Aquifer Thermal Energy Storage use in heating and cooling networks

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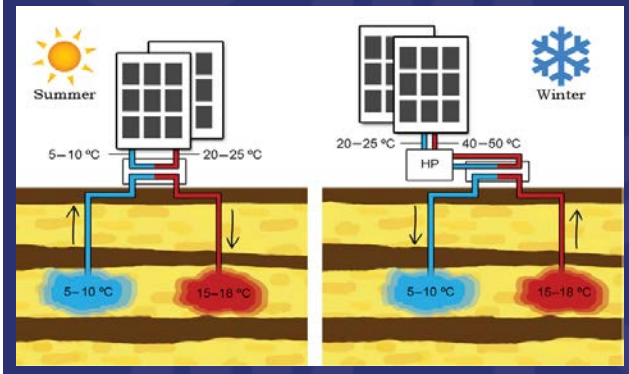
Aquifer thermal energy storage (ATES) systems are used for seasonal storage of warm and/or cold groundwater.



In winter, buildings are heated with a heat pump (HP) which extracts heat previously stored in the warm well.

This creates cooling capacity which is used in summer to cool the building, by storing the excess heat in the warm well[1]

Key messages

- ✓ Excess of heat can be stored
- ✓ Reduction of CO_2 emissions
- ✓ Integration in District heating & cooling grids (DHC)

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Temperature level of ATES

	Low-temperature ATES (LT-ATES)	Medium-temperature ATES (MT ATES)	High-temperature ATES (HT ATES)
Temperature range	less than 30°C	30 – 50°C	higher than 50°C*
Storage depth	10 – 150 m	150 – 500 m	300 – 1.500 m
Technology Readiness Level (TRL)	7 – 6	5 – 6	5 – 6
Pros	Low development risk; Small surface footprint	Low development risk; Small surface footprint	High efficiency rate; Decarbonisation of HT DHC
Cons	Only applicable in aquifer	Only applicable in aquifer; Moderate risk of clogging/scaling	Only applicable in aquifer; High development risk; Higher expenses

What are the preconditions for ATES?

[2]Picture source: Ghelin et al., 2015

- ✓ A sufficiently thick and hydraulic conductive aquifer – some of its properties are open sourced. More detailed properties can be checked on local or government agencies or measured in place
- ✓ The depth of the aquifer – the deeper the aquifer the higher the costs of drilling
- ✓ Building stock – bigger buildings or those connected to DHC network with heating and cooling demand are prevailed
- ✓ Balanced heating to cooling ratio – some climate analysis can identify the ratio.

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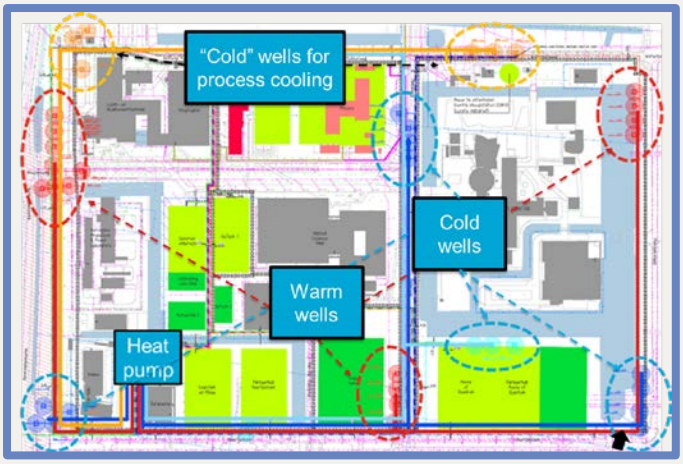
➢ Case study 1: LT-ATES – Delft University of Technology (NL)

An ATES grid supplies multiple buildings using a heating and cooling grid. The buildings are strongly cooling dominated, including a considerable amount of process cooling.



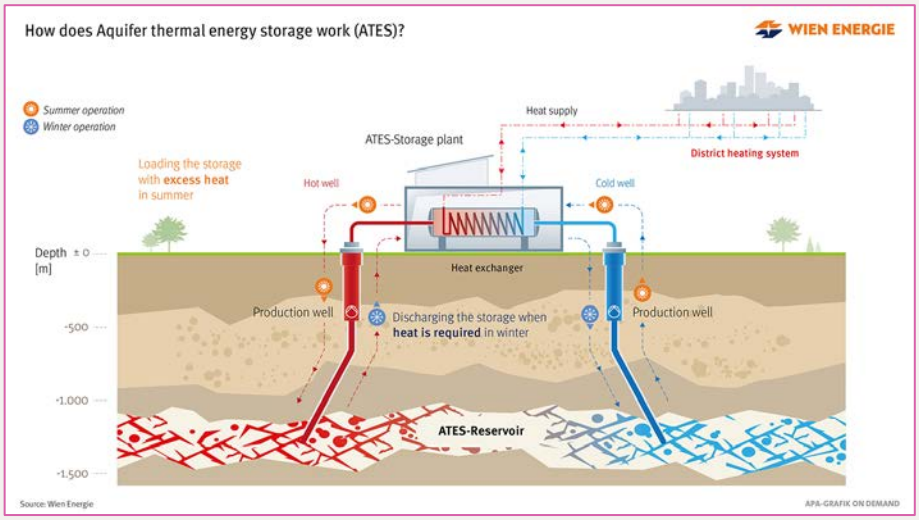
The figure shows the lay-out of the ATES well clusters in the S–part of TUD campus.

There are about 100 large - scale ATES systems worldwide integrated in DHC networks[3]

➢ Case study 2: HT-ATES – Vienna (AT)

The ongoing project focuses on the evaluation of aquifers in a depth of 1000 – 1500 m with the aim of storing temperatures of ~100°C.

The heat could be provided by deep geothermal wells that are currently being developed and contribute to the decarbonisation of Vienna's DHN.



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