The development of District Heating in the Nordic countries

- Impact of pricing structures

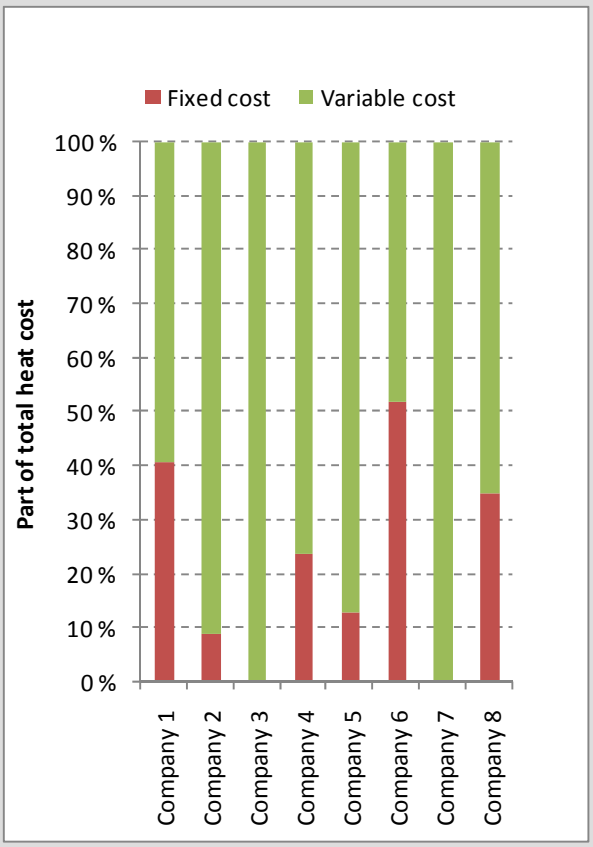
Preliminary results from NEP studies of district heating (DH) in the Nordic countries indicate that the pricing strategies used by the DH companies may be of crucial importance for the future development of the business. The major challenge is the competiveness towards local alternatives like heat pumps.

Pricing strategies for District Heating (DH)

Hypothesis 1: *The main part of the district heating price (including taxes) paid by customers is a variable part related to energy consumption, while the main cost element is the fixed costs.*

Cost: Investments in heat producing equipment and distribution infrastructure make up a substantial part of the heat production costs. Labour is also a fixed cost. The main variable cost element is fuel costs. Fuel costs are low for many of the base load technologies (waste incineration, waste heat and heat pumps). In CHP in Sweden) income from electricity and electricity certificates reduces the variable cost of heat production. Thus, the fixed cost is the major part of the total cost of heat production in most DH systems. In Finland, the total cost in CHP is allocated between power and heat using different methods, none of which are based on incomes. Electricity is not seen as a side product of heating.

Price: In Sweden the average variable price for DH is in line with the average marginal cost. The marginal production technology varies during the year and between different DH systems. Many DH systems have access to low cost alternatives during the summer (waste heat, waste incineration, heat pumps). During the winter high cost alternatives are used for short periods (e.g. oil boilers). The cost of heat from CHP is Cost (heat+electricity) minus income (electricity). Heat from CHP comes at a relatively low cost when electricity prices are high (high load). Heat prices in several DH systems differ between summer and winter.



Fixed and variable cost for district heating, for a typical office building customer in Norway

In Norway the variable part of the DH tariff is large in most companies, and unrelated to both base load and peak load technology. The DH price is often linked to the electricity price by regulation; The DH price may not be higher than the price of electricity for heating. Marginal production during winter comes from electric/oil fired boilers. Large systems usually use low cost technologies during the summer, but since maintenance must often be done in this period the marginal cost may still be high.

In Finland it is common to have one large solid fuel (coal, biomass, peat) boiler or a CHP plant sized to

meet 40-60% of the heat load. Peak load amounts to only 10-15% of the total heating energy. The peak is often managed by using heavy and light fuel oil burners, which have low investment costs and are expensive to run. The availability of low cost alternatives may be weak in the summer, and especially during annual maintenance, in small CHP networks. In larger DH networks there is usually enough load for one CHP unit to be running. DH prices are mostly related to the long term heating alternatives of customers.

In Denmark DH is regarded as a natural monopoly and prices are regulated. Small scale gas fired CHP typically consist of several gas-motors, with gas boilers used for peak load. This means that the marginal cost can be as high during summer as in winter.

Consequences of different strategies

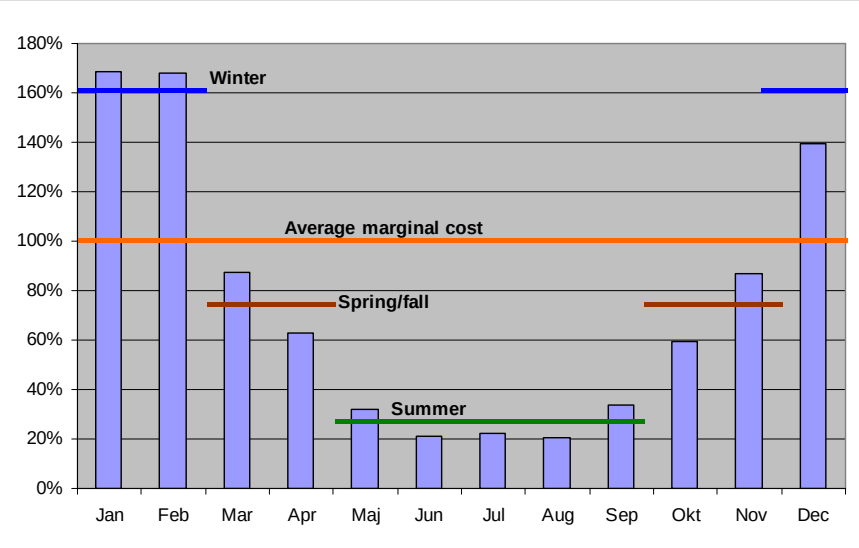
Hypothesis 2: *If the variable price of district heating is constant with no seasonal differentiation, district heating could end up as peak load for heat pumps and other local energy alternatives.*

District heating is a collective heat supply system, with substantial sunk costs in both the distribution system and the heat production systems. A relatively high "heat density" (demand of heat per square meter) is required for new district heating systems to be competitive to local heat supply systems. Even for existing DH systems decreasing demand (due to more efficient use of energy) is a challenge. If the volume of heat sold per year decreases, the per unit price of heat may have to increase to cover the total cost of heat production.

In the last couple of years two different challenging alternatives have emerged:

- Very energy efficient buildings
- Local heat production (increasingly more efficient heat pumps)

Both alternatives implies reduced demand for DH, but yield different profiles over the year. Very energy efficient buildings require only small amounts of heat, and have the largest heat demand during winter nights, and for tap water during the whole year. Due to the overall low consumption, the main problem is to make the customer profitable for the DH company, and at the same time keep the heating price competitive compared to local alternatives (heat pumps, resistance heating).



Marginal cost in winter, spring/fall and summer relative to the average marginal cost (Sweden)

For the DH customers (both existing and potential), heat pumps or other local alternatives could supply much of the customers' baseload heat, and DH could end up being of interest only as back up and peak load. For the DH companies the outcome is a low volume delivered when the cost of production is at its highest. From the DH company's point of view this alternative could still be attractive if DH is priced according to the marginal cost for the specific season. However, if the price is based on the yearly average marginal cost this type of customers would be economically unfavorable. Tariffs reflecting true seasonal DH costs could also make some of the competing alternatives less economically attractive.