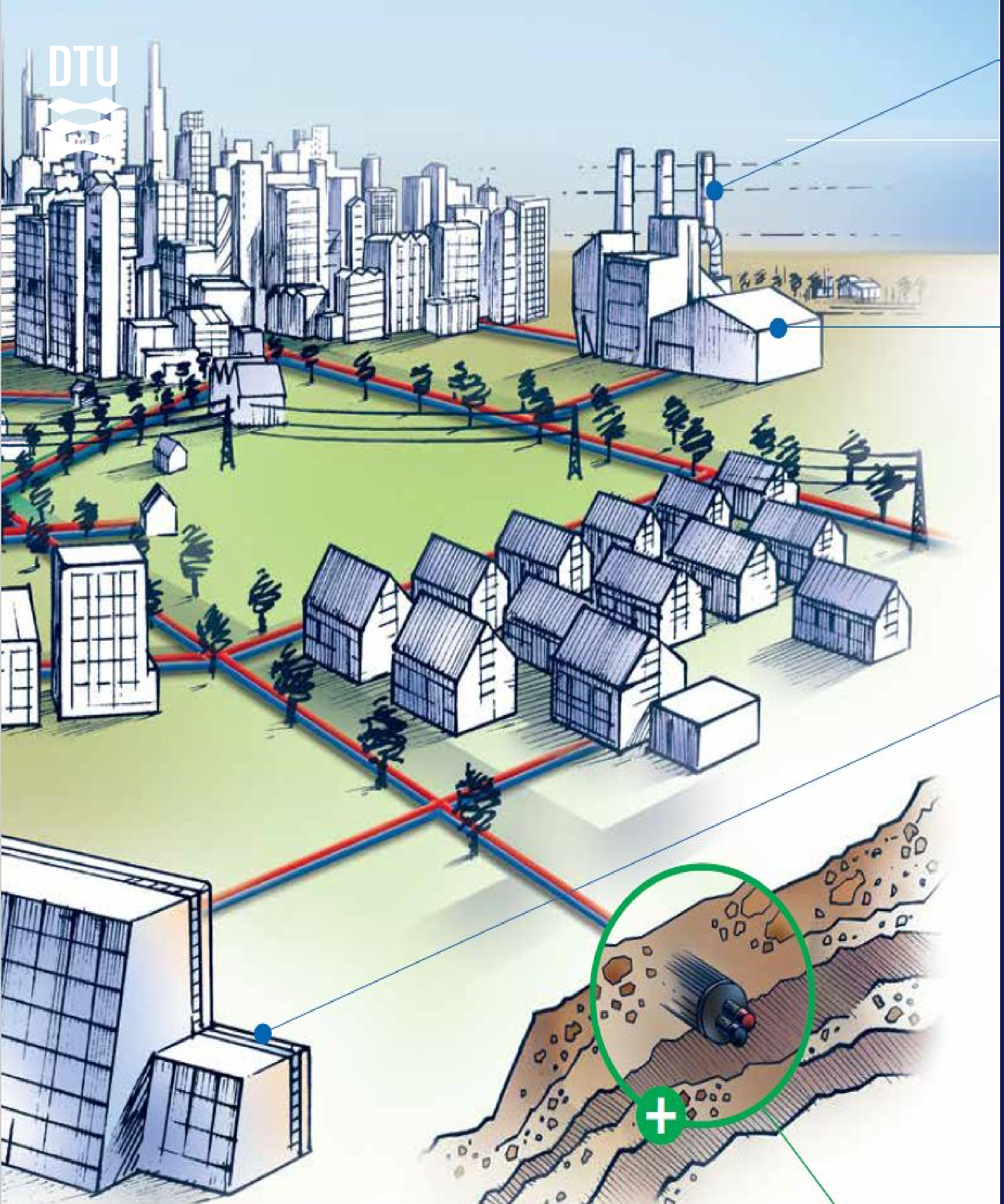

Smart double loop network for ULTDH in low-heat density areas

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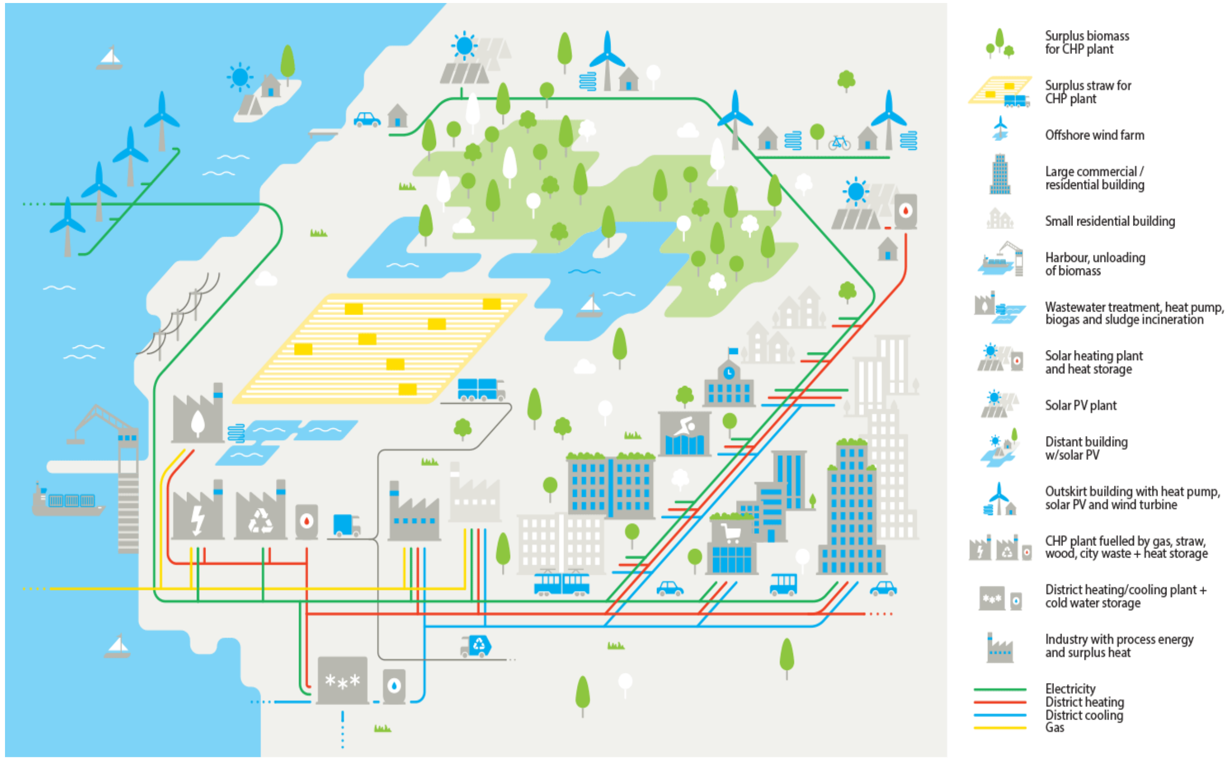
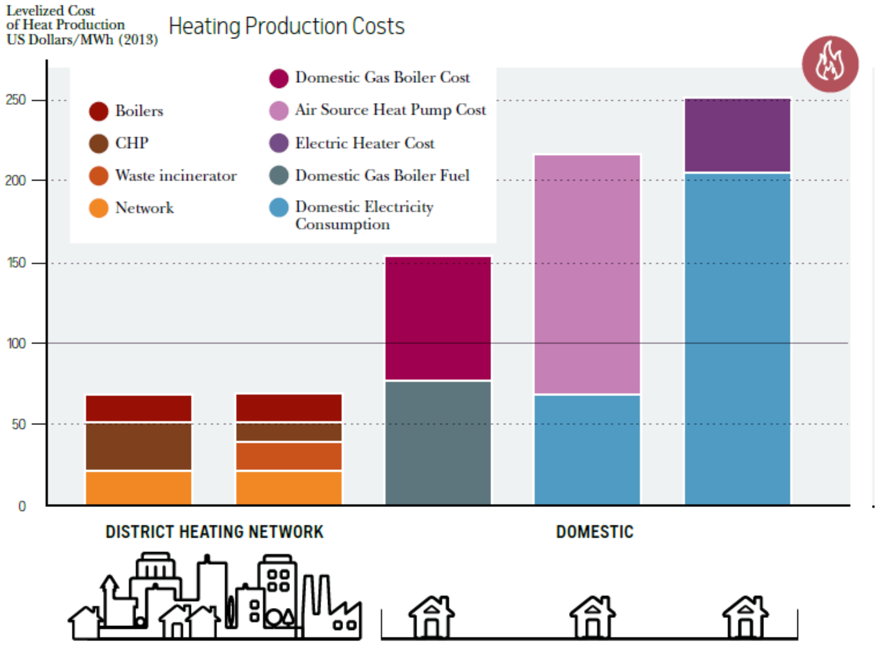
Introduction

- Future competitiveness of DHC sector
- New concept for a combined heat and cool network
- Preliminary analysis and results
- Highlights and future work



Future scenarios for district energy competitiveness

- DHC is a cost-effective method of supplying heat and cool from aggregated energy sources
- Urbanisation is expected to grow in Europe to 84% by 2030 as well as the improvement of building energy performance
- Increased housing development of 12% and population growth of 14% expected in Copenhagen by 2025
- Low heat density areas and the phase out of fossil-fuel energy supply will challenge the competitiveness of conventional DHC technology



Source UNEP: District energy in cities

New challenges for the future DHC competitiveness

1. ***Operation of DHC networks with ultra low-temperatures***

Lower operating temperatures are fundamental for the DHC economy (unlocking the possibility to use local/renewable energy sources and higher efficiency energy generation plants). Due to improved buildings' performances, DH networks can be operated with supply temperatures (35-50 °C) and ensured indoor comfort

2. ***Reduction of heat distribution losses***

Due to lower energy demand, the profitability of DHC networks, in particular in low heat density area, will be affected by the distribution losses. These can be higher than 25%

3. ***DHW preparation with no risk of Legionella***

To comply with DS 439 with ultra-low temperature, new solutions are required to boost the supply temperature and safely deliver DHW. Synergies between electricity and heat from DH networks

4. ***Supply heat during summer periods***

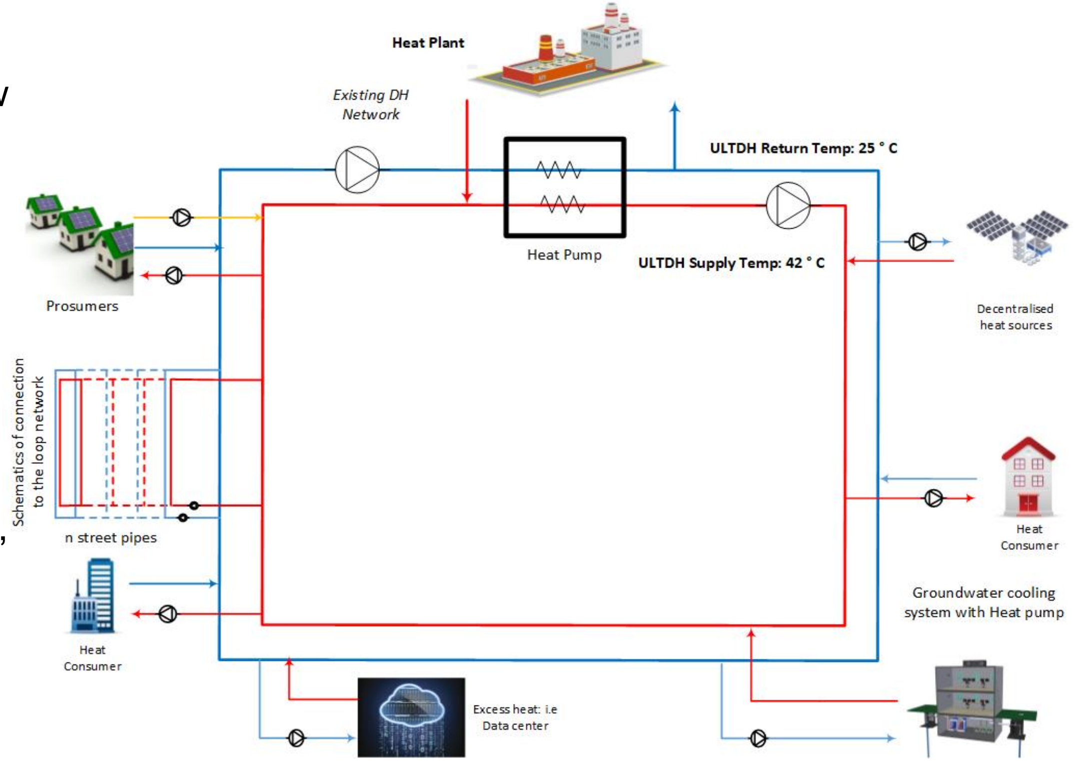
Technical solutions to avoid street and sub-station by-pass valves and contamination of return temperatures

5. ***District cooling***

The cooling demand is higher than heating demand worldwide. Although the market for DC is currently smaller than for DH in EU (< 1%), it is growing fast today and expected to pick up further in the future

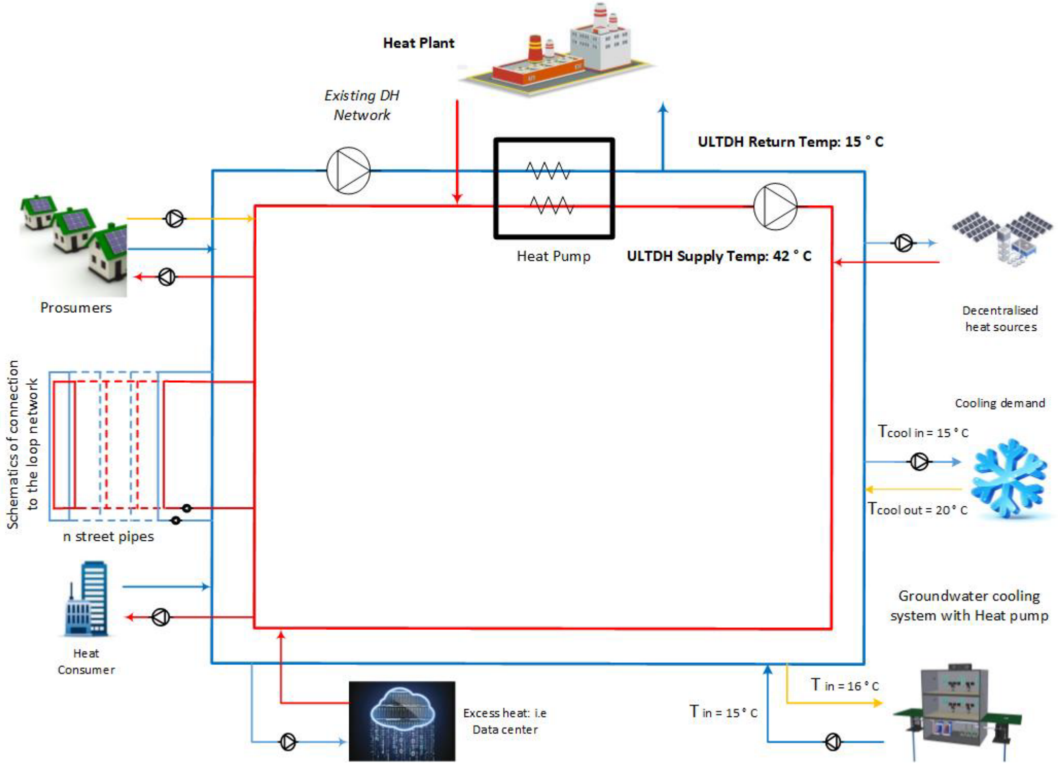
Smart double loop concept: winter operation

- New local (U)LTDH as an extension of existing DH networks in new areas (or re-arrangement of existing networks in loops)
- The central pumps will adjust the circulating flows in the main loop to displace heat/cold in the network and guarantee the required temperature everywhere
- Higher static pressure available locally and in the main loops. Minimization of pipes' size and distribution losses
- The optimal supply temperature as combination of the existing DH, de-centralised heat sources and/or heat recover
- High flexibility: low temperature excess heat can increase return temperature locally (using the local pump) and used by the central heat pump to deliver heat in the supply loop at the optimal temperature



Smart double loop concept: summer operations

- Heating and cooling networks embedded in the same infrastructure, using return loop during summer to cover cooling demand
- Due to the possibility to circulate the supply flow, no need for by-pass valves and no return temperature contamination
- During no-load periods, the service pipes will be isolated with closing valves and only street pipe will be kept warm with circulation
- Return temperature as low as 15 °C, return loop could be used to distribute and meet local cooling demand
- Locally installed groundwater cooling systems with heat pumps can be the cooling sources of the system and will guarantee the needed temperature in the return loop

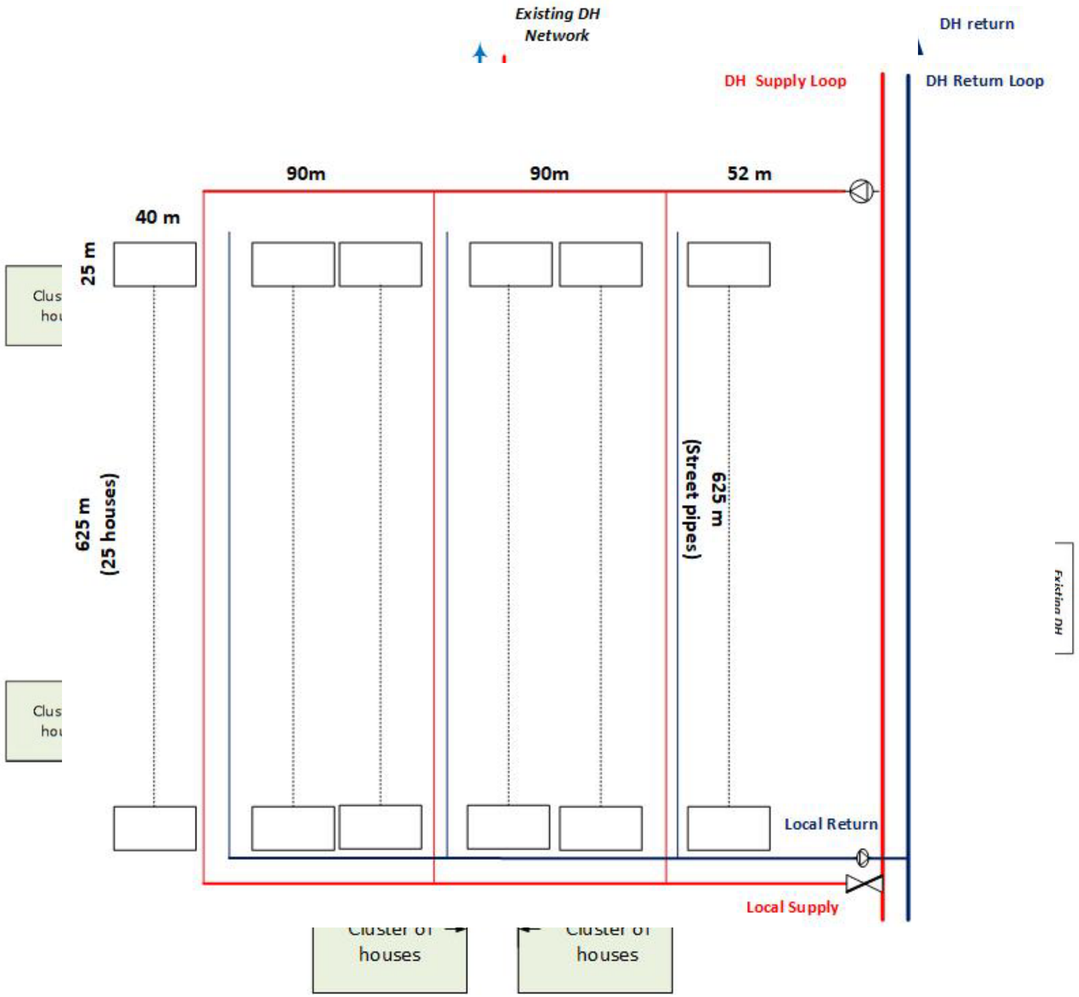


Smart double loop network concept development

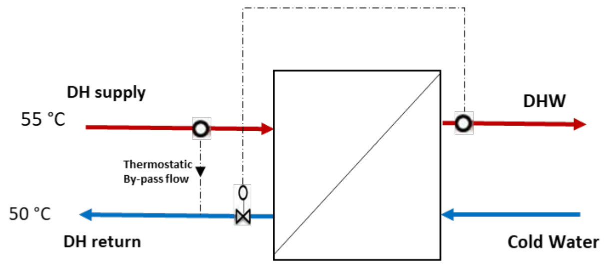
- Preliminary work based on an assumed new urban area:
  - 1500 detached-houses
  - SH peak demand 15 W/m2 and floor area of 200 m2
  - Instantaneous DHW demand 32.3 kW
  - Simultaneity factor (SF) according to DS 439 curve
  - 10 cluster of 150 houses each

- Comparison of design and operation for 3 cases:
  - Tree network with LTDH (55/25 °C)
  - LTDH Double loop with triple pipe (55/25 °C)
  - ULTDH Double loop with micro tank (45/25 °C)

- Main assumptions:
  - Heating network with single heat source
  - Main network 10 km (8 bar static pressure available)
  - Local pumps only in the clusters of double loop networks (8 bar static pressure available)
  - Twin pipes for distribution and main pipes
  - Cost of equipment from manufacturers or literature
  - Discount in heating cost of 1% per each °C of average return temperature below 35 °C
  - Elect and heating price of 0.26 and 0.10 €/kWh

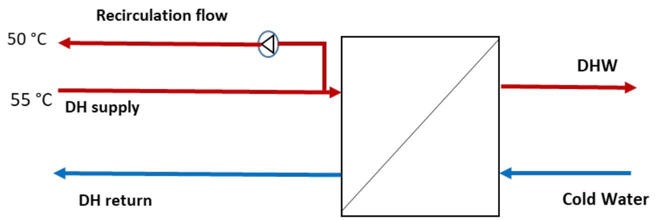


Connection to the end-users



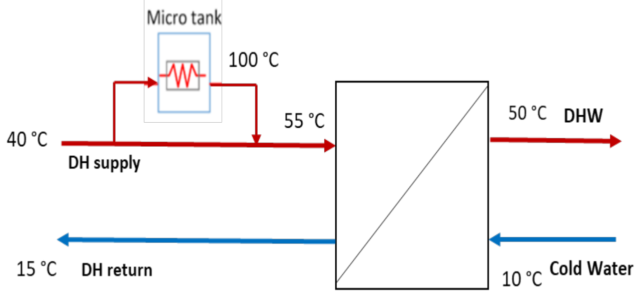
LTDH Tree Network

- By-pass flow
- Higher return temperature
- Summer heat loss from service pipes
- Larger diameters due to standard design



LTDH Double loop with triple pipe

- No by-pass flow
- No return temperature contamination
- Smaller service pipes' diameters
- Lower heat loss from service pipes due to smaller sizes

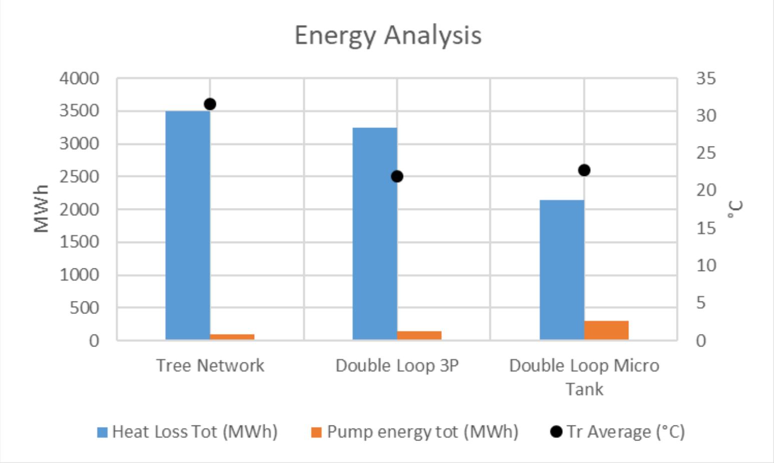


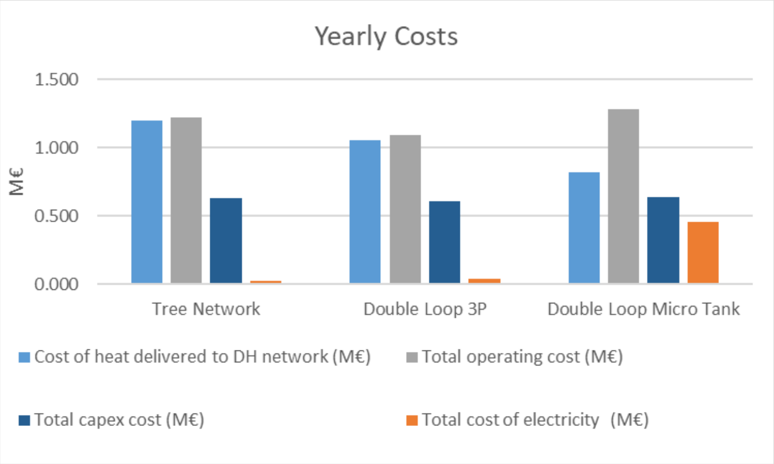
ULTDH Double loop with Micro-Tank

- No by-pass flow
- No return temperature contamination
- No circulation and no heat loss from service pipes
- Smaller service pipes' diameters
- Reduction of supply temperatures would reduce the impact of electricity for DHW preparation

Energy and cost analysis - Preliminary results

- Consistent reduction of heat losses in ULTDH due to the lower operating temperature and circulation only in the street pipes
- Lower average return temperature for the double loop cases compared to the tree network
- Yearly cost analysis based on 30 year lifetime investment
- Increasing pumping energy have a positive impact on reducing both distribution heat losses and capital costs
- Double loop with 3P has lower costs. Electricity for boosting DHW temperature have high impact on operating costs of double loop with micro tank





Highlights and further work

- By circulating the flows in the double loop networks, no contamination of return temperature due to by-pass valves. Lower average return temperature compared to tree-structure network
- Increased pumping energy ensures lower piping costs and minimizes the distribution heat losses
- High impact of electricity cost for ULTDH network due to DHW preparation
- Outdated 45 °C for kitchen use – no need to hand-wash dishes with high melting point fat
- Possible reduction of required supply temperature for hygiene and comfort: 45 °C in the HE (primary side) and 40 °C (secondary side)
- Integration of heating and electricity for the future smart energy systems based on 100% renewable sources. Different energy price can enhance the competitiveness of the new technical solutions
- By embedding heating and cooling in the same infrastructure, the double loop network can enhance the DHC technology and improve its future competitiveness

Acknowledgments

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