



Research on Marketization Path of Clean Heating in Northern China

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Abstract. From 2017 to 2022, the central government has supported 88 pilot cities to promote clean winter heating in northern China. Affected by the factors of large investment in the construction of clean heating projects and high cost of use, the finance faces greater financial pressure and the severe situation of bulk coal re-burning after the cancellation of financial subsidies. Focusing on financial funds, green finance, social capital and user payment, this study sorted out the current investment status of clean heating projects, identified the main manifestations of the imperfect investment return mechanism, and put forward suggestions to promote the marketization of clean heating projects from four aspects. It aims to establish a sustainable long-term mechanism for diversified investment and financing of clean heating, better support the in-depth fight against pollution prevention and control, and help achieve carbon neutrality.

Keywords: clean heating, marketization, central finance, green finance, investment and financing.

1 Introduction

To achieve carbon neutrality, promote energy structure adjustment and green low-carbon transformation is the only way ^[1, 2], which involves many aspects of urban and rural life, and clean heating is an important part of it ^[3]. Since the central government supported pilot cities to promote clean heating in 2017, a total of 88 pilot cities have been supported to carry out clean heating by 2022. Affected by the factors of large investment in the construction of clean heating projects and high cost of use, local finance is facing greater financial pressure, and it is facing the severe situation of reburning loose coal after the cancellation of financial subsidies ^[4, 5]. The cost of clean heating is higher than that of loose coal heating, and the cost is the key factor affecting its sustainability ^[6, 7], which cannot be sustained only with financial subsidies ^[8, 9]. The marketization path of clean heating in northern China is studied, and feasible comprehensive economic incentive policies are proposed. It is of great significance to leverage financial institutions and social capital to increase investment in the field of clean heating and form a sustainable diversified investment and financing long-term mechanism.

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2 Current investment status of clean heating project

2.1 Financial Investment

From 2017 to 2022, the central government has invested 76.72 billion yuan to support clean heating work, and the scope of pilot cities has also continued to expand [10, 11], from the initial 12 cumulative to 88 (Figure 1, the number of pilot cities in the figure is the cumulative value). Due to the population size of the pilot cities, the current situation of clean heating and the amount of transformation tasks are different, the gap between the average household subsidy in some cities is large, with a high of more than two thousand yuan and a low of several hundred yuan. In addition to direct financial subsidies, the state has also introduced relevant price guidance policies in the field of clean heating. Local financial subsidies are mainly "coal to gas" and "coal to electricity", and the subsidy links mainly include pipe network infrastructure renovation and equipment subsidies, operation energy consumption subsidies, and building energy efficiency renovation subsidies. Most of the pilot cities have formulated tiered pricing and peak-valley pricing preferential policies [12, 13].

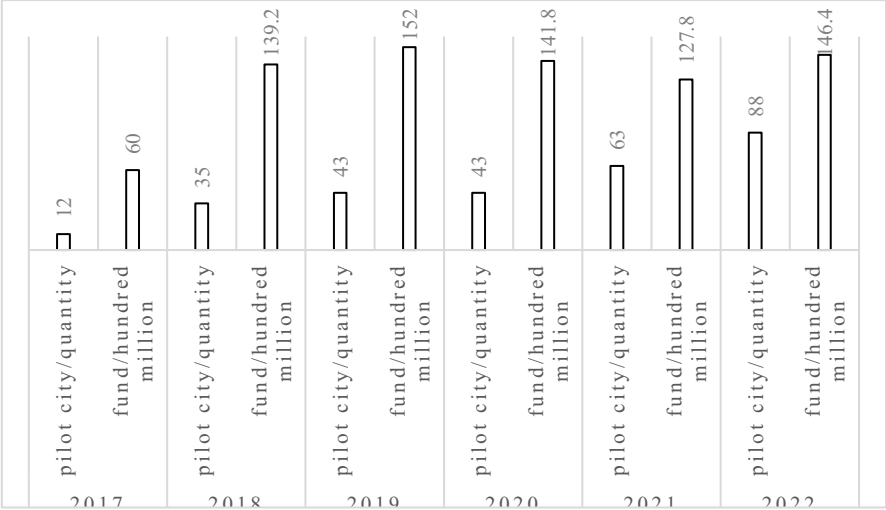


Fig. 1. Central financial subsidies for clean heating from 2017 to 2022

2.2 Financial Support

By the end of 2022, the green credit balance of China's 21 major banks exceeded 20.6 trillion yuan (Figure 2), an increase of 33.8% year on year. Calculated according to the proportion of credit funds in the total investment in green projects, it can support the annual saving of more than 600 million tons of standard coal and reduce carbon dioxide equivalent by more than 1 billion tons. Green credit is the most widely used in the field of clean heating, and other green financial products are not widely used [14].

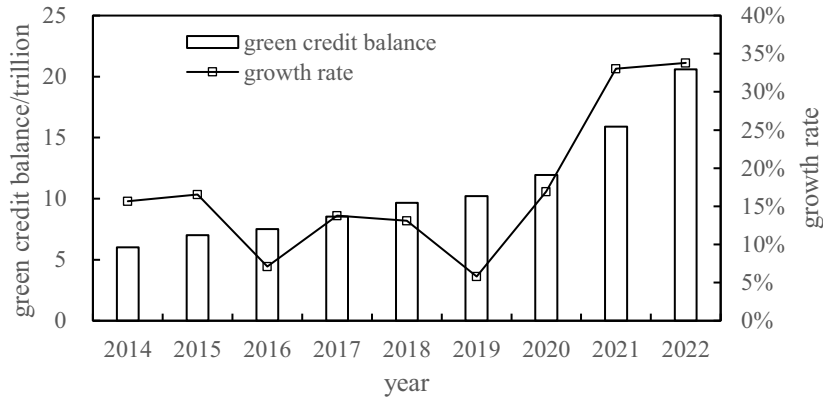


Fig. 2. National green credit balance 2014-2022

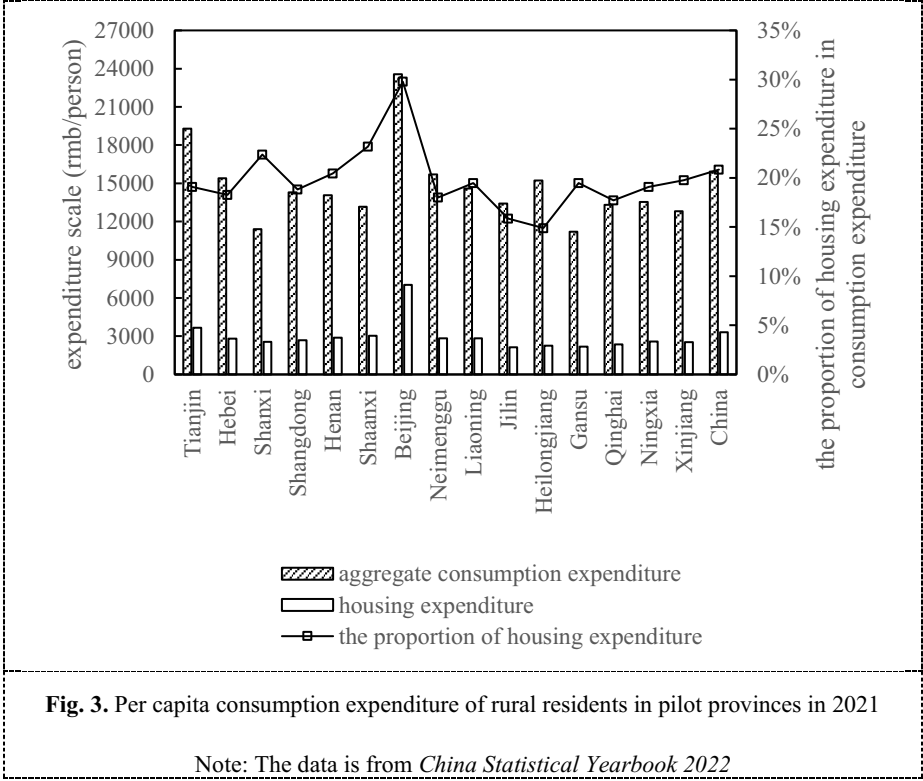
2.3 Social capital and user fees

Due to the strong public welfare and poor profitability of clean heating projects, the participation of social capital is not high [15, 16]. The user's payment is barely bearable, which means that the user's payment is within the affordability range after financial subsidies. Considering the economic level of farmers themselves, most counties and cities generally adopt the method of subsidizing initial investment and operating costs at the same time. Generally, the burden of farmers includes the part of the initial investment equipment purchase that deducts government subsidies, and the price to be paid after the electricity and gas subsidies in the operating costs.

3 Analysis of residents' affordability

In 2021, the per capita residential consumption of rural residents in the pilot provinces for clean heating will account for 14.9%-29.8% of the total per capita consumption (Figure 3), compared with the national average of 20.8%, which has basically remained at about 20% in the past decade. Clean heating is a livelihood project that benefits the whole people and needs to be covered basically, so we should focus on the consumption expenditure level of low - and middle-income farmers. Rural residents are divided into five equal groups according to income (Figure 4), and the per capita disposable income in rural areas is highly unbalanced, with the lower middle income households and low-income households accounting for 52.5% and 23.7% of the national average income level, respectively. In northern rural areas, per capita consumption expenditure in Beijing and Tianjin is much higher than the national average; Shandong, Henan, Hebei, Inner Mongolia, Heilongjiang and Liaoning are basically on par with the national average; Shanxi, Shaanxi, Jilin, Gansu, Qinghai, Ningxia and Xinjiang are about 80% of the national average (Figure 5).

Residential energy consumption mainly includes water, electricity, fuel and other expenses, the proportion of non-heating consumption in residential energy consumption is calculated at 70%, the average permanent resident population is calculated at 3 people, and the average residential consumption expenditure of lower-middle income households and low-income households is calculated at 52.5% and 23.7% of the national average residential consumption (based on the ratio of per capita disposable income). If the national per capita residential consumption in 2021 is 3,314.7 yuan/person, it can be estimated that the annual heating expenditure of lower-middle income households in Shandong, Henan, Hebei, Inner Mongolia, Heilongjiang and Liaoning, which is equal to the national average, is about 1566 yuan/household, and the annual heating expenditure of low-income households is about 708 yuan/household. In Shanxi, Shaanxi, Jilin, Gansu, Qinghai, Ningxia, Xinjiang and other regions, the heating expenses of lower-middle and low-income households were about 1253 yuan/household and 566 yuan/household, respectively.



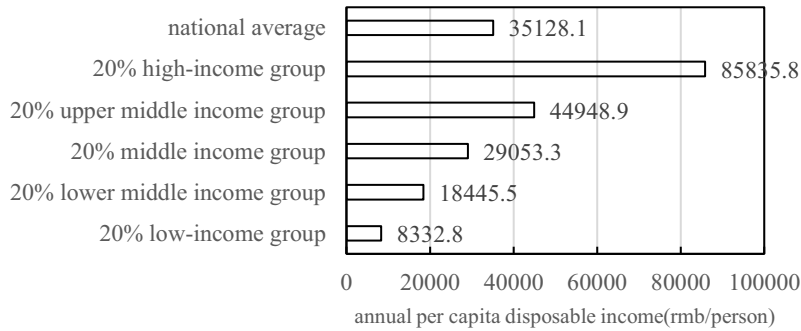


Fig. 4. Per capita disposable income of rural residents in 2021

Note: The data is from *China Statistical Yearbook 2022*

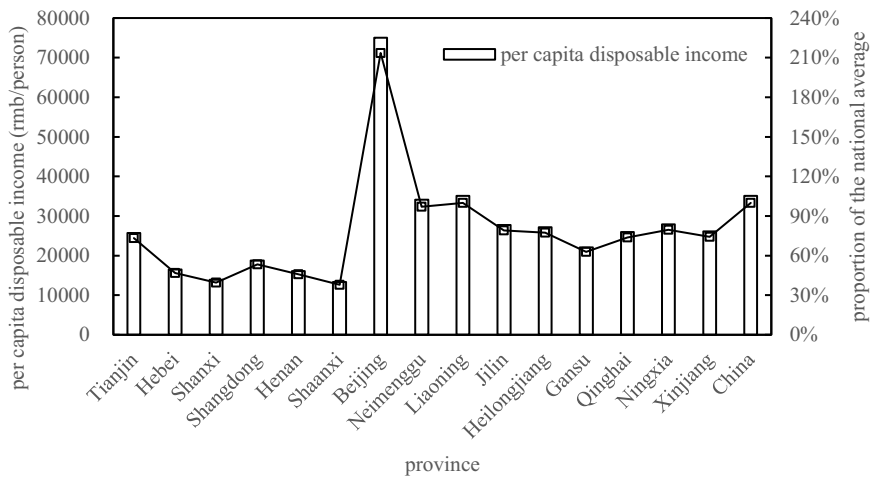


Fig. 5. Per capita disposable income of rural residents in pilot provinces in 2021

Note: The data is from *China Statistical Yearbook 2022*

4 Analysis of problems existing in the marketization of clean heating

4.1 Affordability of rural residents is not strong

Based on the consideration of rural middle and low income residents, the annual heating expenditure of middle and lower income households is about 1617 yu-

an/household, and the annual heating expenditure of low-income households is about 729 yuan/household. The heating expenses of lower-middle and low-income households are about 1294 yuan/household and 583 yuan/household, respectively. Based on actual research and literature research^[17, 18], 85% of rural residents expect the heating cost to be less than 2500 yuan, and 70% expect the heating cost to be less than 2000 yuan. In 2022, the per capita disposable income of rural residents will be 20,133 yuan, only 40.8% of that of urban residents (49283 yuan). The per capita disposable income of the low-income group is 8601 yuan, 17.4% of the disposable income of urban residents. The cost advantages of electricity and gas in rural areas are not obvious, and the economic level is far lower than that of urban areas, so they can only rely on continuous government subsidies to improve their willingness to clean heating.

4.2 The way of financial subsidies needs to be optimized

Clean heating transformation mainly relies on administrative means to promote, from the project's public property, reduce social risks, improve residents' willingness to use and other factors, to subsidize the construction investment is in line with its internal logic. During the operation phase, the cost of energy and fuel consumed for heating should be borne by the user from the perspective of user payment. Continued investment in the operational phase makes financial subsidies unsustainable. The subsidy policy standards introduced by various cities differ, and this standard difference is mainly highly related to the local financial investment and the government's attention, and the correlation with the technical cost is not high. Only some cities in the pilot areas have synchronously promoted building energy saving transformation and formulated corresponding subsidy standards, and most areas are still dominated by heat source side transformation, from the perspective of reducing energy consumption and reducing operating costs, it is necessary to synchronously promote building energy saving and thermal insulation transformation.

4.3 Low enthusiasm for green finance

Due to the short history of clean heating transformation, the relatively simple project implementation mode, and the high cost of clean heating transformation and operation and maintenance, it is difficult for residents to cover the cost, so the business model is relatively lacking and the degree of marketization is not high^[19-21]. Projects generally face huge initial equipment investment costs, long investment payback period, and high operating costs, which weakens the willingness of social capital to invest in clean heating projects. Insufficient means to prevent and resolve project risks. Clean heating projects lack effective pledge products, although there are financial institutions to explore the right to charge and network pledge guarantee innovation, but there are many operational obstacles. Heating pipe network as collateral, the asset situation is complex. Once the enterprise defaults, it is difficult for financial institutions to dispose of the project equipment, and the equipment involves the heating of residents in the later period, and it is difficult to sell and auction.

4.4 Inappropriate reconstruction path increases project cost

Different technology initial investment, operating costs, applicable conditions, the degree of resource security are different, reducing the cost of clean heating should be based on the choice of technical path according to local conditions^[22, 23], the wrong technical path will greatly increase the cost of fuel acquisition, at the same time will increase the risk of secondary transformation. Taking "coal to gas" as an example, the blind large-scale promotion of "coal to gas" in rural areas has resulted in many problems such as high dependence on subsidies, high operating costs, generally exceeding the affordability of farmers, gas company operating at a loss, prominent safety hazards, and low reliability of gas source security. Some provinces and cities have begun to carry out secondary transformation of "coal to gas", resulting in a waste of financial funds in the early stage.

5 Suggestions for promoting the marketization of clean heating

Choose the most optimal technology to reduce construction and operation costs. Currently, the difficulty in transforming clean heating in rural areas in northern China lies in the fact that the technology for clean heating in rural areas cannot follow the "urban route." The decentralized distribution of villages in rural areas makes it unsuitable for introducing or transporting external resources over long distances, in order to avoid increasing investment in external network construction and transportation costs, as well as the energy security and safety issues that may arise. It is advisable to use locally available resources for on-site utilization. Implementing technological and model innovation to promote efficiency and cost reduction. Open up the market access of the clean heating industry, reduce costs through market competition, cultivate more market entities, and choose and cultivate comprehensive energy operators with strength that cross urban and rural boundaries. Explore regional packaging and overall implementation models, and select clean heating operation and maintenance enterprises as units based on established towns or entire counties, thereby promoting the capital aggregation and cost reduction of the clean heating industry.

Increase the accuracy of financial subsidies. Financial subsidies focus on construction subsidies and gradually withdraw subsidies during the operation stage. Increase subsidies for renewable energy heating based on the implementation of the national dual-carbon strategy. Based on the principles of technological and economic policy guidance, establish subsidy policies to promote solar energy, renewable energy electricity, and biomass heating, in order to promote cost reduction through technological progress. Increase investment in rural distribution network infrastructure. Increase financial capital investment in rural distribution network infrastructure, and focus on supporting the implementation of "coal-to-electricity" projects in clean heating pilot areas through methods such as central budget investment and financial interest subsidies. Increase subsidies for energy-saving renovations in rural buildings. Provide subsidies for the renovation of the building envelope structure of rural housing to improve insulation performance and energy utilization efficiency, greatly reducing subsequent energy consumption costs and operation expenses.

Improve green finance incentive and restraint mechanisms. Incorporate loan disbursements and bond underwriting related to clean heating into the annual assessment of local financial institutions. Use measures such as targeted refinancing and rediscount quotas, differential deposit reserve ratios, mortgage supplement loans (PSL), etc., to guide commercial banks to increase their lending to clean heating projects. Implement differentiated credit management, where the mortgage rate for loans in the clean heating field may be appropriately raised compared to other general loans. The loan interest rate for clean heating enterprises and projects may be lower than that for other general loans based on the differentiated environmental behaviors of enterprises and projects. Use positive incentive policies such as FTP (Internal Transfer Pricing) to transfer pricing discounts, setting up special financial resources and reasonably allocating economic capital to provide loan interest rate discounts for clean heating loans. Improve the cooperation mechanism between banking and government guarantees. For banking and financial institutions with fast-growing loan volumes and a large percentage of clean heating households, the national and local financing guarantee funds can increase their own risk responsibility ratio or expand their cooperative loan scale. Support eligible clean heating enterprises to issue sustainable development-linked bonds, and link the energy-saving and environmental improvement brought about by clean heating renovations with the adjustment of interest rates and repayment plans for sustainable development performance bonds.

Broaden channels for expense reduction and revenue increase to increase cash flow. Provide policy preferences for value-added taxes, urban land use taxes, corporate income tax investment deductions, and reduced taxable income for clean heating enterprises. Provide corporate income tax incentives for financial institutions that provide funding support for clean heating projects and reduce their taxable interest income. Social capital invested in clean heating projects can offset a certain percentage of their taxable income. Tap the potential of the industrial chain such as heat source development, pipeline construction and operation, and end-use equipment promotion and application to subsidize heating projects with new market space and business revenue. Combine clean heating projects with rural cultural tourism development and fat and thin matching to broaden the sources of project revenue. Leveraging the national carbon market, develop a CCER methodology for rural clean heating renovation projects, promote carbon emission reduction certification for rural clean heating projects, and promote project participation in carbon trading to offset some of the increased costs of clean heating.

6 Conclusions

With the promotion of clean heating work, clean heating in urban areas has entered the final stage, and the key difficulties are in rural areas. "Coal to electricity", "coal to gas" and other clean heating methods are 3 to 4 times that of loose coal heating, limited by the level of economic development, the price affordability of rural residents is poor, if there is no financial subsidies, most farmers can not afford clean heating prices. Clean heating projects have strong public welfare, poor economy, low degree of

marketization, and poor investment return mechanism, which cannot meet the commercial goals of financial institutions and social capital to maximize economic benefits. In order to attract social funds to enter the field of clean heating, it is recommended to improve the assessment incentive mechanism and risk sharing mechanism to attract financial institutions to enter, and promote the marketization of clean heating projects from the aspects of reducing construction and operation costs and broadening investment return channels.

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