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Research on the Differences in Assessed Prices of Geothermal Mineral Products for Heating in Tianjin City, Hebei Province, and Shandong Province, China

WANG Hao[1,2*], LIU Mei-jing[3], CHEN Meng-hui[1,2], YE Shuai[3], SONG Yang[1,2], XU Zheng-qin[1,2], GAO Jian[1,2]

[1]Hebei Geothermal Energy Recycling Technology Innovation Center, Xiong'an New Area 071800, China; [2]Hebei Green Energy Geothermal Development Co., Ltd., Xiong'an New Area 071800, China; [3]Sinopec Green Energy Geothermal Development Co., Ltd., Xiong'an New Area 071800, China; *wangh.xxsy@sinopec.com

INTRODUCTION

In the context of reforms to mining rights transfer revenue policies, Tianjin City, Hebei Province, and Shandong Province have successively established the assessed prices for the sales revenue of geothermal mineral products used for heating. Through a horizontal comparison of assessed prices and heating unit prices in different regions, a vertical comparison of transfer income under new and old policies, and a multi-dimensional analysis based on actual cases, the research discovered that the current assessed price in Hebei Province is particularly high, raising corporate costs and dampening enthusiasm for development. The calculation methods for the assessed prices were further explored, including the heating price conversion method and the return on investment back-calculation method. Together with Hebei Province's geothermal resource development policy, scientifically sound suggestions for assessed prices were proposed, aiming to balance national, local, and corporate interests and promote the sustainable development of the geothermal industry.

METHODS

Data Collection and Analysis

This study collected data on the assessed prices of geothermal mineral products for heating from Tianjin City, Hebei Province, and Shandong Province. Additionally, 642 samples of heating unit prices from various districts and counties under the jurisdiction of these provinces were collected. The heating unit prices were standardized to a uniform basis of a 120-day heating period, charged by building area, and excluding value-added tax (VAT) for comparison.

Heating Price Conversion Method

The heating price conversion method is used to convert the current heating unit price into a sales unit price per cubic meter of geothermal fluid. The calculation process involves determining the heat provided by a unit volume of geothermal fluid (W), dividing it by the building heat consumption index (q_h) to obtain the heating area per cubic meter of geothermal fluid (s_h), and then multiplying it by the current heating unit price (P_h) to calculate the sales unit price (S). The calculation expressions are shown in equations (1), (2), and (3).

$$S = s_h \times P_h \tag{1}$$

$$s_h = \frac{W}{q_h} \tag{2}$$

$$W = \frac{c\rho(t - t_0)}{N \times 24 \times 3600} \tag{3}$$

Evaluation Income Reverse Calculation Method

The evaluation income reverse calculation method uses the assessed mining revenue to back-calculate the sales unit price. The method involves using the comparable sales method to assess the mining revenue over the mine's service life, with the sales unit price (S) as the unknown variable. The calculation expressions are shown in Equations (4) and (5).

$$P = \frac{\sum_{i=1}^{n} \left(P_i \cdot (\mu \cdot \omega \cdot \tau \cdot \theta \cdot \lambda \cdot \delta)\right)_i}{n} \tag{4}$$

$$S = \frac{P - S_0}{\nu \cdot \gamma \cdot Q} \tag{5}$$

RESULTS

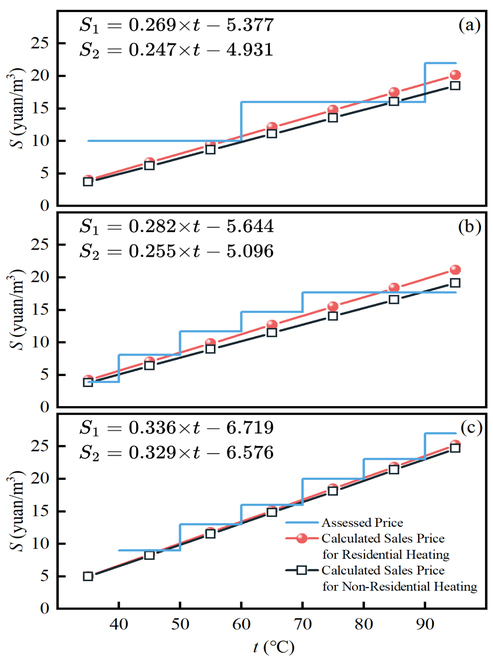


Figure 1. Comparison of the sales unit price calculated by the heating price conversion method and the approved price in (a) Hebei Province, (b) Shandong Province, and (c) Tianjin City.

Assessed Price Analysis

Non-Residential vs. Residential Heating Prices: Despite higher non-residential heating fees compared to residential fees in all three provinces, the difference in calculated sales prices per cubic meter of geothermal fluid for residential (S_1) and non-residential (S_2) heating is minimal. In fact, S_2 is slightly lower than S_1. This suggests that distinguishing between residential and non-residential heating prices in the assessed pricing is unnecessary. For example, in Shandong Province, the same geothermal well may serve both residential and non-residential heating, making it difficult to accurately allocate resource usage and increasing regulatory complexity and costs.

Hebei Province's Pricing Discrepancy: As shown in Figure 1, Hebei Province's stepped assessed price curve is significantly higher than the calculated sales price curve, especially in lower temperature ranges. Under the current heating price framework, Hebei's geothermal enterprises cannot achieve the assessed prices, indicating a disconnect between the assessed prices and market realities.

Calculation Methods and Recommendations

Heating Price Conversion Method: While this method intuitively reflects the sales revenue of geothermal products, it does not accurately represent market conditions or mining rights value due to the fixed nature of government-set heating prices.

Evaluation Income Reverse Calculation Method: Using 134 assessed geothermal mining rights as reference samples and 86 new mining rights under the new policy, the reverse calculation of sales prices (S) was conducted (Figure 2).

A dual-method approach, averaging the results from both the heating price conversion and evaluation income reverse calculation methods, is recommended for Hebei Province. The suggested assessed prices based on temperature intervals are shown in Table 1.

Table 2 Suggestions for assessed prices of geothermal mineral products' sales income for heating purposes in Hebei Province

Temperature Interval (℃)	Calculated Price by Heating Price Conversion Method (yuan/m³)	Calculated Price by Evaluation Income Reverse Calculation Method (yuan/m³)	Suggested Assessed Price (yuan/m³)
t < 40	4.03	4.17	4.10
40 ≤ t < 50	6.72	6.72	6.72
50 ≤ t < 60	9.41	9.26	9.33
60 ≤ t < 70	12.10	11.81	11.95
70 ≤ t < 80	14.78	14.36	14.57
80 ≤ t < 90	17.47	16.90	17.19
t ≥ 90	20.16	19.45	19.80

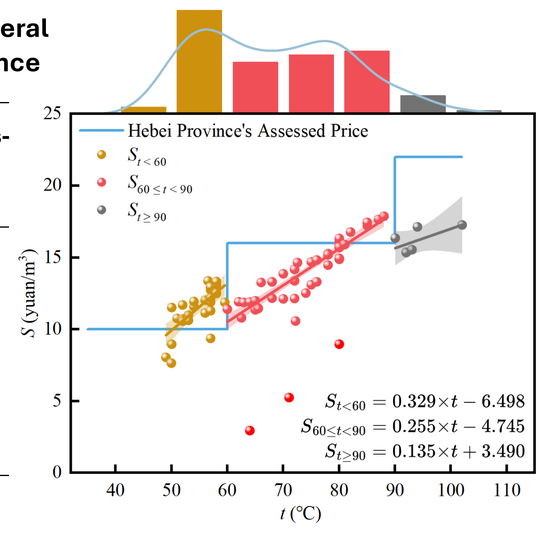


Figure 2. Comparison of the sales unit price calculated by the evaluation income reverse calculation method with the assessed price in Hebei Province.

CONCLUSION

This study analyzed the assessed prices of geothermal mineral products for heating in Tianjin, Hebei, and Shandong, revealing significant regional disparities and policy implications.

Regional Price Disparities: Hebei has the highest assessed prices, especially in lower temperature ranges, while Shandong has the lowest, better aligning with market conditions.

Policy Implications: The new policy aims to reduce enterprise costs, but Hebei's high prices increase costs instead. Tianjin and Shandong have seen cost reductions.

Methodological Recommendations: A dual-method approach combining heating price conversion and evaluation income reverse calculation is proposed for Hebei to provide a more rational assessed price.

Policy Recommendations: Adjust Hebei's prices to reduce enterprise burden. Simplify Shandong's pricing by unifying residential and non-residential heating prices. Implement a dynamic adjustment mechanism to ensure prices remain market-oriented.

In summary, adopting the proposed methods and policy recommendations can enhance the sustainability and economic viability of the geothermal industry in these regions, supporting energy security and environmental protection.

DISCUSSION

Rationality of Assessed Prices

Hebei's current assessed prices are excessively high, potentially reducing enterprise enthusiasm for geothermal development.

Suggested prices should better reflect market conditions to reduce enterprise burden.

Calculation Methods

Combining heating price conversion and evaluation income reverse calculation methods provides a balanced and rational assessed price.

Policy Recommendations

Adjustment of Assessed Prices in Hebei Province: The study recommends adjusting the assessed prices in Hebei Province to better align with market conditions. The suggested prices are calculated using a combination of the heating price conversion method and the evaluation income reverse calculation method.

Simplification of Pricing in Shandong Province: The study suggests that Shandong Province should unify the assessed prices for residential and non-residential heating to simplify operations and reduce regulatory costs.

Dynamic Adjustment Mechanism: A dynamic adjustment mechanism for the assessed prices of geothermal mineral products is recommended to ensure that the prices remain rational and reflective of market conditions over time.

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