

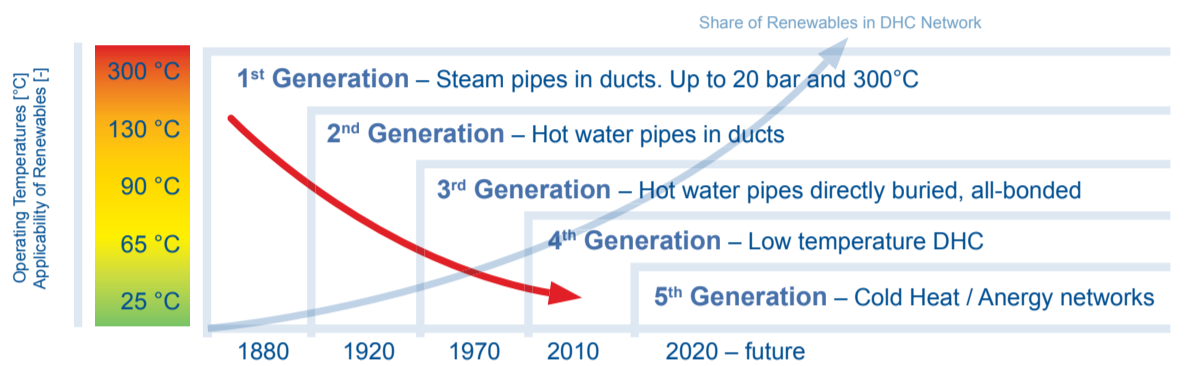
Low Temperature and Cold District Heating & Cooling Systems

Transition, Implementation, Planning, Long-term Evaluation

Lorenz Leppin, Hermann Edtmayer, Harald Schrammel, Ingo Leusbrock¹

Introduction

District heating plays a central role in the Austrian energy supply scheme and already covers 25% of the national heat demand. On a European level district heating was identified as one of the key technologies to drive the transition towards a decarbonized, efficient, sustainable and fossil-free energy system. The recent development of district heating systems shows a decrease in supply temperatures and an increase in the share of renewable energy sources in the system.



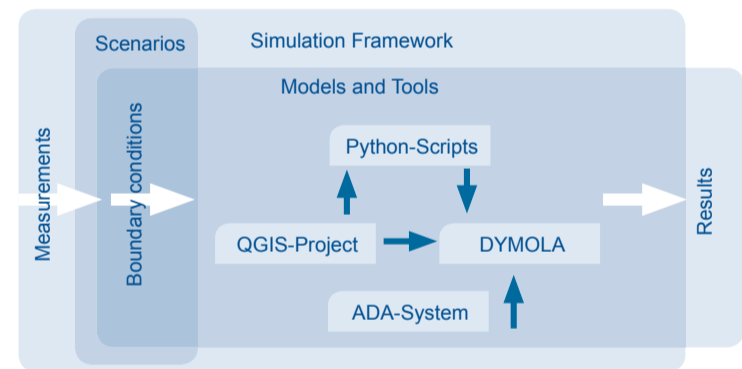
Development of district heating systems. (in accordance with: Lund, H. et al.: "The status of 4th generation district heating: Research and results", 2018)

Motivation

Cold heat is characterized by supply temperatures below 30°C. That makes it particularly suitable for using renewable energy sources and low-temperature heat from other local sources. Another positive side effect is that heat losses in the grid are minimized and novel polymeric materials for piping can be used. The high degree of flexibility allows for expansion and later integration of additional sources, sinks and storages. Compared to conventional district heating networks (2nd and 3rd generation) a high reduction in primary energy consumption is expected.

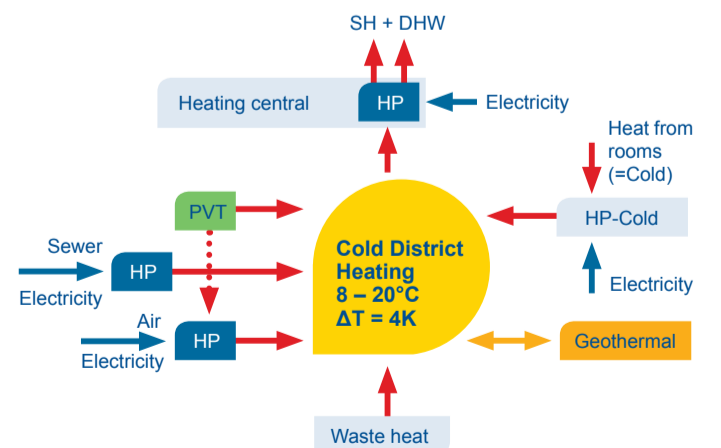
Methods

For a detailed evaluation of the various system configurations and for the investigation of the energetic long-term behaviour of the proposed systems the use of simulation tools is indispensable. Using co-simulation tools, one can utilize different tools especially designed for certain applications, allowing for detailed simulations on a component, building and system level.



Framework for the system simulation studies.

For a long-term evaluation of LTDH/CDHC concepts, constantly changing system environment conditions need to be taken into account. For this reason, a simulation framework is established, which considers external factors, varying framework conditions and exogenous scenarios like e.g. climate change, changes in usage behaviour or renovation rates of buildings.



Potential layout of a cold district heating network, including several producers.

State of the Art in LTDH / CDHC & its Limitations

Research

Most research projects focus on the area of low-temperature networks, with few on cold heat.

Waste heat regeneration

Heat regeneration from waste water, industrial processes or server facilities

Network design

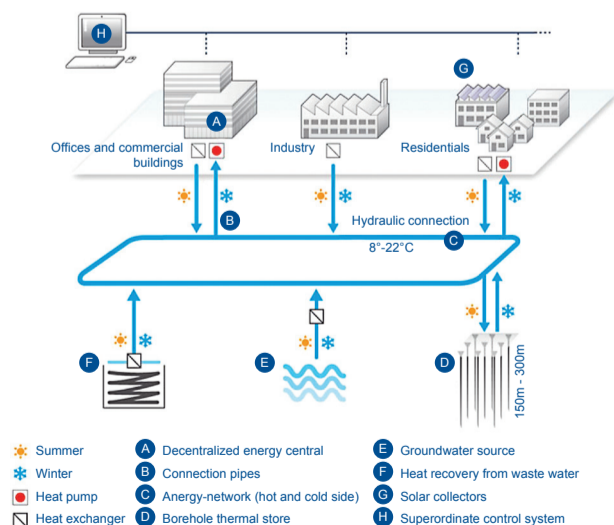
In CDHC-Systems a special form of the ring-shaped topology, the "anergy"-network layout, can be used.

Demonstration sites

- Munich: waste/cooling water from subway tunnels to supply municipal utilities
- Zurich: waste heat from server facilities to feed a anergy network

Flexibility

The current linear topology of district heating grids lacks the required flexibility when it comes to extending the network and implementing decentralized energy sources.



Layout of an anergy network (special form of a cold heat network) as proposed by Amstein & Walthert.

Research Project DeStoSimKaFe

What's missing?

- Scientifically sound, basic knowledge
- Methods for the development of holistic system solutions and system optimization
- Minimum requirements, areas of application and application limits
- Scientific methods for long-term assessment and basic principles for the evaluation of benefits
- Business models

Project Goals

Development of possible system concepts

- Variants for different system configurations and general conditions
- Evaluation of possible system solutions for different configurations and boundary conditions

Development of simulation models

- Deterministic modelling approach for technical evaluation
- Development of a simulation framework
- Evaluation of technical and economic benefits

Development of a stochastic optimisation model concept

- Parameter model comprised of fluctuating external and internal factors
- Evaluation of optimisation strategies
- Long-term system evaluation

Development of economic evaluation methods for LTDH / CDHC

- Business model prototypes and new services for cold heat
- Economic evaluation

¹AEE Institute for Sustainable Technologies, Department of Thermal Energy Technologies and Hybrid Systems, Feldgasse 19, 8200 Gleisdorf, Austria