Borehole Thermal Energy Storage (BTES)- Deeper – Hotter

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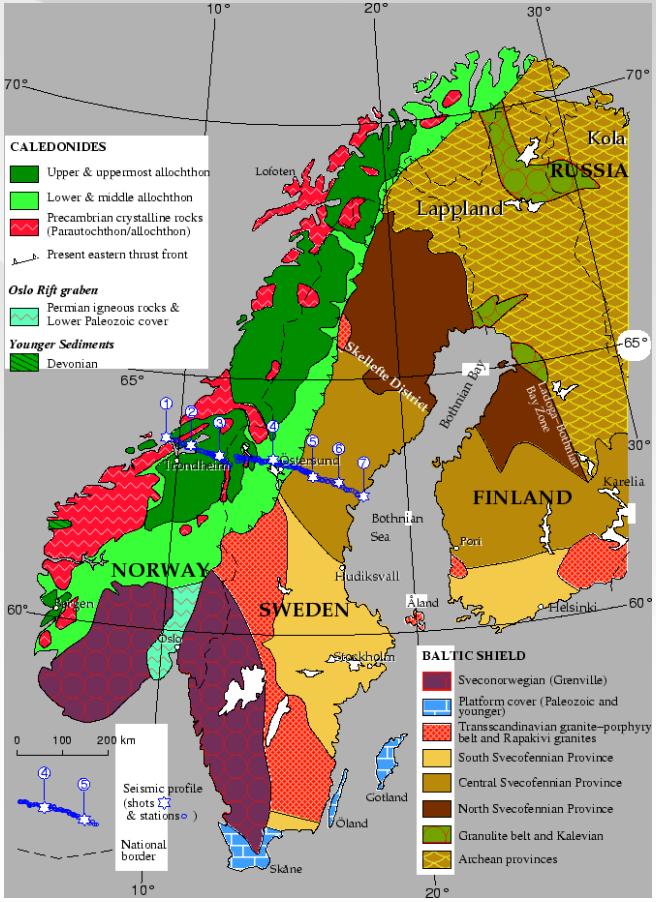
Status GHP's in Norway

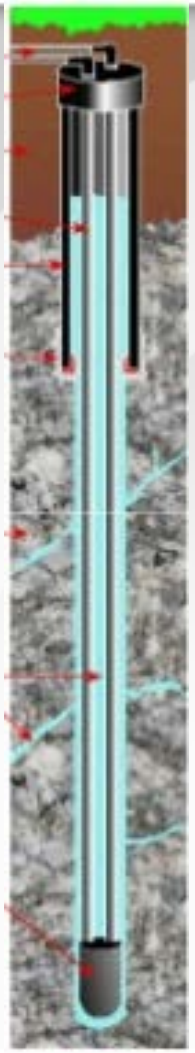
- About 60 000 Geothermal Heat Pumps (GHPs)
- More than 400 Borehole Thermal Energy Storage (BTES) installations

- Installed capacity ~1.5 GW_{th}
- Annual energy use ~ 3.0 TWh

Geologocal map Scandinavia



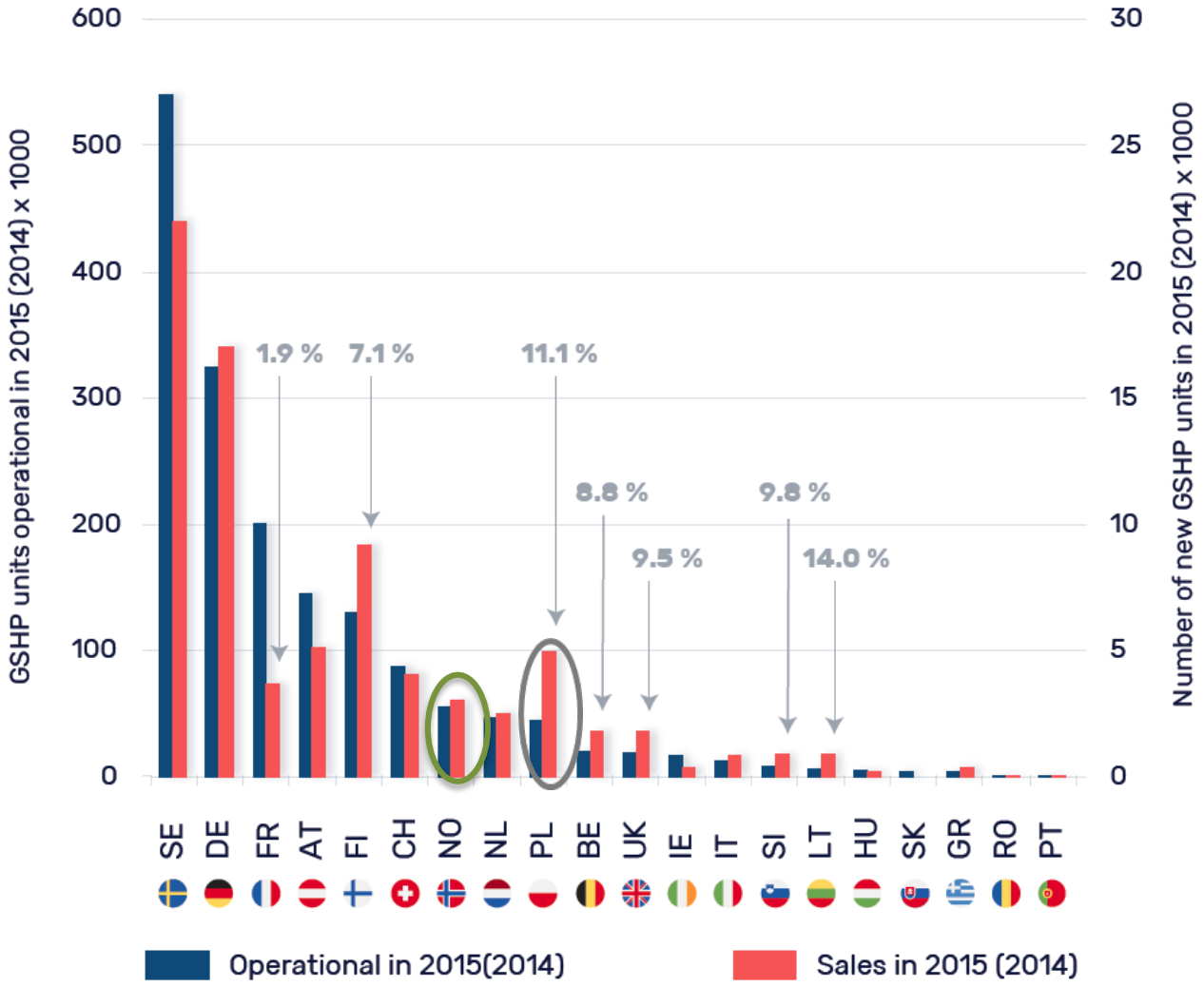
Nordic standard borehole heat exchanger (BHE)



- Borehole depth: 100-300 m
- Borehole diameter: 115mm
- Casing: > 1 m in crystalline rock
- Water filled (No grouting)
- Singel U-pipe d= 40 mm
- BTES: Borehole distance 6-10m

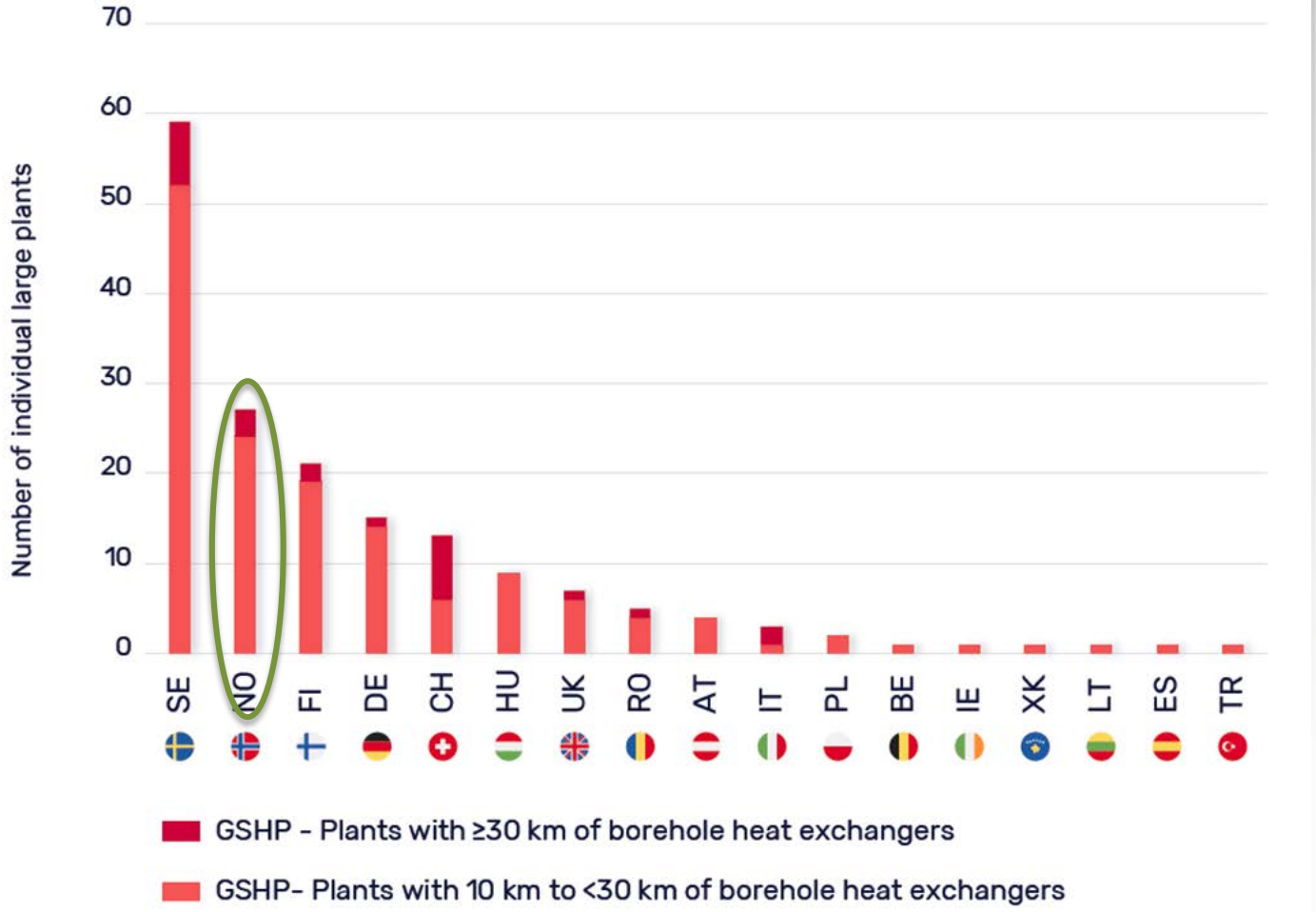
Standard BHE

FIG. 20 - GSHP / NUMBER OF INSTALLED GSHP UNITS AND ANNUAL NEW INSTALLATIONS IN 2015; NUMBERS SHOW THE RATIO OF NEW UNITS IN RELATION TO EXISTING GSHP STOCK



RENEWABLE ENERGY

BTES with more than 10 km BHEs



BTES in Bergen

2013

Sartor mall
165 BHEx 200m

2011

Kleppestø school
19 BHE x 180m

2010

Clampon
5 BHE x 180m

2013

COOP Åsane
112 BHE x 212m

2001

Ahlsell Åsane
6BHE x 160m

2010

Olav Grevstad AS
6BHE x 190m

1984

2012

4 apartment houses Varden
12BHE x 160m

2012

University College Bergen
80 BHE x 220m

2013

Haukeland Hospital
75BHE x 250m

2012

Kolstien
11BHE x 200m

2009

Ådnamarka school
14BHE x 190 m

2016

Sweco Fantoft
14BHE x 220 m

Scandic Flesland Hotel
50 BHE x200 m

2016

Spar Kjøp Kokstad 18BHE x 170m

2010

Sælenveien 91
18BHE x 170m

2012

Chr M Vestreheim
7BHE x 170m

2010

Espehaugen 45
6BHE x 200m

2012

Apeltun school
10BHE

2003

Scandic Flesland Airport Hotel

- Largest congress hotel in Bergen
- 27 meeting rooms
- Capacity of the largest meeting room: 1100 persons
- The Hotel opened April 4 , 2017

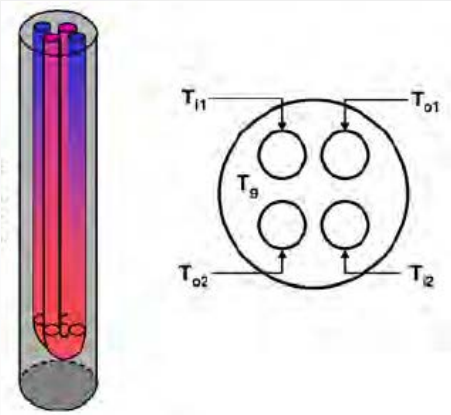
→High cooling peak loads

Scandic Flesland Airport Hotel

Solar collectors 17 % of the heat in May

Scandic Flesland Airport Hotel
Location of the BHEs

- 50 BHEs to 200 m depth
- Localized due to available area
- Double U-pipe BHE d= 32mm



Scandic Flesland Airport Hotel
Energy data

- 4 x two- steps heat pumps, 4x80 kW =320 kW (Bosch)
- Estimated direct cooling capasity 450kW

- Delivered energy 1.1-28.9.2017: 1071 MWh
- Delivered direct cooling 1.1-28.9.2017: 43MWh
- Average COP (SPF) heat pumps **5,5**

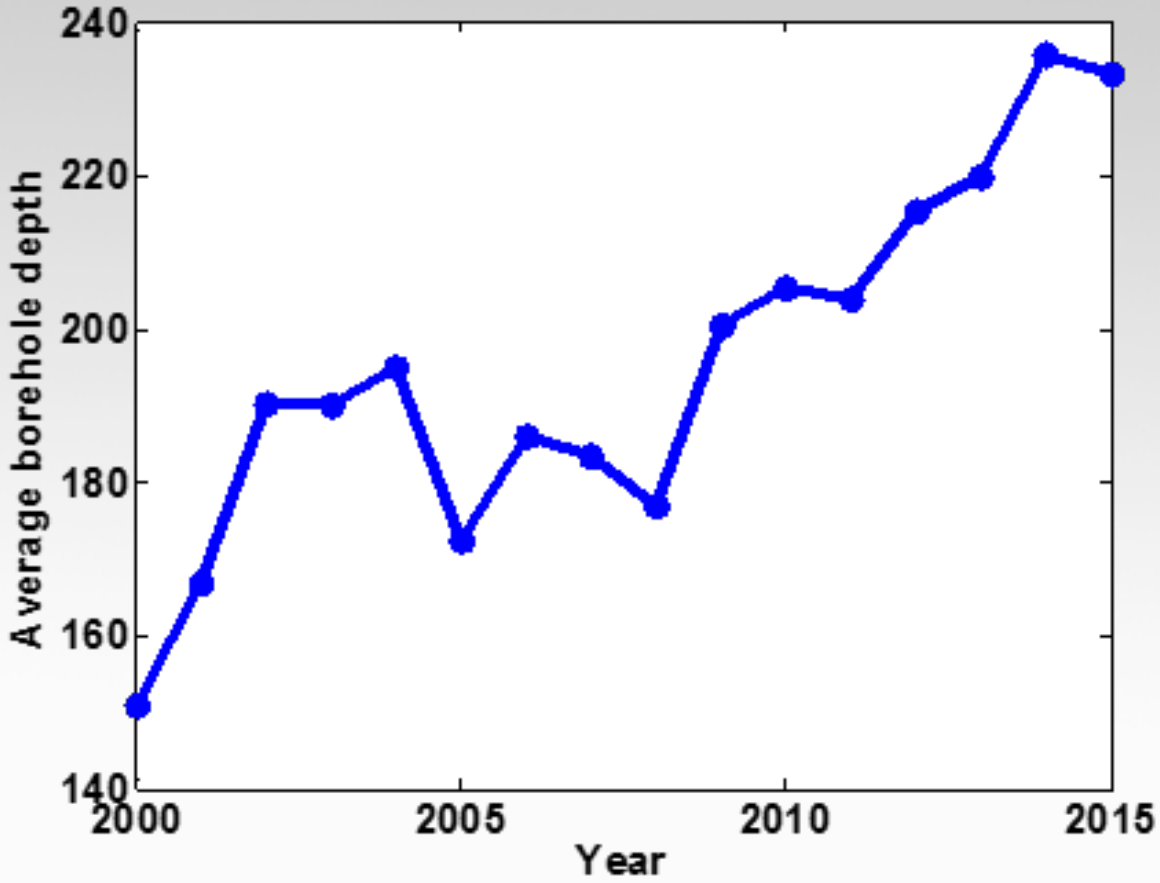
- The property owner (BGO eiendom AS) sell heat and cooling to the hotel

Geothermal heat pump installations, Arcus,

Oslo 90 BHE a 300m

Ref: Båsum Boring

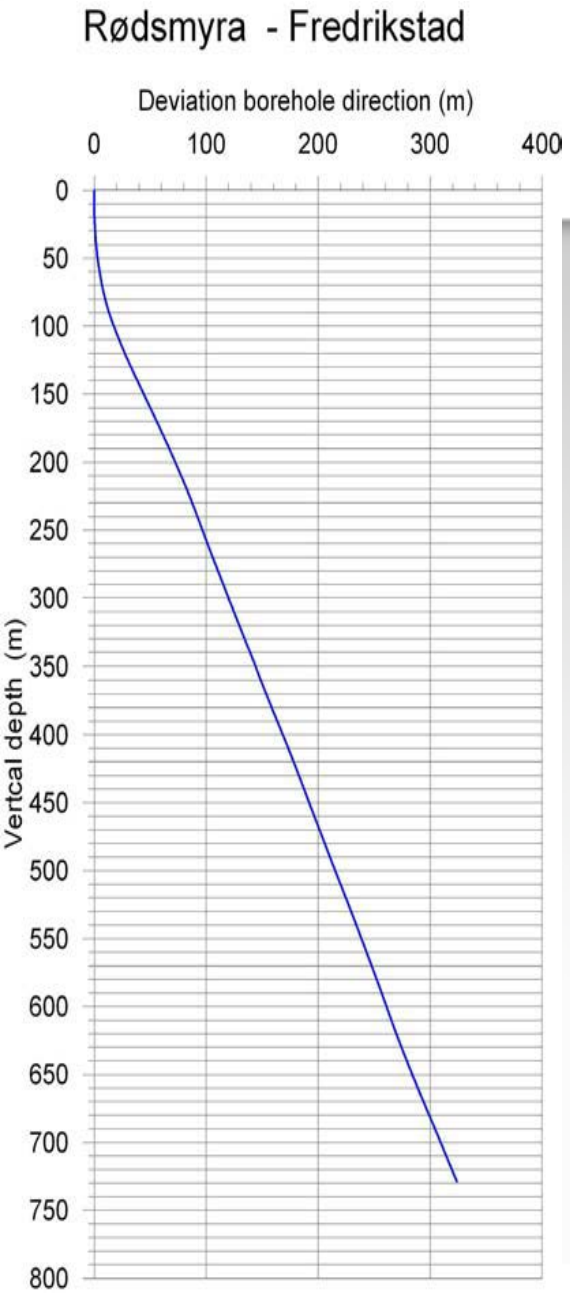
Average borehole depth (BTES)



RENEWABLE ENERGY

Deep BTES

Ref: Båsum Boring



Borehole deviation

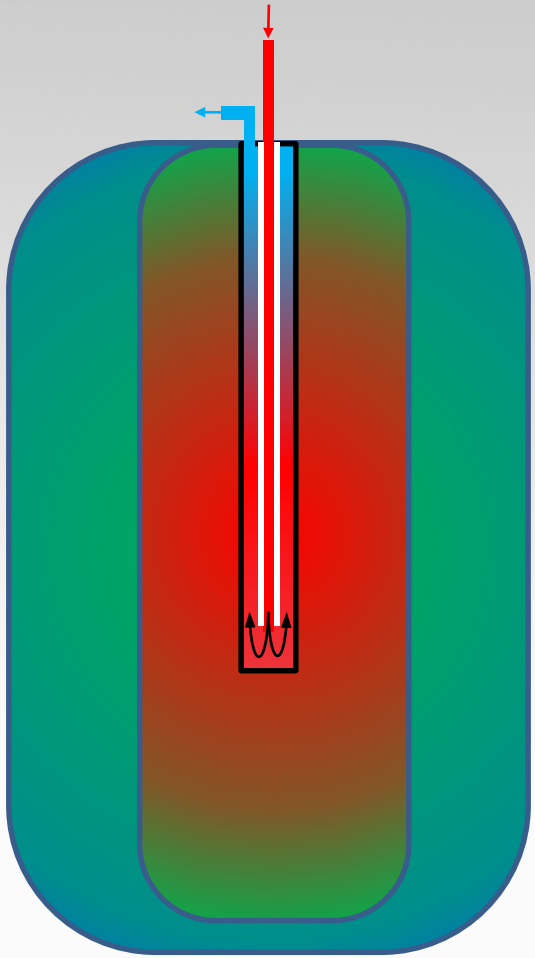
- Directional drilling is not common
- The borehole deviation is seldom measured

Rødsmyra, Fredrikstad drilling

- The deviation of the 800 m borehole is 320 m.
- The vertical depth of the borehole is 728 m
-

Føyka, Asker Muncipality, Norway

- 2 BHEs x 800 m depth
- Special designed coaxial collektor
- Water as circulating fluid
- Fiber optic for temperature measurement installed



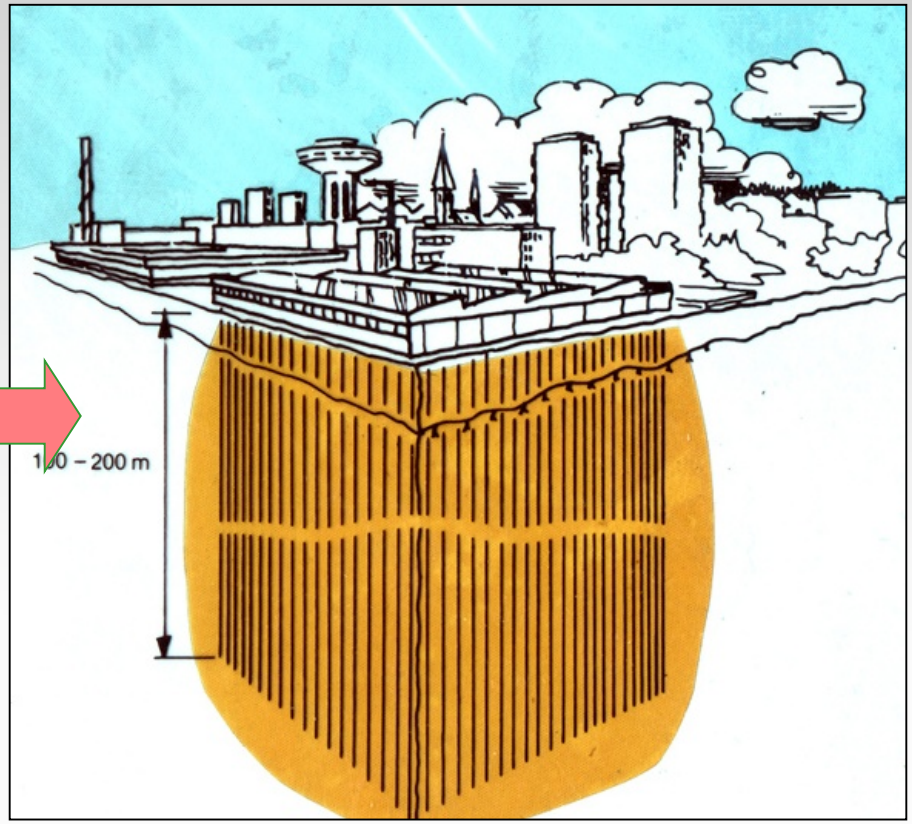
Ref: Båsum Boring

Ref: Jakub Koczorowski
Rehau
Manager Sprzedaży
Technika Instalacyjna

Rozwiązanie 3.
Sonda głębinowa do 800 m wytrzymała na temperaturę 80 °C oraz na ciśnienie do 100 bar

Emmaboda, Sweden

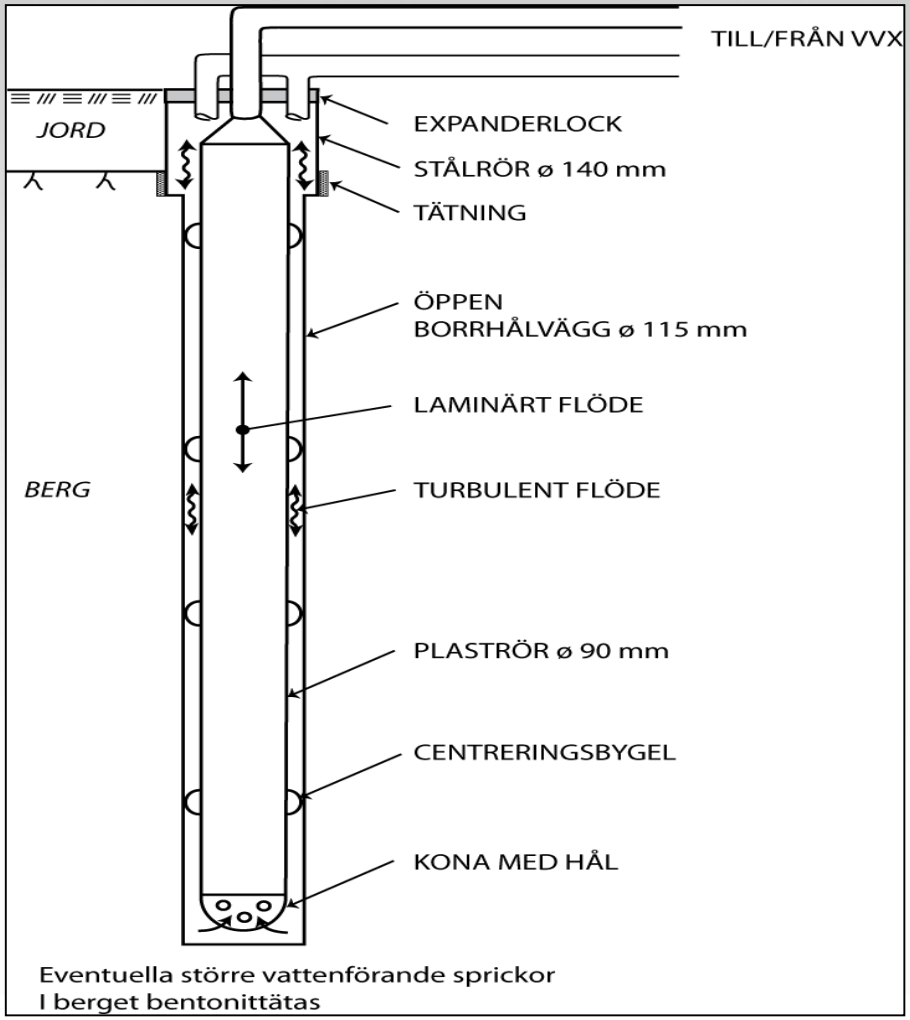
Seasonal storage of waste heat from the foundry in the summer - to be recovered for space heating during winter



Ref: Olof Andersson, Sweco

Emmaboda, High temperature BTES

- 140 boreholes á 150 m
- Borehole spacing; 4 m
- 7 sections á 20 boreholes
- 14 collecting pipe
- Inner “hot core”, 3 sections
- Ground (top) insulation
- Coaxial BHE



Emmaboda, high temperature BTES

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Summary and recommandations for Poland

- BTES technologies are commercial proven, but further documentation and verification of system efficiency is needed.
  - Demonstration projects with long term monitoring
- Deeper and hotter BTES installations are under developing
- Best practice UTES for Poland can not be copied from Norway
  - Depending of energy use, geology, climate and regulations
- Marketing and dissemination is important !
  - The technology is invisible
- Bad installations can lead to bad reputation
- Show the success histories and learn of the mistakes!