This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768936.

TEMPO

Temperature Optimisation for Low Temperature District Heating across Europe

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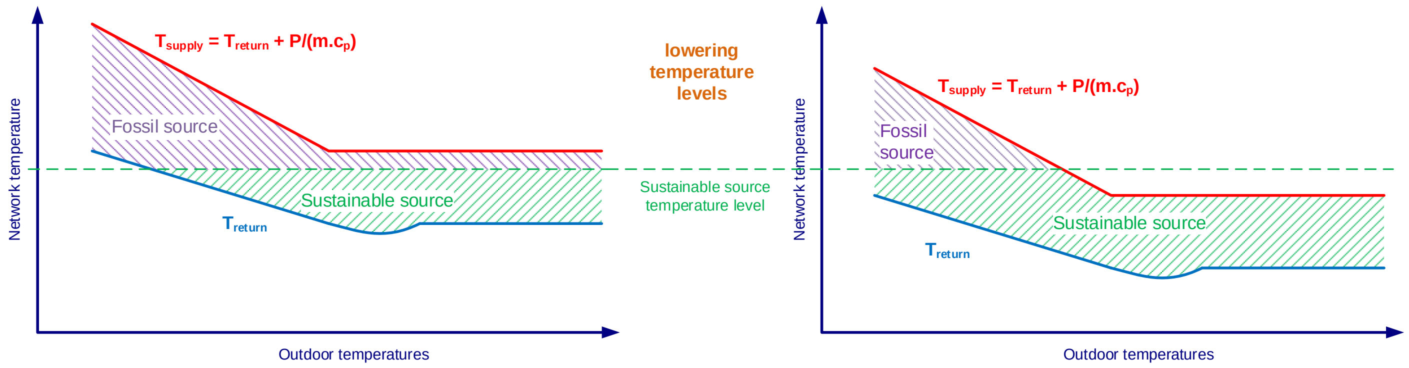
Lower network temperatures

Benefits:

- Less heat losses
- Increased share of LT sustainable energy sources
- Increased efficiency of heat production technologies (heat pumps, CHPs, boilers etc.)

Financial benefits estimated at €45/°C.TJ in Sweden[1]



[1] Frederiksen, S. & Werner, S. (2013). District Heating and Cooling (1ed.). Lund: Studentlitteratur.

Lower network temperatures

By technological innovations:

- Digitalisation
- Network and building infrastructure optimization

By business models rewarding low return temperatures

By consumer commitment

- Awareness creation
- Involvement

6 technological innovations

TEMPO

1. ICT platform for building substations supervision
2. Visualisation tools for experts and non-experts
3. Smart DHC network controller
4. Innovative piping system
5. Optimized building installation
6. Decentralised storage buffers for LT DH networks

ICT platform for building substations supervision

A huge amount of building substations return a too high temperature back to the DH network, because of “faults”:

- malfunctioning components (sensors, valves, heat exchangers etc.)
- incorrectly designed components
- inappropriate settings in substation controller
- improper dimensioning of substation
- faults in heating supply systems

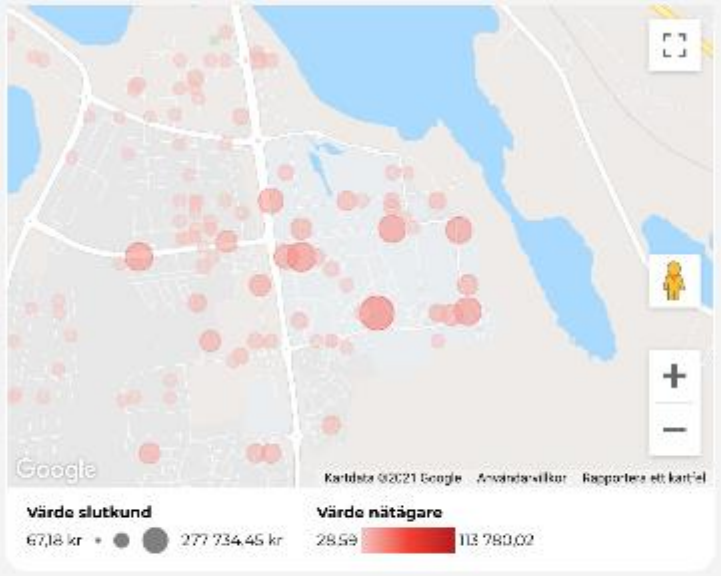
Result: bad cooling of the DH water passing the substation → higher return temperature

ICT platform for building substations supervision

- Development of an **ICT platform** for the supervision of the operation of the building substations
- Calculates performance indicators based on measurement data
- Ranking of the substations based on the performance indicators
- Tool for network operators and building owners to prioritize maintenance on substations and building installations

Visualisation tools for expert and non-expert users

In TEMPO, tools were developed and demonstrated to visualise useful data for expert and non-expert users:



Expert users

- energy supervisors
- maintenance staff
- hardware installers
- …

Support tools to monitor and analyse network behaviour

Support tools to detect and correct faults in the networks

Non-expert users

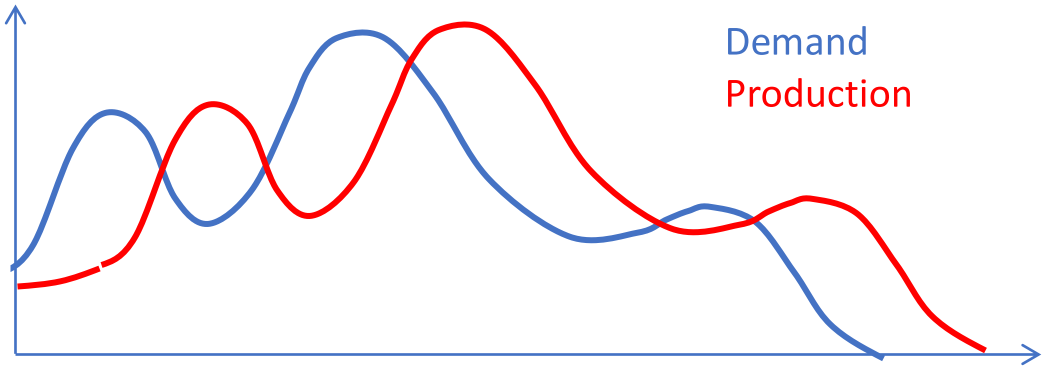
- residents
- building owners

Tools to maximise their financial, evironmental and operational gains:

- they give insight in energy use of the consumers building owners
- suggest energy saving possibilities

Smart DH network controller to balance supply and demand and minimise return temperature

Builds on the STORM controller idea: utilise the intrensic flexibility in the DH network to shift the heat consumption in the network to serve a overall control objective.



In **TEMPO**:
development of additional features for power balancing and temperature optimization in the network

STORM
DISTRICT ENERGY CONTROLLER

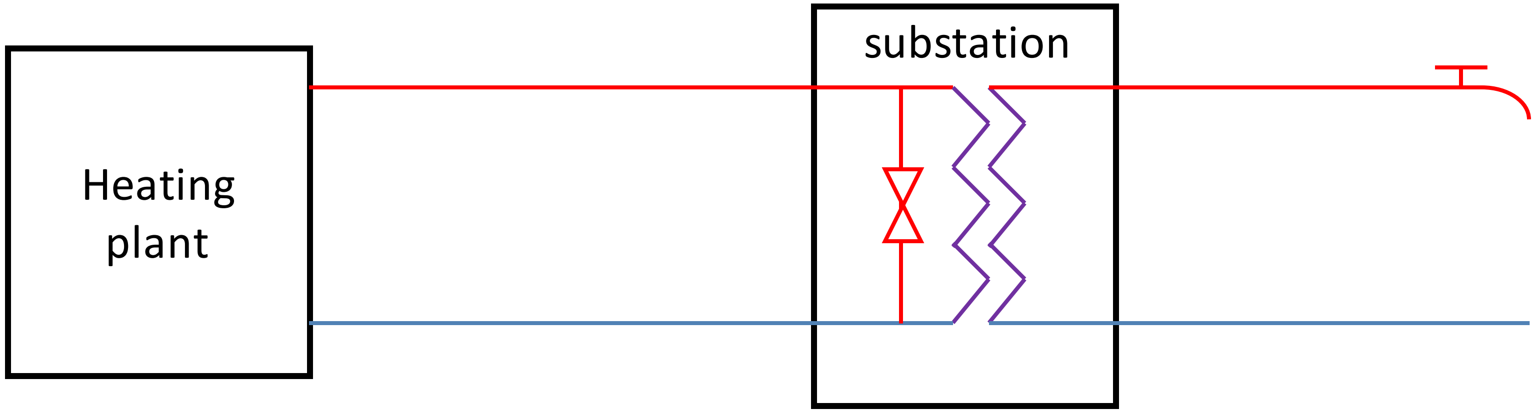
Smart DH network controller to balance supply and demand and minimise return temperature

Concretely, the following control objectives were implemented:

1. Coordinated charging of decentralised buffers (Windsbach demo)
2. Optimized production plans for CHP units (Windsbach demo)
3. Return temperature minimization (Brescia demo)
4. Peak shaving by dynamic adjustment of the network supply temperature (Brescia demo)

Innovative piping system

The issue: bypasses in substations for comfort reasons (DHW tap time) cause high return temperatures, mainly in summer (Flow rate 3.9 – 11.5 l/h [1])

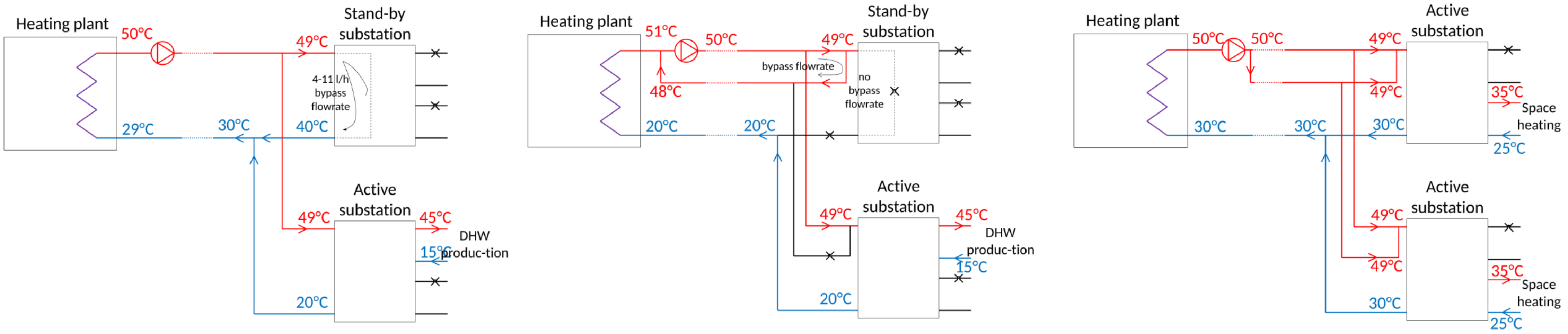


[1] Crane, M., Individual apartment substation testing – development of a test and initial results, 15th International Symposium of District Heating and Cooling, September 4-7, 2016, Seoul, South-Korea

Innovative piping system

In TEMPO:

- Elimination of bypass by 3-pipe concept
- Smaller pipe dimensioning by using the recirculation line as booster pipe in winter



Innovative piping system

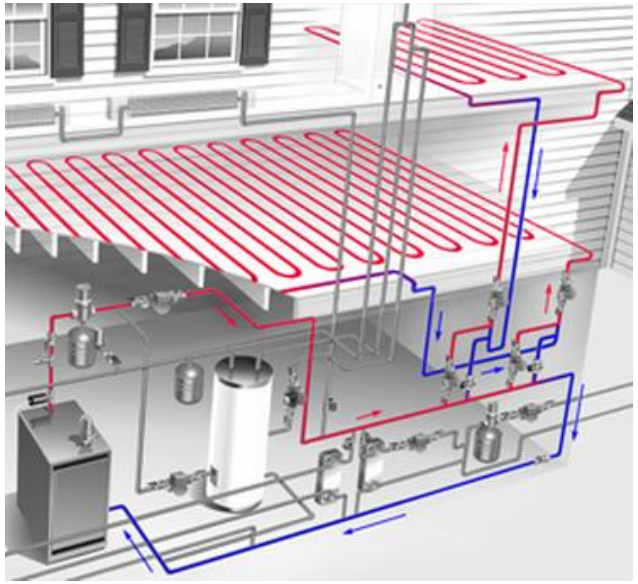
Conclusions:

- Heat loss from triple-pipe systems the **same order of magnitude** as the current twin-pipe systems, since the recirculation pipe can be smaller than the ordinary supply and return pipes.
- Pressure loss from three-pipe systems is **marginal increase** of pumping power demand
- The design criteria for the third pipe can be **2 to 3 standard sizes smaller** without compromising system integrity or system operation concerning heat loss, pressure loss, or space within the pipe casing.
- A future possibility is to use the third pipe to **collect heat flows from prosumers** that can feed in heat locally into low temperature networks

More info: Pipe sizing for novel heat distribution technology, H Averfalk, F Ottermo, S Werner - Energies, 2019

Optimisation of the building installation

The return temperature to the network is determined by the return temperature of the building installation. Often, they are suboptimally designed or operated.



Optimisation of the building installation

TEMPO

- **Investigation of situations leading to high return temperatures**

  → Fault list with 51 fault types, incl. short description, symptoms, corrective measures

Publicly available website

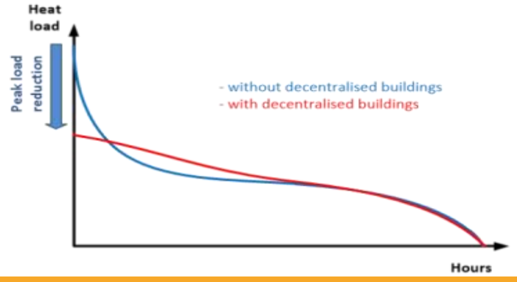
- **Training of fault detection and diagnosis algorithms**
  - Hundreds of simulation runs with varying parameters produced synthetic data for the training and validation of algorithms
- **Development of a guide for technical audit of building installations**

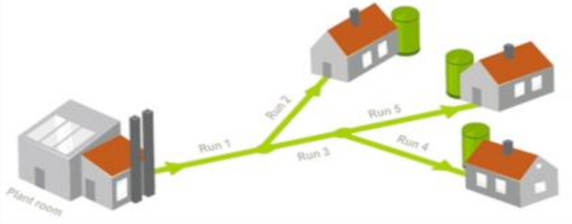
  → Practical guide, incl. flowcharts, for technical audit of building installations

Publicly available website

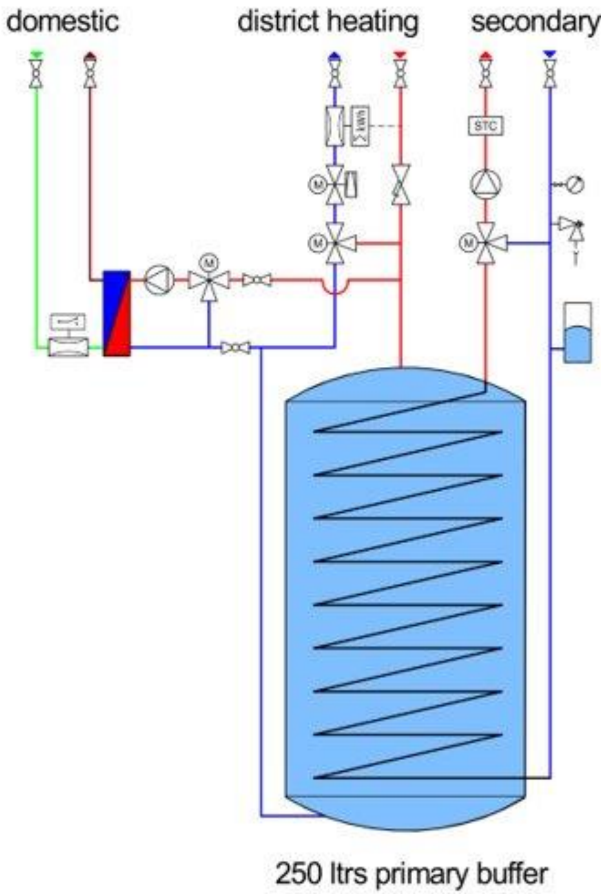
Decentralised buffers at the consumer side

- Especially in rural areas:
  - DH networks are financially burdened by the network investment costs. Therefore, piping dimensions should be minimized to come to a positive business case.
  - Heat losses are relativelly high compared to delivered energy.
- Decentralised buffers, together with an intelligent control concept, can overcome this issue: smaller pipes, no recirculation for comfort reasons.





Decentralised buffers at the consumer side



Improvements made during TEMPO:

- Primary DH water stored in buffer (1 HX less for DHW production)
- Modular design, better accessible
- In-house produced fresh-water station
- EPP housing instead of steel sheeting, lighter and better insulated
- Smart control for coordinated charging
- 5 versions developed during the TEMPO project

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Questions?

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