

**Donnerstag, 20. Februar 2025, 12.10 Uhr**  
Baden Arena Kongress 2  
Oberflächennahe Geothermie

**Thursday, 20 February 2025, 12.10 pm**  
Baden Arena Congress 2  
Shallow geothermal energy



## **Borehole exchangers as thermal batteries: towards a new standard in GSHP dimensioning**

*Erdgekoppelte Wärmepumpe als thermische Batterien: ein neuer Standard für die Dimensionierung von AKWs*

**Etienne Coudert**  
**Celsius Energy**

The presentation will describe a modelling approach for ground-source heat pump systems which characterises a site as “geothermal batteries”, described by their power capacity (kW) and energy capacity (MWh/year), as a function of the subsurface thermal properties and well design. This approach is built in Celsius Energy’s bespoke dimensioning software.

Celsius Energy is a technology company who designs, develops and installs ground source heat pump (GSHP) systems for collective building and district heating and cooling. Among the innovations in Celsius Energy systems, boreholes can be drilled with an inclined geometry, typically arranged in a star-shaped exchanger; this reduces significantly the installation footprint and the cost of surface networks. Moreover, it has been shown that this architecture can achieve the same heating demand as a vertical borehole field, delivering an equivalent “geothermal battery” but with shorter drilled lengths (Sosio et al., GT HP Days 2023).

To facilitate the comparison between different exchanger architectures for a given site, both in terms of performance and of cost, Celsius Energy has implemented a thermal battery function in the bespoke Design Assistant dimensioning software (Parry et al., EGC 2022). This function allows characterizing the borehole exchanger as a battery, described by its power capacity (kW) and energy capacity (MWh/year) under standardized load profiles. This takes inspiration from the G.POT method (Casasso & Sethi, Energy, 2016).

Given the subsurface thermal properties (thermal conductivity and capacity and initial temperature) and completion design (single U-tube, double U-tube or co-axial, type of grout), the new feature allows characterizing the thermal battery properties according to two scenarios: heating only or balanced heating and cooling demand.

Moreover, Design Assistant already includes algorithms to optimize the well geometry according to the target site’s constraints (possible drilling locations, built areas, property boundaries, etc.), facilitating the dimensioning of the system.

This approach will be demonstrated through the application to several case studies in Europe, including Celsius Energy’s recently commissioned UK demonstrator plant.