

Contracting and Payment Models of District Heating

Introduction

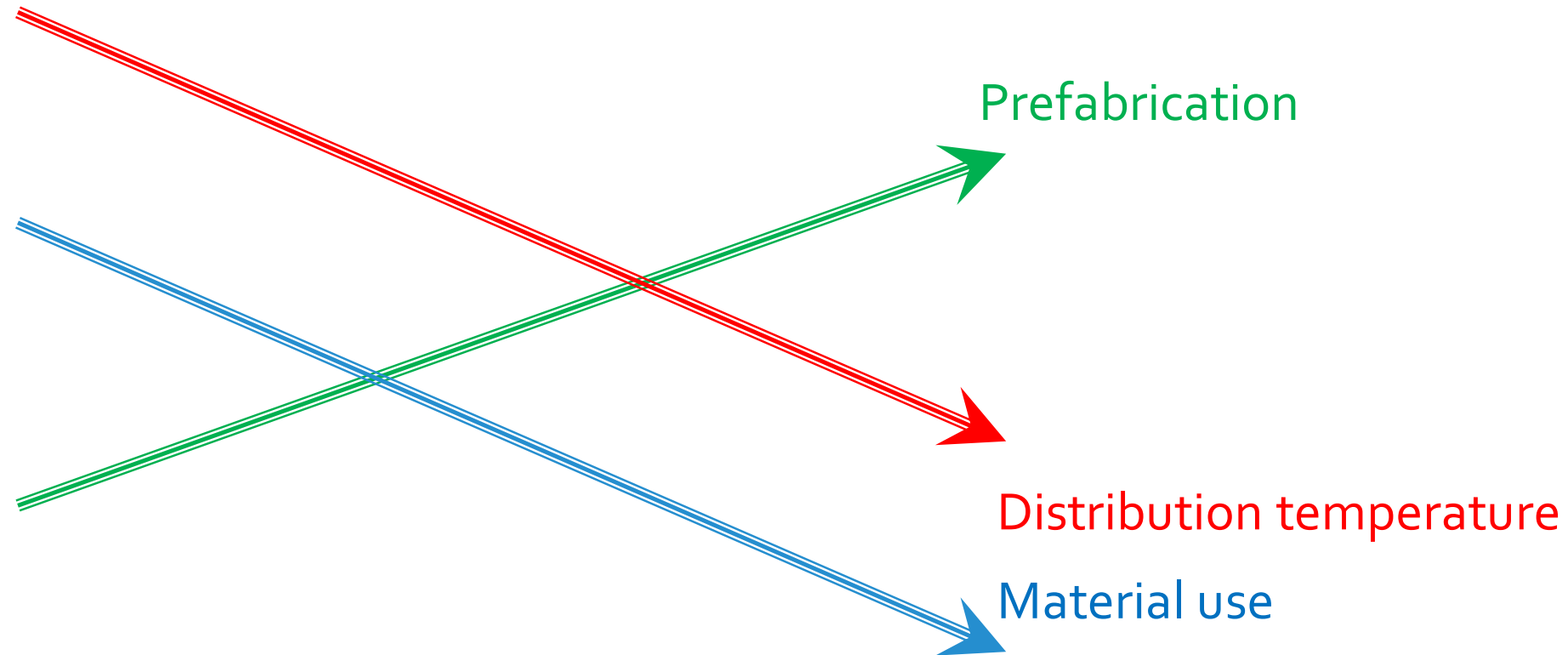
Historic Overview of DH Systems

- Gen 1. Introduced in USA in 1880s.
 - Steam as heat carrier. Generally used system in USA and Europe until 1930s.
 - Substantial heat losses and risk of explosion due to high pressure.
- Gen 2. 1930s up to 1970s
 - Pressurised hot water as heat carrier. Temperatures over 100 °C. Extensively used in Soviet –based DH systems. Material intensive heavy systems
- Gen 3. Introduced in 1970s, also called „Scandinavian District Heating“.
 - Heat carrying pressurised water has lower temperature than in Gen 2. Pre-insulated pipes are directly buried into ground.



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Trends in developmenr of district heating



Heat Supply Agreements

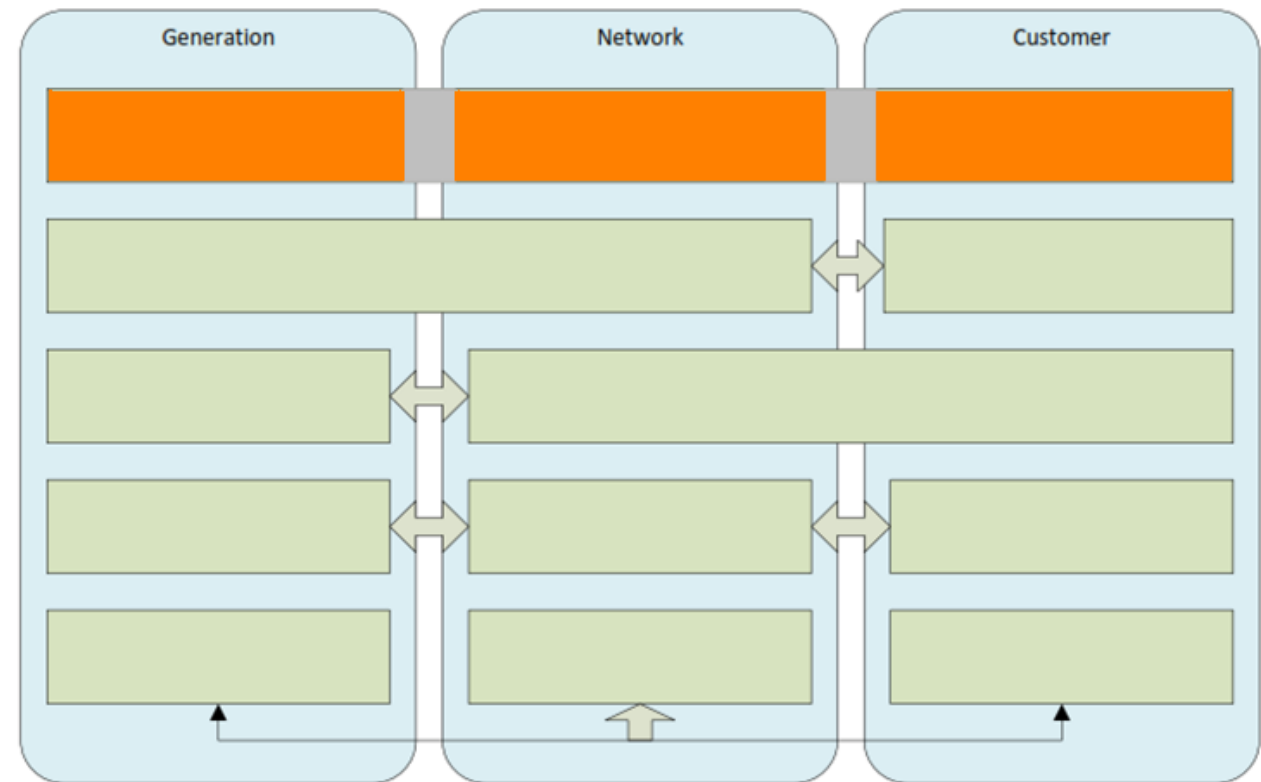
Physical Assets of Heat Network

- Generation – assets which produce heat for distribution. Generally involves development, construction, operation and maintenance of an energy centre.
- Distribution – the main heat network infrastructure for the distribution of heat from the energy centre to the end customer(s).
- Supply to customer plant – the installation and operation of a heat interface unit / substation; interface to the customer's internal heat distribution network through which thermal energy is transferred from the primary distribution network to the customer building. Includes metering and billing.

Types of Heat Supply Agreements

Self-generation / self supply.

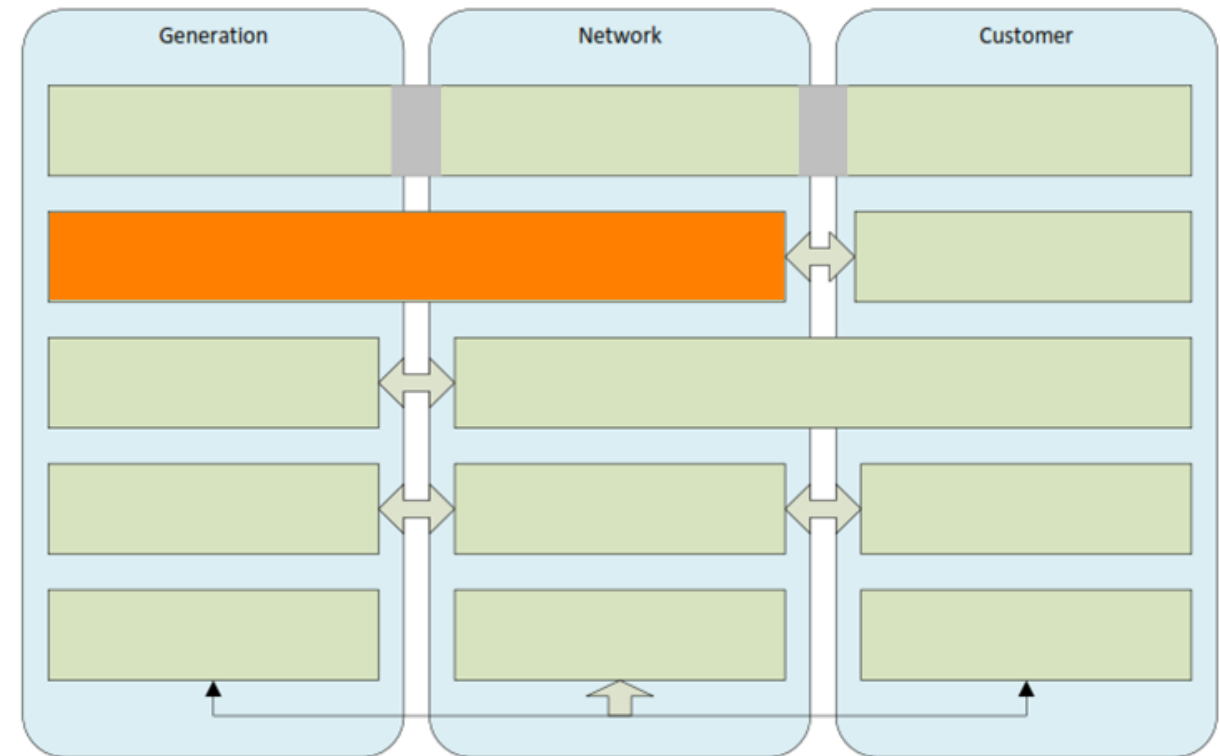
An organisation owns all assets. It self-supplies to meet its own heat demand. A variant of this model is where multiple public sector bodies collectively own a heat network, which is used exclusively or predominantly to supply their own buildings.



Types of Heat Supply Agreements

Self-generation / supply to third parties.

A single organisation (e.g. a local authority) owns the generation assets and distribution network, and supplies heat to a combination of its own buildings and buildings owned by third parties

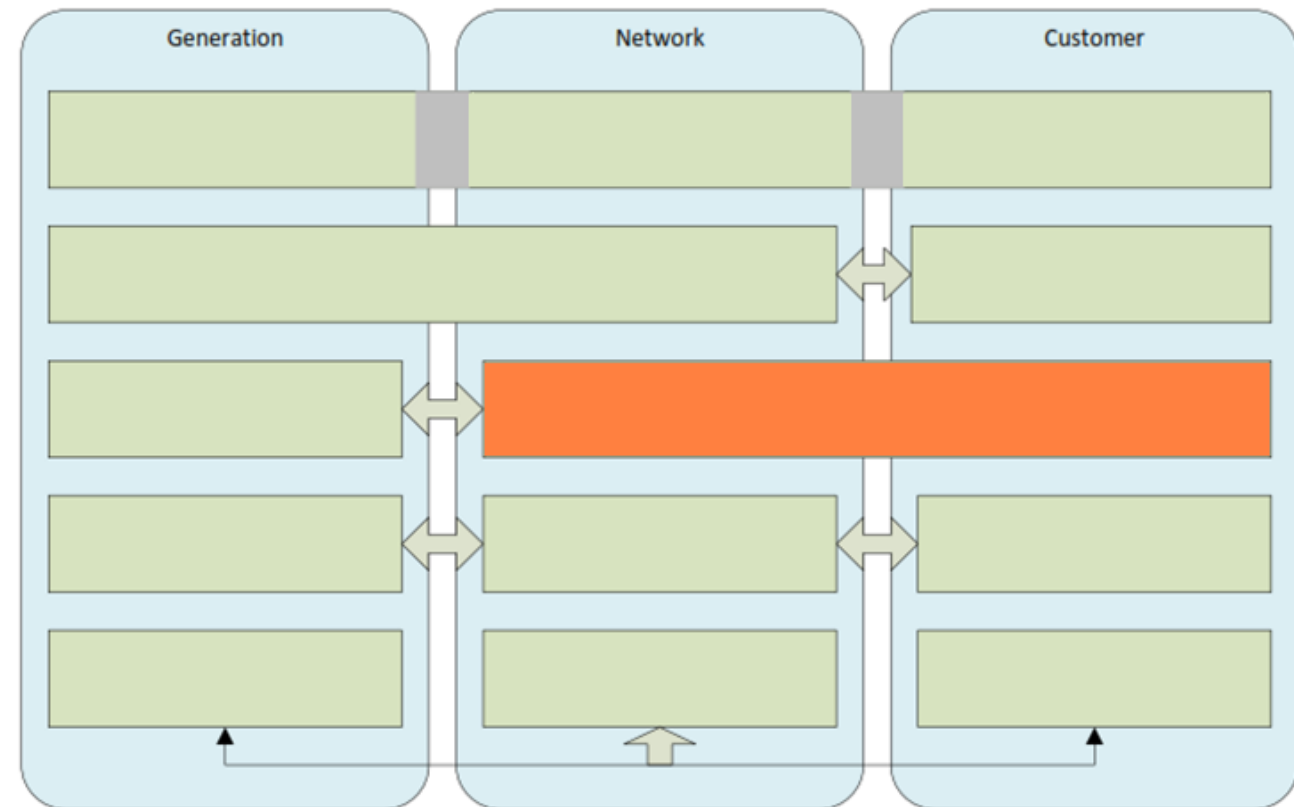


Types of Heat Supply Agreements

Third party generation / self supply.

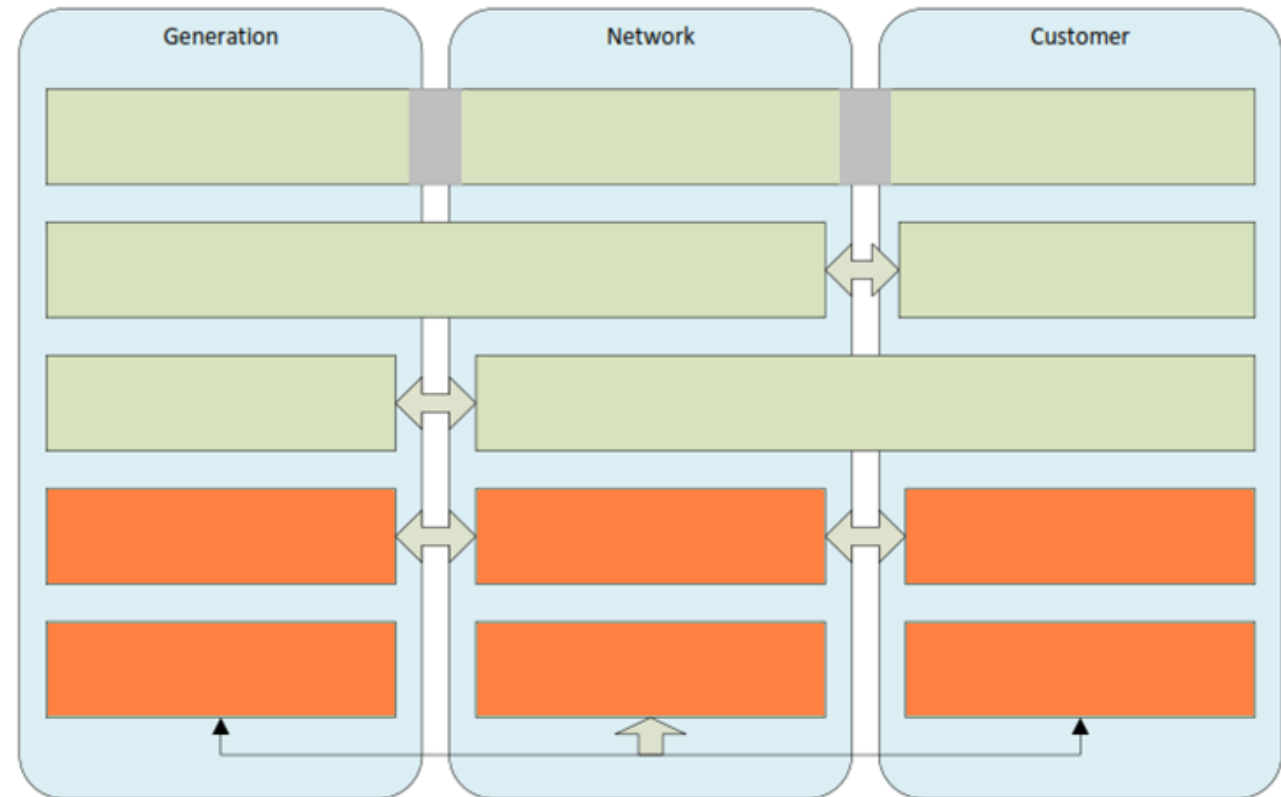
Generation assets and distribution network are under separate ownership, and the network owner supplies its own buildings.

For example, a local authority buys waste heat from waste facility and supplies a number of its buildings through its own distribution network.

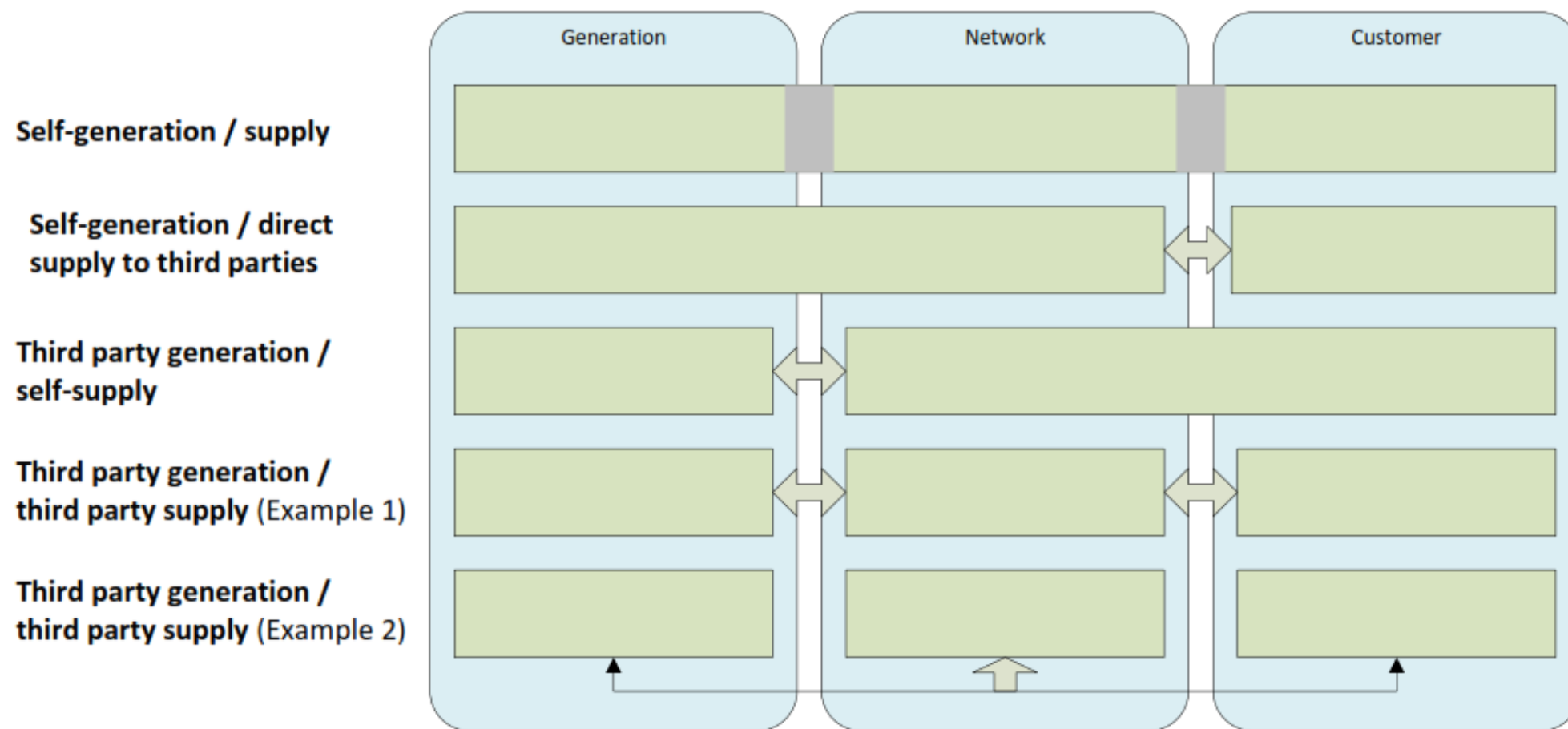


Types of Heat Supply Agreements

- **Third party generation / third party supply.** There will be multiple different heat supply agreements, which could be structured in different ways:
 - Heat generator supplies heat to the network operator under a network / bulk HSA, and the network operator sells the heat to end users under individual customer HSAs;
 - Heat generator contracts directly with end-users for the supply of heat under a customer HSA. Both the end-users and the heat generator pay the network operator connection charges and a 'use of system' charge.



The Main Supply Models



Components to a Heat Tariff

Heat charges and the structure of charges, depend on a number of factors, and must be carefully modelled on a project-specific basis. There are normally several components to a heat tariff:

- **Connection charge.** A one-off charge representing the cost of providing a new connection from the network to the customer.
- **Fixed element** – an annual fixed amount, similar to a standing charge for other utilities, and typically calculated on a €/day basis per customer type.
- **Variable element** – a volumetric based charge (in €/MWh) which varies according to the amount of heat consumed by the customer, as recorded by a heat meter.



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Market Challenges

- Financing district heating projects can be a challenge, as is the case for all infrastructure projects. It requires the right investor, willing to accept stable but long-term investment horizons.
- District heating providers also face market competition for heat provision.
- Local authorities and national governments are important in the delivery of district energy. They can help in providing the business cases with more long-term vision by enabling and easing access to low-cost finance in order to stimulate private investment and industry activity.
- European climate mitigation policies are driving energy efficiency measures which reduces the energy demand for heating and, as a consequence, the district heating market.

Relevance of the role of public sector in DH project development:

- The public sector is able to leverage finance for project more easily and at a lower cost. Financing district heating infrastructures can be challenging, as the long term period of their returns on the investment does not always easily match private sector capital expectations;
- The public sector could have an interest in developing and maintaining control over the project in order to meet wider social and environmental objectives;
- it could provide anchor loads in order to secure ex-ante sufficient heat demand and minimize energy demand risk (i.e. the risk of not having enough heat demand and relative revenues to sustain economic viability of the investment).

Situation in some partner countries

Sweden (1)

- Heat Supply Agreements: In Sweden, self-generation/supply to third parties dominate, but there are also quite a few grids have third party generation/third party supply or a mix of both. The grid operator is normally always in charge of the peak load supply in those cases.
- A current trend set by one of the largest DH companies in Sweden EON, is that they are selling their production and focusing on being grid operators.



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Sweden (2)

- In the majority of the DH grids in Sweden, the customer owns the heat exchanger/district heating central in their building, but in some cases, it is owned by the grid operator.

	No of grids where operator own HE	No of grids where building owner owns HE
Single family homes	18	316
Small multistorey residential houses	28	317
Large multistorey residential houses	26	302

- Most of Estonias heat agreements belong to Self generation / direct supply to third parties type with the exception of a few smaller DH grids which may be of different types.
- According to the District Heating Act, heat distribution operators will be required to harmonise the maximum fee chargeable for thermal energy sold to consumers with the Estonian Competition Authority.



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- In case of Lodz and Poznan heating networks and main sources of thermal energy remain the property of the same company (Veolia Energia Polska SA). In this case, one can specify the heat supply agreements as **self-generation / supply only to third parties**. In other major cities the most important type of heat supply agreement is **third party generation / third party supply to third parties**.
- There is a large variation in the rates of fees – individual components of the resulting heat price, even in one heating company and the same city, depending on the location (taking into account the type of heat source) and type of customer.

Russia (Karelia)

- **Third party generation / third party supply.** The technological processes in the heat supply system are overseen by the dispatcher of the heat transporter.
- At present, connection to the networks is done for a **connection fee** and is paid to the network owner in several installments over 18 months. The amount of the connection fee is set by the State committee for rates and tariffs of the Republic of Karelia



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Denmark

- Typical heat supply agreements in Denmark are: **self-generation/ supply to third parties; third party generation / third party supply.**
- There are normally several components to a heat tariff: **connection charge, fixed element and a volumetric based charge** (in €/MWh) which varies according to the amount of heat consumed by the customer, as recorded by a heat meter.
- In Denmark the district heating companies are **non-profit companies**; they are not allowed to charge more than the real costs of the heat supply, including future investments with a payback time of 30 years.



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Finland

- District heating is based on **self-generation / supply to third parties**
- The HSAs follow the terms of contract by The Finnish Energy (Energiateollisuus). The price for district heating is determined typically by **connection charge, energy fee** (€/MWh) and **fixed fee**, bound to the water flow or heating power.
- District heating networks will be open for third parties in future. There are some pilots where third parties can already feed surplus heat to the district heating network.
- Some district heating companies have **seasonal pricing**, where the energy fee is a fixed price for specific months.



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Conclusions

Pricing dilemma and dynamic pricing

Fixed cost vs variable cost

- A DH company would have financial risks if its DH price is predetermined for a long time. A common way to reduce this financial risk is to divide the price into two parts: a fixed component and a variable component.
- A pricing approach comprising a fixed component can reduce producers' risks caused by fluctuations in consumption. A fixed charge can streamline the cash flow of producers.
- It is common to link the fixed cost to the heat capacity of the users. Consumers prefer a high share of the energy cost, which can increase the flexibility of consumption and price transparency.
- The pricing mechanism, especially the magnitude of the fixed component, should be decided to balance the needs of producers and requirements for consumers.

Historic consumption vs. current heat demand

- Some DH companies are reforming their price models and the capacity cost receives the most attention. **The purpose of changing the capacity cost is to encourage consumers to reduce their peak heat capacity** and therefore DH companies can reduce the investment cost and production cost, which may lead to a lower heat price.
- The charge of capacity cost is determined according to the historical heat consumption data. However, the climatic condition changes year by year, resulting in a dynamic change of capacity. Even though a correction based on the normal year can be introduced, there could still be a big deviation in the determination of the heat capacity, because the yearly degree-day may not accurately reflect the peak heat capacity.

Peak load vs. individual peak consumption

The intention of using capacity based pricing is to **motivate the consumers to change their behaviors** to reduce the peak load on a long-term basis.

Unfortunately, this may not solve the problem of high peak loads in the system. Different consumers have different consumption profiles; and their individual peak consumption may not occur at the same time.

Therefore, **reducing the individual peak consumption may not really reduce the peak load.**

Complex price model vs. pricing transparency

There are a couple of methods to determine the heat capacity demand for charging the capacity cost.

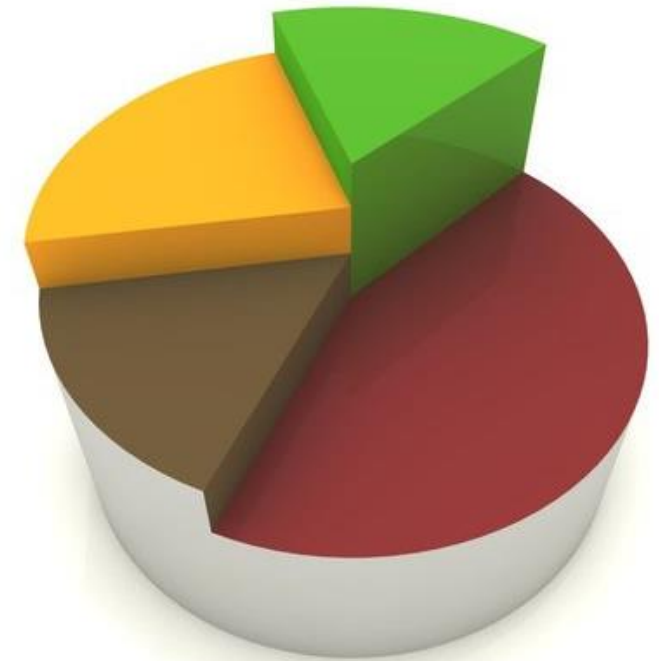
One is the **assigned consumption hour method**, which determines the capacity by dividing the customer's annual consumption by assigned consumption hours.

THE ASSIGNED CONSUMPTION HOUR is a constant but different for different types of customers. However, how it is obtained is not fully clear.

In addition, the capacity cost is charged as capacity price multiplied by capacity. The determination of capacity price is not easy to understand. It is commonly assumed that the **income from the capacity cost accounts for 30-50% of total income**.

Need for dynamic pricing mechanism (1)

- Big concern coming from the high capital cost is the main driving force for charging a higher capacity cost in order to motivate consumers to reduce their peak consumption.
- Meanwhile, charging a higher capacity cost doesn't contribute much to encourage consumers to save energy.
- A good price model should be able to:
 - Reflect the dynamic production cost accurately,
 - Motivate consumers to reduce the peak load and save energy at the same time
 - Be predictable
 - Be transparent and easy to understand



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Need for dynamic pricing mechanism (2)

- A dynamic pricing mechanism based on the prediction of system heat demand becomes more attractive bearing in mind what a good price model should be able to do.
- Based on the demand prediction, DH companies could more accurately foresee the peak load and estimate the extra cost for covering the peak load.
- By charging a higher price for the peak, it should be possible to reduce the peak load. Since most of the heat productions are based on CHP, a dynamic heat price can also cope with the dynamic electricity price in a better way.
- **By understanding the pricing mechanism, consumers can change their behaviors in order to reduce the heat consumption and save the cost.**