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DOI
10.5194/egusphere-egu24-14989

Publication date
2024

Document Version
Final published version

Citation (APA)
Vardon, P., van der Schans, M., Koulidis, A., Grubben, T., Beernink, S., & Bloemendal, M. (2024). *High-Temperature Aquifer Thermal Energy Storage (HT-ATES) system for research development and demonstration on the TU Delft campus*. Abstract from EGU General Assembly 2024, Vienna, Austria. https://doi.org/10.5194/egusphere-egu24-14989

EGU24-14989, updated on 07 May 2024
https://doi.org/10.5194/egusphere-egu24-14989
EGU General Assembly 2024

High-Temperature Aquifer Thermal Energy Storage (HT-ATES) system for research development and demonstration on the TU Delft campus

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At present, over half of all primary energy used in Europe is used for heating and cooling. Therefore, decarbonizing the heating supply is essential to achieve climate targets. Underground thermal energy storage is a key enabling technology for the energy transition to buffer the large seasonal mismatch between thermal energy demand and sustainable thermal energy production capabilities. In Delft, a High-Temperature Aquifer Thermal Energy Storage (HT-ATES) system will be installed at the campus of Delft University of Technology (TU Delft). It will be integrated in the wider heating system on and around the TU Delft campus, which itself is undergoing a transformation to optimally supply sustainable thermal energy. The district heating network will be extended and utilize the thermal energy from a geothermal doublet producing heat at around 75-80°C with a flow rate of ~350m^3/hr. Excess energy produced by the geothermal well in summer will be stored in the HT-ATES system, and will be utilised when demand exceeds production throughout the winter. The HT-ATES system will comprise of 7 wells (3 hot wells of 80°C and 4 warm wells of 50°C) to a depth of approximately 200m, with storage in an unconsolidated sedimentary aquifer between 160-200m depth. It is designed so that the instantaneous excess power from the geothermal project can be stored and demand from the district heating network be extracted from the system.

The HT-ATES system at TU Delft is partially funded by local stakeholders and the European commission within the PUSH-IT project and has two primary goals: (i) to reduce carbon emissions on TU Delft campus , and (ii) to create a unique demonstration, education and research infrastructure. The complexity of a HT-ATES requires innovative solutions during the entire system life cycle. The scientific programme that is initially planned within the project is therefore focusing on various research fields and includes:

- Characterisation of the subsurface formations including mechanical, hydraulic, thermal, and chemical properties.

- Evaluation and monitoring of the biological conditions and microbial diversity, and potential

impact on water quality.

- Innovations in drilling and completion, monitoring and performance.

- Quantification of the system performance and system impact during multiple storage cycles and the full lifecycle of the HT-ATES. This will include extensively monitoring temperature distribution and water quality in the subsurface to characterise behaviour and improve models.

- Demonstrate and develop the implementation of HT-ATES in an urban setting, including control of the system in the built-environment and transforming the conventional heat network to a future-proof heat network.

- To allow access to other universities or institutions with active programmes in the field of Geothermal Science and Engineering to jointly carry out research and perform experiments.

-Societal engagement and legal evaluation for improving the just energy transition.

Acknowledgements: Funded by the European Union under grant agreement 1011096566 (PUSH-IT project). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.