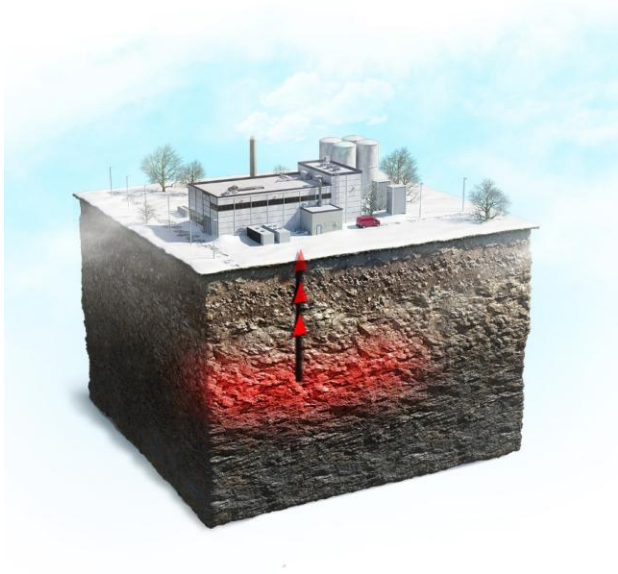
HEAT technology – experience from the development and first storage season of the FTES at Kvitebjørn varme AS

Eivind Bastesen Ruden AS



UTES Symposium Zurich
6 October 2025

«Storage is key!»

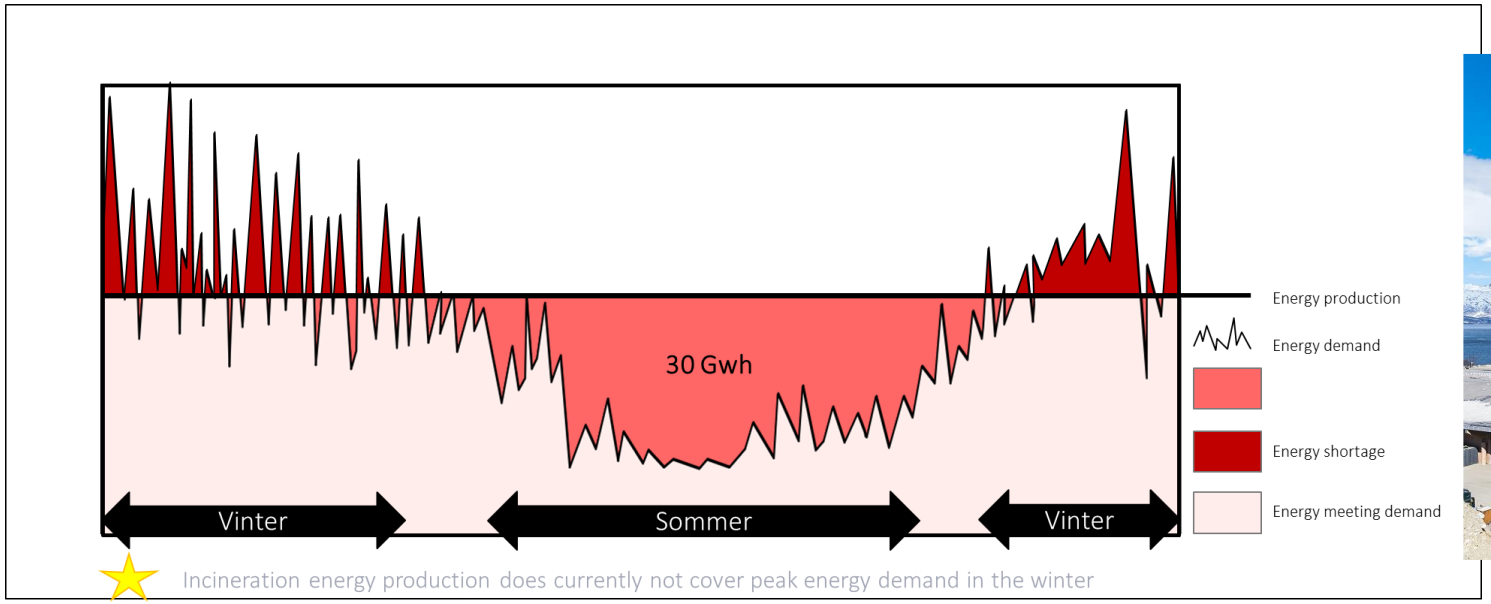
IEA Geothermal GEOTHERMAL IWG GEOTHERMICA INITIATIVE

Potential for energy storage in Norway

- Large seasonal variations — high energy demand during cold winters and low demand in summer.
- Growing future energy need of 30–40 TWh.
- Electric heating/cooling dependence
- Thermal energy storage (TES) and smarter local heat use:
  - Free up electrical capacity, and relieve power grid
  - Reduce the need for new hydropower or wind developments

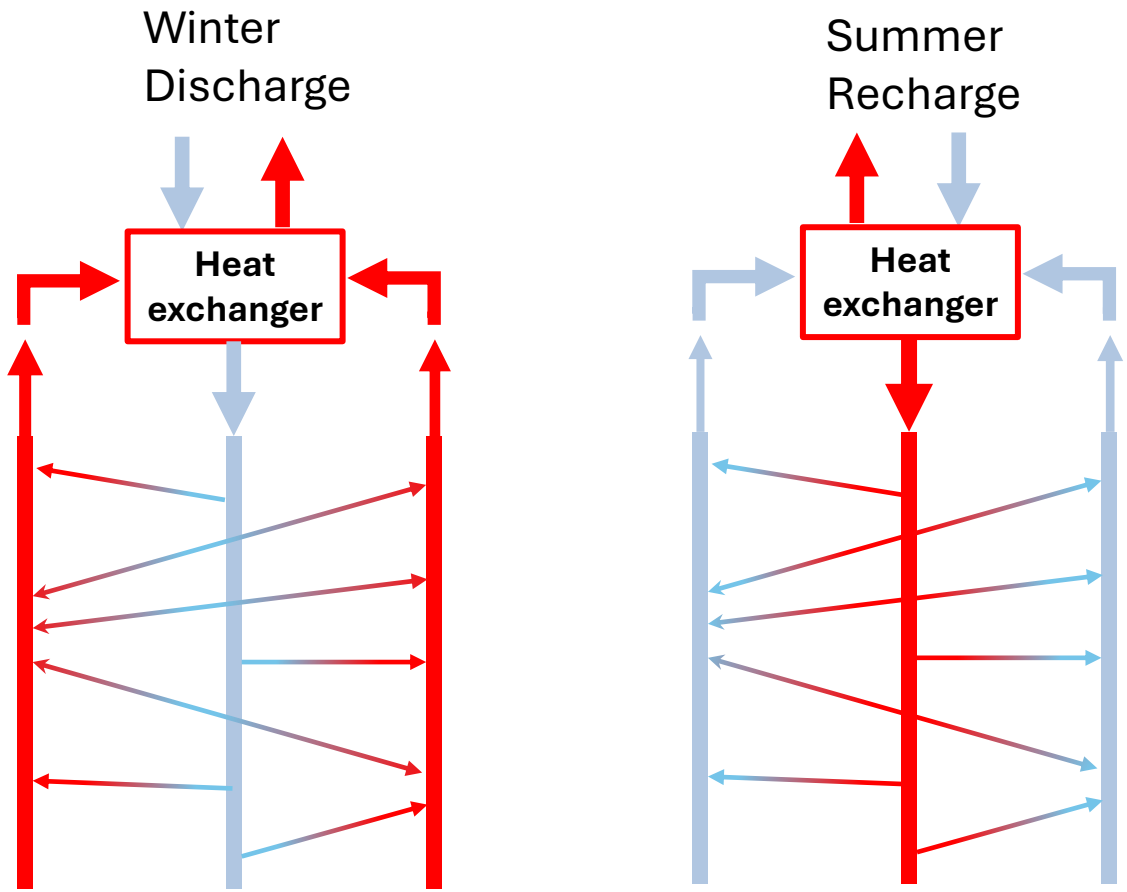
Pilot in Tromsø Kvitebjørn Varme AS

- Kvitebjørn Varme AS 30–40 GWh of waste heat annually.
- Utilize surplus to reduce winter energy consumption by storing heat underground and increasing return temperatures in the district heating network.



HEAT concept?

- Fractures- heat exchange surfaces
- Stimulation increase storage rock volume and flow rate
- Moderately shallow (100-300 m)
- Direct heat transfer enables high-temperature energy storage



Development of FTES Kvitebjørn Varme AS

2021
- Pilot study drilling test wells
- Establish method
- Modelling
- Funding raise

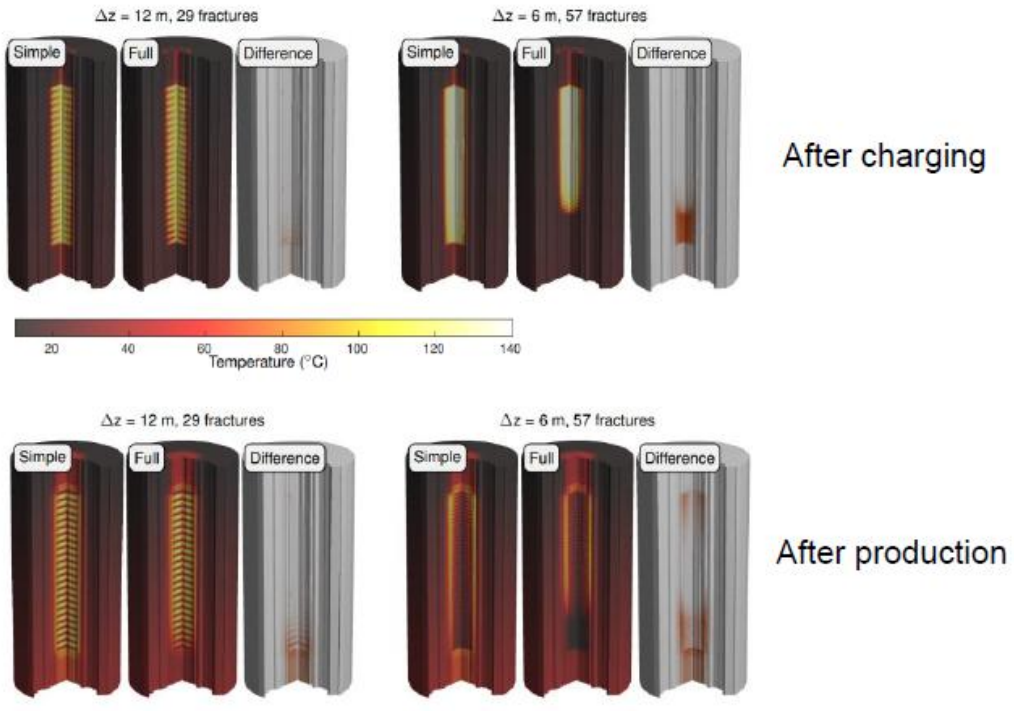
2022
- Modelling
- Storage capacity and design
- Well drilling

2023
- Well completion
- Hydraulic stimulation

2025
- Installation surface pipeline and monitoring equipment
- Test storage season (2Gwh)

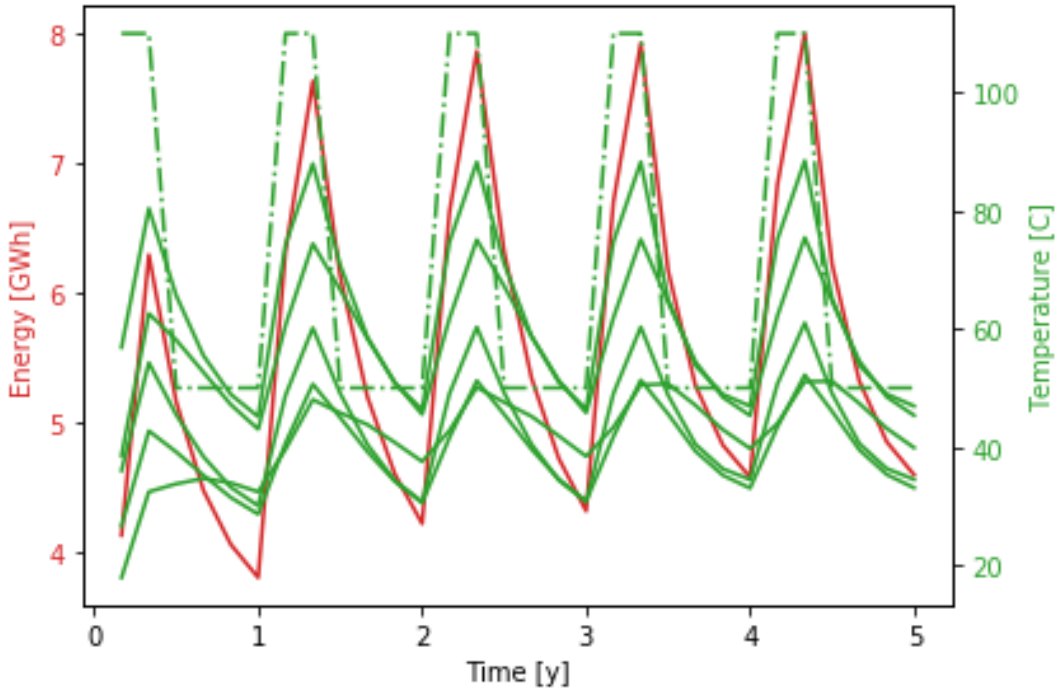
2026
- Optimizing injection and production configuration
- Increase to full scale storage (10Gwh)

Modelling- designing the ideal well configuration and stimulation program



After charging

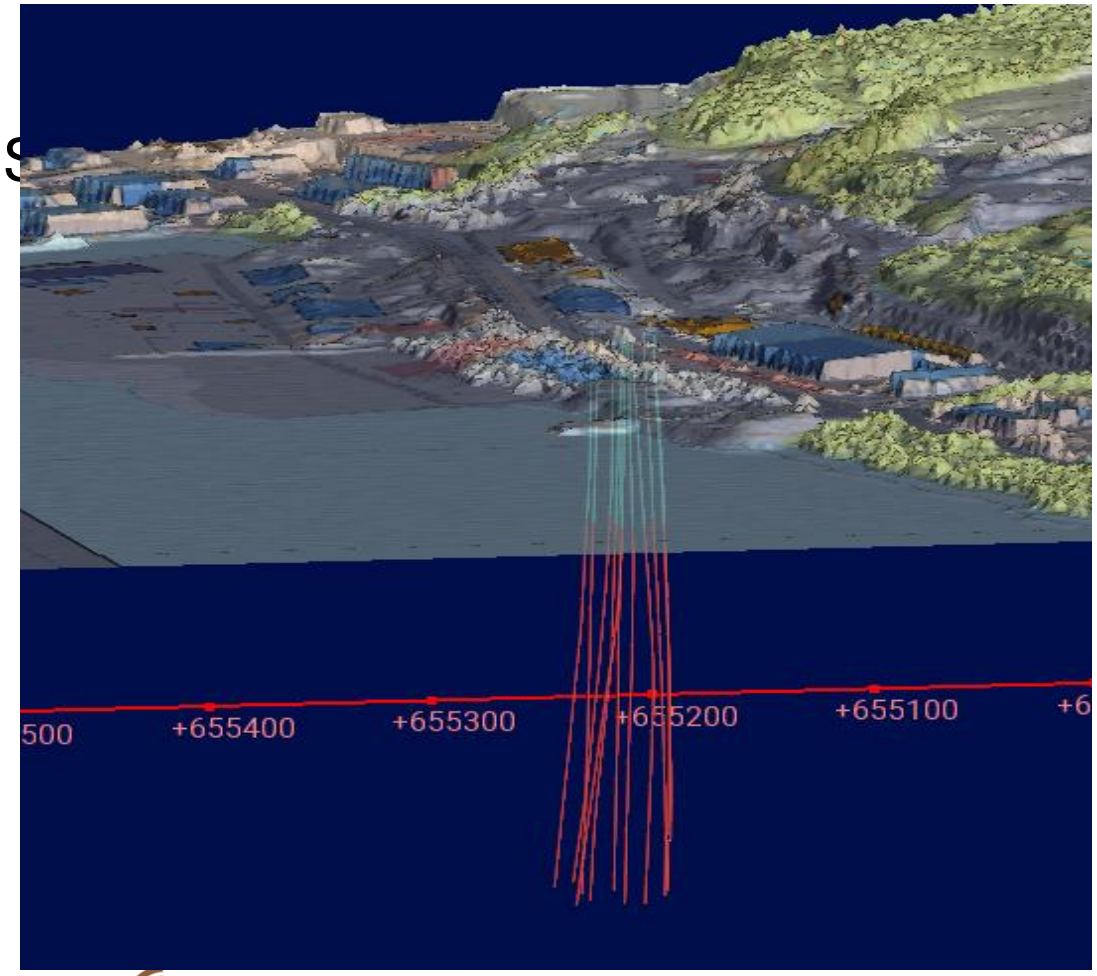
After production

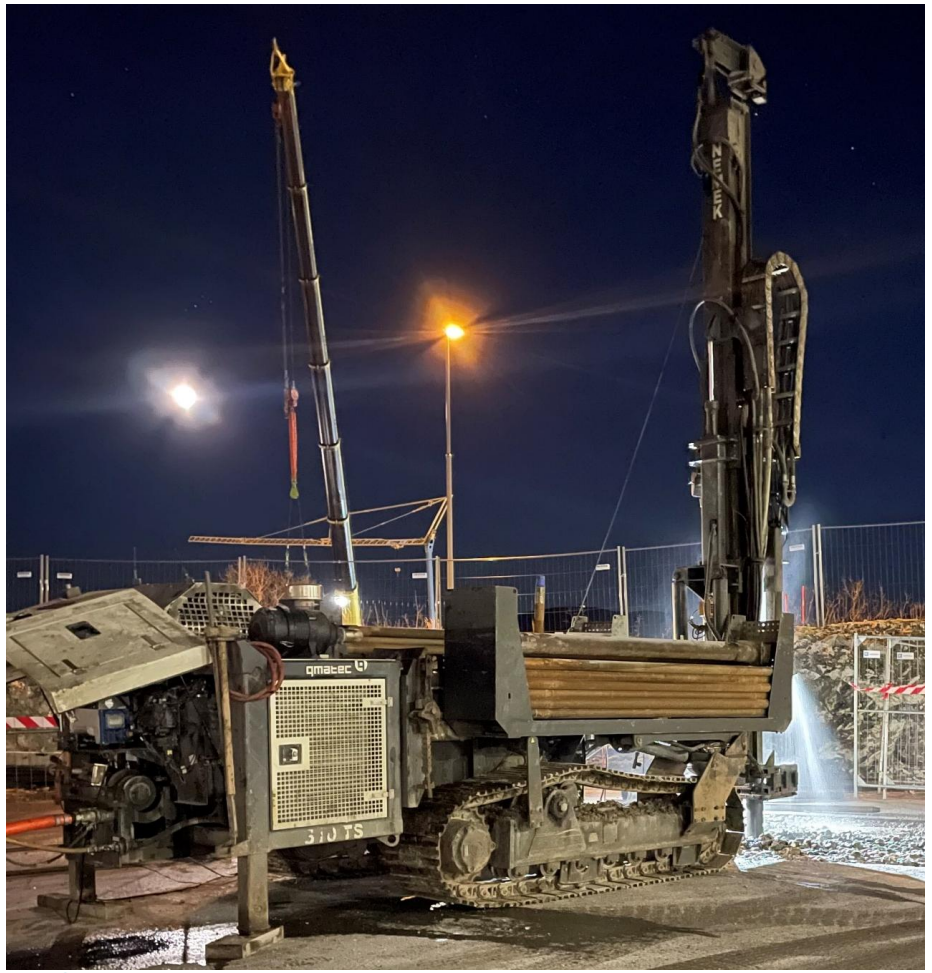


IEA Geothermal GEOTHERMAL IWG GEOTHERMICA INITIATIVE

Ruden Energy

Well drilling



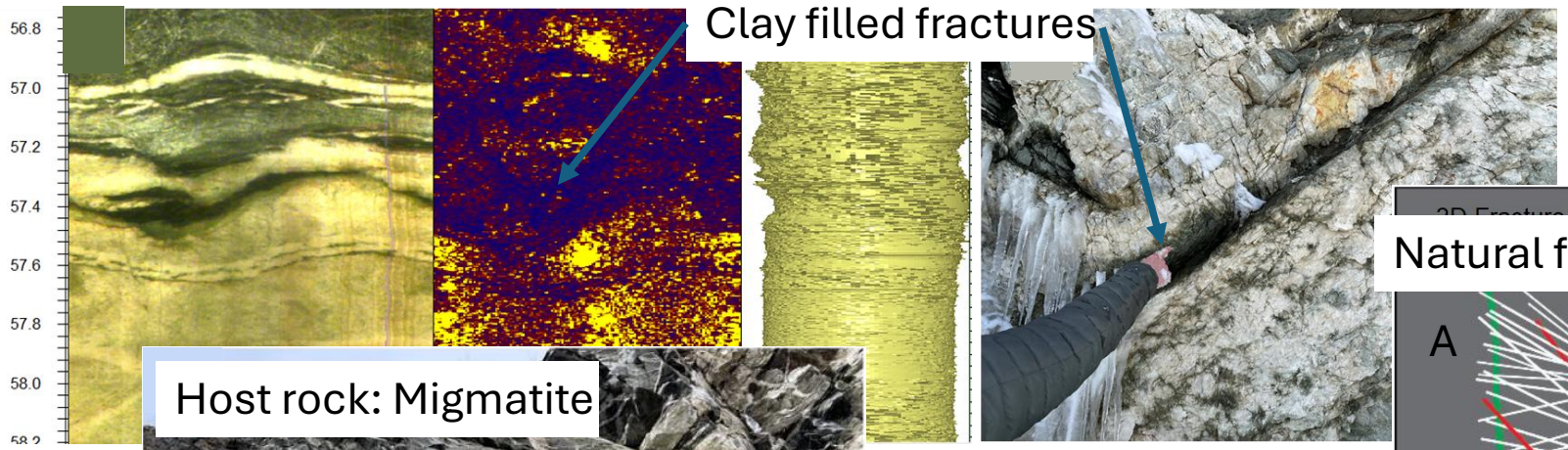


IEA Geothermal GEOTHERMAL IWG GEOTHERMICA INITIATIVE

Ruden Energy

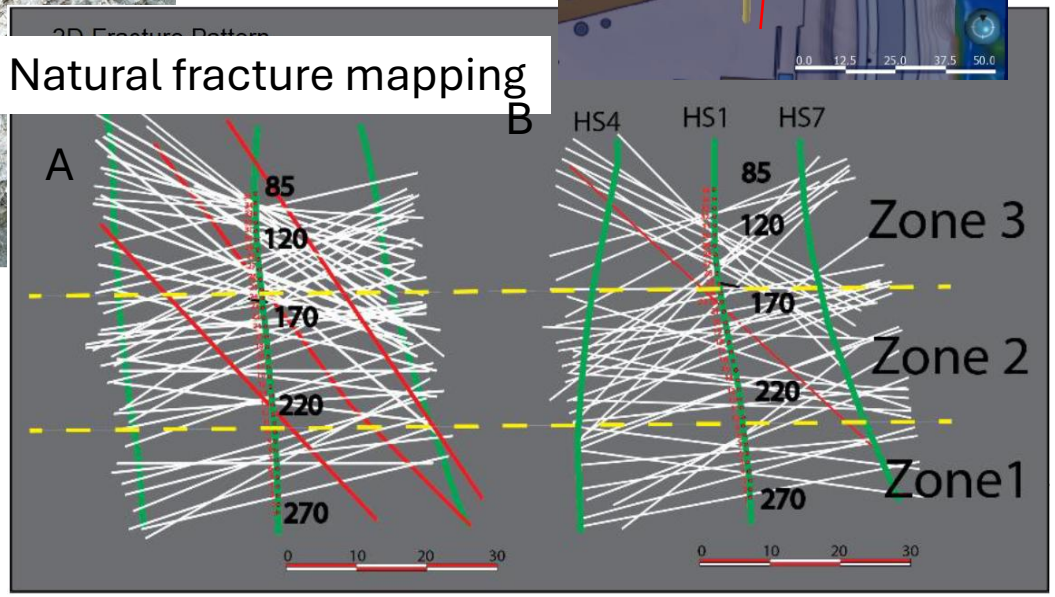
Geological and geophysical data

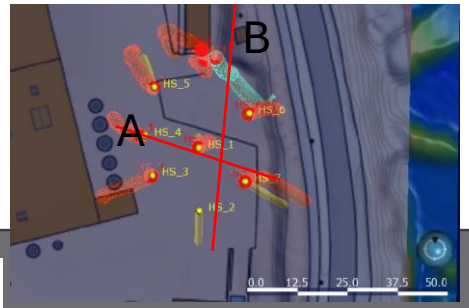
Database on storage rock volume. Geophysical and optical/acoustic wire line logs, field mapping, sampling, well testing, thermal conductivity.



Anorthosite dyke

Amphibolite

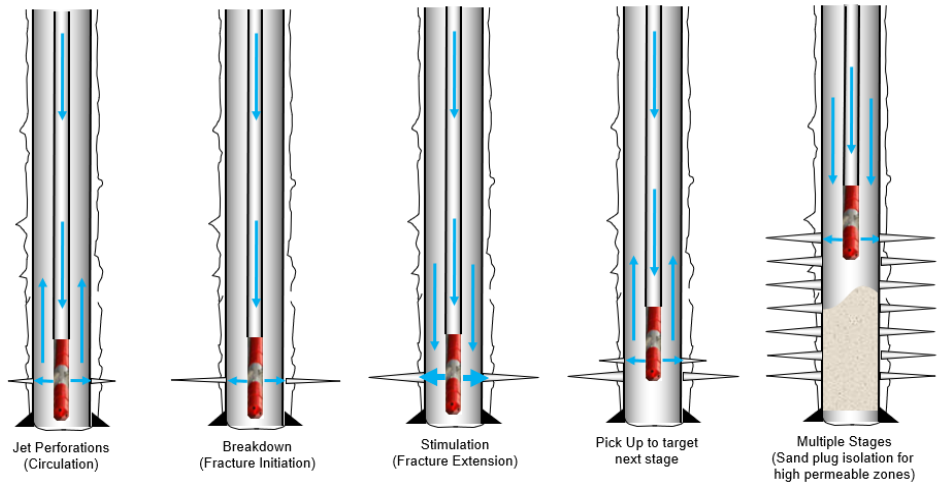




GEOTHERMICA INITIATIVE

Ruden Energy

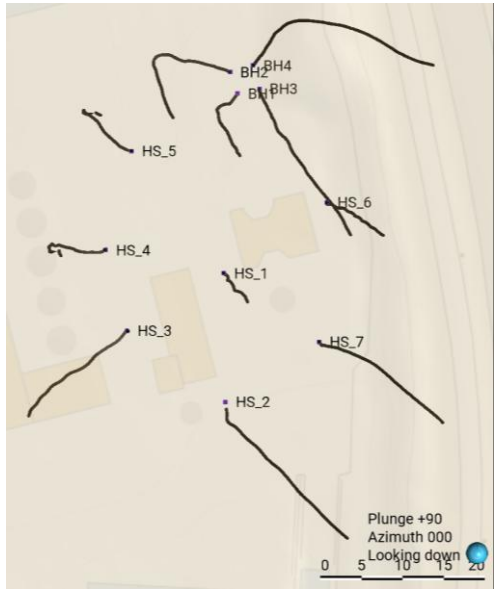
Hydraulic stimulation

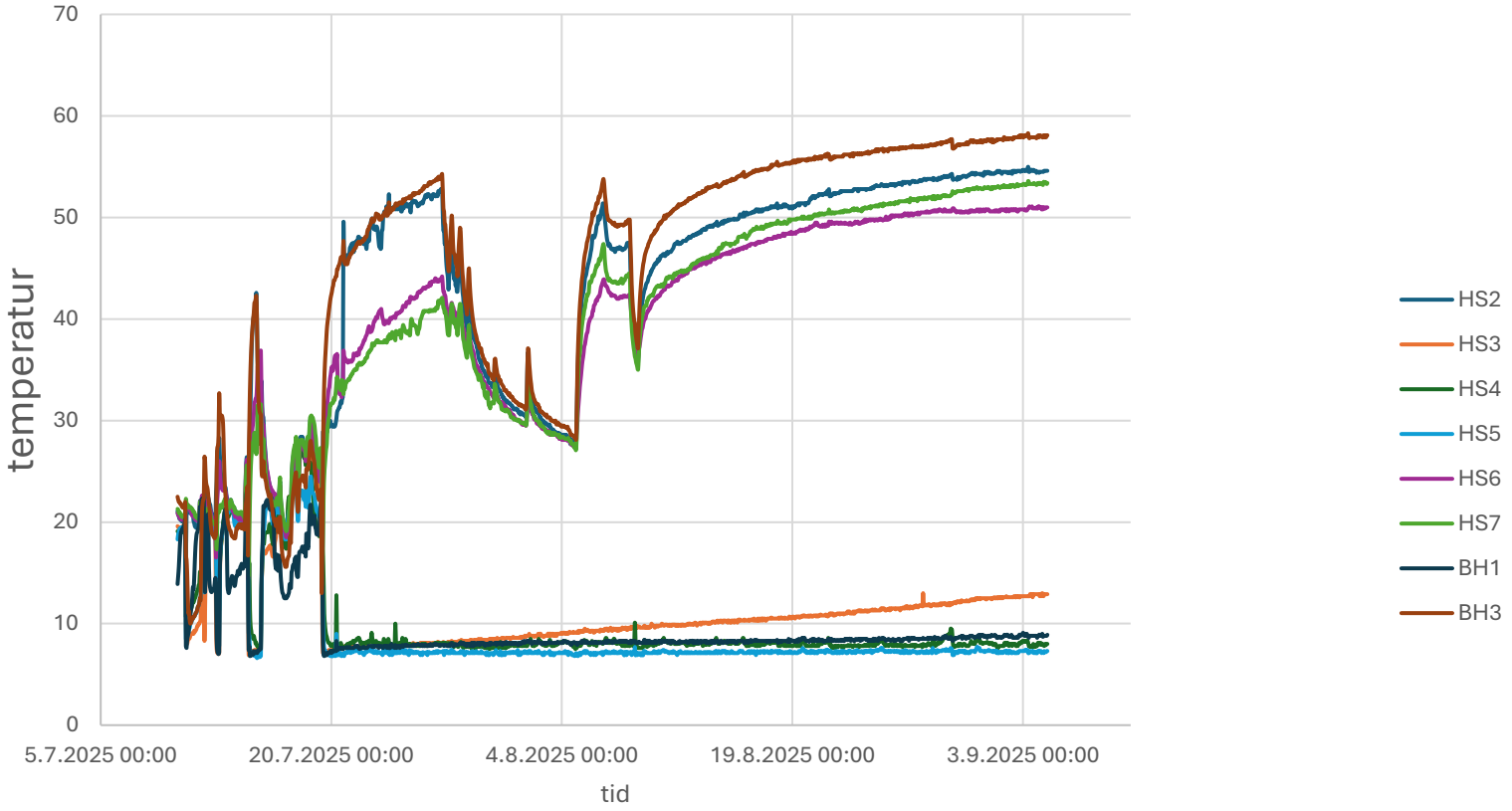


Well control system

Long term storage test August-September 2025

Successful storage of 2 Gwh thermal energy utilizing 90 ° C and 110 ° C injection temp.





Lessons & Innovations

- The system demonstrates that crystalline bedrock can act as a stable, high-temperature storage medium.
- Fracture-based heat exchangers allow for high storage temperatures (100 °C+).
- The approach can work without heat pump, reducing system complexity and cost.
- The method is site-dependent, emphasizing the need for geological mapping and adaptive well design.

Next steps

- Optimization Phase (2025–2026):
  Improve flow between wells, test new injection strategies, and monitor heat recovery efficiency. Perform a full year charge- recharge.
- Integration with Solar Thermal Systems:
  Couple storage with solar collectors to utilize summer surplus heat — creating a self-sustaining seasonal energy loop.
- Scalability & Replication:
  Evaluate potential sites across Norway and Northern Europe with crystalline geology for commercial deployment.
- Partnership & Commercial Pathway:
  Collaboration with industry partners to scale up the technology toward a 10 MW-class demonstration.

Key takeways

- **Sustainable and scalable:**
  The system uses no heat pumps, no critical minerals, and requires minimal surface footprint, making it both environmentally friendly and adaptable to many regions.
- **Smarter use of surplus heat:**
  Integrating waste heat and solar energy into subsurface thermal storage reduces winter energy demand, relieves the power grid, and strengthens energy security.
- **Proven concept, ready to scale:**
  The Tromsø pilot has validated the principle — the next step is to optimize performance and replicate the system at larger commercial sites.

- *“Turning excess heat into stored power — in the most stable and natural battery on Earth: the rock beneath our feet.”*