heating costs often happens. The waste of financial subsidies arises and the real purpose of "Coal-to-Gas" isn't achieved because local subsidies are granted after use of natural gas, with slow distribution of subsidies and large pressure of common people using the natural gas.

The cost of natural gas is high, and the fiscal subsidy policy also increases the burden of the government. Complicated application procedure for subsidy funds and the long distribution period often occur.

4.1.3 Policy implementation

The promotion of "Coal-to-Gas" policy involves many rural and urban areas nationwide, with a wide coverage and complex task engineering.

The problem is more prominent in rural areas. Scattered housing and imperfect infrastructure in rural areas are not conducive to collective heating; compared to urban house, the large per capita space, poor insulation and special structure occur to the house of each household in rural areas, so one heater cannot meet the heating demand during the heating season, the cost is high and the Coal-to-Gas engineering is progressing slowly. The gas shortage frequently happens, and residents in rural areas endure the cold due to failure in getting heat timely during the heating season. Secondly, subsequent equipment repair and regular maintenance are not timely, resulting in major equipment security risks. During the implementation period, the policy supervision is not thorough, the rural coal sale has not been completely cut off and the use of clean energy has not been promoted deeply in rural areas.

4.2 Policy suggestions

The Coal-to-Gas policy shall not be promoted based on quantity, but step by step adjust measures to local conditions and systematic planning pragmatically to give full play to the value of the Coal-to-Gas policy to benefit the people and improve the energy structure.

4.2.1 Scientific overall planning

Improve the implementation policies for "Coal-to-Gas" and relevant supporting policies as well as carry out overall planning and coordination of the implementation of policies. Promote the integrated and coordinated development of the Beijing-Tianjin-Hebei Region and thoroughly implement the policy of Coal-to-Gas by helping each other among various regions.

4.2.2 Expand the scope of policy subsidies

Form the government and enterprise cooperation and optimize the sources and channels of subsidy funds. Re-

duce unnecessary procedures for distribution of funds and implement subsidies timely; Improve subsidy policies, enrich gas sources and reduce natural gas costs.

4.2.3 Improve regulation capacity and establish a scientific evaluation and feedback system

We need to improve the construction standards in rural areas and establish a system of coordinated supervision among all departments by regularly reviewing the implementation effect and using a variety of indicators to evaluate the implementation of policies in terms of local conditions. What's more, strengthen regional supervision capacity, cut off coal supply and marketing channels and regularly maintain heating equipment, find the problem timely and reduce safety hazards are also of great importance.

5. Conclusion

To sum up, the "Coal-to-Gas" policy has had a significant impact on air quality in various regions, effectively increased the usage rate of clean energy and reduced the use of traditional coal, thus reducing the common inhalable particles in the air, increasing the number of days with good air quality throughout the year and improving people's living standards. The "Coal-to-Gas" policy implementation shall not be of sweeping approach, but the government shall carry out in-depth research on the living habits and living environment of local rural residents, formulate specific plans in line with the heating needs of different families and implement the transformation of heating equipment in different categories. [5] The further implementation of the policy requires considering energy sources and strengthening supervision to better fight for the blue sky and white clouds.

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