

#	Vraag	Antwoord
1	Is the bore hole technologie suitable for small scale heat distribution systems	Yes, these systems are suitable for small local DH system very well. Usually efficiency and economics improve for larger systems though.
2	Is there a temperature limitation in the Netherlands	Normally, it is 25 or 30 oC. However, there are ATES project running at 90 oC. So, we expect that this is possible after a good judgement of the effects.
3	how do you insulated the side ground to avoid dispersion in the ground?	The storage is not insulated to the surrounding ground. The ground itself is the storage medium. Luckily heat moves very slowly though in soil.
4	how do you manage if any pipes in the ground has a leakage?	Usually, a couple of boreholes are connected to one collector. After installation, they will be tested. If it happen during operation, the collector will be closed to prevent any further leakage.
5	What is the motivation for the hydronic configuration (e.g series/parallel..) of the different boreholes? What is taken into account and why? How does it relate to the charging/discharging use case?	Connecting multiple BHEs in series increases the temperature difference between inlet and outlet which can be beneficial for system integration. It is a tradeoff between higher storage temperatures and a higher delta T of the fluid. It should be optimized during design stage. Furthermore it can result in a natural temperature zoning of the inner and outer BHEs and decrease losses. The BHEs in the center are the inlet during charging getting the highest temperatures. For discharging the flow direction is reversed.
6	What do you mean by higher temperature difference (between the whole system or single BHE inlet and outlet)? And how is this a result of the series connection?	Each borehole heat exchanger has a temperature delta between fluid inlet and outlet. This is often quite small (3-5 K). If multiple BHEs are connected in series their overall temperature delta between storage inlet and outlet increases.
7	Over a storage time of 6 months (e.g. in Norway), how much heat is lost to the surrounding soil? (in percent)	Typically the efficiency is around 65-85% depending on the storage design and to what low temperatures the storage is discharged.
8	Is ground heaving a concern when installing BTES, especially higher temperature systems? I.e. could you install the borehole field beneath a building or would it disturb the foundation?	BTES is often installed below a building, or even also in the pillars for the foundation. The closed loops are often 100-150 m while foundation is 10, 20 or 30 m. So, yes, you can combine it.
9	What is the maximum charging/discharging temperature we can go with HT-TES ?	BTES operation temperatures are limited by regulation to protect groundwater and by materials. Standard materials for shallow geothermal allow temperatures up to 80-85 °C. For medium-deep systems other materials are used which allow up to 95 °C. The regulatory limitation depends on the local hydrogeological situation and laws.

10	What is the minimum number of boreholes needed to retain enough heat?	1 :-) Usually these systems start at about 40-50 BHEs"
11	Is de stroming in de wisselaars laminair of turbulent?	It should be turbulent
12	Do you use U tubes?	Yes!
13	What is de liquid in the pipes of the boreholes?	It can be water if operation temperatures stay above 5°C. If the storage should be discharged to lower temperatures a water-glycol mixture has to be used as for conventional ground coupled heat pumps.
14	Wat is een Non-dispatchable heatsource (Vattenfall)?	Live beantwoord, hernieuwbare warmtebronnen zoals zonnewarmte of zonne-/windenergie (via power-2-heat)
14	What is a non-dispatchable heatsource (Vattenfall)?	Answered live, renewable heat sources like solar heat or solar/wind energy (via power-2-heat)
15	How is BTEH different from a typical geothermal energy source?	Many borehole systems are GSHP systems, which means that they harvest heat or sometimes cold from the subsurface. In the concept BTES, you manage the heat and also add heat during the summer to be able to have higher yields during the winter period. So, it will be used as a storage technology and not only as a heat harvest method. Generally boreholes are also drilled much closer together than with geothermal systems.
16	Additional information about why brædstrup was less used than designed: the buffer tanks (TTES) were implemented for the full-scale version of the BTES, 10 times larger, which was planned for an extension of the solar collector field. Therefore the TTES were big enough to store most of the solar heat, and the seasonal use of the BTES became much less important, eventually leaving the BTES only to be used for the excess heat and as a geothermal heat source for heat pumps	Thank you Geoffrey!
17	If you would want to charge it with PVT installations and heatpumps from homes in a neighbourhood, would that work?	Yes!
18	Where are the limits in temperature up to that you can heat up the underground before you start getting mineralogical reactions that might cause damage to the borehole or even to the surface. Has this been studied in different rock types?	I do not know about the existing literature, but the operational systems are operated with temperatures up to 85 °C for some years now.