ANNEX
47
HEAT PUMPS IN DISTRICT HEATING AND COOLING SYSTEMS

www.heatpumpingtechnologies.org

ANERGY NETWORK AT CAMPUS ETH HÖNGGERBERG (ZURICH) - SWITZERLAND

Anergienetz ETH Hönggerberg (Zürich)

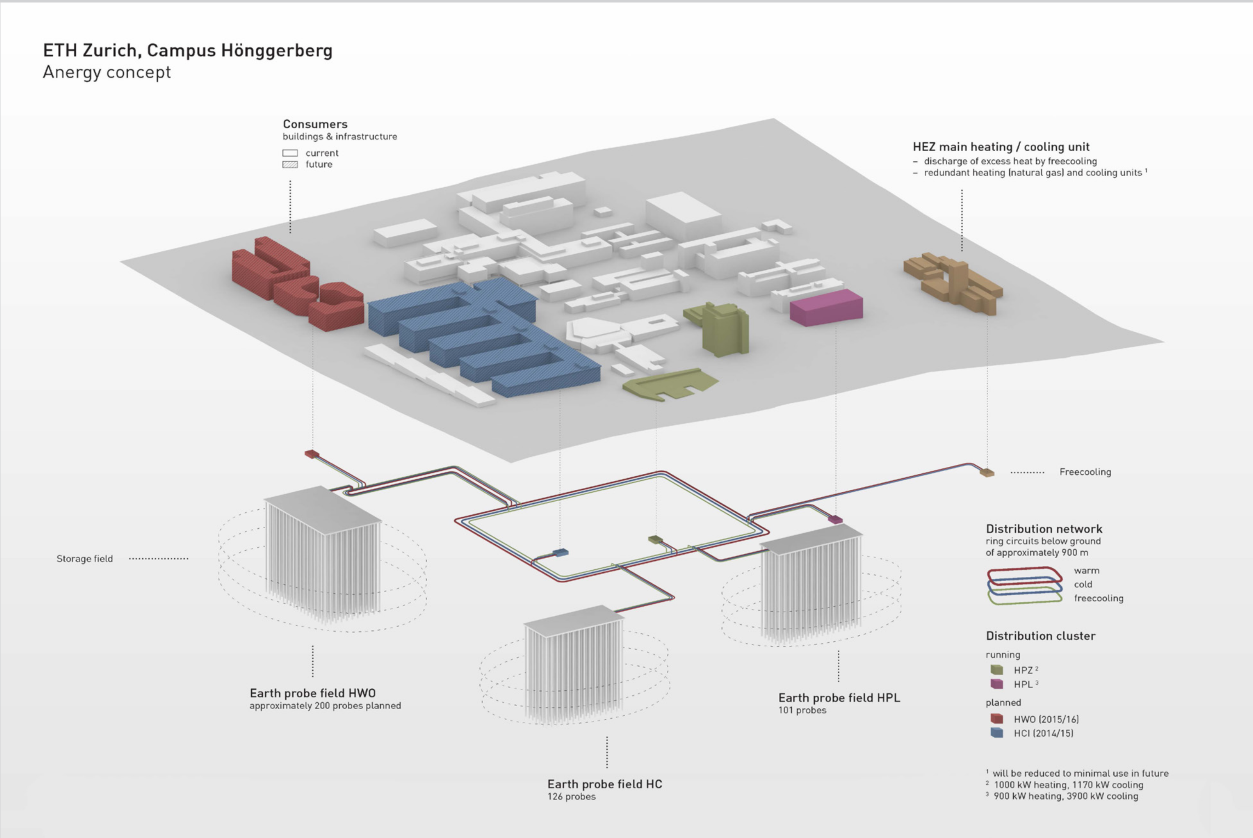

Fig 1: 3D-representation of the anergy network of the ETH Zurich Hönggerberg.

Summary of the project

On the campus of the Swiss Federal Institute of Technology (ETH) at Zurich Hönggerberg, the ETH Zurich operates the campus, an area which is primarily used for research and teaching purposes. Heating and cooling is provided to an increasing number of buildings by means of a geothermal storage system, an anergy network and decentralized heat pumps. The intelligent networking of heat sources and sinks in combination with a dynamic geothermal storage system is intended to significantly reduce the distribution losses and CO_2 emissions.

" INTELLIGENT NETWORKING OF HEAT SOURCES AND SINKS IN COMBINATION WITH A DYNAMIC GEOTHERMAL STORAGE SYSTEM TO REDUCE CO_2 EMISSIONS "

IEA Technology Collaboration Programme on Heat Pumping Technologies (HPT TCP)

Detailed description

The campus ETH Hönggerberg was built in the 1970s and has been continuously expanded ever since. The laboratories, lecture halls and offices require not only space heating but also space cooling and laboratory cooling. ETH Zurich has decided to gradually replace the existing system based on district heating and district cooling with centralized gas boilers and cooling machines respectively, with an anergy network, a geothermal storage system and heat pumps.

The ring-shaped anergy network – consisting of a warm and cold pipe – connects the individual clusters with each other and the geothermal storage system. The temperature level of the network varies between 8 °C and 24 °C, the cold duct usually lays 4 K lower. Temperatures in the network depend on the amount of excess heat available and on the period of the year. The aim is to reach a low temperature (8°C/4°C) in the geothermal storage system at the end of the heating period in order to maximize the cooling capacity for summer. End of summer – after the regeneration of the geothermal storage system – the network achieves the highest temperatures (up to 24°C/20°C), which enables very efficient heat production of the heat pumps for the upcoming heating period. A third pipe helps operating the geothermal storage system and controlling excess waste heat if necessary. Heating and cooling demand in the clusters is covered by means of heat pumps and heat exchangers respectively. A cluster is most efficient when operated autonomously, i.e. without energy supply from the thermal network.

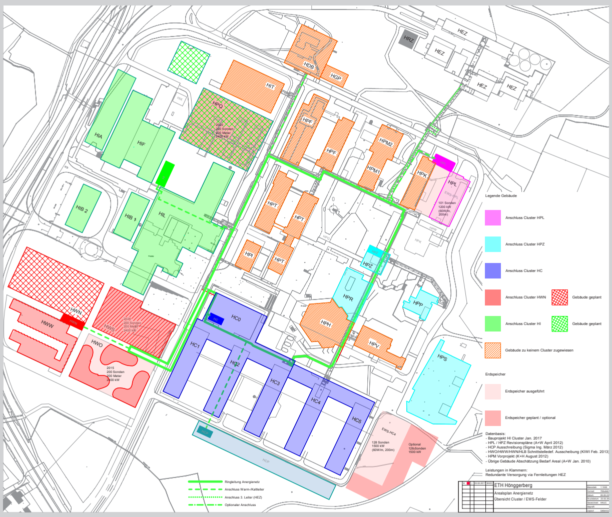

Fig 2: Representation of the different clusters on the campus, interconnected by the anergy network.

FACTS ABOUT THIS PROJECT

Building type: University Campus (school, laboratory and apartment buildings)

Heated floor area [m²]: 475 000 m² (in 2035)

Installed heat capacity [kW]: 5.5 MW (in 2015)

Heat source: Waste heat (from space cooling and laboratory) and geothermal storage

Investment cost: 37 millions CHF (until 2015)

Participating countries: Switzerland

Time frame: 2012 - 2026+

Project organisation:

Project leader: Amstein + Walthert AG

Project partners:

- ETH Zurich, Abt. Immobilien
- Amstein + Walthert AG
- Lauber IWISA

Link to web page or report: https://www.ethz.ch/de/die-eth-zuerich/nachhaltigkeit/sustainable-campus/energie/anergy%20grid.html (in German)

The ring structure allows a continuous expansion of the network, since the heating demand is supplied decentrally in the clusters. Additional clusters and geothermal storage systems can be integrated at any point. In addition, the concept of decentralized supply has the important advantage that the system is only active when there is cooling or heating demand. The main challenges lie in the size and complexity of the plant as well as in the wide range of possible operation modes. Nevertheless, with continuous monitoring and optimization, coverage of 83 % of heating demand and 65 % of cooling demand has been achieved (in 2015) by the anergy network.

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