From Willingness to Warmth: End-User Payments to District Heating

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Overview

Globally, heating is responsible for approximately 45% of energy demand and contributes to 80% of carbon dioxide emissions from buildings [1]. This corresponds to 12% (4.3 Gt CO_2) of global energy-related greenhouse gas emissions as of 2019 [2,3]. As such, the heating sector is pivotal both for energy security and decarbonisation efforts. According to the IEA, progress in heat sector decarbonisation remains insufficient, with district heating (DH), a key sub-sector, deemed "Not on track" [4,5]. This context underpins recommendations such as those in the Draghi report [6], which advocates for "[…] extending acceleration measures and emergency regulation to heat networks [and] heat generators […]". DH has been deployed since the late 1800s, reaching a global market share of around 9% of global heating demand in buildings and industry in 2022 [4]. While in Europe, it accounted for 13% in 2023 [7]. Studies suggest significant future potential for DH in Europe, with projections ranging from 25% [8] to 48% [7] of total heat supply by 2050. Achieving these potential European market shares requires growth rates to increase from approx. 1%-point per decade to that same growth every 1-2 years.

Among the challenges brought by such rapid deployment are the conversion of end-users to DH and the investment costs of deploying the infrastructure (generation facilities and pipes). End-users' connection fees may provide a valuable addition to the investment. Partly to ensure end-users are serious by having skin in the game, partly because it provides valuable liquidity for utilities during the development phase and because this customer-provided equity can reduce financing costs from alternative sources [9]. This practice has been applied as a business model in Danish DH utilities for decades. DH companies have traditionally applied a business model where pricing of connection can be summed up as "now = cheap; later = expensive". This makes sense from a business perspective, as high up-front connection-rates in a new DH area (typically 70% of potential end-users in Denmark) are necessary to ensure a robust business case. Also, it makes sense from a practical perspective, as connection costs are least expensive during the actual build-out of networks (excavation and roadwork), compared to dispatching crews ex post for connection of individual customers. But as it has been seen in Denmark, bottlenecks in labour and materials have driven up costs and delays, partially due to high deployment of DH relating to the 2022-crisis [10]. This becomes a catch-22, since costs are driven up and DH utilities may be forced to increase expansion costs, leading to customer defection and cancellation of projects due to inflated costs and insufficient customers. Avoiding bottlenecks and attracting potential customers is thus a challenge in the heat transition. On an international scale, fast transition to DH and the resulting bottlenecks may become even more pronounced, leading to the need for a different approach than the current Danish end-user model. In this study, we propose an outline for an alternative business model, based in a survey of Danes' perception of heat sources.

Methods

The willingness to pay (WTP) for district heating was elicited among 1,200 respondents being open to switching to district heating from their current heating system using a single-bound dichotomous choice Contingent Valuation Method (CVM) approach [11]. The data was collected in the summer 2022. As part of the CVM scenario, the respondents were randomly presented to one of the following four fees for connecting to district heating 8-11-13-16 kEUR. Prices are in 2023-EUR. After the WTP question, the respondents were randomly divided into groups representing differences in years of postponing the year of connection with 1 to 5 years. Conditional on the respondents' group, they were subsequently asked if they were willing to accept the randomised year of district heating connection and if they required compensation. The connection fee compensation was a randomised value based on the initial connection fee in the WTP for a district heating connection.

Results

The average WTP for connection was 3,520 EUR among all respondents. Among respondents who had already been offered DH in 2023 or later but had not yet been connected, the WTP was 6,495 EUR. These respondents were queried regarding their willingness to accept compensation (WTAC) for postponing their connection 1-5 years – Figure 1.

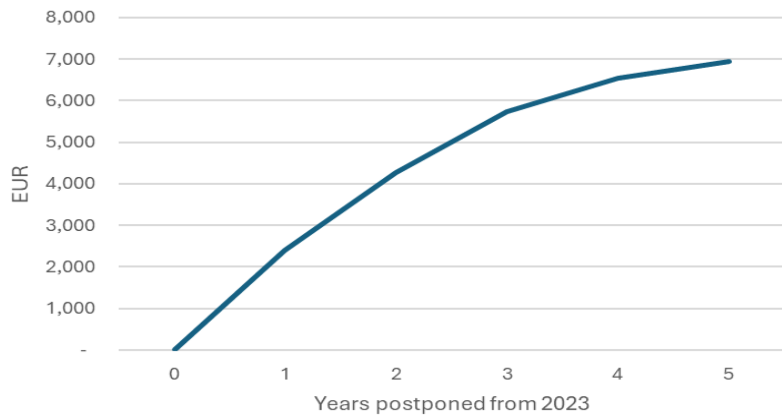

Figure 1 WTAC of postponing connection to DH. Own data.

The flattening curve indicates increasing WTAC-indifference, as years of postponed connection increase. Also, end-users waiting more than four years want free connection and 38-438 EUR compensation relative to their initial WTP. The curve can be described by the polynomial $y = -255x^2+3170x-2920$, applicable in business model development. Additionally, our analysis shows that yearly compensation decreases as a function of the expected connection year. Accordingly, households offered connection in 2023 require significantly higher compensation for postponing compared to households offered connection in a later year. Compensation is thus marginally decreasing with the number of years postponed and the expected year of connection.

Conclusions

A pertinent challenge in the heat transition is striking the right balance between the speed of expanding DH systems, avoiding supply-chain bottlenecks, and attracting customers. We propose turning the current DH business model upside down by a stepwise approach that smoothes out the deployment of DH to reduce labour- and material bottlenecks. In turn, this may enable more predictable projects, less need for government subsidies and a more stable cash flow, attracting lower cost finance due to the lower risk associated with the projects. Concretely, we have explored the end-user WTAC for delaying their connection to DH. Our results show that end-users are willing to delay their connection at 37%-107% WTAC relative to no-postponement WTP. This indicates that postponement comes at a cost, which must be weighed against the benefits, e.g. in further research on the subject.

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