

Acceleration of Underground Thermal Energy Storage (ACCEL-UTES) – public progress report

RVO project number	DEI124009
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Project partners	TNO (coordinator); Utrecht University Department of Earth Sciences, Utrecht University's Energy Distribution Company, IF- Technology
Contact person	Jens Wollenweber (jens.wollenweber@tno.nl)

Thermal energy storage is considered crucial by the EU commission for achieving an independent, low-CO₂ energy supply system for urban district heating. Storage in high-temperature underground thermal aquifers (HT-UTES) can provide a solution to the seasonal mismatch in heat supply and demand in district heating. High-temperature aquifer thermal storage (HT-ATES) is not yet widely implemented for optimal embedding in heat networks in the energy transition where fossil fuels are being phased out. This is due to several (non-) technical challenges. Most importantly, technical enhancements are required to improve the cost efficiency and to facilitate independence from public funding and large-scale implementation. In urban areas with existing and/or future district heating, the technical, economic, legal and organizational aspects of embedding HT-ATES in heat networks should be considered from a system perspective.

ACCEL-UTES aims at realizing a flagship HT-ATES at Utrecht Science Park (USP), embedded in a complex heat and energy system, marked by multiple renewable energy sources and consumers. The inclusion of HT-ATES is essential for phasing out fossil fuels (Combined Heat and Power) by 2030 without the need for grid enforcement for the area. This will be achieved through unique seasonal storage of power-heat derived from photovoltaic (PV). This will result in a significant lowering of costs (LCOE) as well as CO₂ emissions. Objectives for demonstration are (Figure 1):

1. Development of detailed site characterization methods to increase the probability of success of pre-drill feasibility for optimal embedding in the energy system;
2. Application and demonstration of key improvements in subsurface engineering and monitoring, based on lessons learned from e.g. HEATSTORE-Middenmeer and WarmingUP;
3. Optimization of HT-ATES design, source strategies and operational scenarios of the energy system; and
4. Construction, scientific assessment and one-year operational success, to promote replication potential of HT-ATES in urban areas with heat networks in transition as well as future (collective) heat networks.

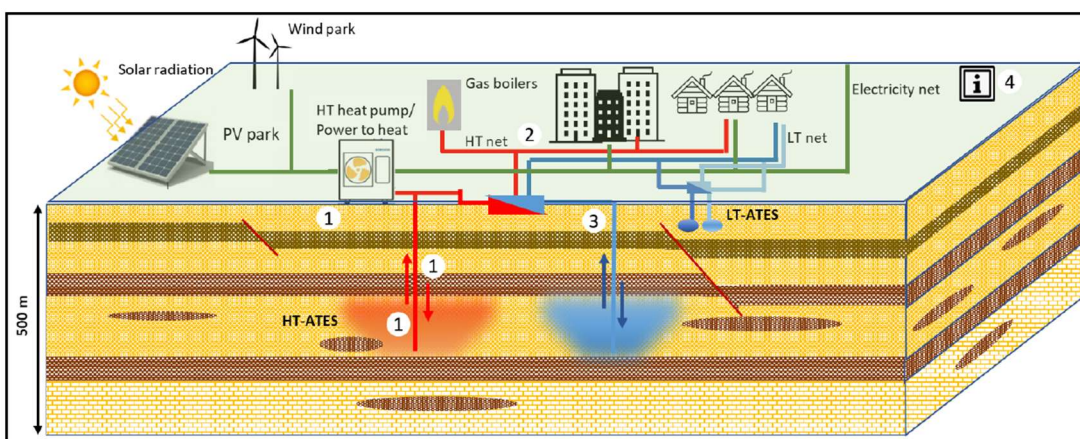


Figure 1: Objectives 1-4 of the ACCEL-UTES project illustrated in an energy system of the future

The project will be implemented by a consortium with Utrecht University's energy distribution company as the main investor for the demonstrator project, supported by TNO, IF-Technology and the Utrecht University Department of Earth Sciences. Main activities envisioned by the USP demonstrator include:

1. Detailed site characterization HT-ATES: enhancing assessment of geological and environmental performance prior to drilling activities. Demonstration of advanced exploration methods for improved capacity estimates and design;
2. Demonstration of technical innovations for enhanced HT-ATES technical performance on drill pipes, wellhead and operational envelopes for pumps. These include the implementation of thermal insulation of drill pipes to prevent thermal losses, reduction of surface footprint of the wellheads, and mitigation of sand production;
3. Further enhancement and practical application of design tools (derived from Design Toolkit) for HT-ATES integration in evolving energy systems comprising multiple sources and consumers, capable to optimize source strategies and Power to Heat options;
4. Construction and operation of HT-ATES; and
5. Development of standards and blueprints for fast-track market uptake and improvement of environmental and monitoring guidelines.

The USP demonstrator will serve as a field lab for future technical and system innovations to promote innovations for economic viability and reliability. In addition, the project will help reduce regulatory barriers and gain societal acceptance for the introduction of new (power-to-heat (P2H)-driven) HT-ATES systems in The Netherlands. Furthermore, it will support building profitable business cases for Dutch (P2H-driven) HT-ATES systems.

The project is divided into 3 phases, stage 1 and 2 end with a go/no-decision gate:

1. Study to decide on drilling a monitoring well (month 9)
2. Final design of the demonstrator and its integration into the heat network (month 18)
3. Construction, testing, operation and scientific exploitation (until month 36)

During the first year of the project, the main focus was on a feasibility study, collecting necessary information on the subsurface conditions and an optimized, flexible energy system design at USP, with a HT-ATES as main component. This included:

- An expert overview of state-of-the-art of HT-ATES systems in the Netherlands
- Best practices for HT-ATES safety and operations focusing on subsurface conditions at USP
- A HT-ATES feasibility study from system integration perspective and feasibility concept
- An overview of HT-ATES regulatory framework within the new law

Based on this study, a decision will be made in May 2025 to move to stage 2 in which the business case and technical suitability will be evaluated in detail, including the preparation of a monitoring well, to prepare a final investment decision at the end of stage 2, if a construction of a HT-ATES will be realized.

The objectives of ACCEL-UTES directly contribute to the ambitions and goals of the DEI+ subsidy regulation. The HT-ATES system can store renewable energy (solar, wind) during peak production periods for increased flexibility and optimum efficiency of the heat network to meet heat demand which significantly reduces CO₂ emissions and provides simultaneously energy savings.

“The project was carried out with a Top Sector Energy subsidy from the Ministry of Economic Affairs and Climate Policy, and a national EZK and LNV subsidy scheme, implemented by the Netherlands Enterprise Agency (RVO).”