



## Large-Scale Geothermal Collector System with 5<sup>th</sup> Generation District Heating and Cooling Network in Bad Nauheim (Germany)

### Background

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Natürlich versorgt in die Zukunft.



TECHNISCHE  
UNIVERSITÄT  
DRESDEN



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For achieving climate protection targets, the energy industry is of particular importance, on the fact that the ambitious goal of greenhouse gas reduction requires a gradual phasing-out of fossil fuels. Climate-friendly thermal energy can supply entire residential areas by principles of 5th Generation District Heating and Cooling networks, (5GDHC), which can be supplied by large-scale geothermal collector systems (LSC). These work as the energy source, sink or as a thermal storage system. The 5GDHC in the KNW-Opt project is primarily used for heat and cold distribution, but according to the low temperature niveau it can also contribute to the energy generation in this system from the surrounding soil. The result is a system with almost no distribution losses during energy supply. Once the heat transfer medium has been transported from the LSC to the buildings via the 5GDHC network, the required temperature is then achieved in residential buildings using the decentralized heat pumps, so that the buildings are supplied with heating and hot water. During summer months passive cooling can also be provided.

In 2019, "Stadtwerke Bad Nauheim" (Bad Nauheim's municipal utilities company) decided to use LSC to supply the development area "Bad Nauheim Süd" with 100% renewable heating and cooling energy. All of the planned 400 residential units in approx. 180 residential buildings have been completed in the construction area since 2024. The double layer LSC has an area of around 11,000 m<sup>2</sup> per layer. In addition, a 6 km-long active 5GDHC network was constructed and installed for modern energy supply.

### Project structure

In order to investigate the long-term effects of the extraction and use of thermal energy on the soil and to optimize the entire system, the Technische Hochschule Nürnberg (OHM) has developed and implemented a comprehensive measurement concept.

The LSC, the 5GDHC and the buildings heat pumps have been included in the monitoring in the KNW-Opt project. In addition, there is a weather station installed on the roof of the energy centre for measuring the systems boundary conditions. The behaviour of the geothermal collector can be analysed by using the measurement field within the LSC and additional soil studies. One central question is how the two geothermal collector layers can be optimally used, according to energy efficiency to match the districts energy demand. Operating scenarios will be developed and tested. In addition, the data can be used for further development of the simulation program DELPHIN, which is going to be further developed during this project. Besides the planning and assessment of the monitoring data, the sub-project at OHM also comprises the systematic commissioning of the entire system. OHM has also been entrusted with developing optimization strategies and coordinating the project. The projects outcome will allow practical design tools, for more precise and better system planning in the future.

### Project aims

The concept of geothermal collector systems with 5GDHC were already the subject of multiple scientific investigations but never in this dimension. Earlier research projects such as ErdEis, ErdEisII and EnVisaGe-Plus have delivered initial results, from basic research at smaller applications. Two-layer, horizontal LSC systems in combination with an active 5GDHC network are still largely unexplored on this scale and thus form the subject of this research project. Within the framework KNW-Opt, the aim is to develop transferable solutions for other sites, in order to establish a scalable and sustainable thermal energy supply solution.

