



Temporal and spatial development of Aquifer Thermal Energy Storage (ATES) systems worldwide – a review

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While heating and cooling accounts more than half of EU's final energy consumption, the share of renewables is stagnating on a low level. The challenge associated with the integration of renewables into the thermal energy sector, however, is attributed to the mismatch between times of highest energy demand and times of highest energy supply. Subsequently, thermal energy storage has gained increasing attention. In this work, we present an overview of the global application of Aquifer Thermal Energy Storage (ATES), reviewing historical ATES development and current operational statistics.

Worldwide, more than 2,800 ATES systems are in operation, storing over 2.5 TWh of thermal energy. This equals the heating demand of 90,000 single detached houses. 99% of all ATES are low temperature systems with a storage temperature below 25°C. 85% of all ATES systems are located in the Netherlands, further 9% in Sweden, Belgium, and Denmark. China, where ATES was first applied in the 1960s, is experiencing the beginning of a revival. After early projects had to be shut down due to operational problems, 6 ATES systems have been successfully implemented since 2013.

The worldwide variations in ATES application are not only attributed to underground-related and climatic conditions, but also to several market barriers, impeding ATES development. These barriers are of socio-economic and legislative nature, such as a lack of awareness for the technology, high investment costs or a shortage of underground space.