



## **Novel combinations of aquifer thermal energy storage with solar collectors, soil remediation, and other types of geothermal energy systems**

Marco Pellegrini (1), Martin Bloemendal (2), Nanne Hoekstra (3), Gemma Spaak (3), Alicia Andreu Gallego (4), Julian Rodriguez Comins (5), Tim Grotenhuis (6), Sara Picone (7), Adrian Murrell (8), and Hendrik-Jan Steeman (9)

(1) University of Bologna, School of Engineering, Department of Industrial Engineering, Italy (marco.pellegrini3@unibo.it), (2) Delft University of Technology, Department of Water Management, (3) Stichting Deltares, (4) Ceramic Technology Institute, Sustainability Department, (5) Itecon, (6) Wageningen University, Sub-Department of Environmental Technology, (7) ASTER, (8) Naked Energy Limited, (9) Arcadis Belgium

A transition to a low carbon energy system is needed to respond to global challenge of climate change mitigation. Aquifer Thermal Energy Storage (ATES) is a technology with worldwide potential to provide sustainable space heating and cooling by (seasonal) storage and recovery of heat in the subsurface. However, adoption of ATES varies strongly across Europe, because of both technical as well as organizational barriers, e.g. differences in climatic and subsurface conditions and legislation respectively. After identification of all these barriers in a Climate-KIC research project, six ATES pilot systems have been installed in five different EU-countries aiming to show how such barriers can be overcome. This paper presents the results of the barrier analysis and the results of the pilot plants. The barriers are categorized in general barriers, and barriers for mature and immature markets. Two pilots show how ATES can be successfully used to re-develop contaminated sites by combining ATES with soil remediation. Two other pilots show the added value of ATES because its storage capacity enables the utilization of solar heat in combination with solar power production. Finally, two pilots are realized in countries with legal barriers where ATES systems have not previously been applied at all.