Challenges and potentials for low-temperature district heating implementation in Norway

Natasa Nord, Elise Kristine Løve Nielsen, Hanne Kauko, and Tymofii Tereshchenko
Department of Energy and Process Technology, Norwegian University of Science and Technology
Challenges in transition to LTDH

- Higher share of distribution losses
- High return temperature and low temperature difference
- Aims of the study:
  - Integration of low energy and passive house buildings
  - Estimate possibilities and increase competitiveness of the LTDH in the low heat density area
Network structures

Network A
Linear heat density: 1.3 MWh/m

Network B
Linear heat density: 2.3 MWh/m

ks – consumer substation
Planning of the LTDH network

Planning the LTDH for low energy buildings

Existing networks

Development of new networks

Pipeline is sized for the high temperature
\(T_{\text{sup}} = 80^\circ C, \Delta T = 45 \text{ K}\)

Pipeline is sized for the high temperature
\(T_{\text{sup}} = 55^\circ C, \Delta T = 30 \text{ K}\)

<table>
<thead>
<tr>
<th></th>
<th>Temperature in primary</th>
<th>Temperature in secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing network</td>
<td>Reference case - 80°C</td>
<td>65°C</td>
</tr>
<tr>
<td>Case 1 - 70°C</td>
<td></td>
<td>55°C</td>
</tr>
<tr>
<td>Case 2 - 60°C</td>
<td></td>
<td>50°C</td>
</tr>
<tr>
<td>Case 3 - 55°C</td>
<td></td>
<td>50°C</td>
</tr>
<tr>
<td>New network</td>
<td>55°C</td>
<td>50°C</td>
</tr>
</tbody>
</table>

Obs: Legionella problem has to be treated
Heat and energy demand

- Heat demand data on hourly level were provided from different low and passive house buildings
- Heat demand of the area:
  - Heat load: 791 kW
  - Heat energy use: 1.9 GWh
Duration curve for the area

- Total aggregated heat output
- Outdoor temperature
Temperature distribution

Reference case - 80°C

Low temperature - 55°C
Pump energy for existing networks
Pump energy for new networks

<table>
<thead>
<tr>
<th></th>
<th>Δp1</th>
<th>Δp2</th>
<th>Δp3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main pipe</td>
<td>R ≤ 150 Pa/m</td>
<td>R ≤ 300 Pa/m</td>
<td>R ≤ 600 Pa/m</td>
</tr>
<tr>
<td>Service pipe</td>
<td>R ≤ 200 Pa/m</td>
<td>R ≤ 550 Pa/m</td>
<td>R ≤ 800 Pa/m</td>
</tr>
</tbody>
</table>
Issues with achieving the low return temperature

Reference case - 80°C

High return temperature due to short circulations or by-passes

Low temperature - 55°C
Issues with achieving the low return temperature

Reference case - 80°C

Issues with the temperature difference due to high indoor temperature

Low temperature - 55°C
Development of the LTDH
Development of the LTDH
Conclusions

• LTDH may be competitive in the low heat density area

• The effects of the system faults are smaller in the LTDH

• The oversized radiators shows the biggest influence on the maximal flow rate – meaning issues in control

• For the distributed area, the pump energy is increasing significantly when the heat density is lower than 1 MWh/m
THANK YOU FOR ATTENTION!

natasa.nord@ntnu.no