Renewable Energy Supply for Cold District Heating Networks

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In Europe, approximately 50% of final energy demand is accounted for by the heating and cooling sector, which underscores the importance of decarbonizing the heating sector through sector coupling with the electricity sector. For this, cold district heating networks can be a viable alternative to conventional (high-temperature) district heating networks or to supplying individual buildings with heat pump systems.

What is cold district heating?

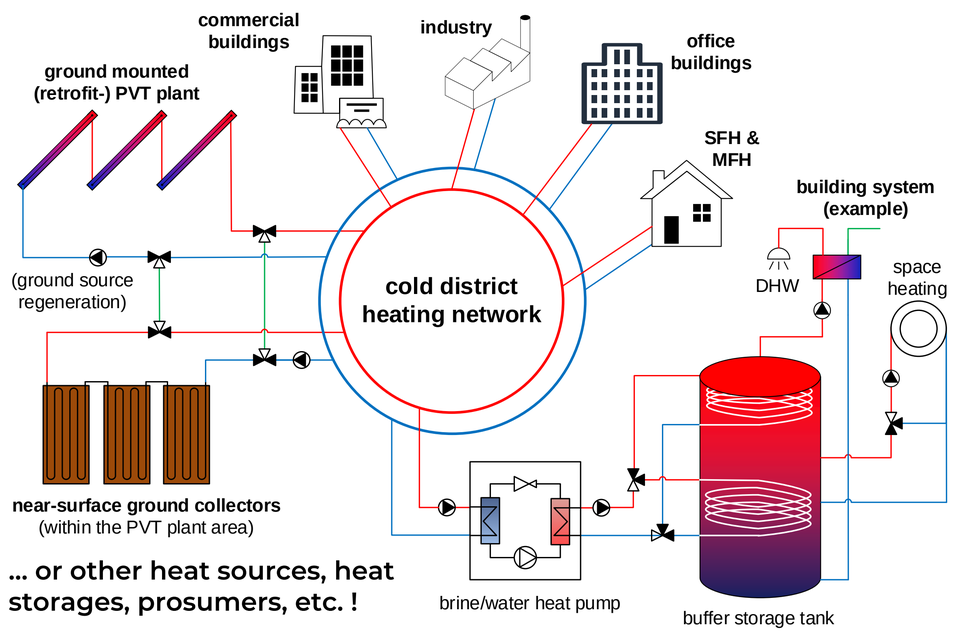
- **Water or brine** circulates as heat transfer fluid in the network and serves as a heat source for decentralised heat pumps of connected buildings
- The energy needed for space heating and domestic hot water is supplied on a **low temperature level**
- Supply and return temperatures can be adjusted flexibly (e.g. seasonally or daily as needed)
- Temperature levels of **cold district heating** depend on the type of heat transfer fluid and often **range from -5 to 20 °C**

New concept: 2nd generation cold district heating

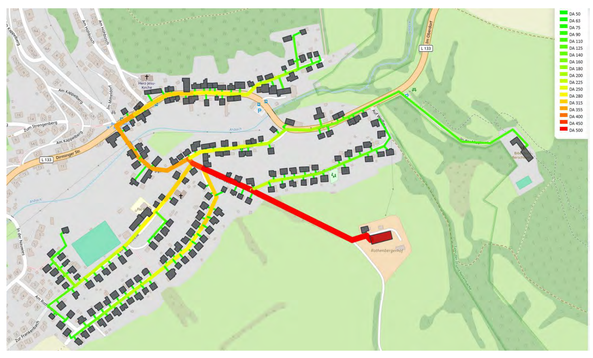
- **Glycol-free operation:** Central high-efficiency heat pumps maintain network temperatures above 5 °C, allowing pure water to replace costly and ecologically critical glycol
- **Grid flexibility:** Central heat pumps enable demand-side load shifting, providing valuable ancillary services to the electrical grid

Configuration of low-temperature heat sources

- The low temperature levels of cold district heating networks enable the use and **combination of various heat sources**, e.g. **photovoltaic-thermal (PVT) collectors**, as well as storage methods and/or technologies

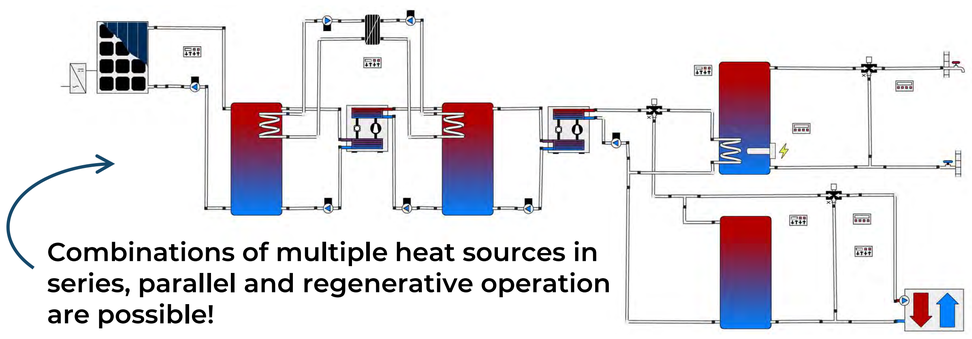


Modelling cold district heating networks



District model for designing the pipe network and for generating load profiles based on geodata and building data (heat loads, heat demands, domestic hot water and more) in nPro

- **Multiple software tools** (QGIS, nPro, Polysun) are used to design the components of cold district heating networks
- **Combinations of heat sources** and/or storages can offer considerable advantages regarding system efficiency
- **Development** of new and complex system models

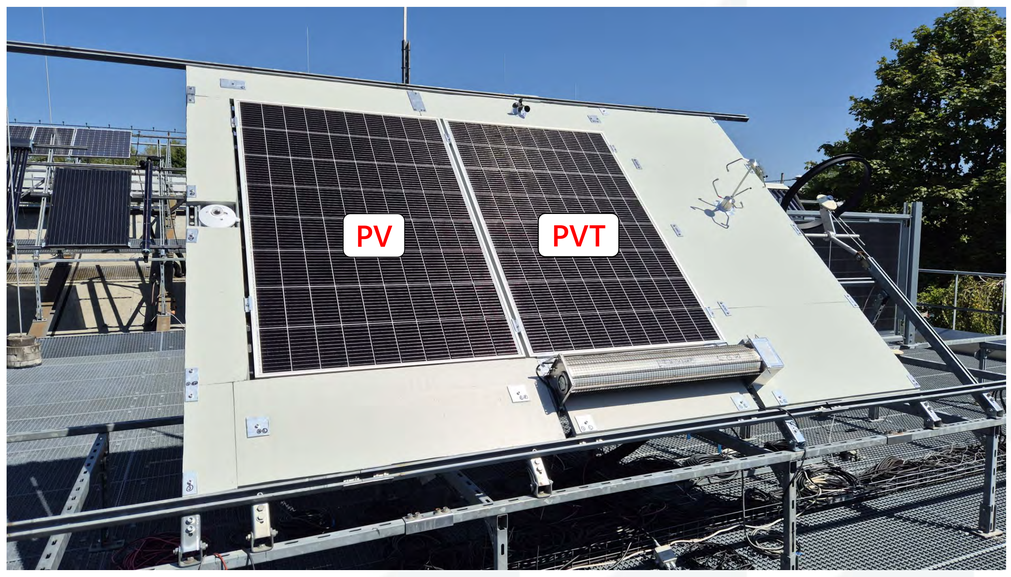


Combinations of multiple heat sources in series, parallel and regenerative operation are possible!

Development of electrical-thermal simulation models for 2nd generation cold district heating networks (shown here: PVT collectors as monovalent heat source) in Polysun

Performance tests of PVT-Collectors

- **Monovalent capability:** Backside-finned PVT collectors operate reliably as a standalone heat source for brine/water heat pumps without requiring auxiliary thermal storage
- **Empirical validation:** Standardized outdoor testing according to ISO 9806 delivers accurate electrical-thermal parameter sets for district simulation tools
- The Laboratory for Solar Energy Systems maintains a **special test bench for PVT collectors** that emulates the installation conditions of ground-mounted PVT systems



PVT test bench for outdoor testing according to ISO 9806

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