Aquifer Thermal Energy Storage (ATES) systems - current global practical experience

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Less an energy, but more a storage problem

Basic principle of an Aquifer Thermal Energy Storage (ATES)

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More than 2,800 ATES systems currently in operation worldwide

Global distribution of Aquifer Thermal Energy Storage (ATES)

Fleuchaus et al. (2020)
Renewable and Sustainable Energy Reviews
2 TWh of abstracted energy in the Netherlands

Monitoring data of 73 ATES systems

• 1 GWh of abstracted thermal energy for heating and cooling of buildings on average
• 380 mio m$^3$ of abstracted groundwater.
• Approximately 2 % of heating and cooling demand (127 TWh) are supplied by ATES systems.

Fleuchaus et al. (2020)
Renewable Energy

Fleuchaus et al. (2020)
Renewable Energy
Balanced operation is required

Comparison of heat and cold storage

- Authorities request a balance operation over a period of 3 years.
- Synergies through combined supply of buildings with large cooling demand (e.g. data centres) and large heating demand (e.g. hotels).
- Average imbalance amounts to approximately 3 %

Fleuchaus et al. (2020)
Renewable Energy
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Average $\Delta T$ of 5 K

Injection and reinjection temperature levels

Fleuchaus et al. (2020)
Renewable Energy
Payback time of ATES after 3 years

Economic comparison of ATES with common supply technologies

Schüppler et al. (2019)
*Geothermal Energy*
Expert survey

Qualitative risk analysis of high temperature ATES (HT-ATES)
Conclusion

• Interaction between subsurface and heating and cooling systems needs to be optimized.

• Large discrepancy between licensed and actual extraction of thermal energy leads to an inefficient utilization of the subsurface space.

• Large economic potential compared to common supply technologies such as compression chillers.

• Implementation of monitored demonstration sites and pilot projects facilitates market entry.

• Project specific risk assessment is highly recommend in particular for HT-ATES.
References


