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Strategies and potentials of temperature reduction on existing district heating substations: two case studies.

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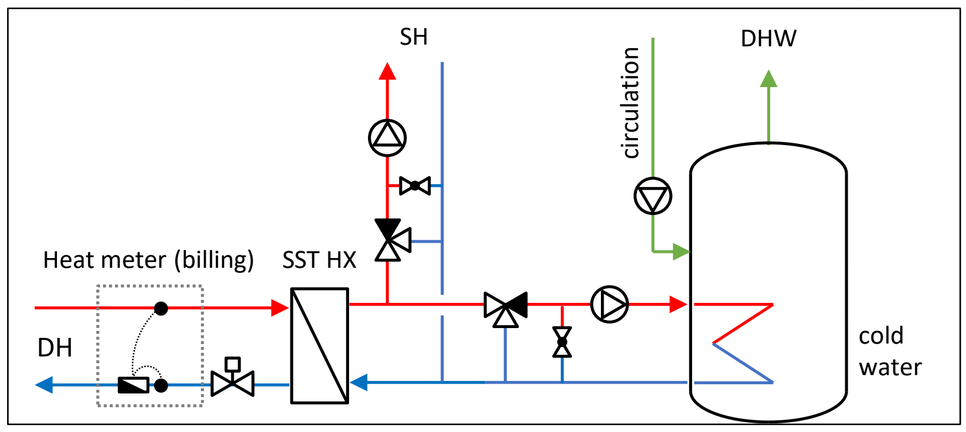
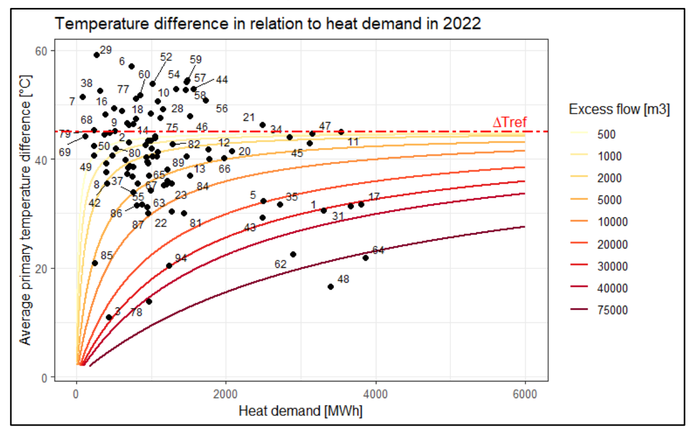
Final report
Callegari *et al.* (2023).
https://archive-ouverte.unige.ch/unige:172333

Introduction & objectives

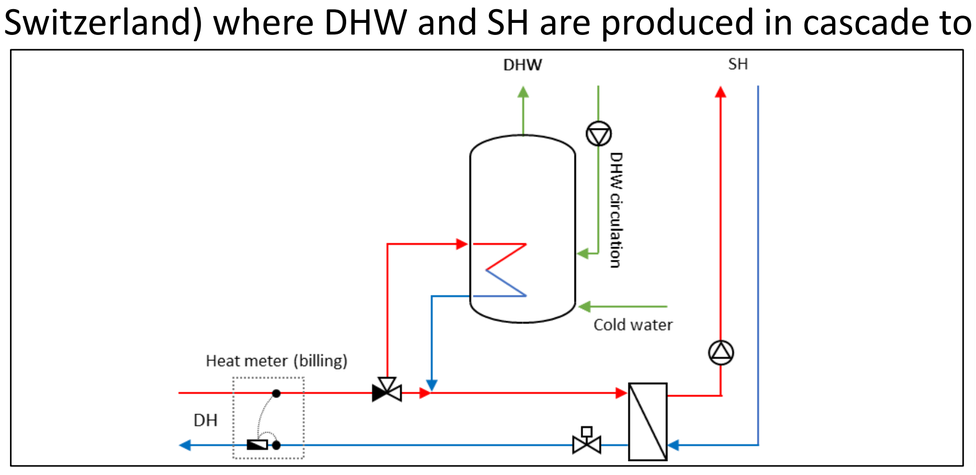
Massive integration of renewable heat in district heating (DH) networks is conditioned by reduction of its operative temperatures, which in turn depends on the temperature level of the individual substations (SST). This study tackles the issue of temperature reduction in existing DH SSTs.

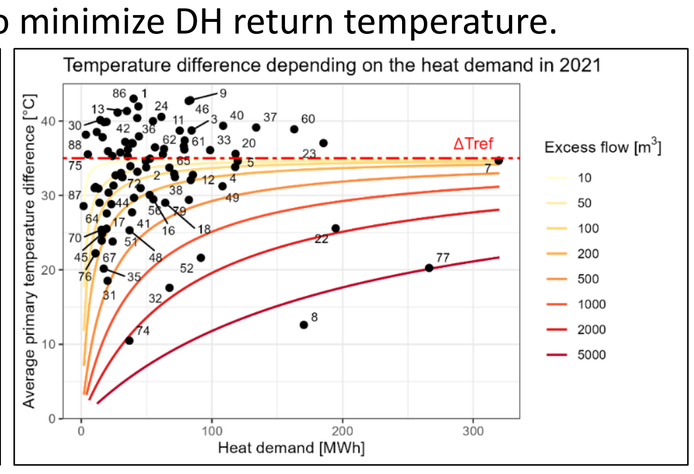
"**CAD-SIG**", 2nd generation (2G) urban DH from the 1960's, 359 GWh/y at 110°C/70°C:
conventional SSTs where space heating (SH) and domestic hot water (DHW) are produced with parallel hydraulic loops.





"**CAD Le Marais-Rouge**", 4th generation (4G) rural DH from 2007, 5.8 GWh/y at 80°C/40°C:
innovative SSTs concept (for Switzerland) where DHW and SH are produced in cascade to minimize DH return temperature.





Methods

- Description and comparative overview of both case studies,
- Ranking of substations by influence on DH return temperature.
- Detailed monitoring on several SSTs, description, characterization of operation, heat exchanger NTU analysis, 4G system numerical modelling (TRNSYS) & sensitivity analysis.

Problems

- Lack of data to identify if the problem is the substation itself (heat exchanger) or on the secondary side (building and/or distribution system) → in-situ measurement campaign
- Multiplicity of existing substation architectures → on-site visits

Results & conclusions

- Both networks supply buildings constructed before 1980, but they differ in their SST architecture: *CAD-SIG* relies on conventional SSTs, and *CAD Le Marais-Rouge* use an innovative (for Switzerland) cascade SST concept for DHW and SH, to lower DH temperatures.
- Visits of *CAD-SIG* SSTs show various existing SST connection and metering typologies, which complicates temperature errors detection and tracking.
- Contrary to expectations, our monitoring campaign on selected SSTs of *CAD-SIG* points out to possible lowering of DH return temperature only by upgrading their main heat exchanger, without modification on the secondary side nor SST architecture change.
- Simulations shows that the cascade SSTs concept of *CAD Le Marais-Rouge* could also be beneficial on *CAD SIG*. However, this advantage is reduced by the shorter heating season.

Example of monitoring results on a SST heat exchanger: DH return is much higher than the building return temperature.

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