THE IMPACT OF A NOVEL HEAT PRICING METHOD ON A SUPRA-REGIONAL DISTRICT HEATING NETWORK

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Abstract: In literature, much research focuses on pricing heat in a district heating network, often assuming the network to be a natural monopoly. These price models often come with either disadvantages for consumers or drawbacks for heat suppliers. Less research is devoted to the analysis of pricing models for supra-regional district heating networks, which can connect existing district heating networks and heat generation units. Consequently, the integration of such a network presents economic consequences that are not yet fully understood. This article aims to close this research gap by providing insights into an innovative heat pricing model, highlighting its impact on heat prices and the levelized costs of heat for heat providers. To achieve realistic results, the described price model is used to simulate and analyse a supra-regional district heating network using a dynamic load flow calculation over the course of an entire year.

Keywords: Supra Regional District Heating Network; Heat Price; Styria, Load Flow Calculation, Industrial Waste Heat; Primary Energy Savings

1 INTRODUCTION

Pricing heat in a district heating network (DHN) is a highly debated topic, both scientifically and socially. Today, heat prices are very often non-transparent leaving end customers with no alternatives once they have opted for a district heating connection. In many cases, this issue arises because the heat provider in a DHN has a natural monopoly [1]. The reasons for this situation can also be traced back to the high investment costs of the heat generation units (HGU). To ensure that these investments are profitable, providers need to set high heat prices, especially when full load hours are low. To address this, regulating the heating market is a potential solution. Some of such models could be the true cost [1] or the true cost plus [2] model. While regulation could satisfy consumers by ensuring transparency and, thus, fair prices, it may also deter companies from investing in efficiency improvements or even entering the market. This is particularly true for companies whose primary business is not heat production, such as those generating industrial waste heat (IWH), which is a secondary product. In contrast to regulated heat price markets, deregulated markets provide e.g. IWH heat suppliers a greater room for manoeuvre, but this can lead to incomprehensible heat prices due to the frequent occurrence of monopoly heat generation lots. Some models could be pricing based on marginal costs, incremental costs or on shadow prices [2].

Even though heat producers often claim their prices follow this scheme, this is not always guaranteed due to a lack of competitive pressure in their monopoly position [3]. A similar approach could be to price heat based on a specific energy carrier price, such as a natural gas-based substitution price [1]. However, such pricing models could lead to over- or underprice the heat and often offers no incentives to become more energy efficient. This leads to the conclusion that a system, balancing consumer protection with incentives for companies to participate and invest in the heating market is strongly needed. One approach to archive this, is described in [4]. The authors propose a transparent pricing system that incentivizes heat providers to improve their efficiency. However, the described system may seem overly complex to operate. The method described in [3] offers a solution for pricing heat with their levelized costs of heat (LCOH). This method simultaneously allows actual costs to be passed on and provides a transparent approach. However, this model assumes there is only one heat supplier company, so the generation units are not in competition among each other. Otherwise, the proposed method would tempt participants to distort LCOHs to gain market advantages. To address the issue of fair and competitive heat pricing for heating networks with multiple suppliers, this article presents a novel approach by using a LCOH based bid pricing system for supra-regional district heating networks (SRDHN). To analyse its effects, the approach is applied to a SRDHN in Austria.

2 METHOD

SRDHNs offers the possibility for multiple heat providers with different types of HGUs to integrate in a deregulated heat market. This leads to the positive outcome that improving energy efficiency becomes key for participating in the market, and overpricing can be avoided. Therefore, a heat merit order (Figure 1) needs to be implemented. To avoid low or negative prices, which would deter companies, especially IWH, from entering the market, the prices in the merit order should follow LCOH rather than marginal costs. Since it must always be assumed in a merit order system that the bid prices (BP) do not correspond to the actual LCOH, additional rules must be implemented.

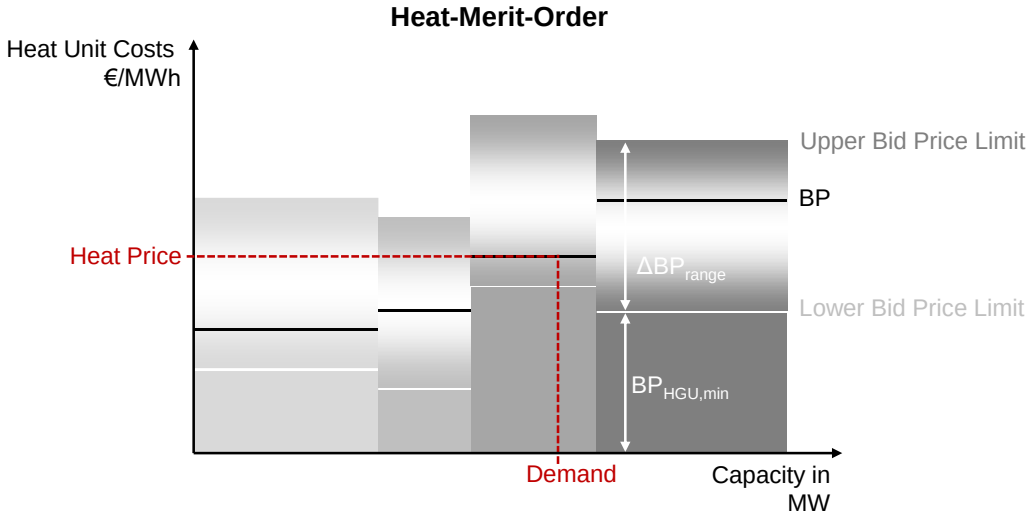

Figure 1 Final Heat Price based on a Merit Order System

Lower and upper bid price limits are introduced to ensure that heat providers submit bids for their HGUs that closely align with their actual LCOH, while still allowing for some flexibility. The lower limit should be based on the most efficient HGU of each type in the SRDHN area. This lower limit should be based on the specific investment and operation costs, excluding fuel costs, like the LCOH without fuel costs. To calculate these specific costs the amount of the generated heat for each year should be chosen based on the maximum achievable full load hours in the considered SRDHN, assuming the HGU would be the sole heat provider.

3 RESULTS AND CONCLUSTION

The paper analyzes the influence of the proposed method on the development of the heat-price in comparison to a conventional approach. Additionally, there is a discussion on how the new method impacts the cash flow and, consequently, the net present value of the most important HGU types. This can be achieved by comparing the costs or the net present value of the non-connected grids with those when connecting these grids with the SRDHN.

The novel heat pricing approach enables transparent heat pricing within a free market context. This system creates incentives to encourage improvements in plant efficiency to ascend in the merit order sequence. This approach is facilitated by the innovative concept of an interconnected, supra regional heat transmission network, whose technical feasibility has already been confirmed in an initial study. The price model is tested using a load flow calculation [5] that realistically simulates daily operations, leading to comprehensible and realistic results. Hence, the results can be regarded as a valuable initial assessment of the actual costs associated with a SRDHN.

4 REFERENCES

[1] Ole Odgaard, Søren Djørup. Review of price regulation regimes for district heating. International Journal of Sustainable Energy Planning and Management. 2020;Vol. 29:127–40. dx.doi.org/10.5278/ijsepm.3824

[2] Hailong Li, Qie Sun, Qi Zhang, Fredrik Wallin. A review of the pricing mechanisms for district heating systems. Renewable and Sustainable Energy Reviews. 2015;42:56–65. doi.org/10.1016/j.rser.2014.10.003

[3] Hailong Li, Jingjing Song, Qie Sun, Fredrik Wallin, Qi Zhang. A dynamic price model based on levelized cost for district heating. Energy, Ecology and Environment. 2019;4:15–25. doi.org/10.1007/s40974-019-00109-6

[4] Junli Zhang, Bin Ge, Hongsheng Xu. An equivalent marginal cost-pricing model for the district heating market. Energy Policy. 2013;63:1224–32. dx.doi.org/10.1016/j.enpol.2013.09.017

[5] Josef Steinegger, Stefan Wallner, Matthias Greiml, Thomas Kienberger. A new quasi-dynamic load flow calculation for district heating networks. Energy. 2023;266:126410. doi.org/10.1016/j.energy.2022.126410