Development prospects for small low-temperature district heating networks

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• Main designer of District Heating and District Cooling networks in Estonia
• DH networks up to DN1200
• 75 km on DH pipelines engineering during last 3 years
• *netSim* for hydraulic calculations, *sisKMR* for static calculations
District heating in Tallinn, Estonia

- DH network from 1956
- Length: 430 km
- 40% pre-insulated pipes, other in concrete channels
- Age of DH network: 24.6 years
- Heat losses: 13.8%
- Temperature graphic: 130 °C / 70 °C
Real object – Kopli, Tallinn, Estonia
Data of region

- 2 development stages (from 2019 until 2026)
- Flat houses, shop, kindergarten, school
- 925 flats, 90 000 m²
- Floor heating + hot water
- Heating capacity *ca* 5 MW
- District heating network:
  - 1.stage: 1 140 m
  - 2.stage: 1 166 m
Heating source and network options

1. Connection to Tallinn district heating network
   - Investments from DH operator for connection
   - Network graphic 95 °C / 55 °C

2. Local gas boiler house
   - Separate building
   - Network graphic 60 °C / 35 °C (or 80 °C / 40 °C)

3. Local gas boiler house + sea water heat pump
   - Separate buildings
   - Network graphic 60 °C / 35 °C
Investments

1. Connection to Tallinn district heating network: 730 000 EUR
   • Investments for connection: 110 000 EUR
   • Investments for DH network (2 stages): 620 000 EUR

2. Local gas boiler house: 1 020 000
   • Investments for gas boiler house: 400 000 EUR
   • Investments for DH network (2 stages): 620 000 EUR

3. Local gas boiler house + sea water heat pump: 2 200 000 EUR
   • Investments for gas boiler house + pump: 1 580 000 EUR
   • Investments for DH network (2 stages): 620 000 EUR
District heating network design

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Heat losses for different DH network

1. Initial data for calculations
   • Heating period 260 days / year
   • Hot water every day
   • Average air temperature for heating period: -1.5 °C
   • Average air temperature for non heating period: 14 °C
   • Depth of district heating pipelines: 1m from the ground
   • Pipe material: pre-insulated steel

2. Results
   • 95 °C / 55 °C: 913 MWh / year
   • 80 °C / 40 °C: 762 MWh / year
   • 60 °C / 35 °C: 653 MWh / year
Heat pump calculations

- Annual amount of heat: 17173 MWh / year
- SCOP: 4,04
- Lifetime: 20 years
- Primary energy factor (electricity): 2,0
- Cost of heat production without investments: 18,05 EUR / MWh
- Cost of heat production with investments: 26,59 EUR / MWh
- District heating price in Tallinn (fixed by Competition Authority): 56,65 EUR / MWh
Heat pump calculations

1. Connection to Tallinn district heating network
   • Natural gas consumption: 20 096 MWh
   • Primary energy: 20 096 MWh
   • CO₂ emission: 4 039 t

2. Local gas boiler house
   • Natural gas consumption: 19 928 MWh
   • Primary energy: 19 928 MWh
   • CO₂ emission: 4 005 t

3. Local gas boiler house + sea water heat pump
   • Natural gas consumption: 5 229 MWh
   • Electricity consumption: 3 248 MWh
   • Primary energy: 11 724 MWh
   • CO₂ emission: 4 948 t
Expectation / Reality
Performed solution

- Local gas boiler house
- Temperature in DH network 80 °C / 40 °C
  (pipelines are dimensioned for 60 °C / 35 °C)
- “We do not want to be the first developer with 4DH in Estonia”
- Lobby from gas boiler house manufacturers
- Lack of time for calculations / heat pump solution
Hope for 2. stage project

- District heating network with graphic 60 / 35
- Implementation of sea water heat pump
- Gas boiler house as peak load source
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