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Guidelines on Temperature Reduction Strategies

Vinicio Curti[1], Markus Auer[2], Marco Belliardi[3], Artem Sotnikov[2], Riccardo Innocenti[1] and Willy Villasmil[2]
[1] Department of Innovative Technologies, University of Applied Sciences and Arts of Southern Switzerland
[2] Institute of Building Technology and Energy, Lucerne University of Applied Sciences and Arts
[3] Department of Environment Constructions and Design, University of Applied Sciences and Arts of Southern Switzerland

Goals

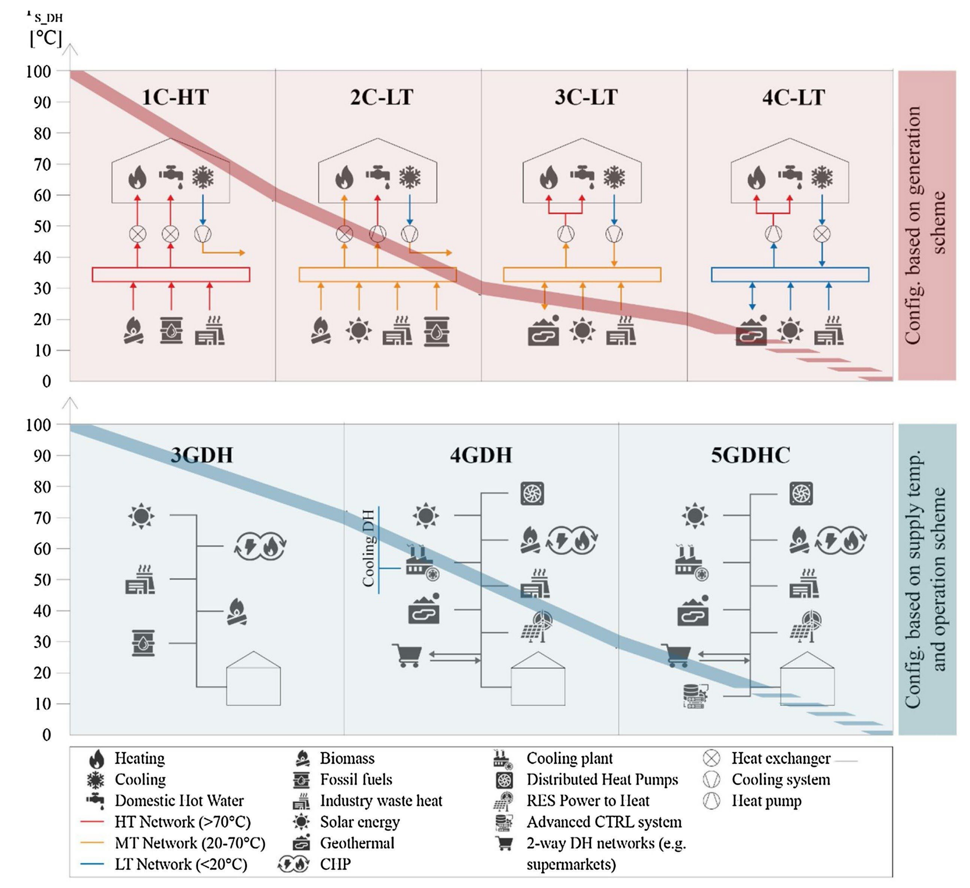
Develop a guideline which

- provides an overview of available temperature reduction measures,
- quantifies specific measure costs and benefits using analysis of literature, thermal grid measurement data and thermo-hydraulic simulation,
- supports grid operators in deciding on which actions to take for transformation towards decarbonized grids.

Problem

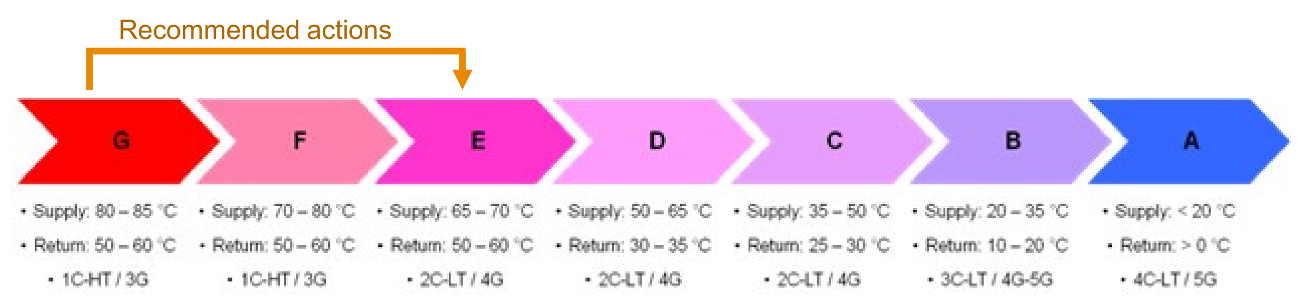
1. Most existing thermal grids are not optimized and operate at too high temperature levels. Future implementation of renewable energy systems require lower temperatures.
2. There is no comprehensive guideline showing temperature reduction pathways and comparing costs versus benefits of single reduction measures. The available information needs to be summarized, prioritized and possible pathways need to be described.

Introduction



District thermal systems: State of the art and promising evolutive scenarios. A focus on Italy and Switzerland. Caputo, Ferla, Belliardi, Cereghetti. Sustainable Cities and Society, 2021

Pathways describe how recommended actions can move a grid towards lower class



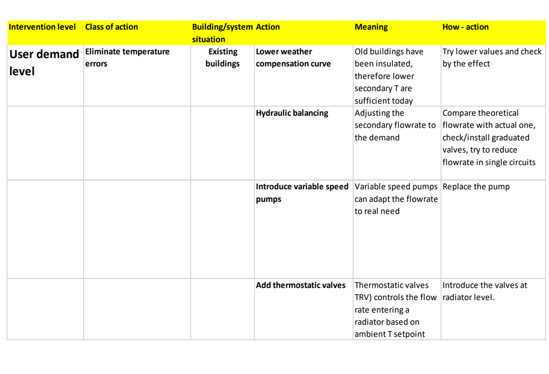
Method

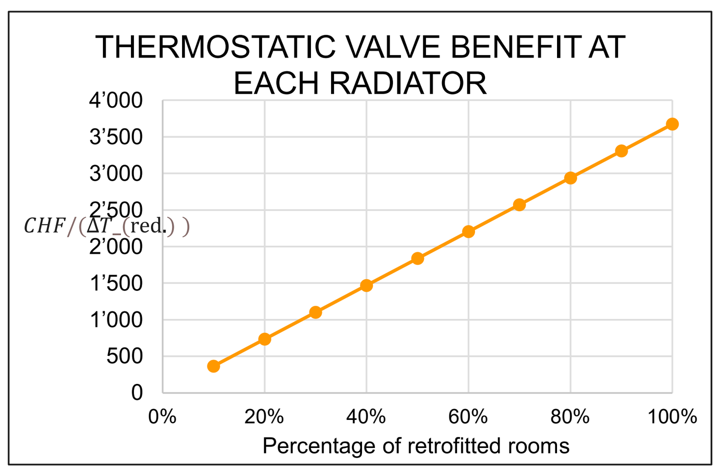
1. Literature review, further actions introduction
2. Actions prioritisation

Level	Class of actions	Actions	
Production	a) Technologies more efficient with low T b) Thermal storage c) Make good hydraulic schemes	• a) Heat pumps • a) Condensing biomass boiler • a) Biomass CHP • a) Heat recovery • a) Shallow geothermal • a) Solar • b) Central TES • b) In network • c) Use separated TES if different T levels • c) Technologies must work at correct temperatures	
Distribution	Eliminate temperature errors	• Exploit the oversizing (at all levels) • Avoid short-circuit flows • Try to insert prosumers • Three-pipe system • Replacement of grids bottlenecks • On-site auxiliary heater (Quooker) • Loop pipes from different streets • Flat stations • In-line circulation • Multilevel T • Return-to-return	
Substat.	a) Eliminate temperature errors b) Adopt longer thermal lengths	**EXISTING BUILDING** • a) Verify malfunctions • a) Secondary circuit with logger (replace controller) • a) Lower flow as much as possible • a) Check operation of valves • a) Fouled HXs • b) Replace HXs in substations • b) Automatic fault detection / data analysis	**NEW BUILDING** • *a) Select the correct SS architecture (new bui)* • *a) DHW: instantaneous production (new bui)* • *a) Flat stations for DHW (new bui)* • *a) DHW: use decentralized booster (new bui)* • *a) Local heat pumps (new bui)* • *a) Local thermal storage for heating (new bui)* • *b) Select HXs with high thermal length (new bui)*
Final user	a) Eliminate temperature errors b) Adopt longer thermal lengths c) Decrease user T	**EXISTING BUILDING** • a) Lower weather compensation curve • a) Hydraulic balancing • a) Introduce variable speed pumps • a) Add thermostatic valves • a) Thermostatic return T control on each radiator • a) Remove main pumps between substation and distribution groups • a) Remove anti condensing circuit • a) Replace old cast iron radiator with new convective radiators • a) DHW: temperature probe close to HX secondary circuit exit • a) No night set-back • b) Keep current radiator [Exploit the oversizing if existing] • b) Replace substations with higher size HXs (max pinch 2K) • c) Building envelope refurbishment • c) Avoid high T technologies • c) Anti-legionella water treatments • c) Reduce /eliminate demand peaks	**NEW BUILDING** • *a) Design without night set-back (new bui)* • *b) Larger heating surfaces of heating elements (new bui)* • *b) Use underfloor heating (new bui)* • *b) Large HX in DHW boilers (new bui)*

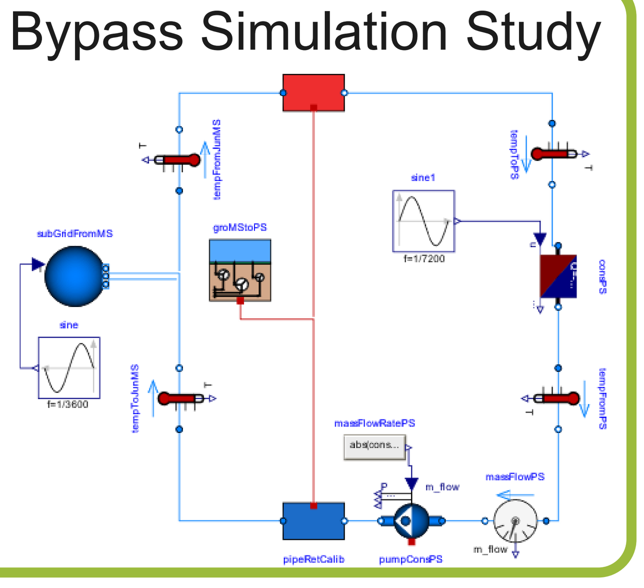
Results

Actions Matrix





Bypass Simulation Study



Conclusions

- 55 available actions in 6 categories for temperature reduction were identified
- Cost and benefit for single actions have been calculated
- A prioritisation based on cost/benefit ratio is currently being carried out

Core partners

Université de Genève, HSLU Hochschule Luzern, OST Ostschweizer Fachhochschule, ETH zürich, zhaw School of Engineering, Empa Materials Science and Technology

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