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Empirical Model Study on Profitability Characteristics of Heating Technologies and Fiscal Subsidy Pressures in District Heating

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INTRODUCTION

Winter heating for residents in the northern region is an important livelihood security project, which is related to the vital interests of the people. Local governments actively respond to the serious implementation and take a variety of means to ensure the heating of residents.

Since 2017, large-scale "coal-to-gas" and "coal-to-electricity" clean heating actions have been launched in various places, At present, there is no coal-fired heating in the jurisdiction of Beijing and Tianjin, and there is basically no coal-fired heating in Hebei Province.

As we all know, the supply and demand of natural gas resources in China are tight. The price of natural gas will rise sharply during the winter heating period, which will lead to the urgent cost of heating. The dramatic rise eventually led to the highlight of the contradiction between heating income and expenditure. In order to ensure the clean heating of residents, local governments have adopted the subsidy difference to promote the stable operation of heating enterprises.

Since 2022, due to the dual impact of real estate and the epidemic, the financial situation of local governments has encountered unprecedented pressure. In the first half of 2024, only Shanghai achieved a surplus of income and expenditure, and the financial self-sufficiency rate of 17 regions was less than 50%. Against this background, we should open source and save as much as possible to ensure long-term security.

In summary, the financial situation in various places is not optimistic, and the effective management and efficient use of financial subsidies for heating has become an urgent problem to be solved.

RESEARCH ON THE EMPIRICAL MODEL OF FINANCIAL SUBSIDY PRESSURE OF DIFFERENT HEATING TECHNOLOGIES

Practice has proved that the main heating technologies to solve the winter heating problem on a large scale are coal-fired, gas and geothermal heating. At present, the country and most regions have restricted the heating of new coal-fired boilers, and issued policies to gradually replace the existing coal-fired heating sources. Therefore, this article establishes an empirical model for geothermal heating, and enters the national typical Regional relevant parameters, test the actual effect of medium and deep geothermal heating on alleviating the pressure of local financial subsidies, compare and analyze its economy and the advantages of rational application of subsidy funds, and then argue the efficient use of effect subsidy funds.

Whole Life Cycle Cost Model (LCC) for Heating:

$$LCC = I_0 + \sum_{t=1}^{n} \frac{O_t + M_t}{(1+r)^t} - \frac{S_n}{(1+r)^t}$$

It is estimated that the financial IRR of the geothermal heating project is basically about 8%, and the net loss of gas boilers without subsidies.

Build the Financial Subsidy Pressure Index (FPI) based on the above situation:

$$FPI = \alpha \frac{S_{sub}}{R_{local}} + \beta \frac{I_{pipe}}{D_{debt}} + \gamma \frac{C_{env}}{G_{green}}$$

From this calculation, the fiscal pressure index decreased from the original gas heating 0.78 to 0.32, the main It should be due to the reduction of subsidy expenditure (α decreased by 52.1%) and the reduction of environmental protection expenditure (γ decreased by 40%).

RESULTS

Table 1. Income, cost and profit and loss table of each heating technology

No.	Type	Unit	Natural gas	Air	Electric Thermal Storage	Geothermal
1	Heating Income	RMB/m^2	22	22	22	22
2	Connection Income	RMB/m^2	8	8	8	8
3	Natural Gas Price	RMB/m^3	3.5	3.5	3.5	3.5
4	Electricity Price	RMB/kwh	0.6	0.6	0.3(Off-peak)	0.6
5	System Efficiency		85%-95%	2.0-3.0	90%-95%	4.5-6.0
6	Gas Consumption	m^3/m^2	8	-	-	-
7	Electricity Consumption	kwh/m^2	-	40	80	16
8	Investment	RMB/m^2	40	70	85	100
9	Depreciation	RMB/m^2	2.86	5	6	7
10	Energy Cost	RMB/m^2	28	24	24	9.6
11	Other Cost	RMB/m^2	3	3	3	3
12	Direct Cost	RMB/m^2	31	27	27	12.6
13	Total Cost	RMB/m^2	33.86	32	33	19.6
14	Profit/Loss(incl.2)	RMB/m^2	-3.86	-2	-3	10.4
15	Profit/Loss(excl.2)	RMB/m^2	-11.86	-10	-11	2.4
16	Issues		Carbon emissions	Electrical capacity, Noise	Electrical capacity	government approval

It can be seen from the above table that the three heating technologies, such as gas, air source heat pump, and electric heat storage, suffered losses in the first year of operation and were all hard losses, and they needed subsidies. After the supporting fees were evenly distributed, the amount of subsidies was greater. Medium and deep geothermal heating basically does not need subsidies, and it can guarantee small profits, that is, potential profits.

Under the current situation that the total number of supporting fees for urban infrastructure of local governments is almost dry and cannot be transferred, the subsidies required for heating technologies such as gas, air-source heat pumps and electric heat storage are greater.

CONCLUSION

According to the results of the regional geothermal survey of the China Geological Survey, China's hydrothermal geothermal resources are equal to 1,25 billion tons of standard coal, and the annual mineable amount is equal to 1.865 billion tons of standard coal; among them, hydrothermal medium and low-temperature geothermal resources (mainly used for heating) are mainly distributed in the Bohai Bay Basin, the North Jiangsu Basin, Songliao In large and medium-sized sedimentary basins and orogenic belts such as basins, Fenwei trenches and South China fold belts, the amount of geothermal resources is equivalent to 1,230 billion tons of standard coal, accounting for about 98% of the total amount, and the annual harvestable amount of geothermal resources is equivalent to 1.85 billion tons of standard coal. The amount of shallow geothermal energy harvestable resources in cities above prefecture-level cities across the country is 700 million tons of standard coal equantable; the amount of medium-deep geothermal energy harvestable resources is 1.9 billion tons of standard coal equant (China's total energy consumption in 2023 is 5.72 billion tons of standard coal), which is enough to support the use of geothermal heating to replace the existing traditional fossil energy supply. Hot.

By the end of 2022, China's direct utilization of geothermal combined installation capacity is 100.2GW. Among them, the combined installed capacity of medium and deep hydrothermal geothermal heating is 50GW, and the heating area has reached 530 million m2, highlighting its mature applicability and reliable stability.

SUGGESTIONS

(1) Practice has proved that the development and utilization of geothermal energy is the most effective and efficient way to completely solve the problem of clean economic heating in winter in the northern region, solve the financial subsidy dilemma, and save a lot of valuable central and local financial support funds.

(2) Heating enterprises should actively communicate with local governments, apply for state financial subsidies as much as possible without increasing the financial burden of local governments, and fundamentally solve the heating problem while effectively ensuring the clean economic heating supply of residents in winter.

(3) The current measures for the management of air pollution prevention and control funds will expire by the end of 2025. Relevant enterprises and local governments should communicate with relevant departments and bureaus as soon as possible. Before the new round of air pollution prevention and control funds takes effect, heat source transformation should be included in the scope of support (clear that the heat source should be clean and low-carbon, both existing projects and new projects are acceptable).

(4) Explore the construction of geothermal regional development collection and irrigation pilot areas, clarify the geothermal management authority of relevant districts and counties, and give them them only for clean heating attributes; set up geothermal regional mineral rights, raise the threshold of geothermal development, and ensure the efficient and sustainable development and utilization of geothermal resources while simplifying the mineral rights declaration process.

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