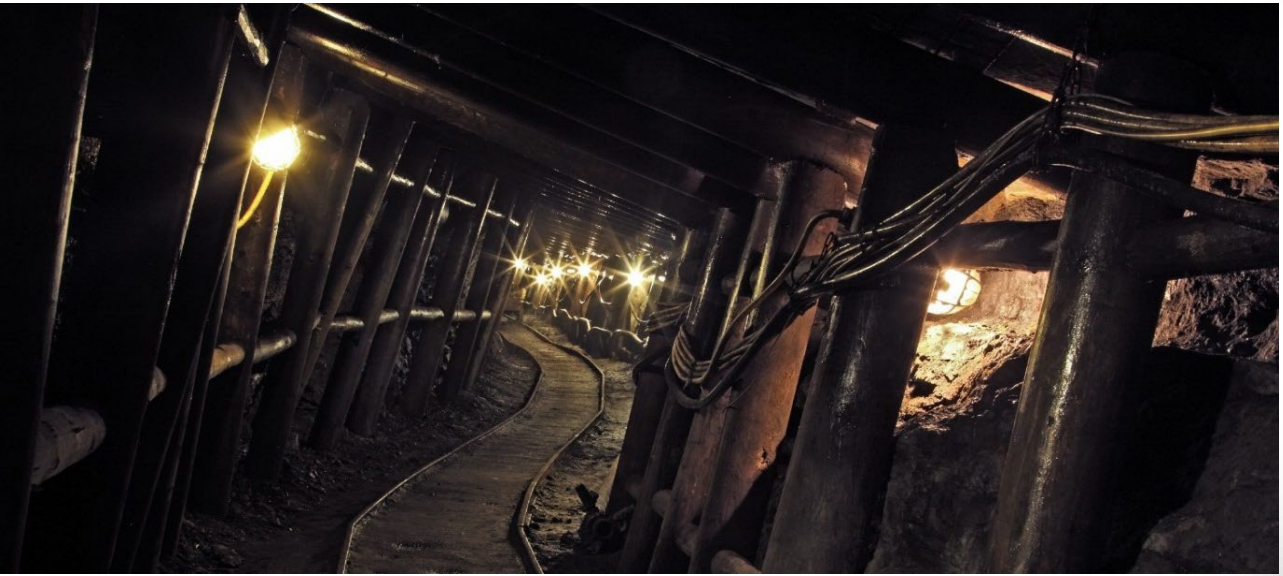
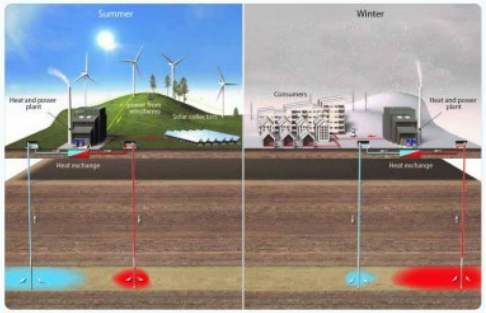


# MTES Bochum

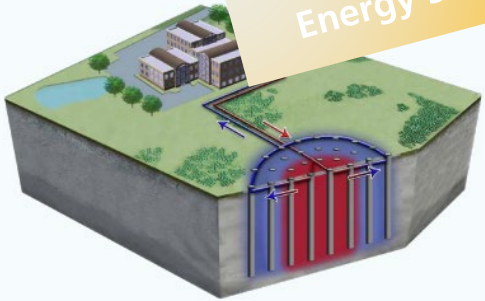
Florian Hahn
florian.hahn@ieg.fraunhofer.de
Offenburg, 28.02.2024

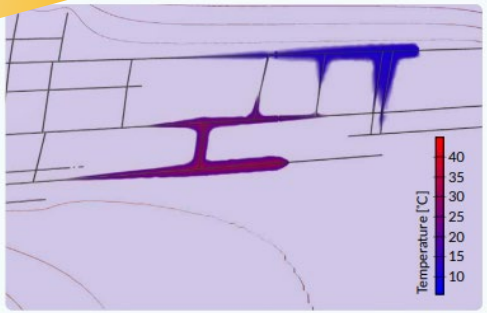



**Aquifer Thermal Energy Storage**
ATES can take place by injection and later re-production of hot water in aquifers in both shallow and deep geological formations. The aquifers can be both unconsolidated sand units, porous rocks like sandstones or limestone or fractured rock formations. It is an open system using geoth... water wells and storing the heat in th... formation around it.

**Pit Thermal Energy Storage**
Hot water is stored in ve... large (multiple) excavated basins with an insul... and bottom are typically covered by a... be made of concrete.

Underground Thermal Energy Storage (UTES)



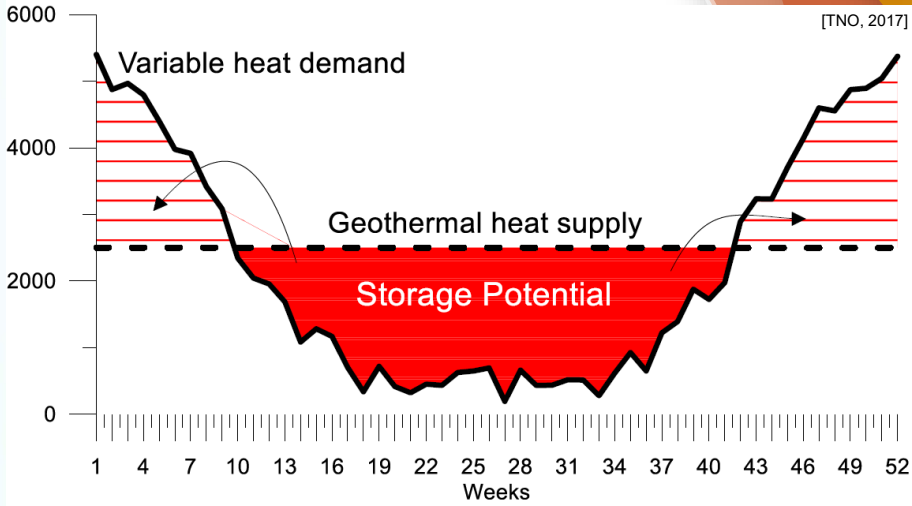



**Borehole Thermal Energy Storage**
The natural heat capacity in a large volume of underground (unconsolidated) soil or rock is used to store thermal energy with or without groundwater as the storage medium. It typically has several closely spaced boreholes, between 50 and 200 m deep; they act as heat exchangers to the underground, usually in U-pipe form.

**Mine Thermal Energy Storage**
Mine water of abandoned and flooded mines is used as a storage medium for high temperature storage. The mine water can also be used as an ambient energy source in combination with heat pumps.

er
IEG

[TNO, 2017]




- How are we going to meet the heating demand with a distinct seasonal profile without fossil fuels but with the same security of supply?

# HT-MTES

HEATSTORE

1

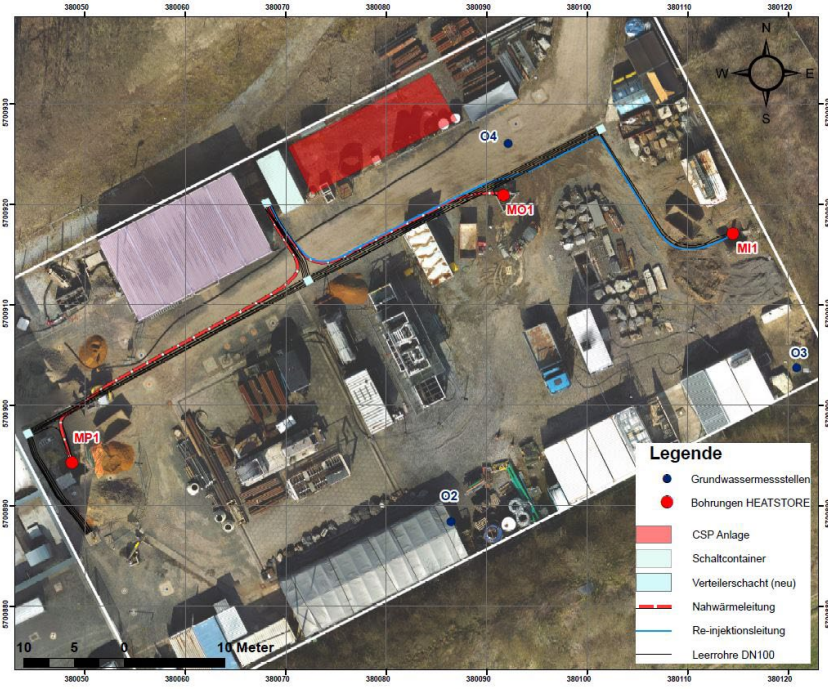
GEOTHERMICA

IEA Geothermal

Fra

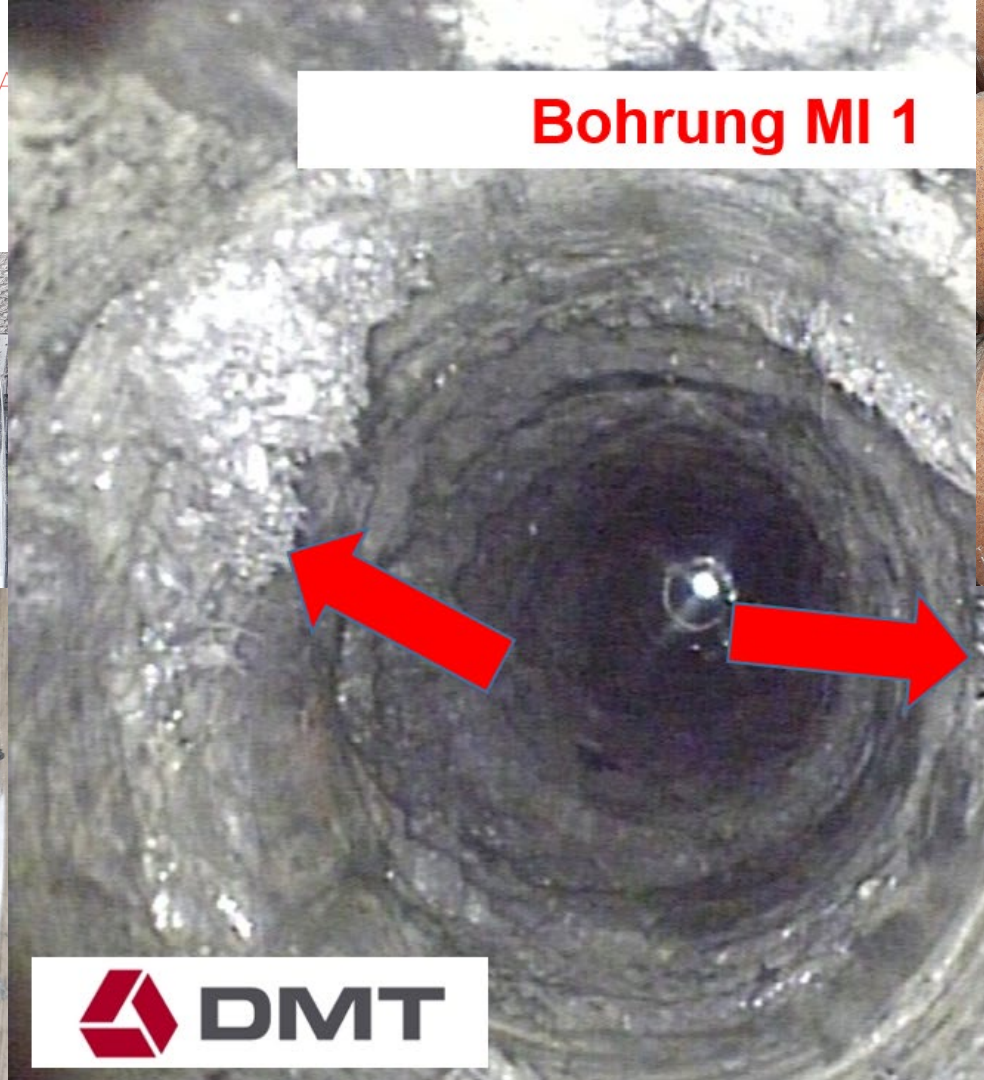
# heatstore

High Temperature Underground Thermal Energy Storage

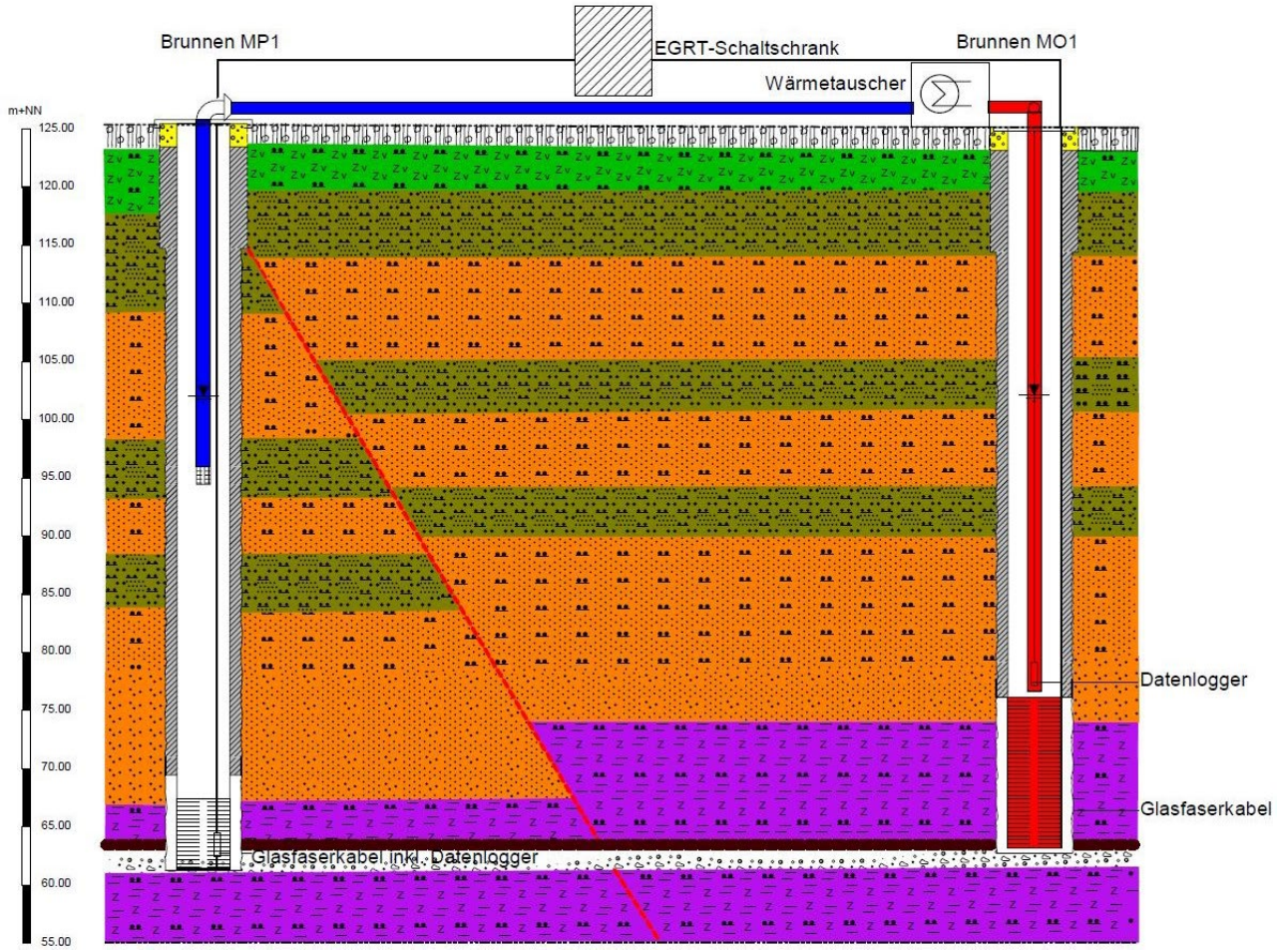


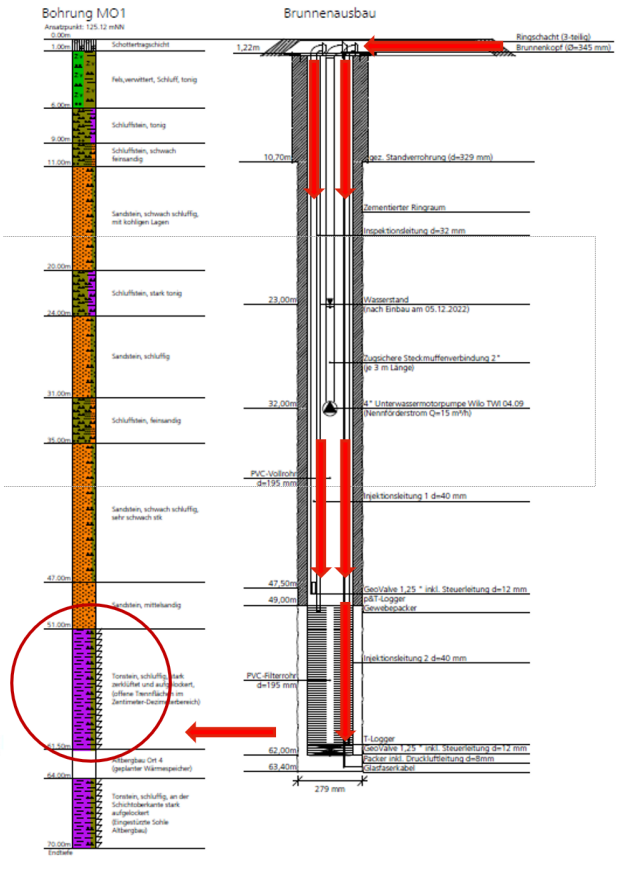

# Bochum Research and Drilling Rig (Bo.ReX)

# Cuttings





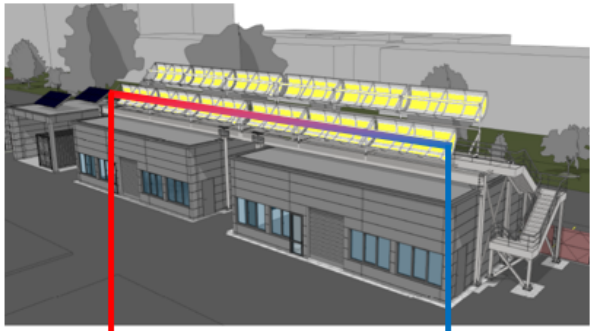

Brunnen MP1
EGRT-Schaltschrank
Brunnen MO1
Wärmetauscher
m+NN
125.00
120.00
115.00
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
Datenlogger
Glasfaserkabel
Glasfaserkabel inkl. Datenlogger

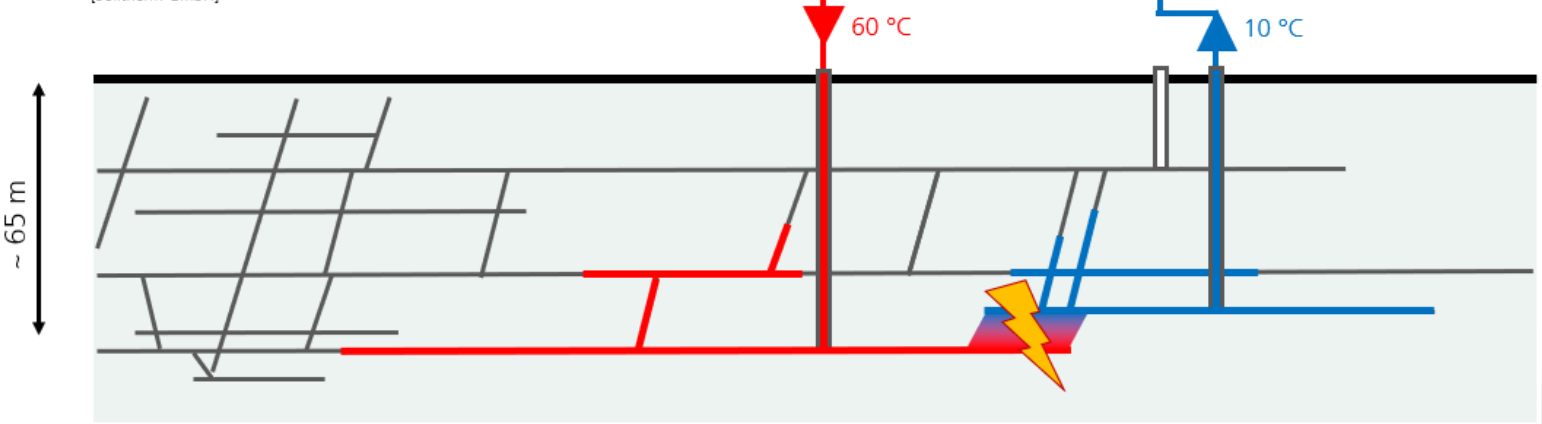

Bohrung MO1
Brunnenausbau
Schottertragschicht
Fels,verwittert, Schluff, tonig
Schluffstein, tonig
Schluffstein, schwach feinsandig
Sandstein, schwach schluffig, mit kohligen Lagen
Schluffstein, stark tonig
Sandstein, schluffig
Schluffstein, feinsandig
Sandstein, schwach schluffig, sehr schwach stk
Sandstein, mittelsandig
Tonstein, schluffig, stark zerklüftet und aufgelockert, (offene Trennflächen im Zentimeter-Dezimeterbereich)
Altbergbau Ort 4 (geplanter Wärmespeicher)
Tonstein, schluffig, an der Schichtoberkante stark aufgelockert (Eingestützte Sohle Altbergbau)
Endtiefe
Ringschacht (3-teilig) Brunnenkopf (Ø=345 mm)
ggez. Standverrohrung (d=329 mm)
Zementierter Ringraum
Inspektionsleitung d=32 mm
Wasserstand (nach Einbau am 05.12.2022)
zugsichere Steckmuffenverbindung 2" (je 3 m Länge)
4" Unterwassermotorpumpe Wilo TWI 04.09 (Nennförderstrom Q=15 m³/h)
PVC-Vollrohr d=195 mm
Injektionsleitung 1 d=40 mm
GeoValve 1,25 " inkl. Steuerleitung d=12 mm
p&T-Logger
Gewebepacker
Injektionsleitung 2 d=40 mm
PVC-Filterrohr d=195 mm
T-Logger
GeoValve 1,25 " inkl. Steuerleitung d=12 mm
Packer inkl. Druckluftleitung d=8mm
Glasfaserkabel
279 mm

# Injection mode (summer)

| | |
|---|---|
| **# of modules** | 12 |
| **# of rows** | 2 |
| **collector area** | 108 m² |
| **max. capacity** | 60 $kW_{th}$ |
| **temperature** | max. 60 °C |
| **medium** | water |

[Solitherm GmbH]





# Production mode (winter)


80 – 120 °C

60 – 65 °C

[Johnson Controls]

60 °C

10 °C

~ 65 m

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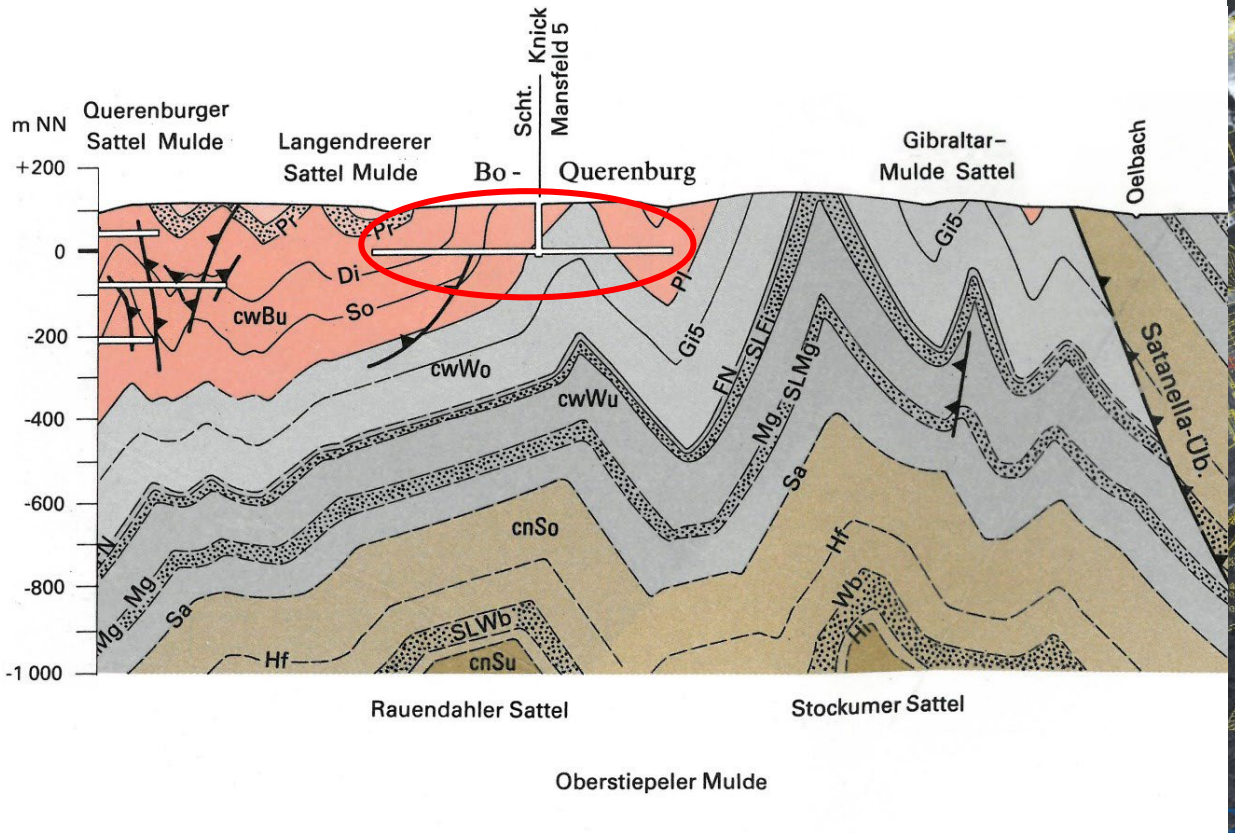
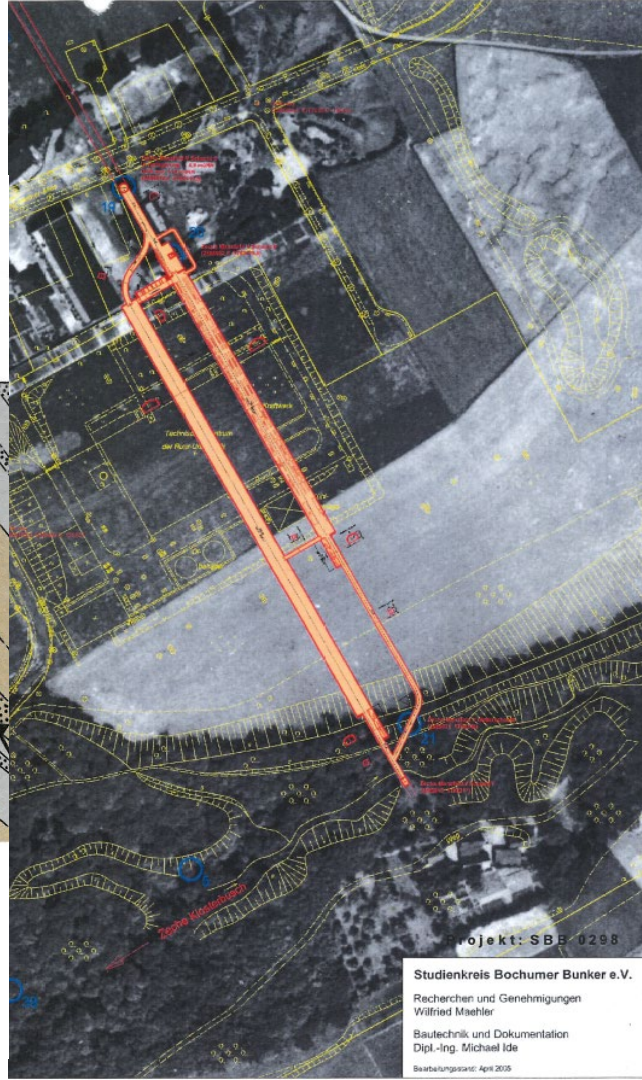


# LT-MTES

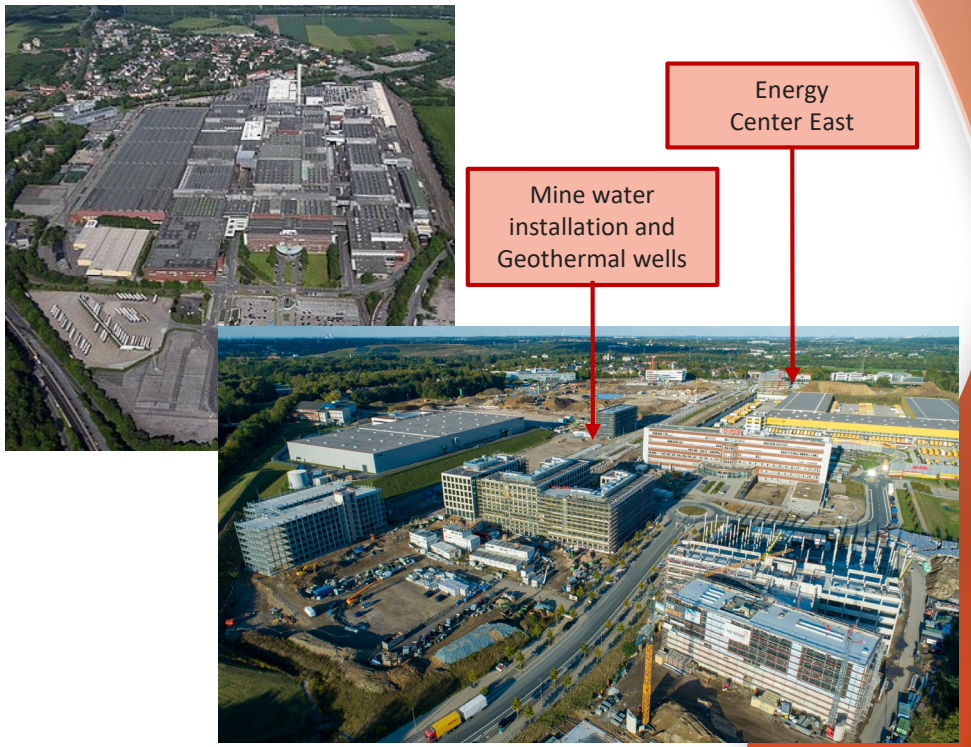
Mark 51°7

# 5G DHC with mine water

1. Area
- 68 ha – Area in Bochum-Laer
- 1859-1958: Colliery Dannenbaum
- 1958-2014: Auto production Opel
- Now: Redevelopment industrial, technology and knowledge campus Mark 51°7
- Building area approx. 210,000 m²

2. 5G DHC
- National Funding Program Wärmenetzsysteme 4.0
- 35% of Investment
- Grids and Energy Center East

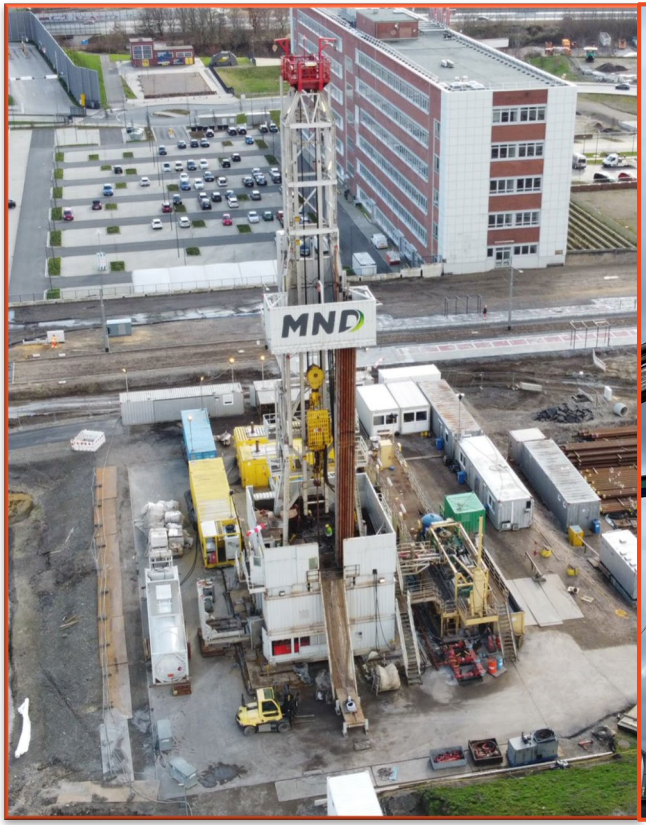
3. Mine water
- Funding Interreg D2Grids
- Mine water installation, wells and demonstrator energy center

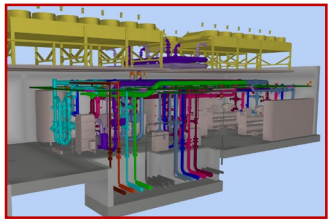


# Access

Drilling concept:

- Singular drilling location
- Cold well vertical drilling: 28.01.2022
- Hot well directional drilling: 09.03.2022
- Hydraulic capacity: 150 m³/h: March 2023



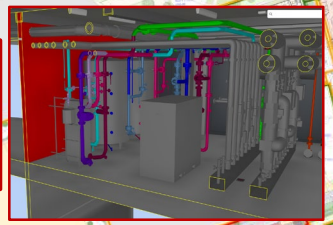



Q3 2025

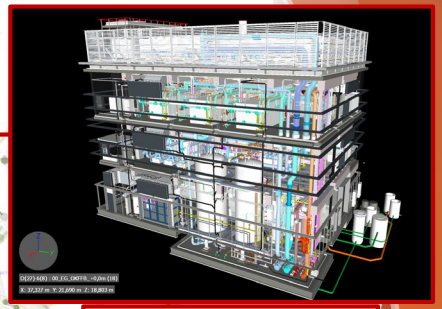
Decentralized Energy Center West
1,150/900 kW

Q4 2023

Decentralized Energy Center Demonstrator
220/190 kW



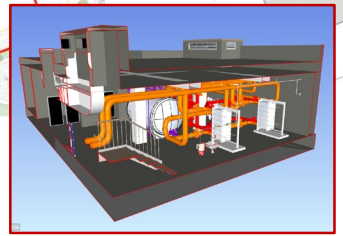
Q4 2025

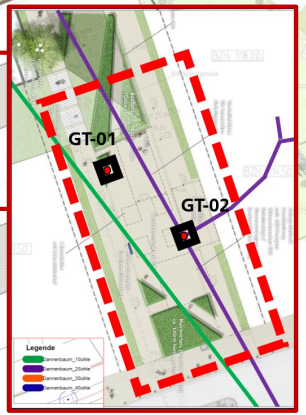


Decentralized Energy Center East (Low-Ex DHC grid)
11,500/8,500 kW

Q2 2025

Mine water installation and Geothermal wells





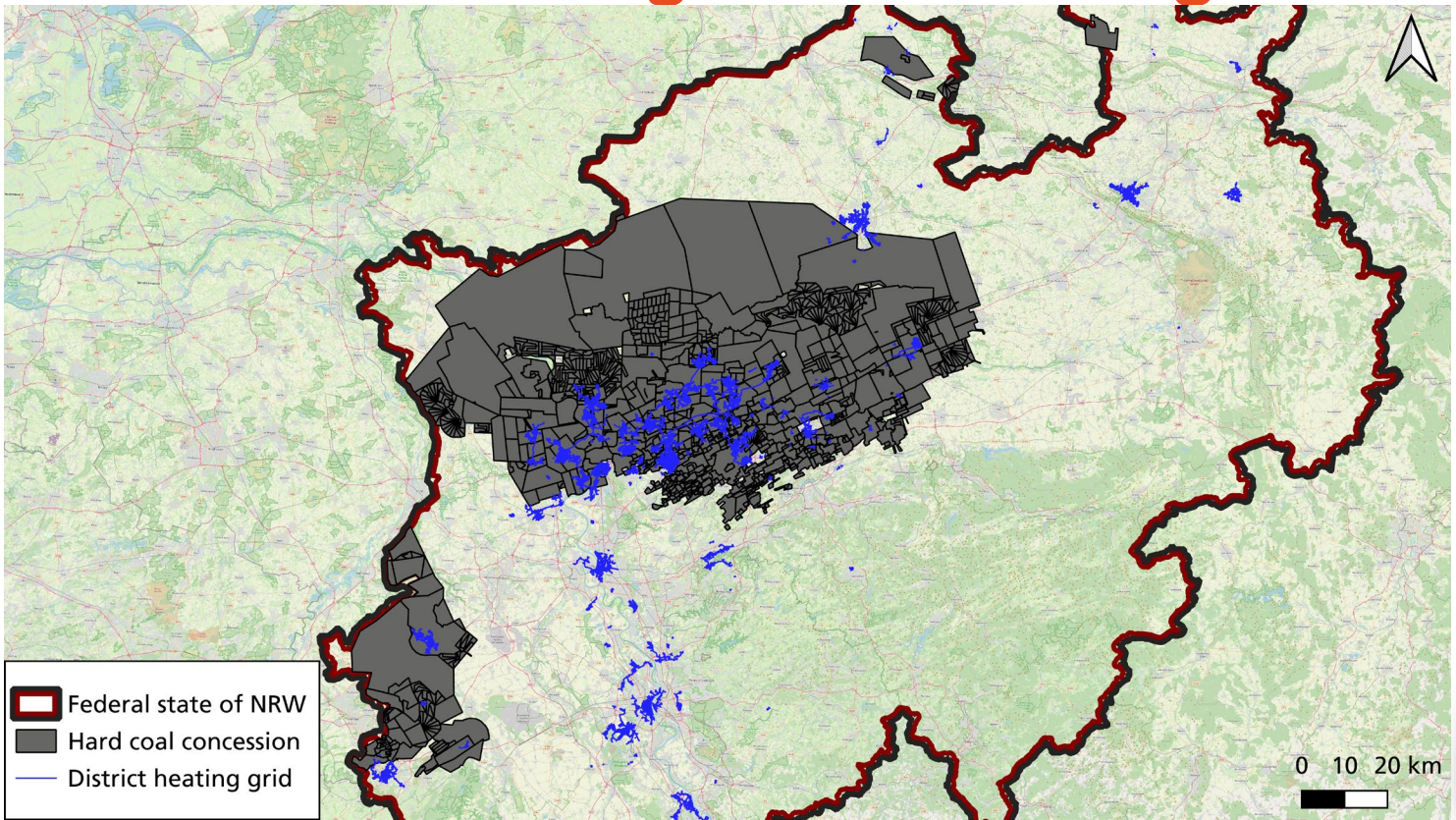

Q1 2022

**Total heat demand: 12.8 MW; 16 GWh**
**Total cold demand: 9.6 MW; 10 GWh**

**Minewater: 2.9 MW; 8.3 GWh; 430,000 m3 (27 °C)**
**Minewater: 3.5 MW; 5.6 GWh; 240,000 m3 (16 °C)**

- District heating grid (HT) 90/40°C
- Exchange grid 7.5/25 – 24/45 °C
- Heating grid (Low-Ex) 48/33°C
- Cooling grid (Low-Ex) 10/16 °C

# From coal mining to heat mining



GEOTHERMICA IEA Geothermal Fraunhofer IEG

# Glückauf!