Ongoing deep geothermal projects in Longyearbyen

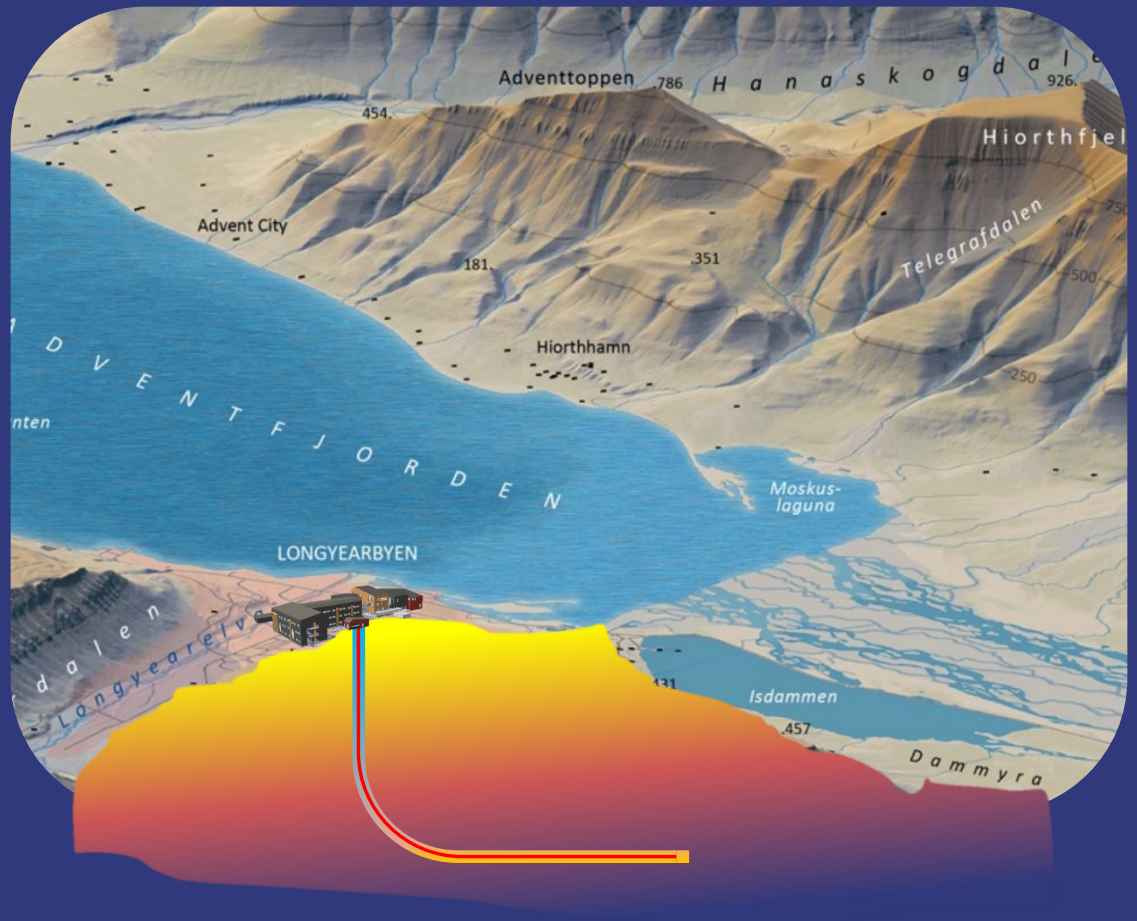
Malte Jochmann

Store Norske Energi & UNIS

& project partners

malte@snsk.no

www.snsk.no




Grønland
Svalbard,
Longyearbyen 78°N
Island
Finland
Sverige
Norge
Storbritannia

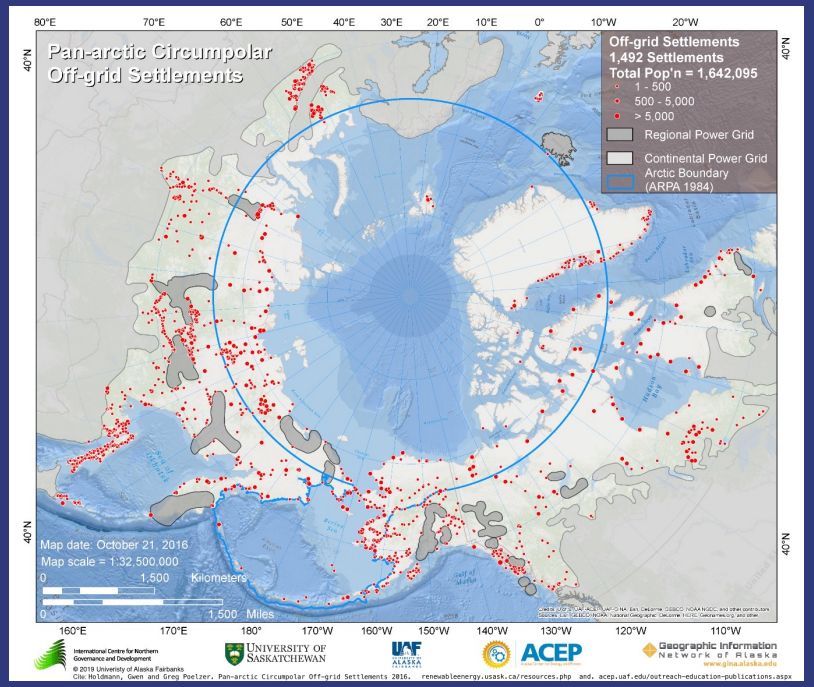
Store Norske: from coal to renewable energy

Store Norske Spitsbergen Kulkompani → Store Norske Energi

End of coal mining: summer 2025

Northernmost PV park worldwide: Isfjord Radio

Store Norske Energi plans to accelerate the introduction of renewable energy in arctic communities

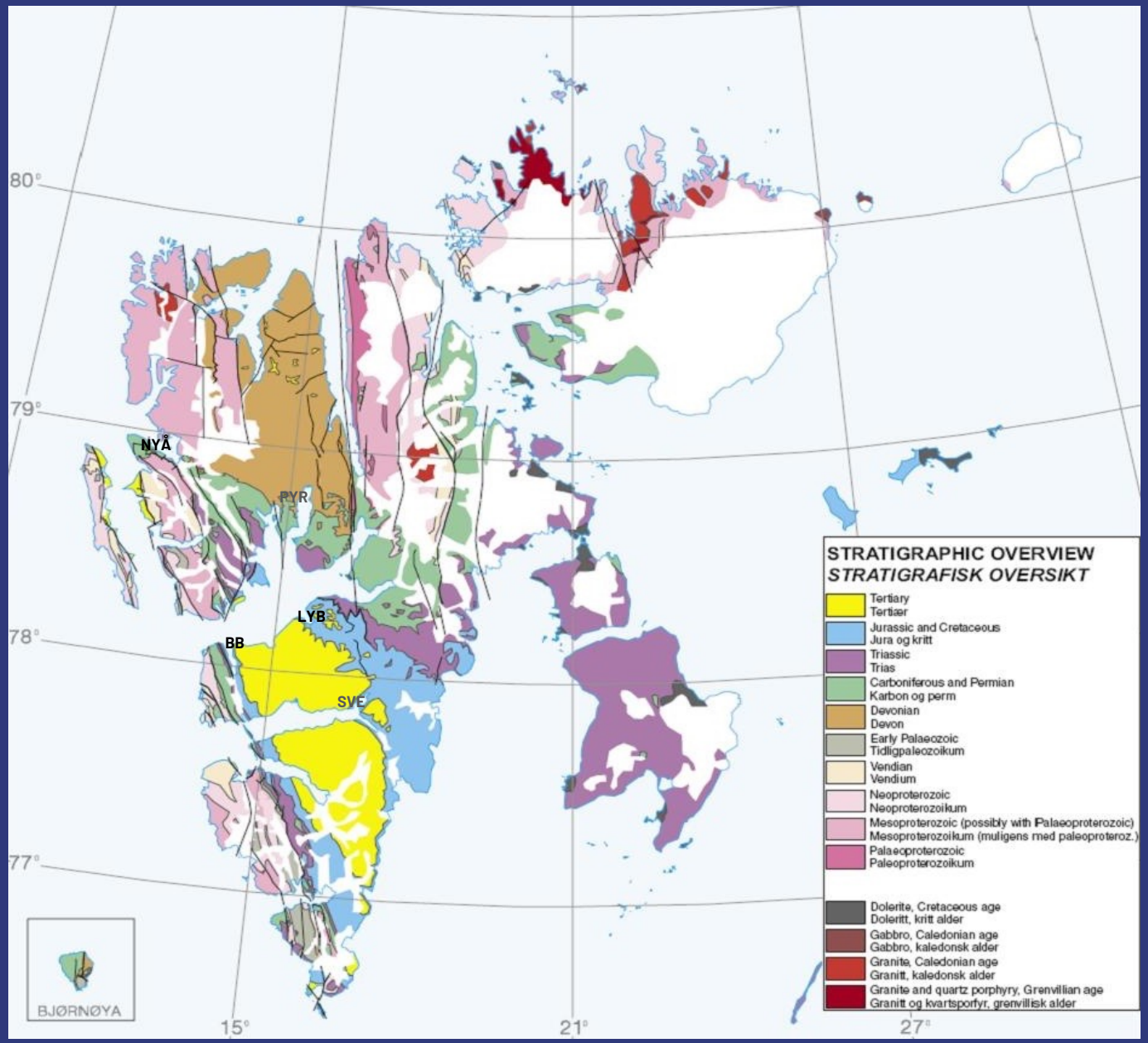


Holdmann, Gwen and Greg Poelzer. Pan-arctic Circumpolar Off-grid Settlements [map]. 1: 32,500,000. Fairbanks, Alaska: Alaska Center for Energy and Power. 2016 https://renewableenergy.usask.ca/resources.php

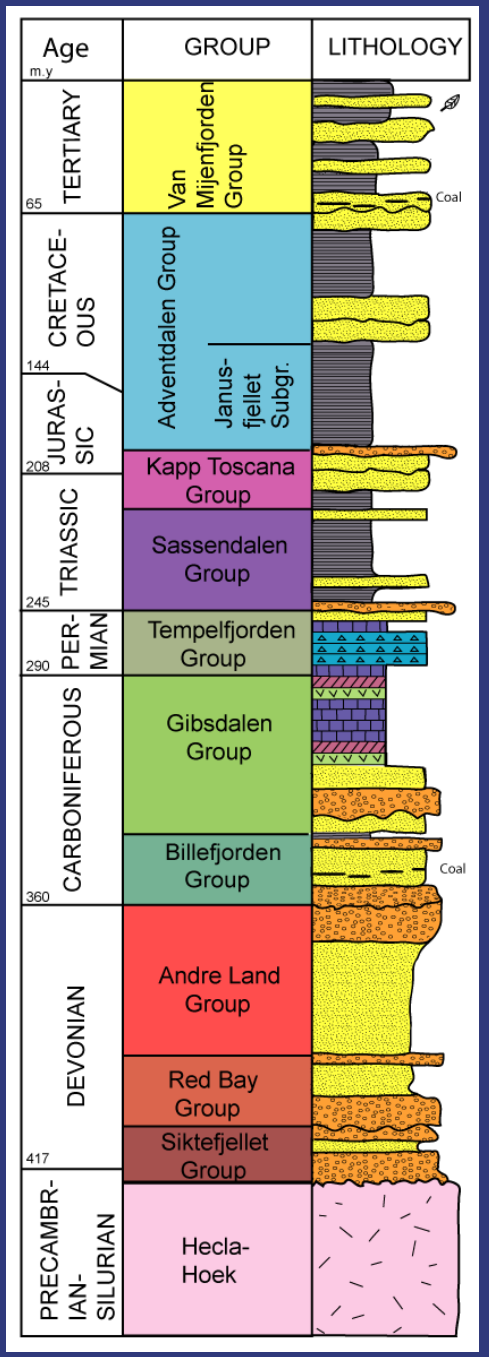
Store Norske Energi + Local partners

Arctic Energy Company

Geology of Svalbard vs mainland Norway



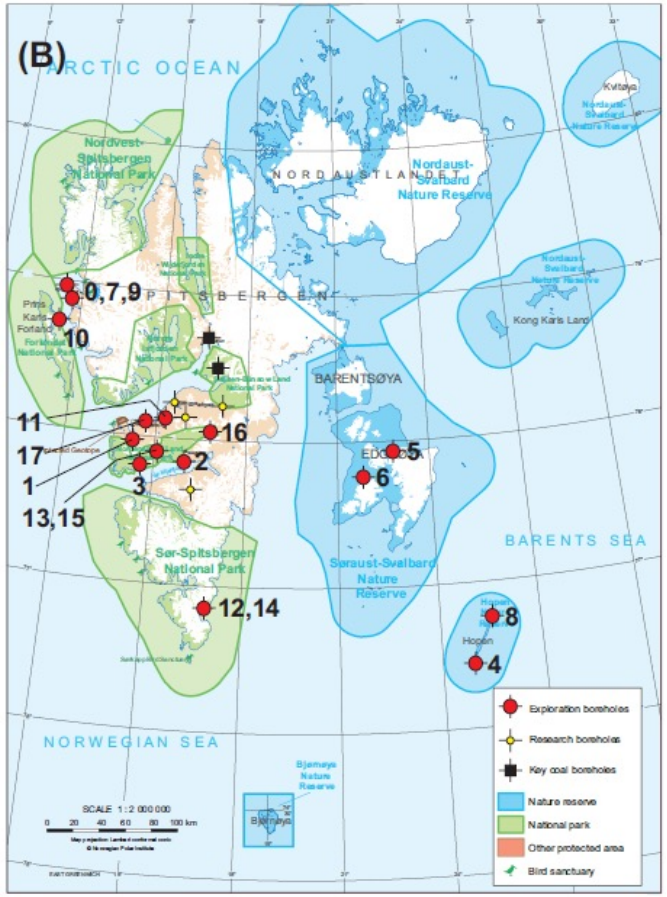
Map by Norwegian Polar Institute



Foundation for geothermal projects in Svalbard

Research, cooperation and O&G exploration

- 18 petroleum exploration wells
- Seismic lines
- A long history with cooperation between O&G-sector, Store Norske and academia:
  - Reindalspasset 1991
  - Kapp Laila 1994
  - Sysselmannbreen 2008
  - CO2-project 2007 ff



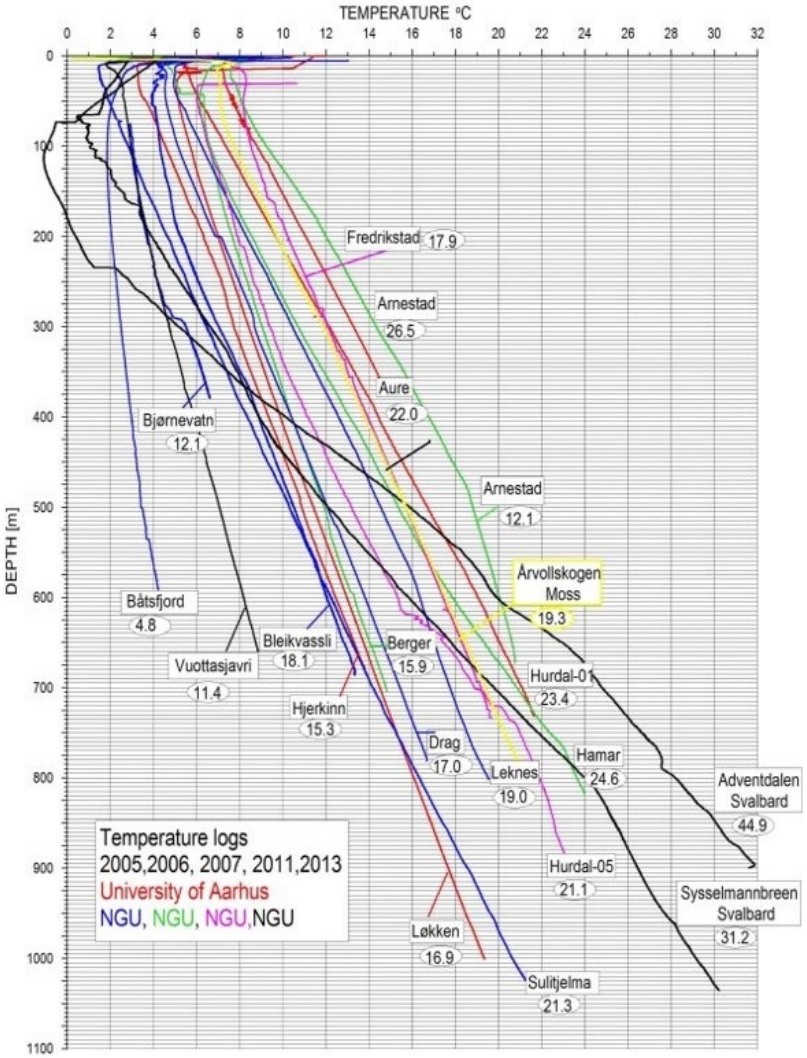
Senger et el: 2019: Petroleum, coal and research drilling onshore Svalbard: a historical perspective. *Norwegian Journal of Geology 99 Nr 3.*

The geothermal potential in Svalbard

2013 – 2016: the first project

- Subsurface temperature based on O&G, research, and coal exploration wells
- New temperature measurments in coal exploration wells
- Subsurface geology, thermal properties of strata, modelling
- Feasibility of geothermal systems in the different settlements

Mainland vs **Svalbard**



Plot by NGU, project «Miljøvennlig energiløsning på Svalbard – utnyttelse av geotermisk energi» 2013-2016

What is «different» in Svalbard?

- Off-grid communities
- Permafrost
- Heating needed 365/24/7
- No close neighbours
- Expensive logistics
- Cold climate

Longyearbyen:

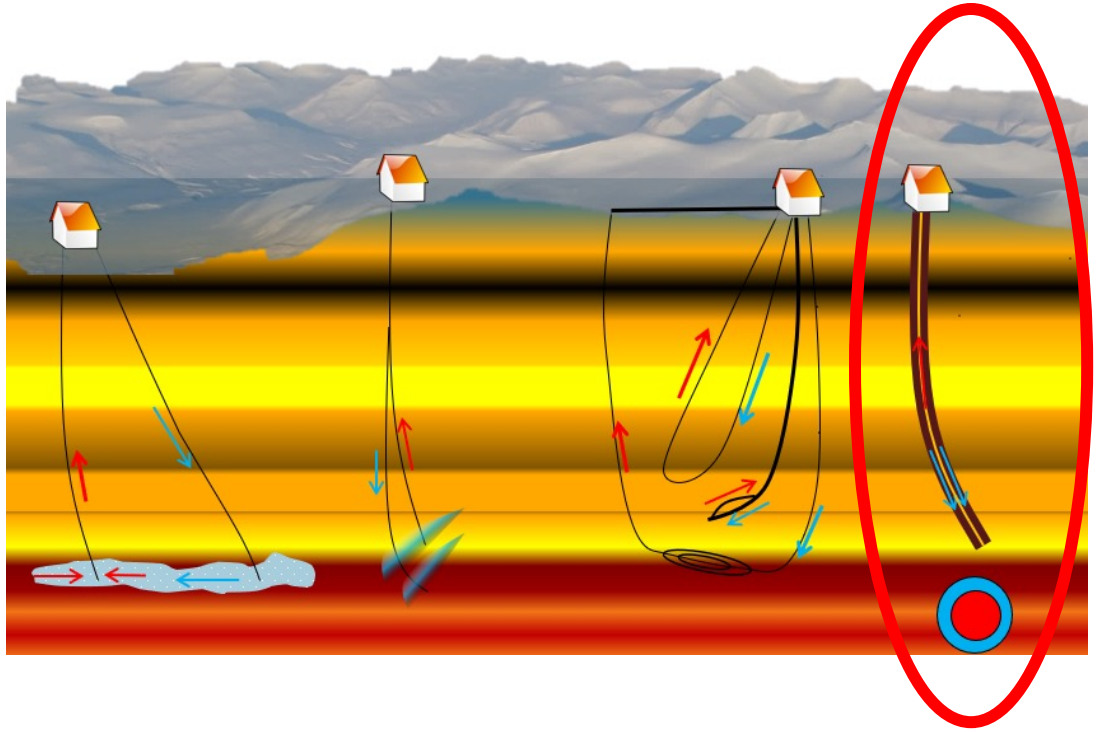
- DHS in place
- 2500 inhabitants
- 2,5 - 3 NOK/kWh
- Easy to attain international attention

→ geothermal philosophy behind the projects

- Can’t afford to fail
- Reliable system
- Commercially special: no possibility to extend locally → universal system to export the technology to similar settlements

→**Deep Borehole Heat Exchanger**

Low Yield, Low Risk



Energy situation in Longyearbyen

Now and in the future

Longyearbyen's energy plan

- from static coal via flexibel diesel to renewables -

2023

Last coal
19.10.2023

2030-33

Testing and phasing-in of renewables

Coal

Diesel

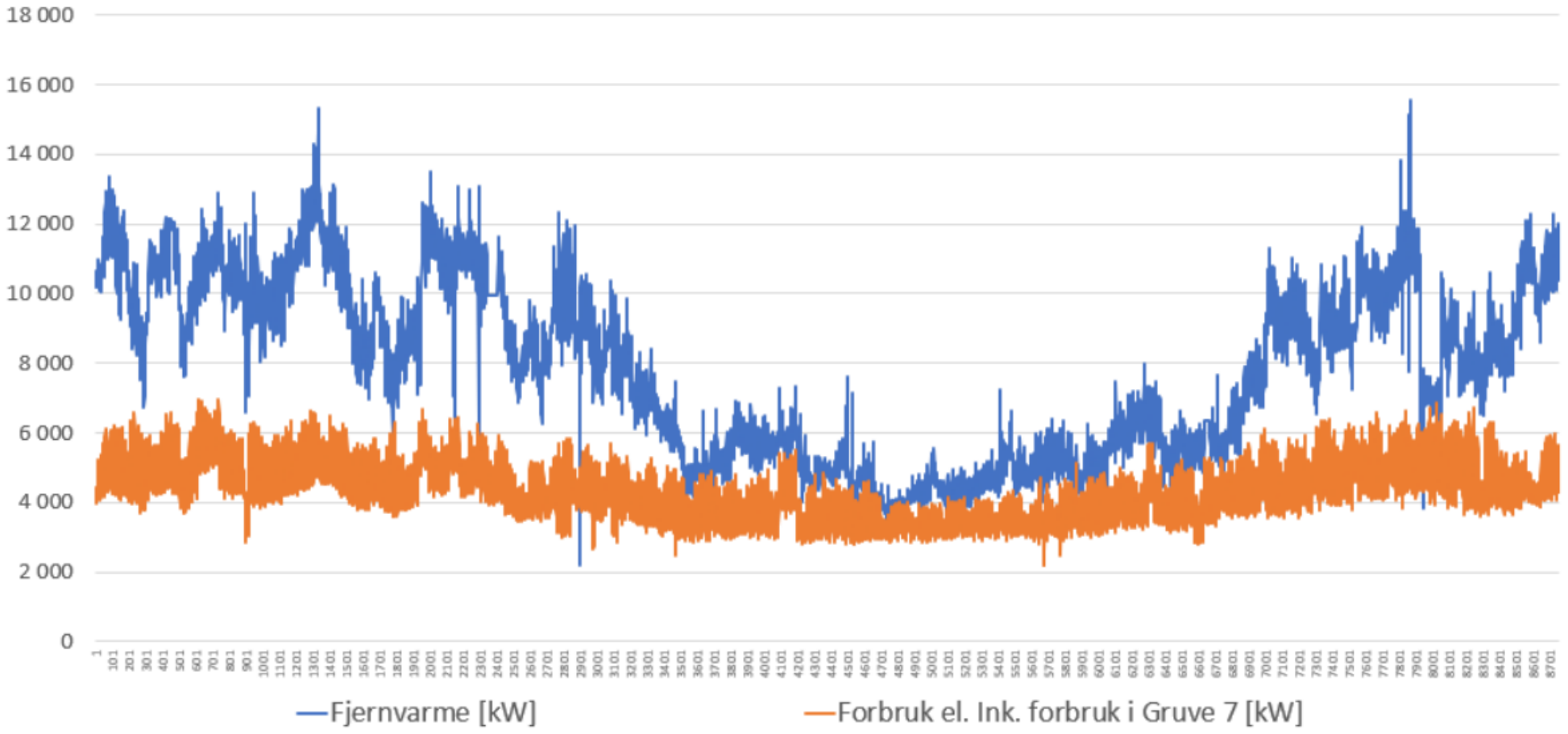
Renewables

Primary loop DHS

120°

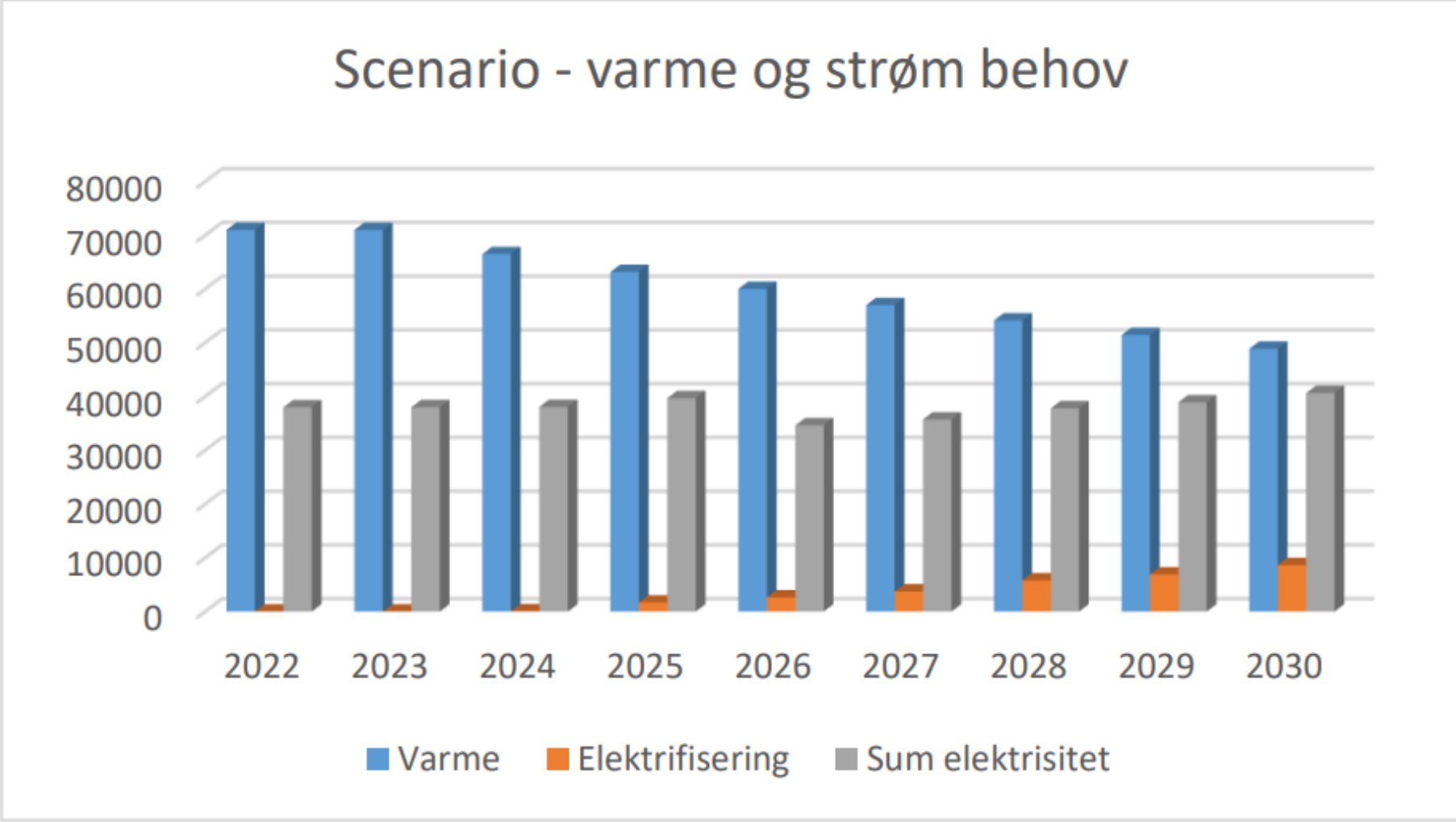
70-80°

Energy demand today



From: Energiplan Longyearbyen, Lokalstyre 2023

Expected Energy demand: 100 GWh (ca. 50/50 th/el)



From: Energiplan Longyearbyen, Lokalstyre 2023

Latest and ongoing geothermal projects

Concept studies, so far no drilling

2021-2022:

Store Norske, GTML, UNIS, support by Enova:

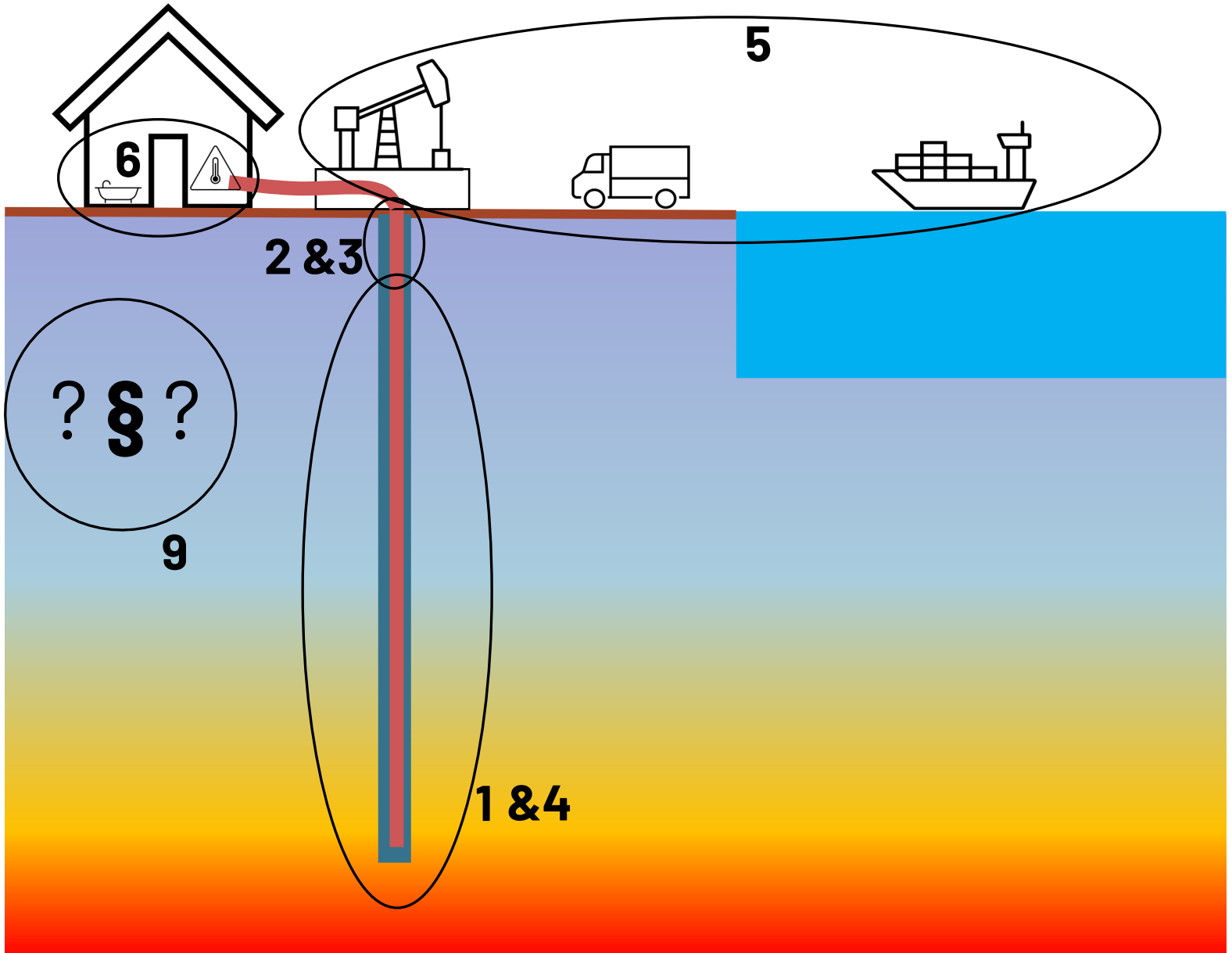
- **Medium deep gethermal project using DBHE and heat pump**

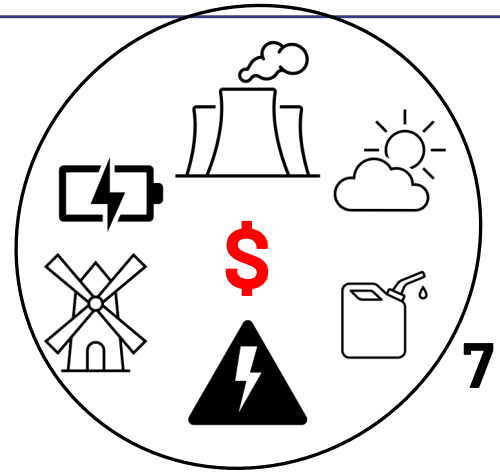
2022–2024:

Reelwell, OMV, Halliburton, IFE, Store Norske, TotalEnergies, support by RCN:

- **Deep geothermal project using DBHE without heat pump**

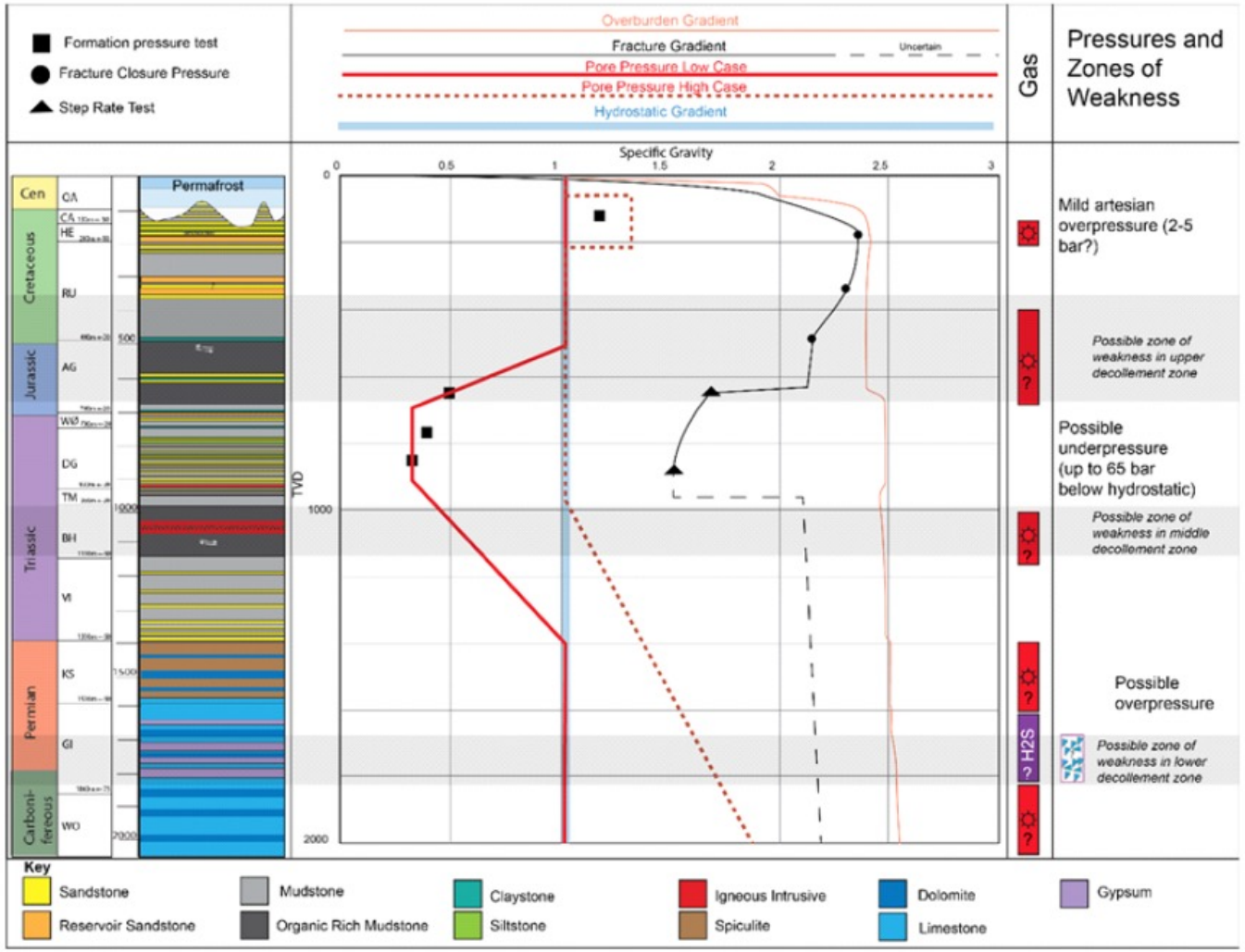
Cost estimate and risk analysis





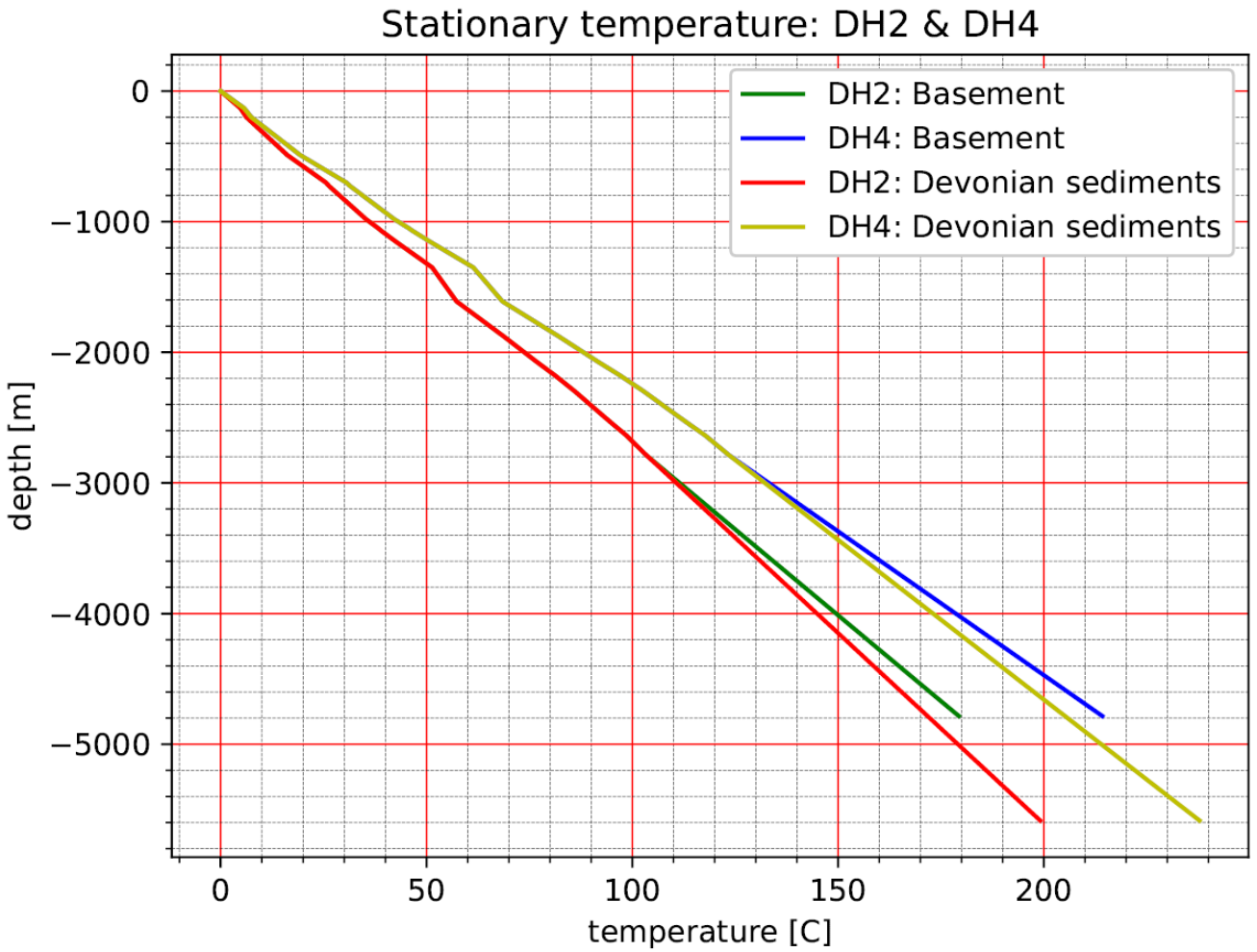
1. Rock subsurface geology and drilling solution
2. Overburden geology and permafrost
3. Technical solutions permafrost
4. Technical solutions heat excanger
5. Logistics and drilling operation
6. On ground energy system/heat pumps
7. Costs
8. Legal issues and permissions

Well prognosis

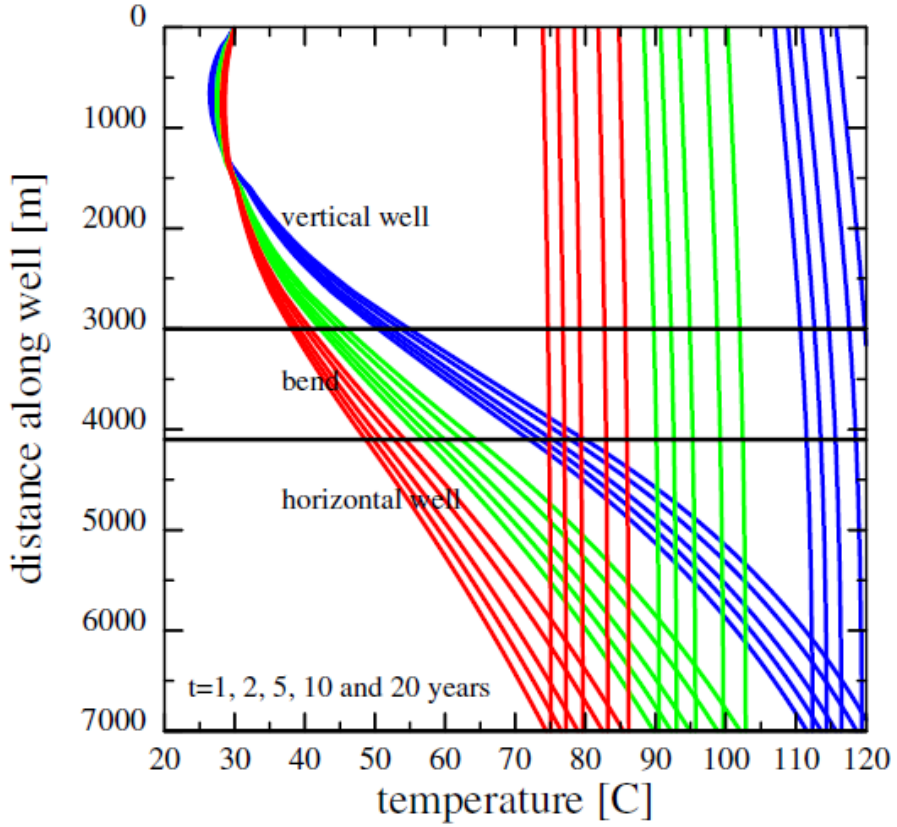


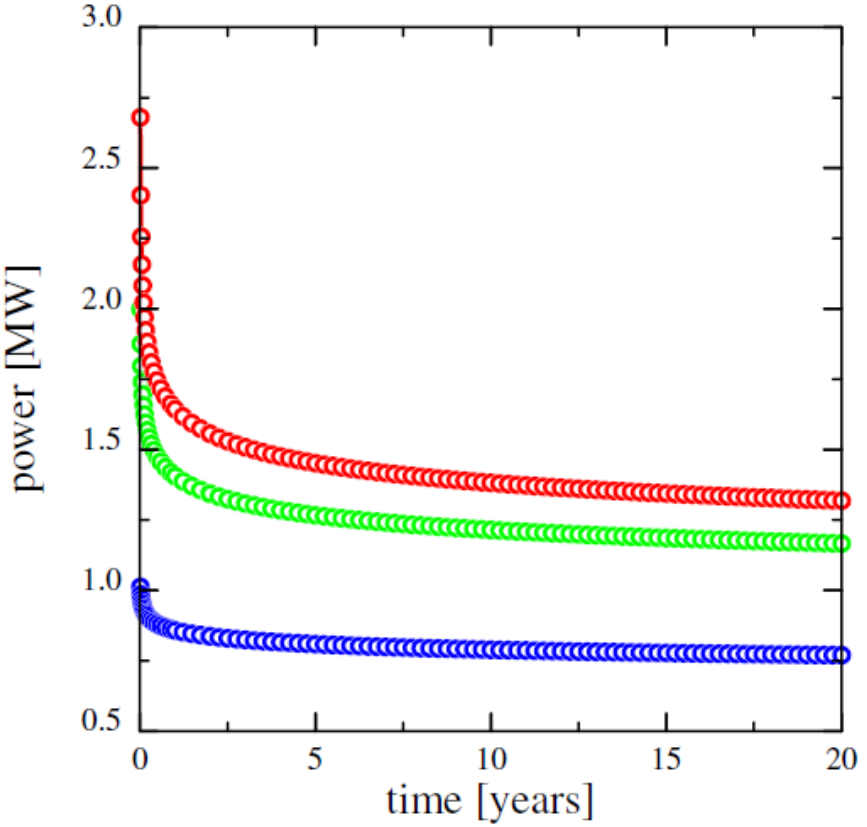
Olaussen & Birchall in Senger et al. 2023

Temperature prognosis, different geologies

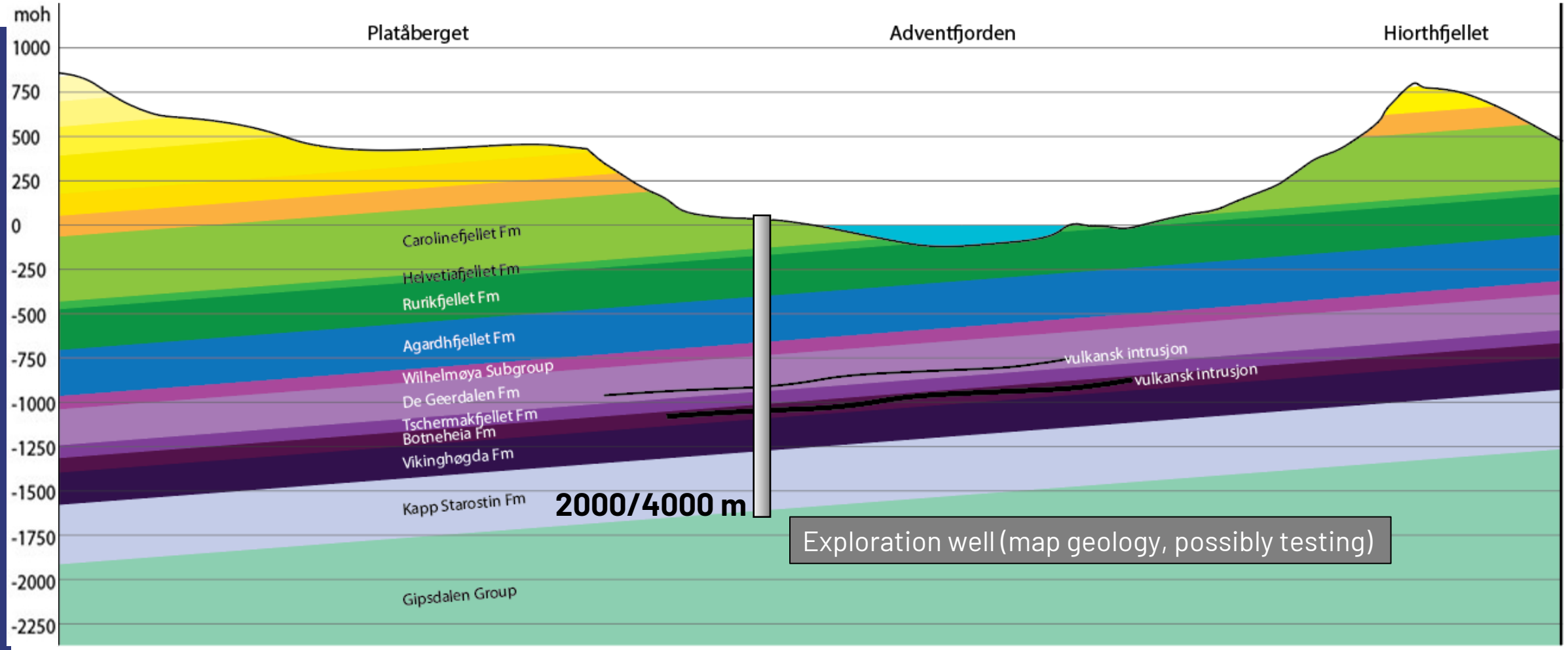


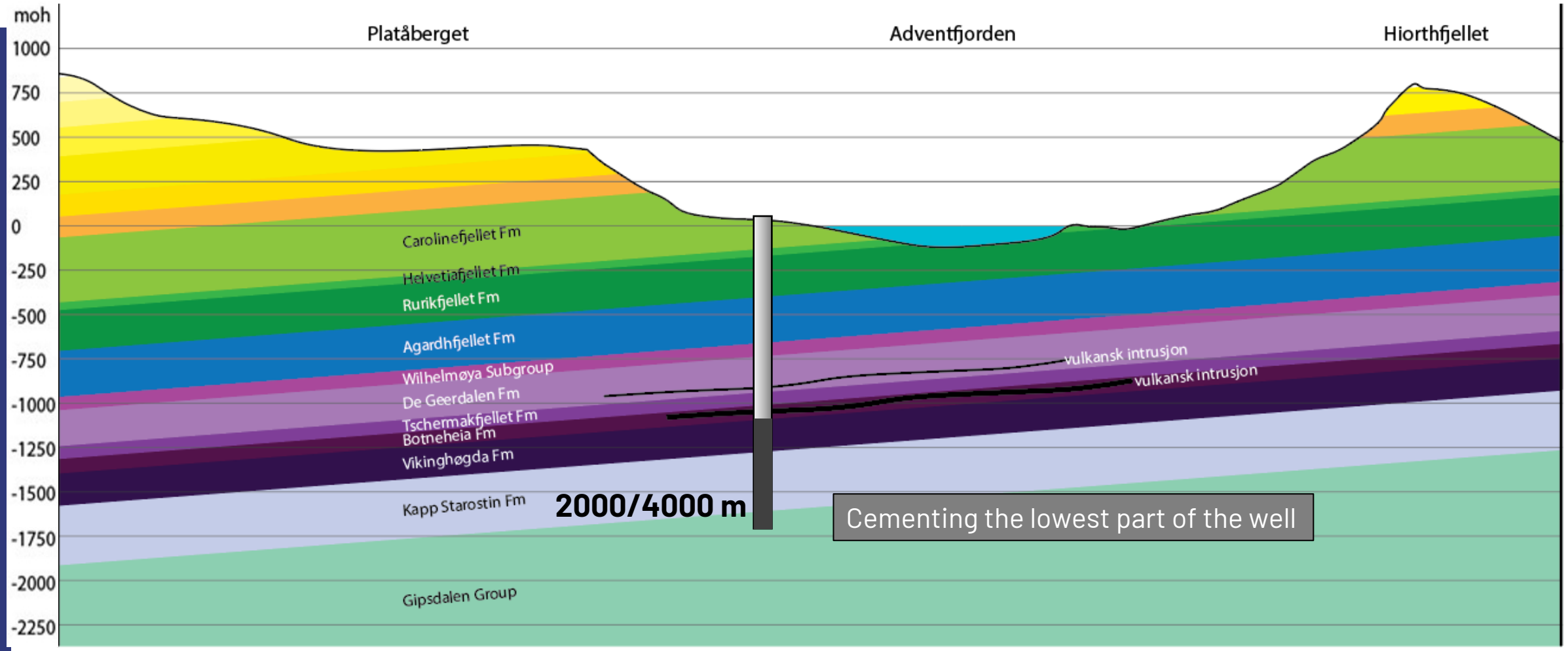
Reelwell-project



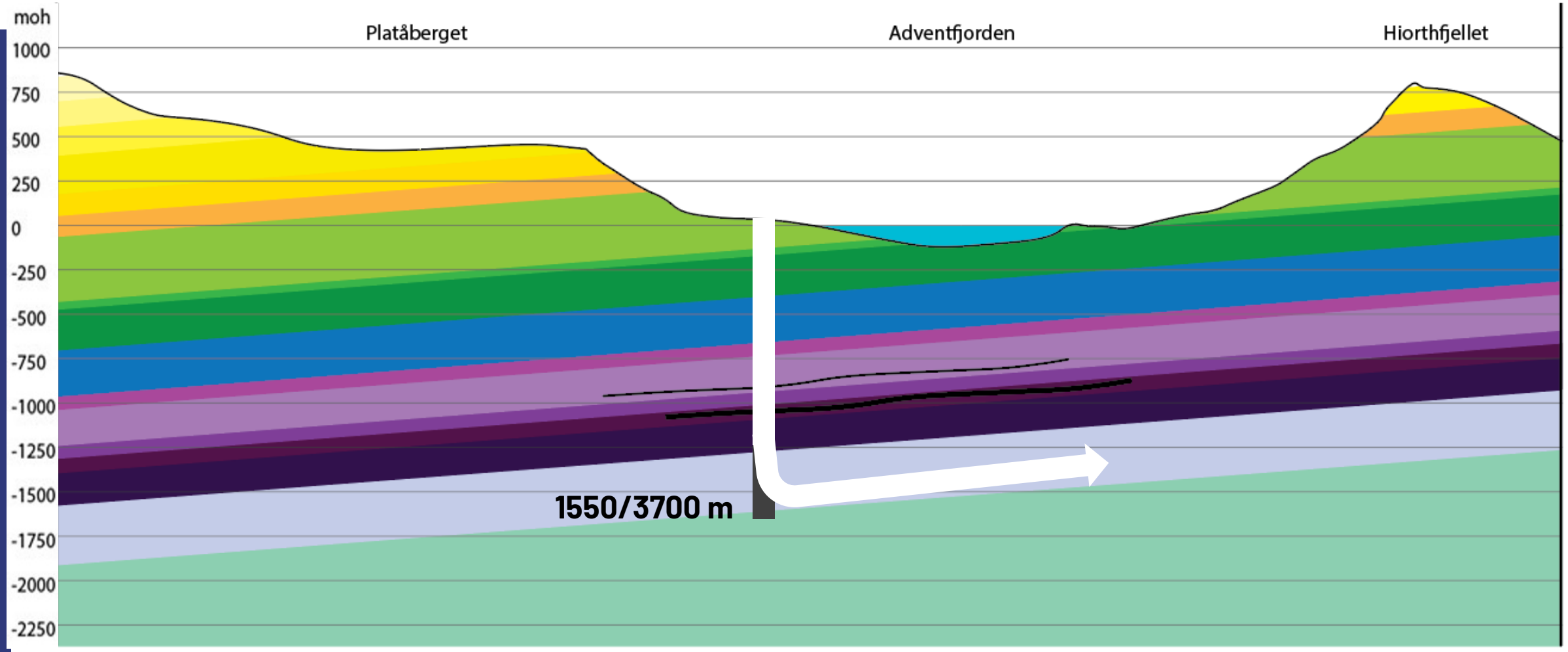


Plot by Magnus Wangen, IFE

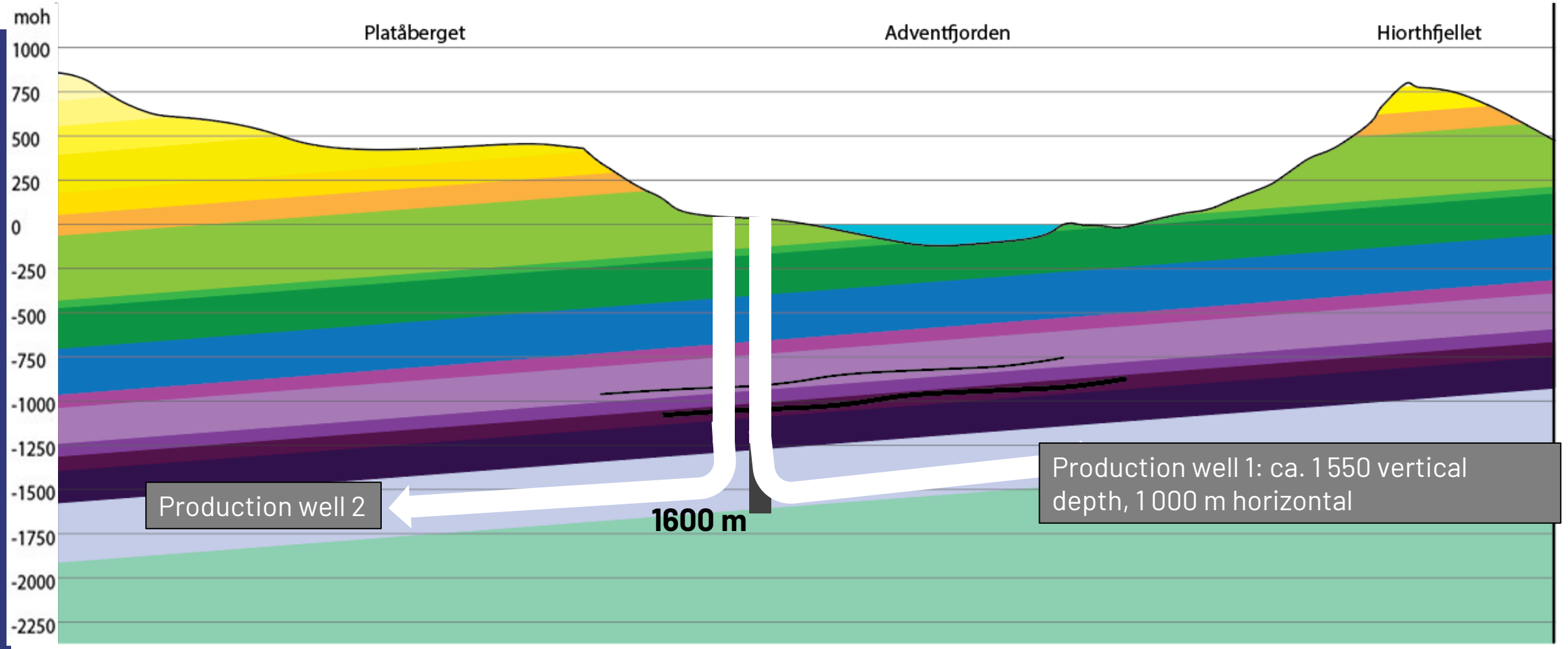

moh
1000
750
500
250
0
-250
-500
-750
-1000
-1250
-1500
-1750
-2000
-2250
Platåberget
Adventfjorden
Hiorthfjellet
Carolinefjellet Fm
Helvetiafjellet Fm
Rurikfjellet Fm
Agardhfjellet Fm
Wilhelmøya Subgroup
De Geerdalen Fm
Tschermakfjellet Fm
Botneheia Fm
Vikinghøgda Fm
Kapp Starostin Fm
Gipsdalen Group
vulkansk intrusjon
vulkansk intrusjon
2000/4000 m
Exploration well (map geology, possibly testing)


moh
1000
750
500
250
0
-250
-500
-750
-1000
-1250
-1500
-1750
-2000
-2250
Platåberget
Adventfjorden
Hiorthfjellet
Carolinefjellet Fm
Helvetiafjellet Fm
Rurikfjellet Fm
Agardhfjellet Fm
Wilhelmøya Subgroup
De Geerdalen Fm
Tschermakfjellet Fm
Botneheia Fm
Vikinghøgda Fm
Kapp Starostin Fm
Gipsdalen Group
vulkansk intrusjon
vulkansk intrusjon
2000/4000 m
Cementing the lowest part of the well

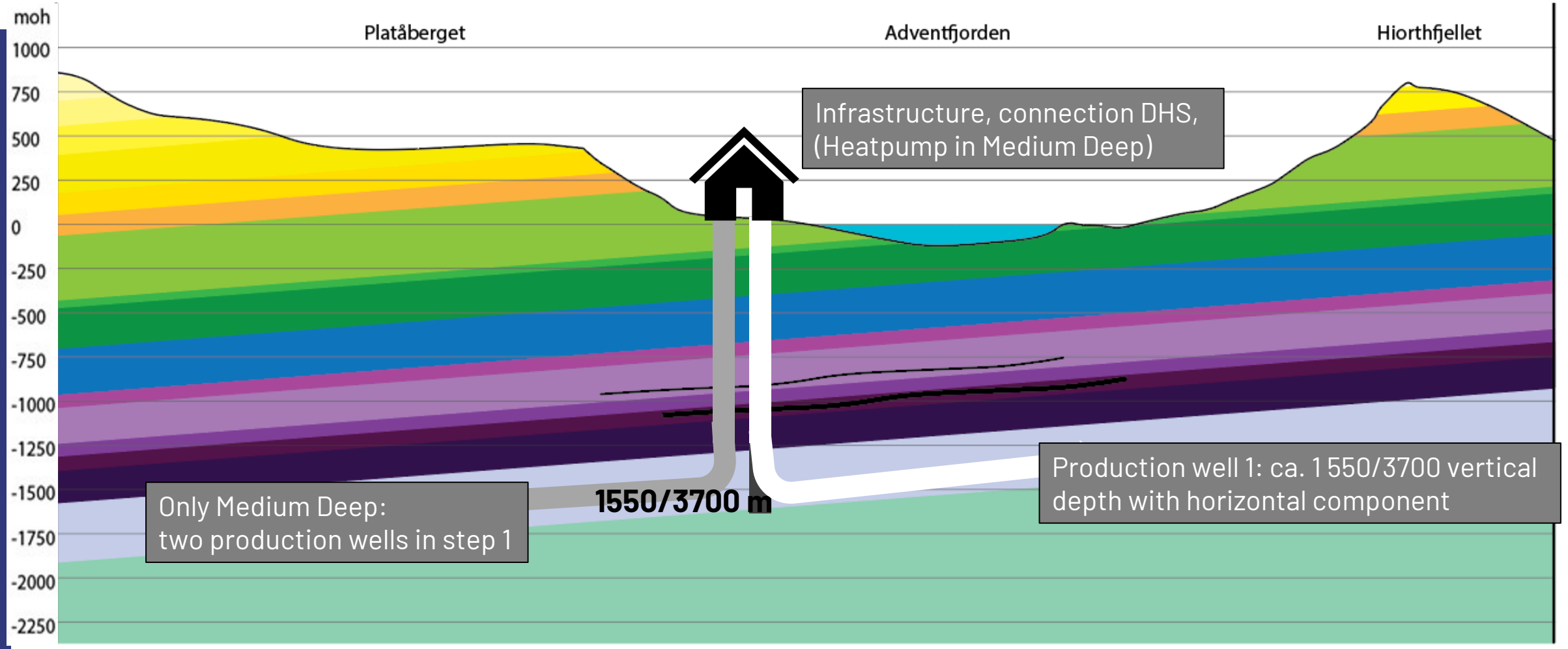
Horizontal part



Only Medium Deep: two wells in step 1



Step 1 finalised → Test→Decision point→ Full Scale



Summary: Geothermal concept studies Longyearbyen

With Heat Pump (GTML)

DBHE depth ca. 1550 m
with heat pumps

Geothermal energy

Establishing Stage 1 → Test Stage 1 → Est. Stage 2 → Stage 2 running

6-800 kW_{th} → 5,2 MW_{th} +

Without Heat Pump (Reelwell)

DBHE depth ca. 3700 m

Geothermal energy

Establishing Stage 1 → Test Stage 1 → Est. Stage 2 → Stage 2 running

800 - 1000 kW_{th} → 6 MW_{th} +
Option for generation of electricity with **ORC-turbine**

Outlook:

- Last Friday: The Norwegian Ministry of Trade, Industry and Fisheries and the Ministry of Justice and Public Security gave Store Norske the mandate to perform a concept study on the future energy solution in Longyearbyen. Plan to finish yje study in 2024.
- Will geothermal energy harmonise with other energy solutions?
- Financing?
- What is most important for Longyearbyen?

Thank you for your attention

Questions?