Aquifer Thermal Energy Storage (ATES) Systems in Smart Grids

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Abstract

Roughly 2000 Aquifer Thermal Energy Systems (ATES) are installed in the Netherlands. Within 10 years, it is expected that this number will increase to 20.000 leading to a reduction of 11% in CO2 emissions of the built environment, along with estimated savings of 4 billion Euros in the coming 30 years. At a global scale, the energy saving potential of ATES is even bigger. However, current performance of ATES does not live up to expectations and the projected efficiency remains below earlier prognoses.

The disappointing actual contribution of ATES to energy efficiency is mainly due to current operation and regulation practices that cannot cope with uncertainties in aquifer characteristics, interaction of neighboring systems, and variability in weather conditions and use of buildings. ATES interact via the groundwater aquifer in a way comparable to how distributed sources and sinks of electricity are interacting via the electricity grid. In ATES, however, the links are dynamically time-varying and plagued by uncertainty due to the absence of models and cooperation regarding interaction of nearby systems.

This research sets out to deliver a proof-of-concept for the potential of so-called Distributed Model-based Predictive Controllers (D-MPC) in the development of ATES systems into ATES Smart Grids by ensuring near-optimal operation and enforcing critical operating constraints. The TU Delft will realize this project in a close collaboration with KWR Watercycle Research Institute, Waternet, Tauw BV and Priva.