District Heating in Copenhagen – challenges and perspectives

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Agenda
HOFOR District Heating
Competitive District Heating
Smart Energy Systems / Digitalization Challenges
Digitalization of assets
Closing considerations
Examples
HOFOR District Heating

Our ambition

Green, Safe and Competitive District Heating (DH)

- **Green DH** >> 100% CO2-neutrality by 2025
- **DH supply security** >> cost-balanced level of supply security
- **Competitive DH** >> Customers should prefer DH in comparison with other alternatives, based on price, CO2-neutrality and security of supply

### HOFOR District Heating - Key Figures 2021

<table>
<thead>
<tr>
<th>Capacity demand in Copenhagen Region</th>
<th>4.870 MW</th>
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</thead>
<tbody>
<tr>
<td>Base Load: CHP, incineration and heat pumps</td>
<td>2.130 MW</td>
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<tr>
<td>Peak Load: Heat-only boilers and turbine by-pass</td>
<td>2.740 MW</td>
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**HOFOR District Heating**

- DH network, length approx.: 1.500 km
- Number of customers, approx.: 35,000
- Number of citizens, approx.: 625,000
- Heat demand covered by DH: 99%
- Degree days for planning purposes (degree days/year): 2,801

**Heat sold (2801 degree days), HOFOR**: 4,500 GWh

Heat loss in distribution, approx.: 10%
Heat loss in distribution, approx.: 500 GWh
Heat demand net, HOFOR: 5,000 GWh
Competitive District Heating

Our ambition
Customers should prefer DH in comparison with other alternatives, based on: price, CO2-neutrality, security of supply and easiness

Our customers’ expectations:
➢ CO2-neutrality
➢ Reliability
➢ Reasonable low District Heating price
➢ Operational easiness – digital interaction

In addition, some customers would like to be autoproducers (prosumers) – producing a part of the needed heat by themselves.
Our main challenge:
The heat density may be reduced in the future, due to changes in the regulatory framework:

➢ In the past, DH customers having a capacity demand of more than 250 kW were obliged to use district heating, only.
➢ This obligation was recently cancelled. Now these customers may use surplus heat or heat generated from renewable sources, if such solution will be better than district heating in socio-economic terms.

➢ The framework for investments in heat pumps has recently been improved significantly – as the taxes on electricity and surplus heat has been reduced, almost to zero.
➢ Although HOFOR is investing in heat pumps, it means that the competition from smaller individual heat pumps will be growing.

The consequence can be that the economic efficiency of district heating operations will deteriorate along with reduced heat density. In addition, our district heating tariff per MWh is the same all year round. If renewable energy or surplus energy is used during the summer season, we will lose money, and must increase the tariffs.
# Smart energy systems / digitalization challenges

<table>
<thead>
<tr>
<th>Issue</th>
<th>Status 2021</th>
<th>Ambition 2025</th>
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<tbody>
<tr>
<td>Remote heat metering</td>
<td>11,000 customers</td>
<td>35,000 customer</td>
</tr>
<tr>
<td>Energy management based on remote heat metering (&quot;Forsynometer&quot;)</td>
<td>400 customers</td>
<td>Approx. 17,000 customers</td>
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<tr>
<td>Performance of customers substations</td>
<td>We have tested a model that is able to analyse the performance of substations</td>
<td>A system monitoring the performance of customers’ substations, enabling interventions</td>
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<td>Performance-based renovation of DH pipelines</td>
<td>We are establishing a GIS database containing performance indicators/drivers</td>
<td>Calibrated model with drivers: technical data, failure data, data from pipe insulation water alarm wires, infrared measurements</td>
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<td>Further use of operation data in the operation and control of the DH system</td>
<td>The network temperatures have been lowered considerably since 2010</td>
<td>Further reduction of temperatures, enabling higher efficiency of heat pumps</td>
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<td>Reduction of the peak load</td>
<td>“Flexsumer” solutions are being tested Water and heat losses in the network have been reduces</td>
<td>Implementation of flexsumer options Further reduction in water and heat losses</td>
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<td>Sector coupling with heat pumps</td>
<td>We are testing and developing digital models optimizing the use of electricity in economic terms</td>
<td>Larger scale implementation of optimization models</td>
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<td>Utilisation of CCS/CCU</td>
<td>We are engaged in the C4 cooperation initiated in 2021. Participants: ARC, ARGO, BIOFOS, CTR, VEKS, HOFOR Copenhagen Malmö Port, Vestforbrænding, and Ørsted</td>
<td>A CCS or CCU plant is in operation</td>
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<td>Ways to success &gt;&gt;</td>
<td>Cooperation with universities, DH companies and other external partners</td>
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Level 0: Smart-Energy readiness
- Metering data (temperature, pressure, etc)
- 800xA SCADA system
- Compressors – reciprocating, screw, turbo?
- Fast regulating
- Synergies between sources
- Combination with heat storage
- Data infrastructure

Level 1: Performance monitoring
- Digital twin (optimization and O&M)
- Aggregation platform

Level 2: Data integration
- Data collection from level 0 and 1
- Internal and external data sharing

Level 3: Total optimization
- Portfolio control of heat pump, wind turbines, chillers, etc.
- Optimization modules for markets
- Ancillary services
- Local flexibility services

Digitalization focus on assets
Closing considerations

- Electricity is not yet CO2-neutral, having a CO2-emission for consumed electricity that is approximately 3.5 times more than district heating.
- Reaching the last percentages of CO2-neutrality may be costly. The money might be better spent for investments in other parts of the world.
- Some customer groupings tend to prefer small energy communities (islands). A DH Company, owned by the municipality, is in fact a large Energy Community.