Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 104 (2016) 323 – 328

Energy Procedia

CUE2016-Applied Energy Symposium and Forum 2016: Low carbon cities & urban energy systems

Marginal costs for district heating

Qie Sun[a], Hailong Li[b*], Fredrik Wallin[b], Qi Zhang[c]

[a] *Institute of Thermal Science and Technology, Shandong University, China*
[b] *School of Business, Society and Technology, Mälardalen University, Sweden*
[a] *China Petroleum University (Beijing), China*

Abstract

District Heating (DH) is facing great challenges on raising production efficiency and reducing production cost in order to improve its competence. A novel pricing mechanism is an effective instrument to promote the sustainable development of DH systems. Based on the data on the daily dynamic operation of DH systems, this work calculated the practical marginal costs of a DH system, which can serve as the basis for developing a new dynamic pricing mechanism. Two methods, namely setting the price of electricity and entropy drop method were used to allocate the fuel costs in order to calculate the variable cost of heat production. Results show that the dynamics of marginal costs can indicate the increase in the variable costs with the increase in heat production. The calculated marginal costs were further compared with real heat prices. It was found that although heat prices varied with temperature in general, it could not reflect the changes in the technology of heat production, and therefore, could not represent the practical production costs.

Peer-review under responsibility of the scientific committee of the Applied Energy Symposium and Forum, CUE2016: Low carbon cities and urban energy systems.

Keywords: District heating, heat price, marginal cost

1. Main text

According to the International Energy Agency (IEA), the heating and cooling sector accounts for more than half of the world energy consumption and consequently a significant share of CO_2 emissions [1]. Therefore, it is extremely important to explore the potential of energy savings in this sector in order to mitigate climate change. Among various ways of producing heat, district heating (DH) is usually characterized as high energy efficiency and little environmental pollution, due to centralized heat

* Corresponding author. Tel.: +46 21 10 3159.
E-mail address: lihailong@gmail.com.

Peer-review under responsibility of the scientific committee of the Applied Energy Symposium and Forum, CUE2016: Low carbon cities and urban energy systems.
doi:10.1016/j.egypro.2016.12.055

generation and advanced control over pollutant emissions. For example, in Europe, DH alone contributes more than 110 million tonne of CO_2 reductions per annum, representing 2.6% of the total amount of CO_2 emissions [2].

However, DH is facing great challenges on reducing production cost in order to improve its competence. The price of DH keeps rising. Taking the market in Sweden as an example, the heat price in 2012 increased by more than 30% compared to the level in 2004, as shown in Figure 1. However, other heating options, such as heat pumps and wood pellets, may achieve a lower cost for typical multi-dwelling buildings. For instance, according to Fortum, a large energy company operating in the Nordic countries, Russia, Poland and the Baltics, the price for district heating was 802 Swedish kr/MWh heat excluding tax in 2013. During the same period, the price for electricity was 800-950 Swedish kr/MWh heat including tax [3]. Heat pumps normally have a coefficient of performance (COP) of 2-3, which implies the cost for producing 1 MWh heat is about 266-320 Swedish krona. Considering the increasingly intense competition faced by DH companies, redesigning the pricing mechanism for DH systems could be an effective way to motivate DH companies to improve production methods in order to reduce operating cost and increase profitability [4]. Moreover, an effective pricing mechanism could also assist in further energy saving and CO_2 emission reduction, given that heat price is considered the most important factor affecting consumers' behavior. Therefore, developing an effective pricing mechanism is essential to promote sustainable development of DH systems.

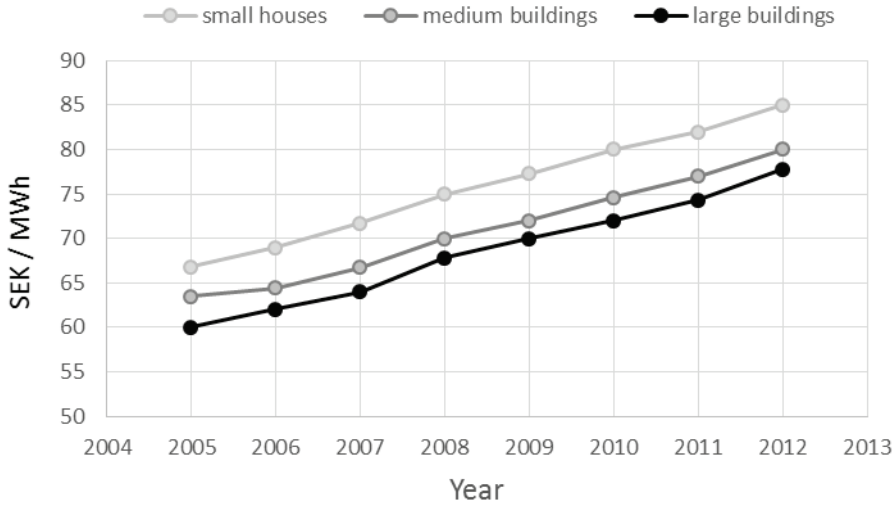

Figure 1 Increase of DH price in Sweden (adapted from [5])

Theoretically, there are two methods for heat pricing, i.e. the cost-plus method and the marginal-cost method. The marginal-cost method is widely used in the deregulated market. In principle, the marginal-cost method reflects the scarcity of resources and it is considered the basic method for determining the price for DH systems. Calculation of a marginal cost should consider fuel cost, allocation of joint costs, price of electricity, system capacity and period term, all of which contribute to a complicated process for calculation. More comprehensive discussion about marginal cost for DH can be found in [4].

To ensure that the heat prices on the wholesale market reflect the dynamics of supply and demand, market participants should have access to all relevant information on production and consumption in a non-discriminatory manner. At the retail level, transparent information is also critical for consumers to choose supplier as well as manage their energy consumption. In Europe, the legislative package plans various dispositions for consumer rights [6]. Even though DH companies claim that they are using the