LOW TEMPERATURE VS. ULTRA-LOW-TEMPERATURE DH FOR HOUSING AREAS WITH VERY LOW LINEAR HEAT DEMAND DENSITIES

Isabelle Best, Copenhagen, 13 September 2017

3rd international conference on SMART ENERGY SYSTEMS AND 4TH GENERATION DISTRICT HEATING
Copenhagen, 12-13 September 2017
ULTRA-LOW-TEMPERATURE DH VS. LOW-TEMPERATURE DH

• Which temperature level + temperature difference?
  – Impact on heat generation technology
    → share of renewable energy
  – Impact on pipe design
    → pressure drop
  – Impact on pump energy demand
  – Impact on heat losses

• Which system is the best from economic point of view?
Qh = 1665 MWh/a

\[ \frac{3}{4} Qh = SH \]

\[ \frac{1}{4} Qh = DHW \]

**Ultra-low Temperature DH**
- 40 °C Supply 25 °C Return
- Semi-decentralised Heat Supply
- SH

**Low Temperature DH**
- 70 °C Supply 40 °C Return
- Central Heat Supply
- SH
- DHW
ULTRA-LOW-TEMPERATURE DH VS. LOW-TEMPERATURE DH

Ultra-Low-Temperature DH: 40°C supply 25 °C return

Low-temperature DH: 70 °C supply 40°C return

DH switched off → decentralized DHW preparation

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DIFFERENT PIPE DESIGN GUIDELINES

![Graph showing flow velocity in m/s vs. inner diameter in mm with different pressure losses (100 Pa/m, 200 Pa/m, 300 Pa/m) and a line labeled 'Praxis'.]
DIFFERENT PIPE DESIGN GUIDELINES

- ÖKL recommendations
- ÖKL recommendations for connecting pipes
- Isoplus Maximum
- Swedish DHA
- Isoplus Minimum
- Praxis
DIFFERENT PIPE DESIGN GUIDELINES

Design Tool: temperature difference + max. load + max. flow rate/ max. pressure drop → pipe diameter

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• From DH 40/45 to DH 70/40:
  shift from DN 100 to DN 65 + significant increase of DN 20

• How much money do I save?

→ Economical Evaluation
ECONOMIC EVALUATION – SPECIFIC NETWORK COSTS IN GERMANY

Specific Network Costs in €/m

Nominal Pipe Diameter

DN 20  DN 25  DN 32  DN 40  DN 50  DN 65  DN 80  DN 100  DN 125  DN 150

Praxis 2016
AGFW 2009 old technology
AGFW 2009 new technology
Manderfeld 2008 unmade terrain rigid pipes
Manderfeld 2008 unmade terrain flexible pipes

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ECONOMIC EVALUATION – HEAT DISTRIBUTION COSTS

Base period: 30 yrs., interest rate: 5.6 %, maintenance costs: 0.5 % of investment

→ In yearly costs nearly no difference
→ In specific costs reduction of 21 %

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ECONOMIC EVALUATION – AUXILIARY ENERGY DEMAND

Pressure Drop at Maximum Load

\[ \dot{V} = 88 \text{ m}^3/\text{h} \quad \dot{V} = 30 \text{ m}^3/\text{h} \]

Yearly Costs

- 15%

\begin{align*}
\text{DH 40/25} & : & 840 \\
\text{DH 70/40} & : & 727 \\
\end{align*}

3.2 kW \quad 1.7 kW

3300 hrs \quad 8742 hrs

0.36\% of total heat supply \Rightarrow 0.61\€/MWh

0.25\% of total heat supply \Rightarrow 0.44\€/MWh
### ECONOMIC EVALUATION – HEAT DISTRIBUTION LOSSES

<table>
<thead>
<tr>
<th>Heat losses in MWh/a</th>
<th>Heat losses in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS 1</td>
<td>6.9%</td>
</tr>
<tr>
<td>DS 2</td>
<td>6.0%</td>
</tr>
<tr>
<td>DS 3</td>
<td>5.5%</td>
</tr>
</tbody>
</table>

- Heat losses x 3 higher at LTDH 70/40
- Yearly costs + 75%
- Specific costs + 6.8%

- **Operating costs for HP €/yr**
  - DH 40/25: 38.0 €/MWh
  - DH 70/40: 40.6 €/MWh

- **SPF**
  - DH 40/25: SPF = 4.8
  - DH 70/40: SPF = 4.1

*ND 4th GENERATION DISTRICT HEATING* per 2017
SUMMARY

- Analyses comprise infrastructure
- Investment costs of pumps here not included
- SPF sensitive parameter → heat supply side

→ Heat losses x 3 higher at LTDH 70/40
→ Yearly total costs of LTDH 70/40 + 27%
→ Specific costs of LTDH 70/40 - 5%

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THANK YOU FOR LISTENING

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