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## Water concerns in UTES: what can be learnt from geothermal experience & what issues need to be specifically addressed?

**Annick Loschetter**<sup>1</sup>, Maud Watkinson<sup>1</sup>, Simona Regenspurg<sup>2</sup>, Setareh Rad<sup>1</sup>, Laurent André<sup>1,5</sup>, Arnault Lassin<sup>1</sup>, Guido Blöcher<sup>2</sup>, Sylvain Stéphant<sup>1</sup>, Niels Hartog<sup>3</sup>, Martin van der Schans<sup>3</sup>, and Philip J. Vardon<sup>4</sup>

<sup>1</sup>BRGM, France (a.loschetter@brgm.fr)

<sup>2</sup>GFZ, Germany

<sup>3</sup>KWR, Netherlands

<sup>4</sup>Delft University of Technology, Netherlands

<sup>5</sup>ISTO, France

The European project PUSH-IT's ambition is to overcome the seasonal mismatch between heat demand and heat generation from sustainable sources using Underground Thermal Energy Storage (UTES) at high temperatures, i.e. up to 90°C (<https://www.push-it-thermalstorage.eu>). PUSH-IT showcases three UTES technologies at six pilot sites: Aquifer Thermal Energy Storage (ATES) in the Netherlands and Germany, Mine Thermal Energy Storage (MTES) in Germany and the UK, and Borehole Thermal Energy Storage (BTES) in Germany and the Czech Republic.

Water quality issues represent technical challenges for viable long-term thermal energy storage, whatever the technology. These include:

- Biogeochemical perturbations in the storage reservoir: the temperature gradient influences the chemical composition of the fluids that may lead to (bio)clogging in near-wells and loss of injectivity/productivity, notably for ATES;
- Corrosion and scaling in the wells and facilities;
- Shallower aquifer perturbation by temperature increase and saline brines from deeper aquifers.

The lessons learnt over decades of geothermal exploitation and low temperature thermal energy storage provide a solid basis for anticipating, monitoring, managing and remediating these issues in a variety of geological contexts. However, for increasing the temperatures of thermal energy storage in geothermal reservoirs several specificities have not been thoroughly investigated, such as the thermal storage at high temperature, the need to use reversible wells, reversible fluxes in the reservoir, temperature and pressure cycling. Furthermore, the role of microbiology has often been neglected and is anticipated to be more sensitive in storage applications.

At the current stage of the project, the main concerns for each site have been mapped. The modelling and monitoring works are at different stages of progress depending on the sites.

Significant methodological work is being carried out on microbiological phenomena and on the elaboration of monitoring protocols.

The project will go beyond the simple feedback on the experience from pilot sites by providing recommendations to anticipate and deal with water quality issues for future sites. We will provide guidelines to assist decision-makers in identifying the main issues, in implementing the necessary modelling, in sizing and adjusting the monitoring plan, in assessing possible water treatment benefit vs. environmental impact. Anticipating and managing water-related issues as far as possible is the best way of making the right choices, guaranteeing the performance and longevity of operations, limiting environmental impact and encouraging society engagement and support.

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