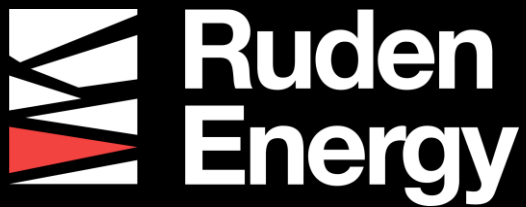
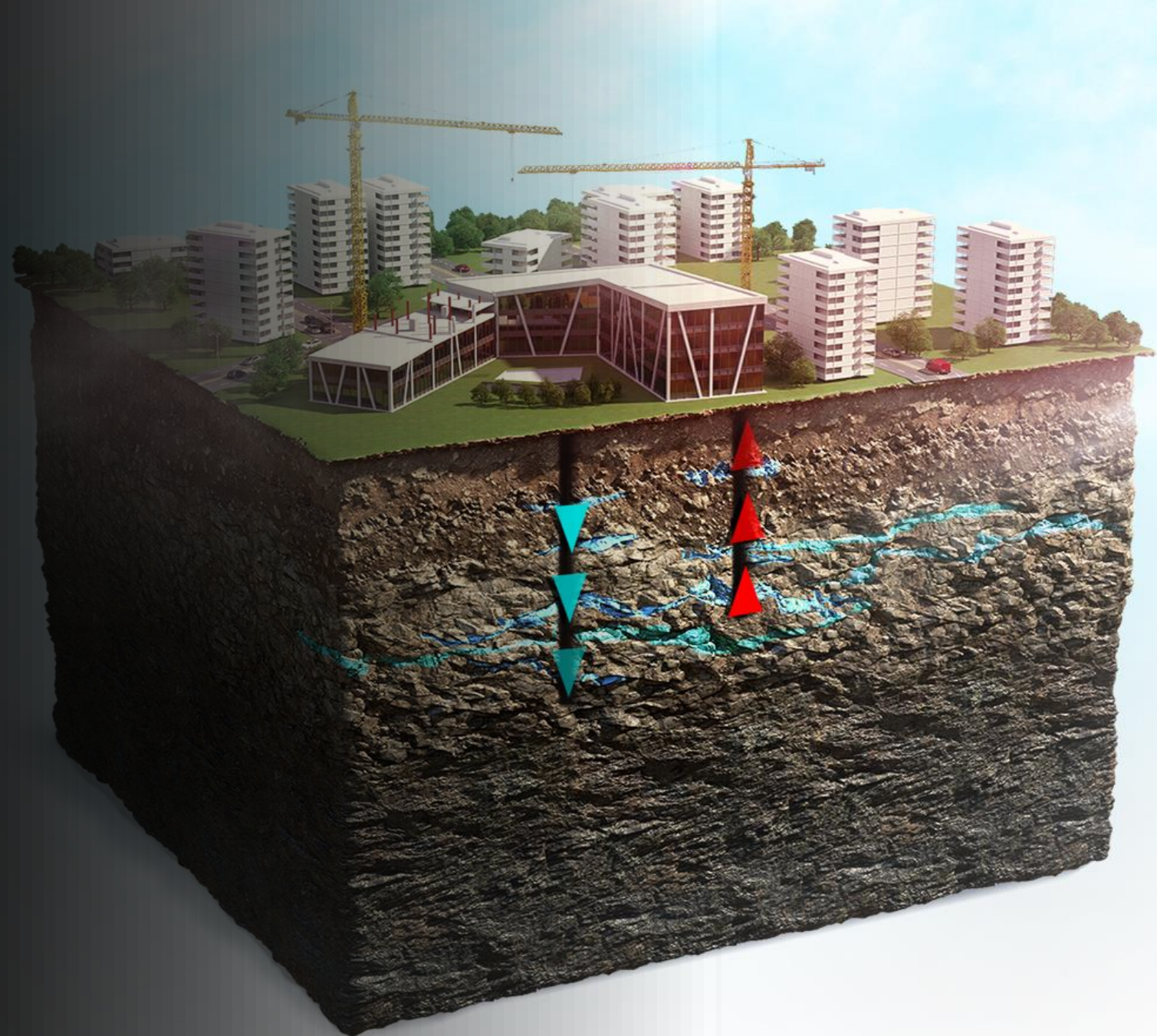
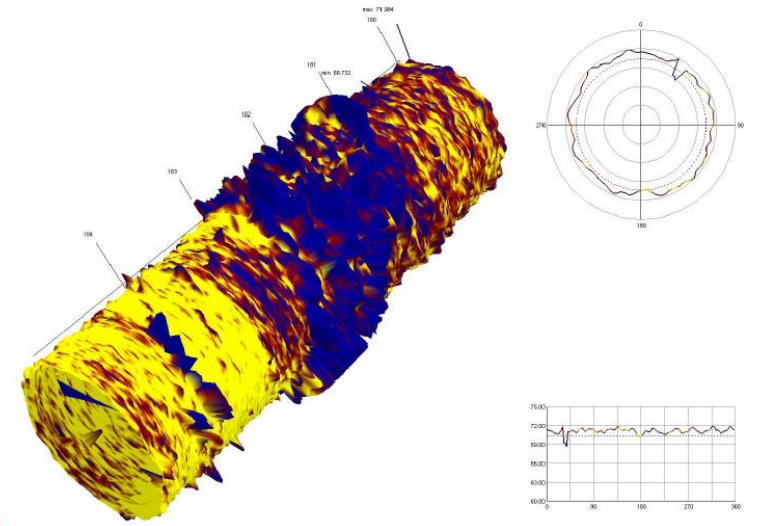
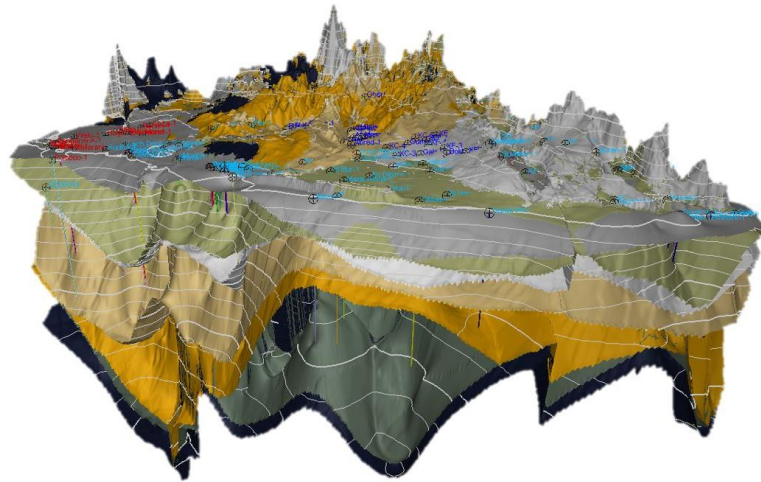
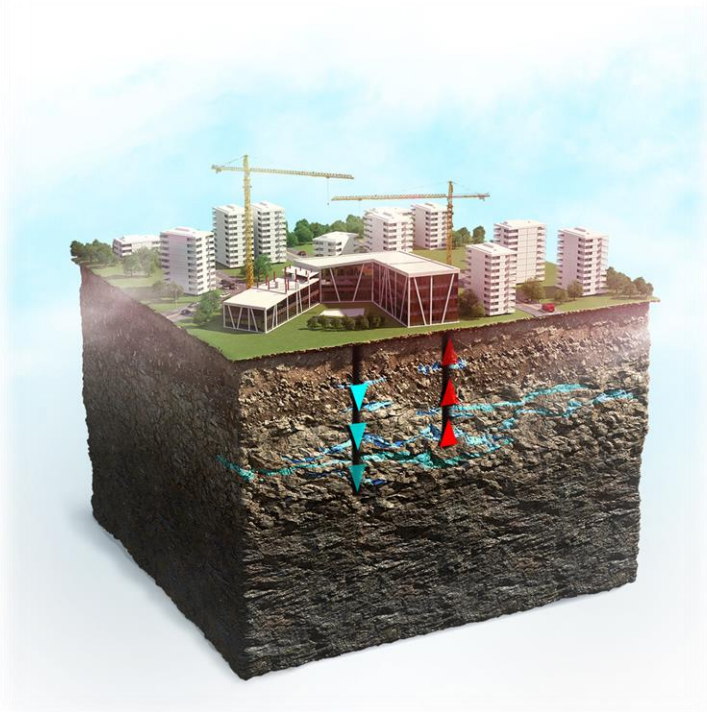


Utilizing the ground water to your advantage –



# Ruden AS



 Ruden Energy

 Ruden Water

 Ruden Geo Services

# Ruden Energy

Innovative solutions for geo-energy

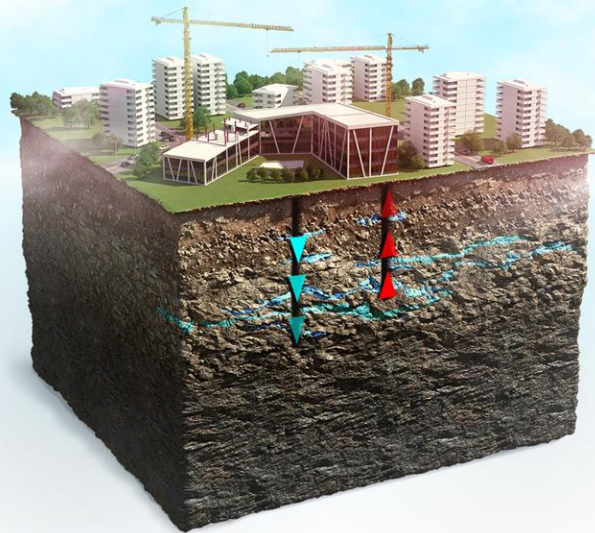
Local needs

Regional needs

National needs

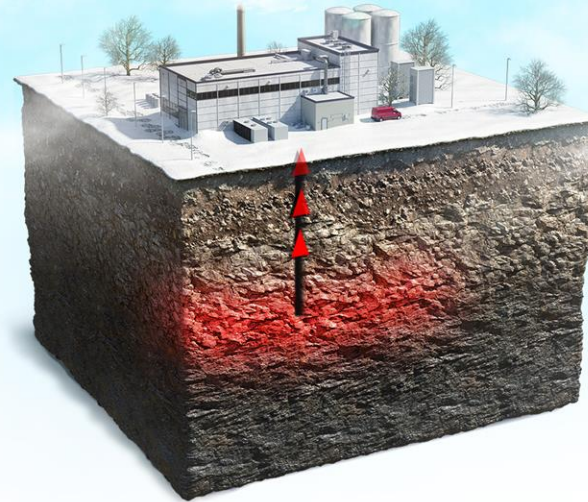
**LEAT**

2-60 °C



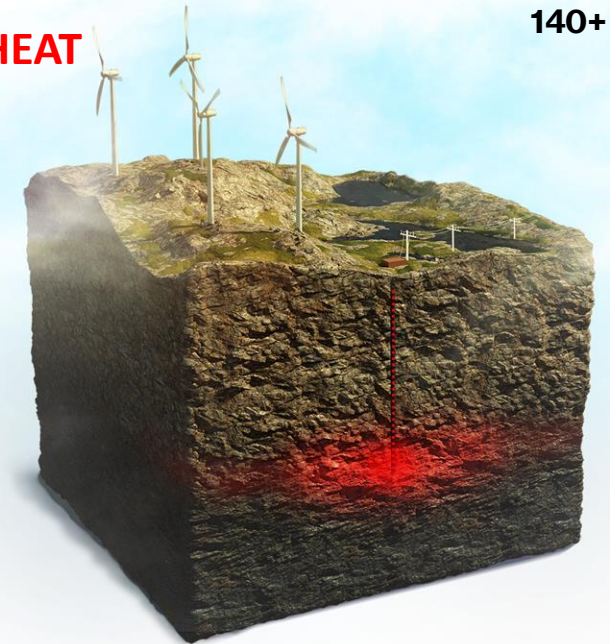
**HEAT**

60-140 °C



**iHEAT**

140+ °C



*Heating and cooling of buildings  
and infrastructure*

*Storage of surplus heat with  
seasonal variations*

*Storage/generation of electricity*

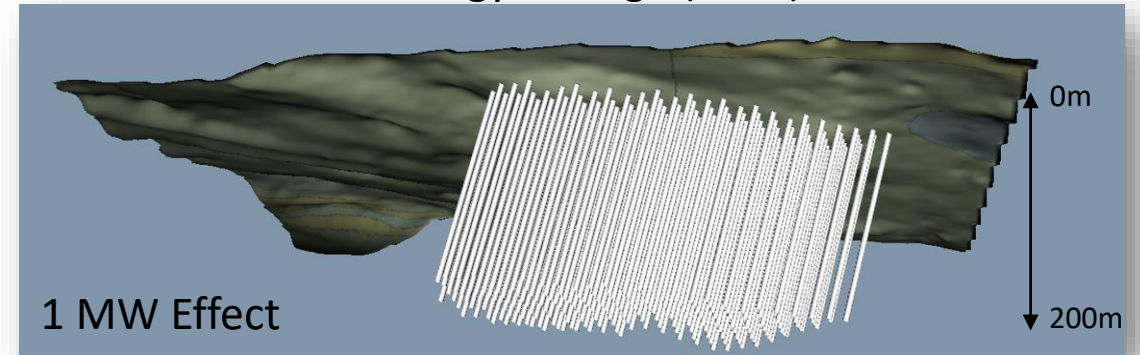
# LEAT – Low Enthalpy Aquifer Technology

Open loop geo-energy system

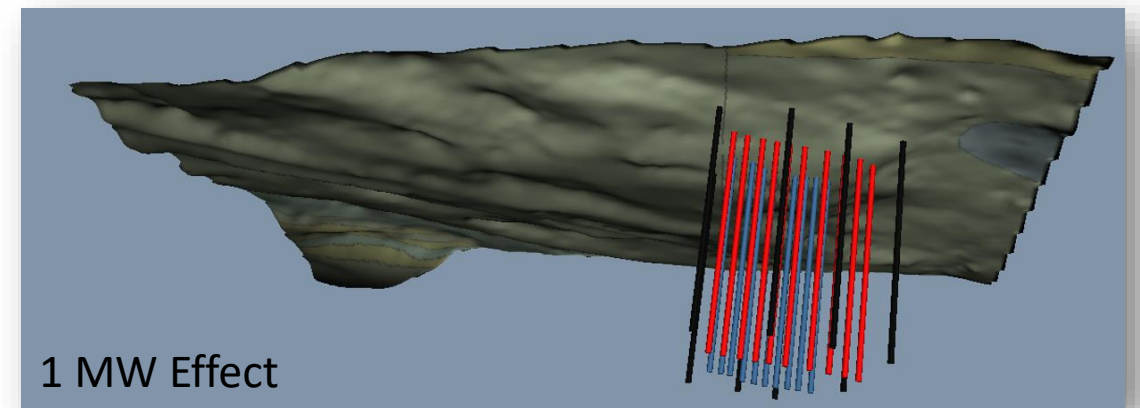
Geo-energy system that uses groundwater as energy source

- Utilization of fractures
- Effective
- High effect (KW)
- Savings
- Proven concept

Borehole Thermal Energy Storage (BTES)



LEAT



# Effective utilization of shallow geothermal energy – ongoing projects

Recently completed



**Campus Bø USN, Bø**  
75 kW, heating and cooling  
2 wells replacing ~10 wells\*



VEDAL

**Økern Portal, Oslo**  
0.85 MW, heating and cooling  
18 wells replacing ~300 wells\*



**Wesselkvartalet, Asker**  
4-5 MW, heating and cooling  
20+100 wells replacing ~450 wells\*



**Asker Panorama**  
2 MW, heating and cooling  
run by 10 wells replacing ~250 wells\*

# Wesselkvartalet

## Project details

- Total Floor area: 22.000 m<sup>2</sup>
- 260 Parking spaces
- 52 Apartments
- 1970 m<sup>2</sup> Commercial
- 5650 m<sup>2</sup> Offices
- Connected to the pavement-heating system of the municipality



# Wesselkvartalet

Hybrid geo-energy system

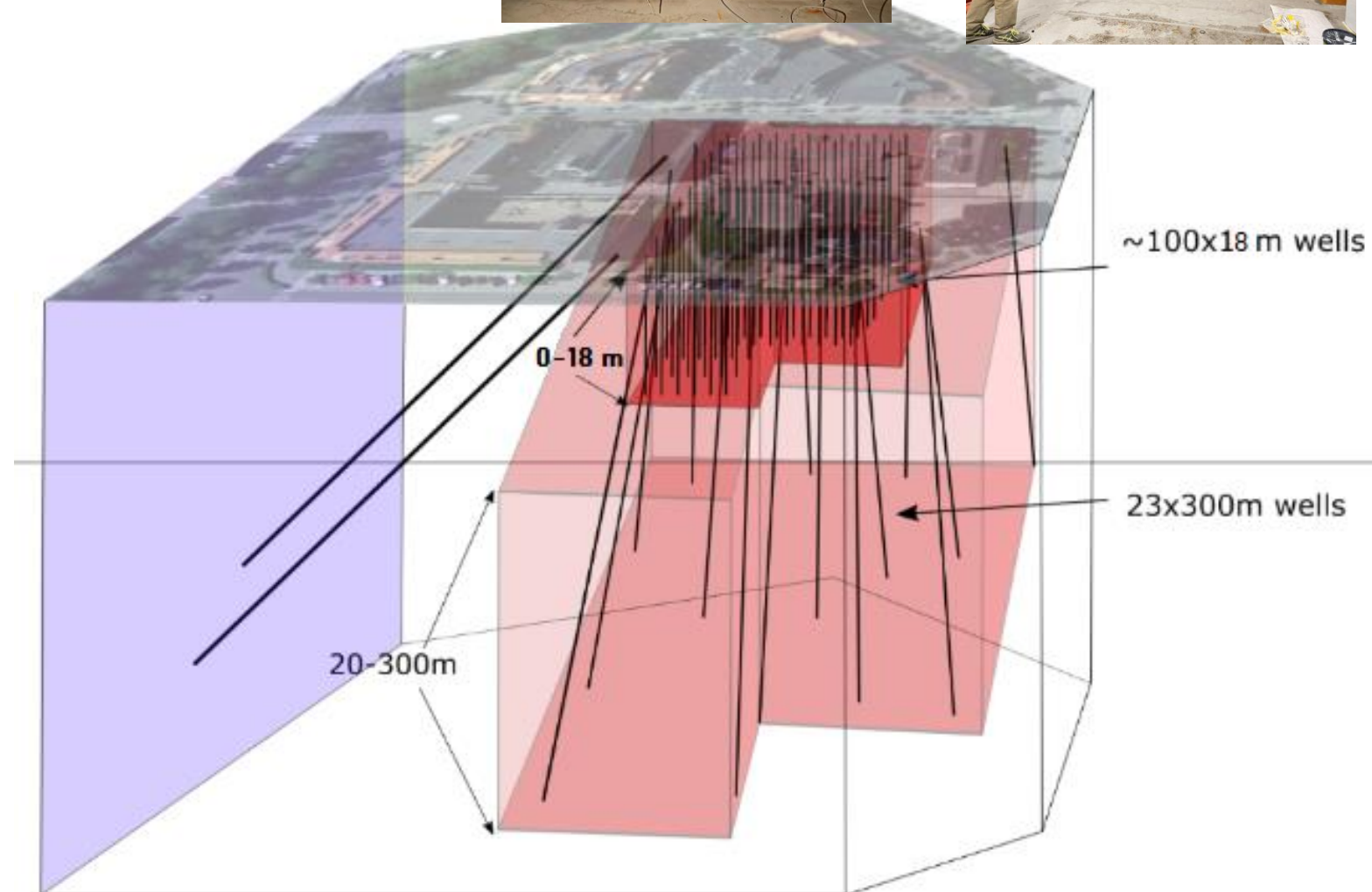


## Stacked aquifer & battery

- Energy reservoir 2-18m
- Energy aquifer: 20-400m

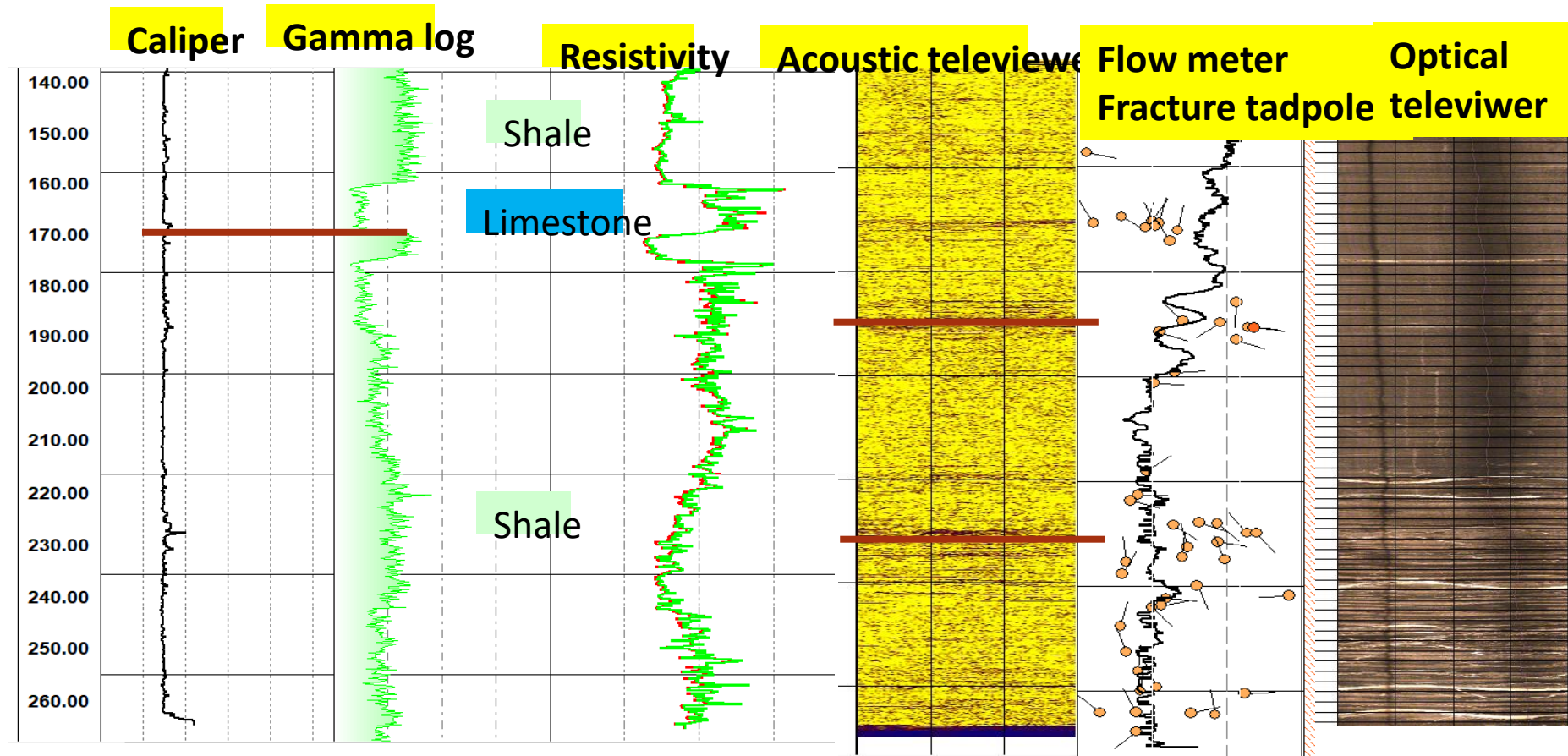
## Energy output

- Heating and cooling
- Pavement-heating (snow melting)
- 12MW peak effect



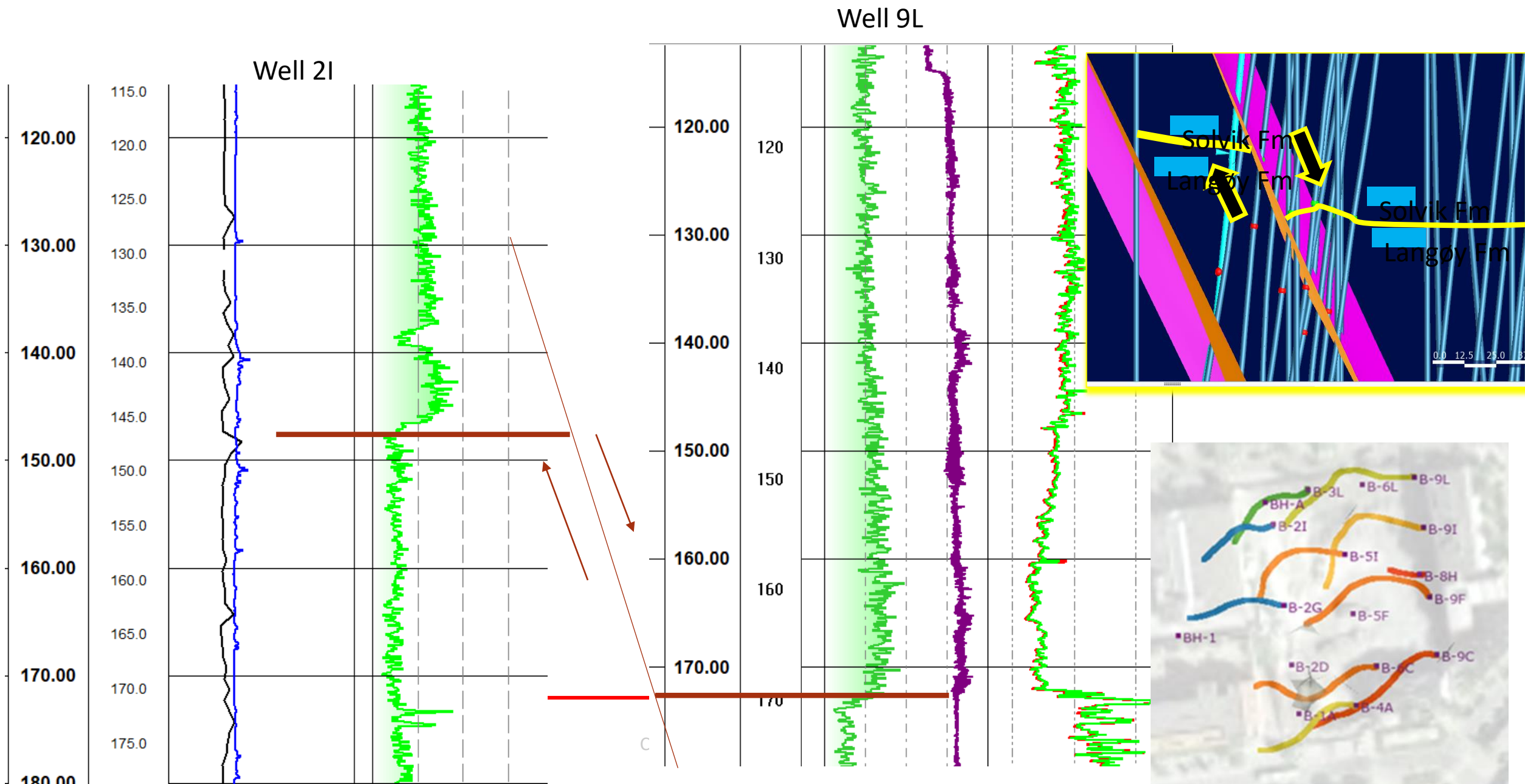
# Well logging - understand reservoir properties

- Identify and characterize fracture networks
- Lithology – flow properties
- Develop geological models and simulations



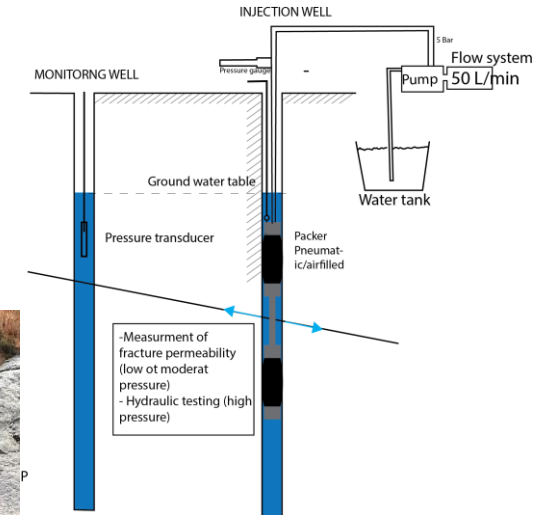


# 3D representation of the subsurface



# Well testing and well stimulation

- The capacity of the reservoir
- How much energy can we extract without influencing ground water level
- Can we circulate/reinject fluids
- Increase capacity by hydraulic stimulation



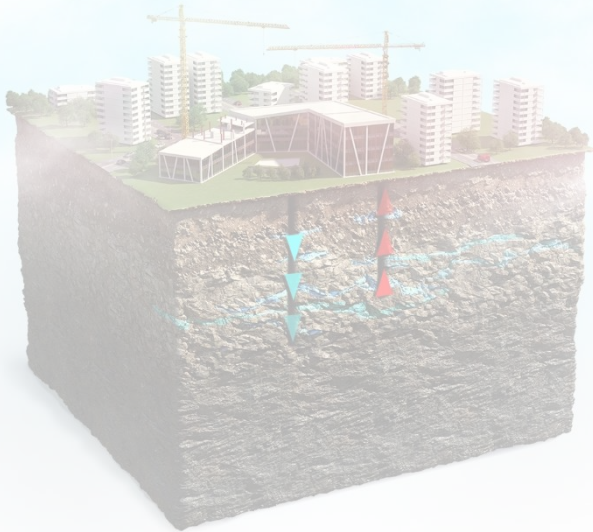
# Innovative solutions for heating and cooling of buildings and energy storage

Local needs

Regional needs

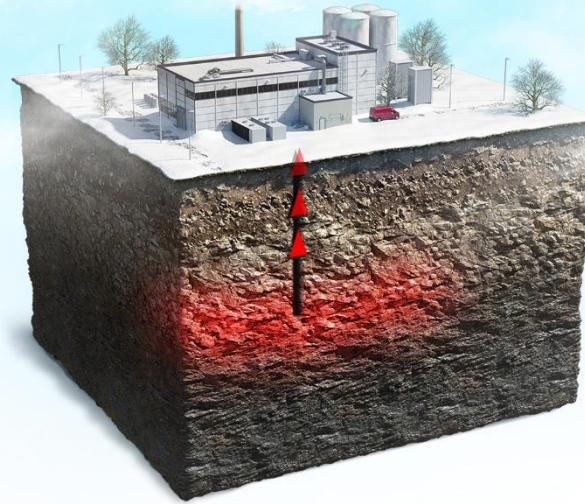
National needs

LEAT



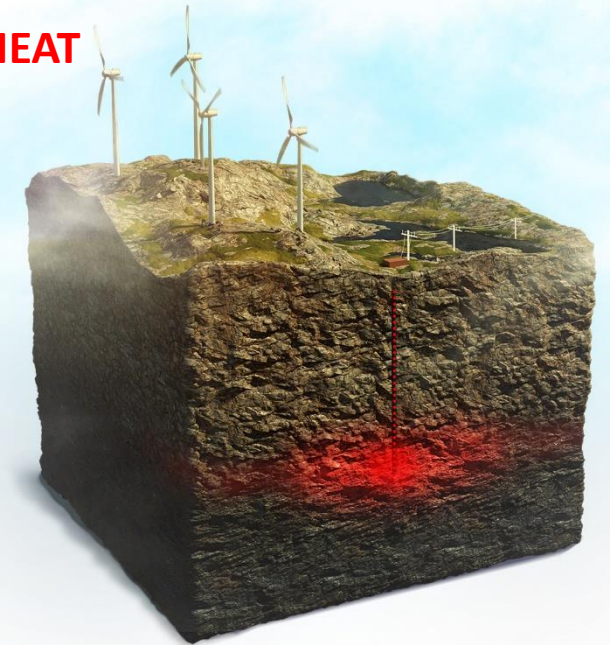
*Heating and cooling of buildings and infrastructure*

HEAT



*Storage of surplus heat with seasonal variations*

iHEAT



*Storage/generation of electricity*

# Geothermal storage

## Need:

Storage required for a wide range of time scales, ranging from seconds to months, as well as storage sizes, ranging from tens of kWh to tens of GWh



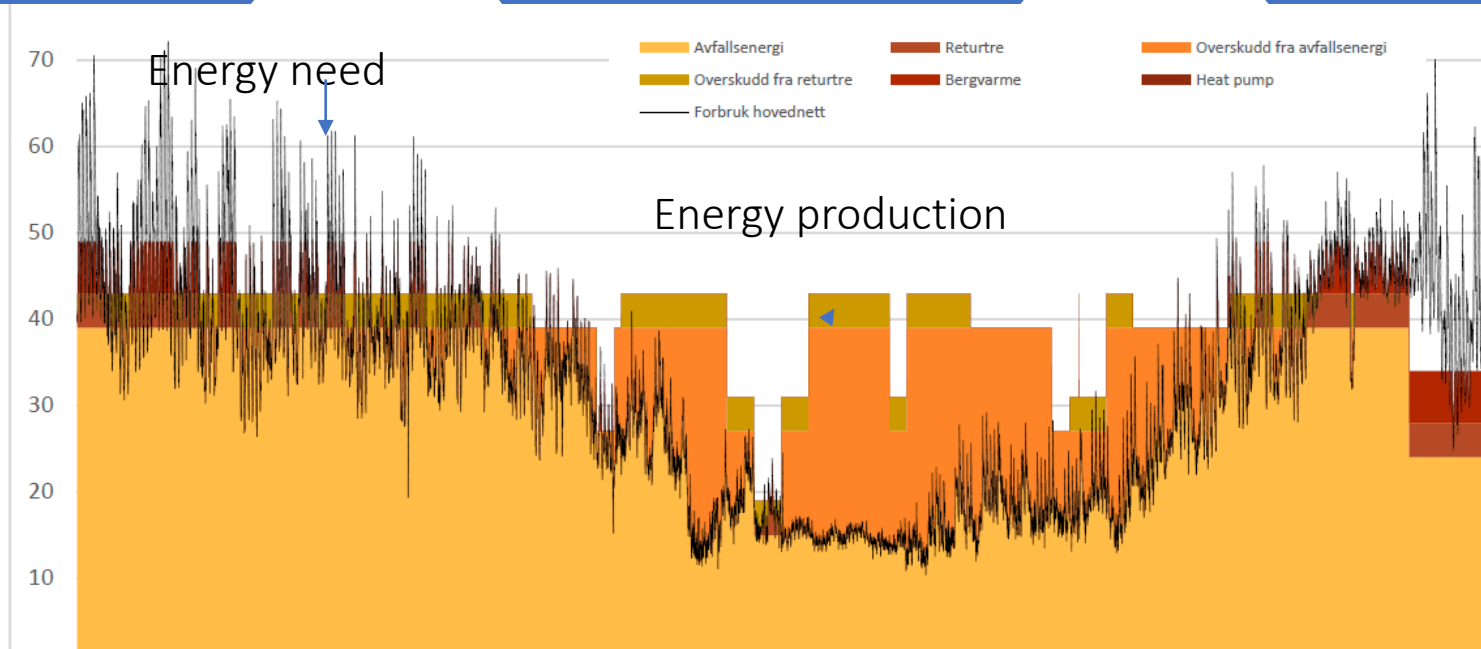
## Challenge:

- Energy supply from renewable subject to fluctuations.
- Do not match the instantaneous energy demand and energy base load



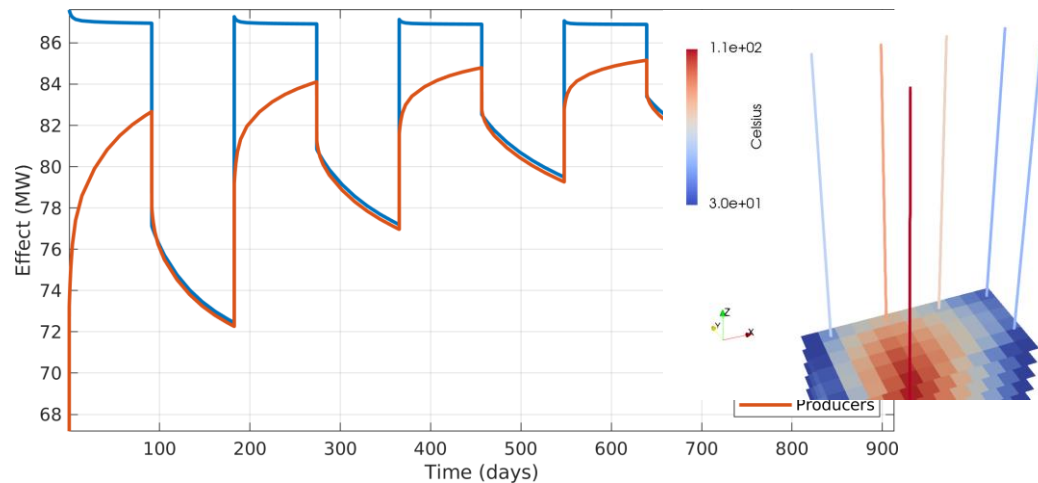
## Solution

- Develop energy storage to dampen fluctuations and to compensate for times of low power production.
- By taking up surplus power, energy storage also contributes to grid stability in times of high renewable energy production.



# Digitalization of multi-reservoir geothermal systems for optimal control of heat production, storage and peak-load management.

- IPN- project Developing tools to model ground water system
- MRST Matlab resevoir simulation toolbox – Sintef
- Platform to optimize design and both short and long term management of complex geothermal systems



**Ansvarlig organisasjon:** Ruden AS

**Partnere:** SINTEF

**Prosjektperiode:** 2020-2023

**Type:** Innovasjonsprosjekt for næringslivet

**Offentlig finansiering:** 6.75 MNOK/totalprosjekt 10 MNOK

**Prosjektnummer:** 309651

# Tromsø pilot project

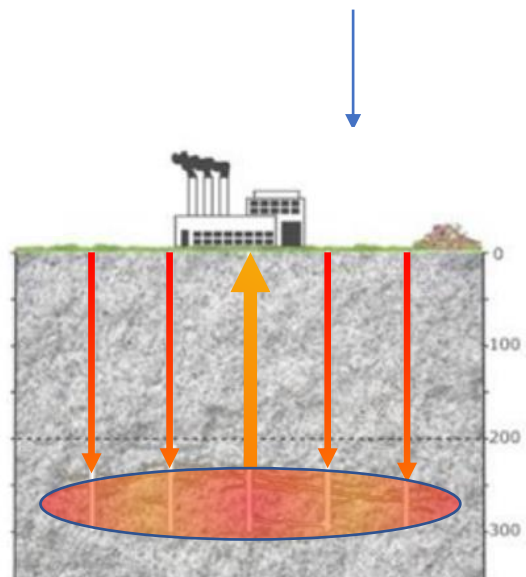
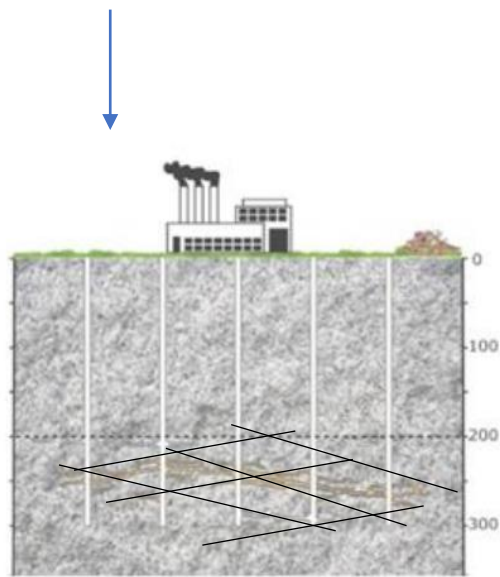
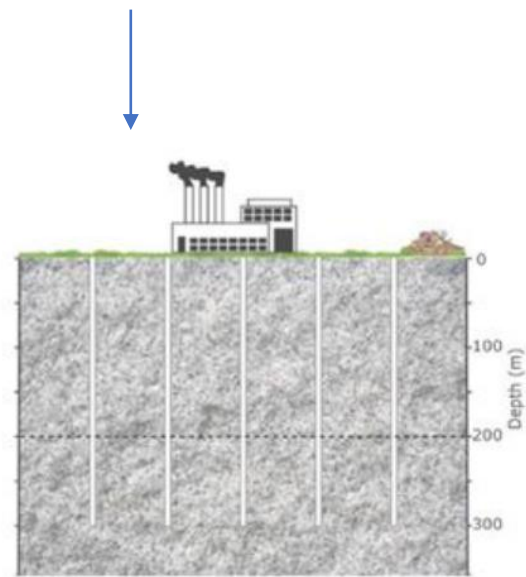
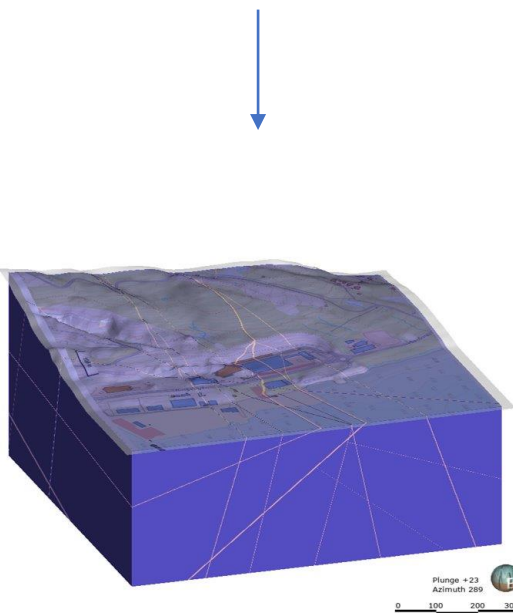


## Project goals

- Effect: 5 - 9 MW
- Injection: > 140 °C
- To be retrieved: > 65 °C
- Inject: 28 GWh each year
- Recover: 10+ GWh each year
- Number of wells: 15
- Max well depth: 300 m



# The HEAT technology



# HEAT Kvitebjørn varme

- ✓ Pilot phase finalized – TRL 5
- ✓ Underground reservoir characterization- challenges identified
- ✓ Technology need from Oil and gas Industry – Established collaboration
- ✓ Simulation and modelling tools under development through RCN funding (IPN)
- ✓ RFF funding to identify risk and potential innovation/research topics
- ✓ Full scale development planned during 2022

Thank you for your attention!

