Heat Roadmap Europe 2050
A low-carbon heating and cooling strategy

4DH
4th Generation District Heating Technologies and Systems

reINVEST

3RD INTERNATIONAL CONFERENCE ON

SMART ENERGY SYSTEMS AND 4TH GENERATION DISTRICT HEATING

COPENHAGEN, 12–13 SEPTEMBER 2017

AALBORG UNIVERSITY
DENMARK

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POSSIBILITIES OF LOWERING DISTRICT HEATING TEMPERATURES IN BELARUS

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Purpose and technical basis of the problem

In the context of the development of a long-term strategy for the development of the Belarusian economy for the period up to 2030-2050, it is important to formulate a strategic policy of improving and developing district heating systems.

District heating systems (DHS) prevail in the heat supply structure of the national economy and are one of the most important elements of the energy complex of the Republic of Belarus.

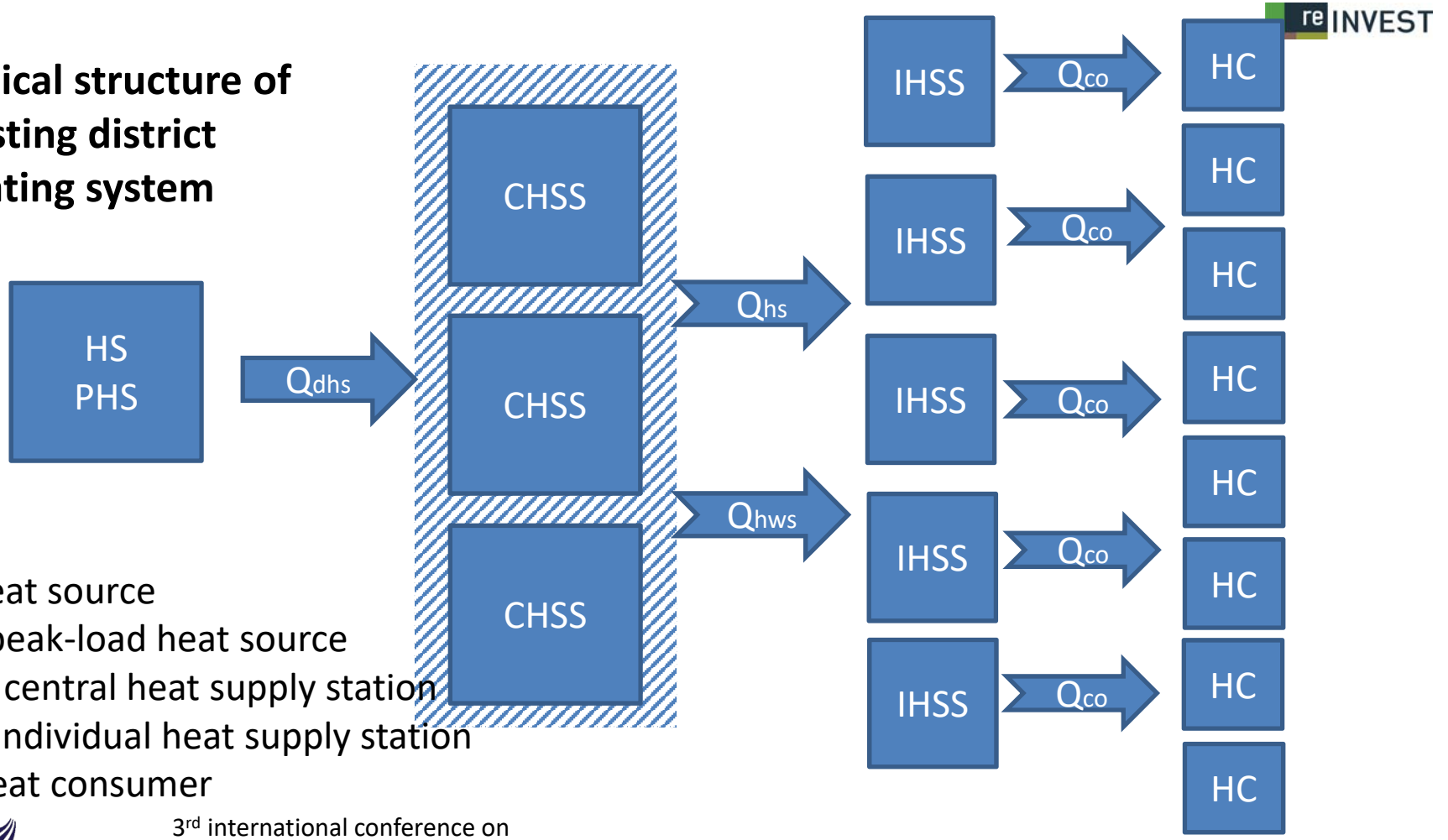
Purpose and technical basis of the problem

The history of the district heating systems development in Belarus is more than 100 years old. The rapid development of district heating systems based on combined heat and power generation began at 50-s years last century. Nowadays, about 60% of heat supplying to DHS are produced by cogeneration plants.

In most of the Belarusian large cities, mainly in old districts, a trimeric system for the distribution of district heating water has been remained: a heat source, a central heat supply station, an individual heat supply station. Central heat supply stations are situated at the boarder of distribution and quarterly networks and distribute the heat energy between the heating and hot water supply systems.

Purpose and technical basis of the problem

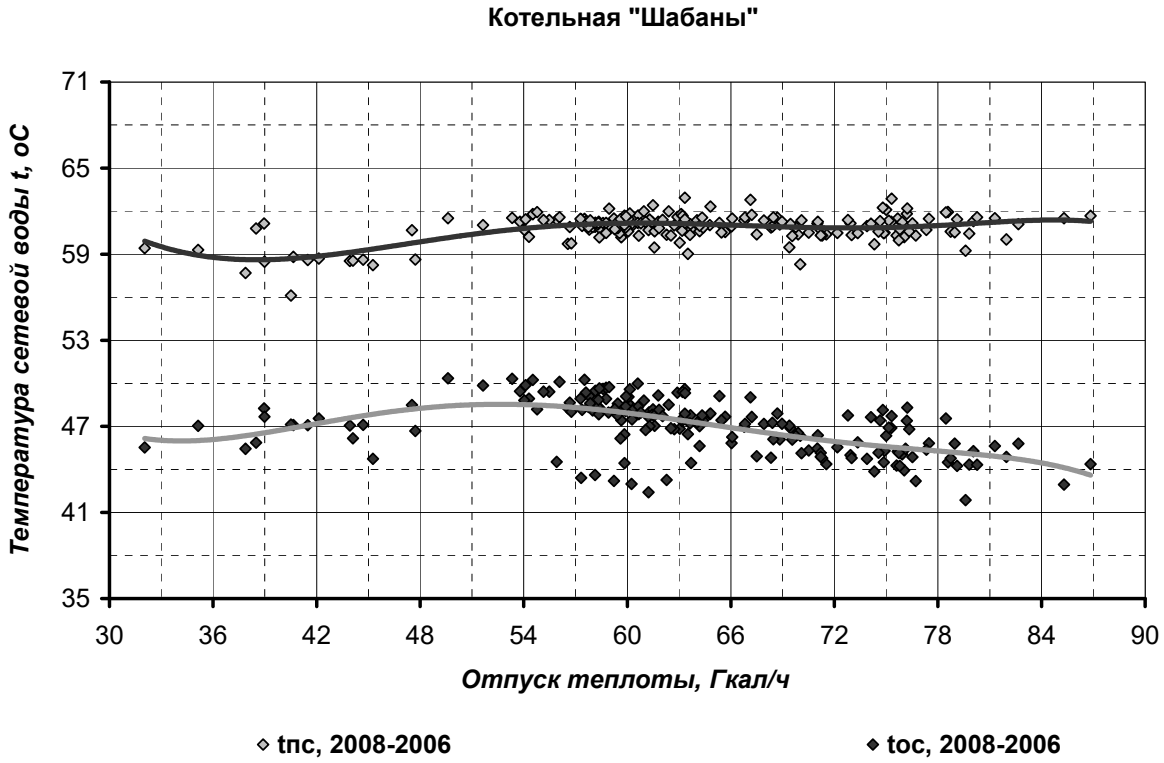
Typical structure of existing district heating system



HS – heat source
PHS – peak-load heat source
CHSS – central heat supply station
IHSS – individual heat supply station
HC – heat consumer

Purpose and technical basis of the problem

Example of existing supply and return temperature (summer period)



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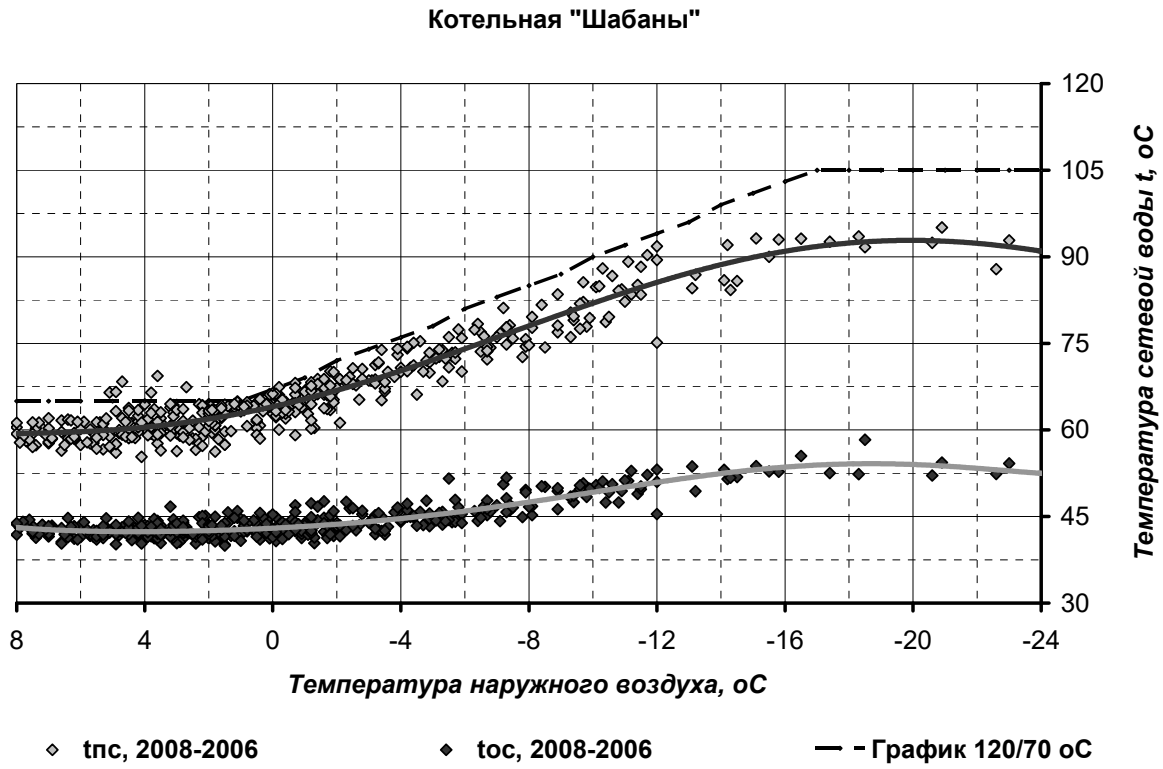
Example of existing supply and return temperature (winter period)



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Purpose and technical basis of the problem

Common ways for improving traditional technologies:

- further increasing of district heating systems;
- Increase the number of CHP plants;
- Increase heat recovery from flue gas condensation ;
- application of heat pumps;
- Increase heat recovery from industrial excess heat;
- Applying the regimes with lower distribution and return temperatures graphs of heating systems;
- Development of DHS automated control systems, with enhanced options like working condition diagnostics, planning and optimizing modes of operation.

Methodological approaches and technical solutions

Methodological solutions for improvement of district heating systems (DHS) should be considered in several ways. First of all, the DHS classification should be carried out according to their size (capacity), dividing them into two main groups:

- local systems with small-scale boiler houses or CHP as a heat source;

- large-scale systems with several heat sources, including large CHP plants and peak boiler houses.

Methodological approaches and technical solutions

The local systems are characterized by a comparatively small heat networks built on a “tree” structure.

For such kind of systems, the main tasks are to increase the efficiency of technologies for generating and transporting heat energy, which can be solved within the implementation of automated process control systems.

At the same time, it becomes possible to organize a system for diagnosing equipment in the operational mode and simulating modeling to predict the operation of power equipment.

Methodological approaches and technical solutions

For large distributed systems with several heat sources, the main methodological task is, first of all, to optimize the structure of the heat network.

At the same time, it is necessary to take into account the changing the structure of electric power capacities with the upcoming Belarusian Nuclear power plant putting into operation (by the end of 2019).

This would undoubtedly led to wide implementation of power-to-heat technologies (electric boilers, heat pumps and so on).

Methodological approaches and technical solutions

Low temperature district heating system complies with two main requirements for the future district heating and the whole energy sector – high energy efficiency and high share of renewable energy.

Corresponding to the current Belarusian conditions the first task is more urgent question due to the small share of the renewable energy.

Low supply and return temperature of district heating systems would allow:

- Wide use of heat pumps;
- - Increase the CHP efficiency;
- Utilization of excess heat from industrial processes or by heat recovery from cooling processes;
- increases the possibility for flue gas condensation

Technical solutions

HYBRID CENTRAL HEAT SUPPLY STATION

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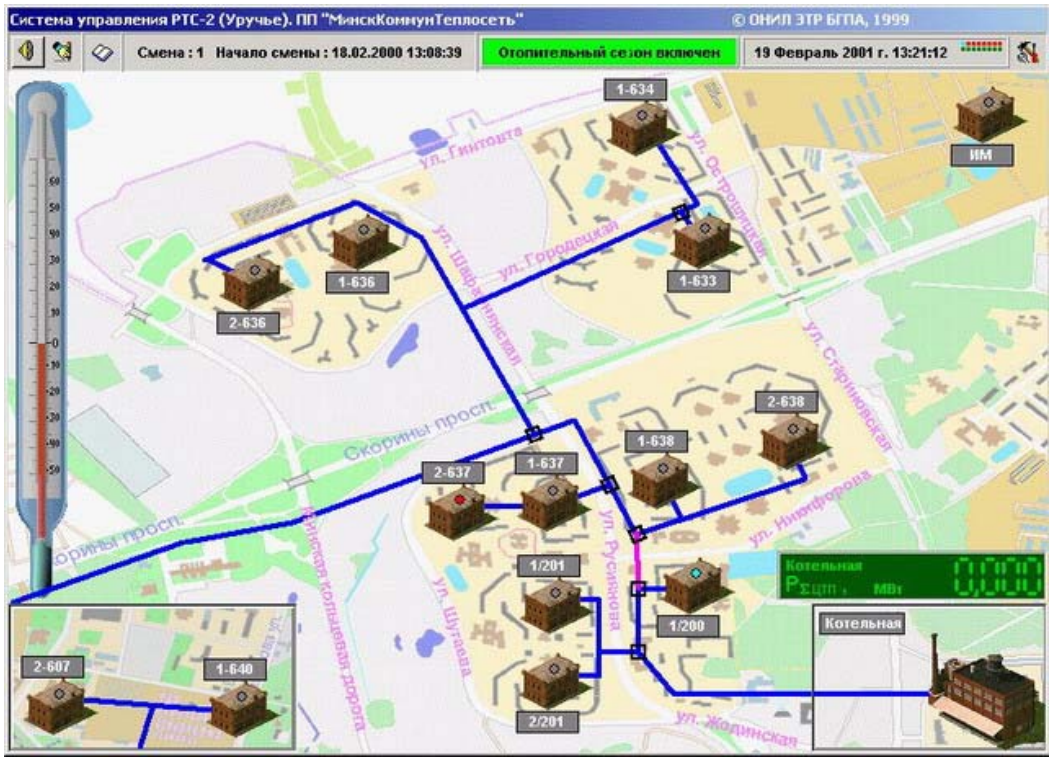
Technical solutions

A central heat supply station is one of the elements of the DHS located in district heating areas. The main functions of heat supply station are:

- Measurement of heat consumption by the group of the consumers;
- Heat distribution by local consumer systems;
- Preparation of hot water with the required parameters;
- maintaining and regulating the parameters of the heat carrier for heat supply systems;

Methodological approaches and technical solutions

Example of central heat supply station location in district heating area



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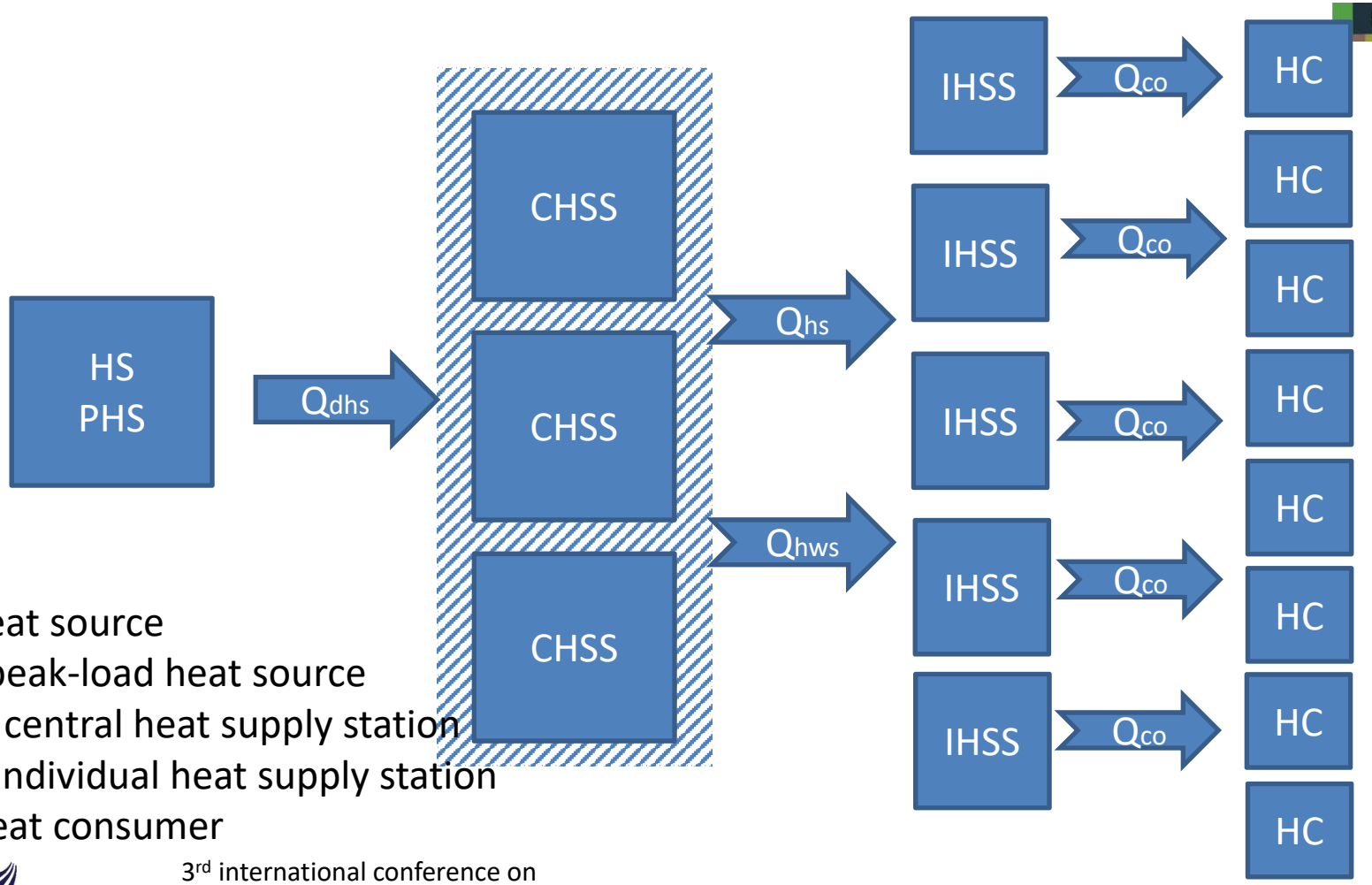
Technical solutions

It is supposed to redesign central heat supply stations to "hybrid“ state by installing additional heat pumps, electric water heaters and heat accumulations tanks.

Those would giving them additional options: generation, including electrical heating and heat transformation, and the accumulation of thermal energy, and the utilization of secondary energy flows.

In this case, there are additional opportunities to reduce the return temperature to the heat source.

Technical solutions



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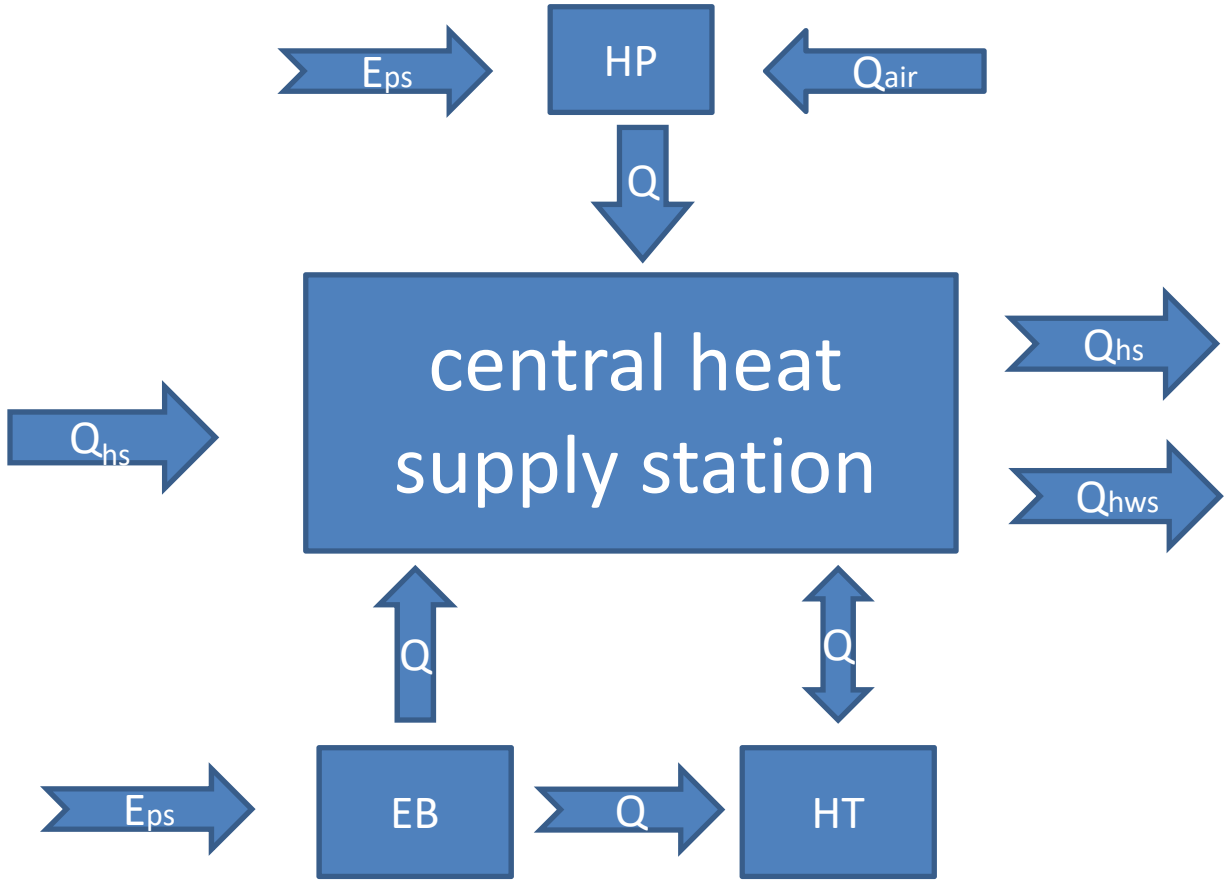
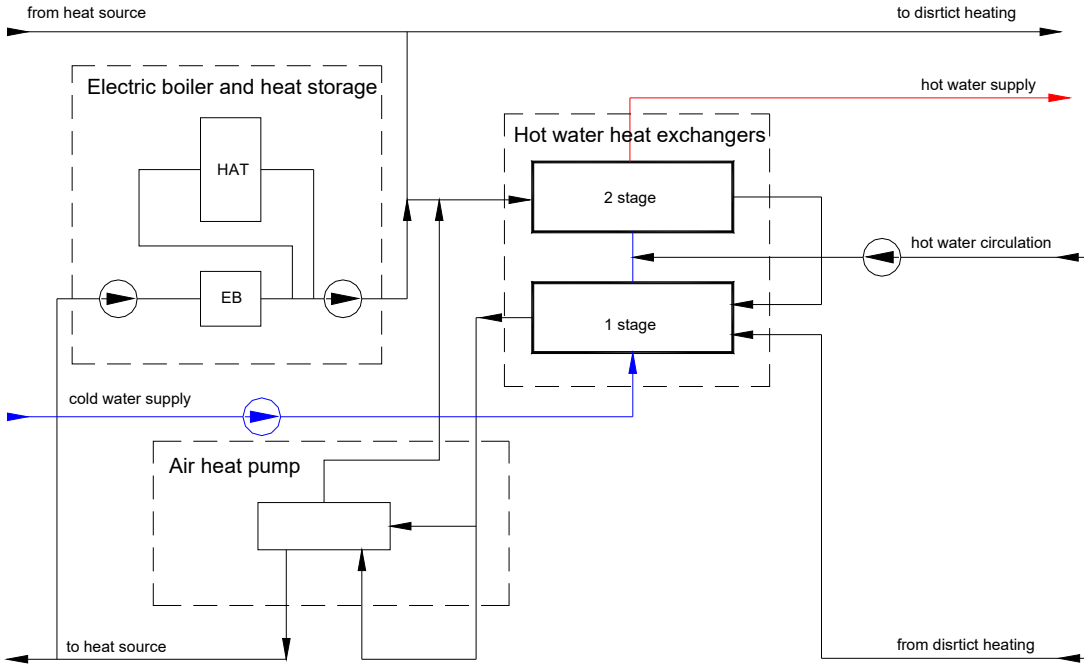
Technical solutions



Technical solutions

Example of “hybrid”central heat supply station (winter period)



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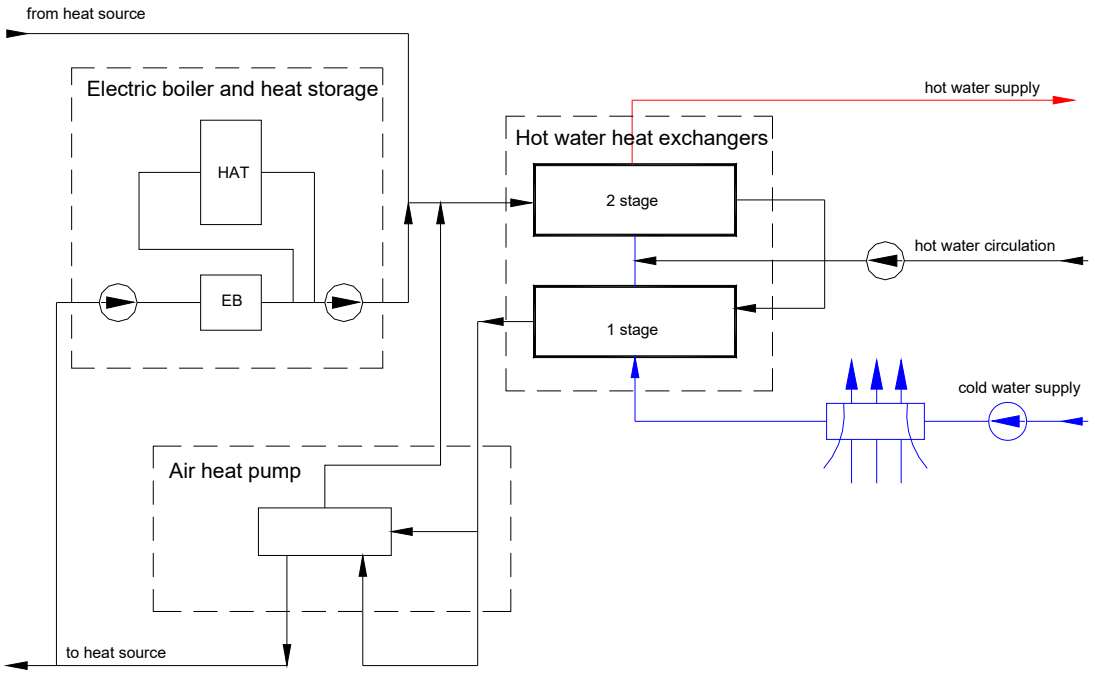
Technical solutions

Example of “hybrid”central heat supply station (summer period)



Technical solutions

Parametric analysis of the “hybrid” central heat supply station with a compression heat pump shows that the heat load of the hot water systems can be completely covered by the transformation of the return heat with a corresponding decrease of return water temperatures up to 11 °C (depending of ambient temperature).

THANK YOU

FOR ATTENTION

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