





Fraunhofer Institution for Energy Infrastructures and Geothermal IEG

# Mine Thermal Energy Storage & 5 Generation District Heating & Cooling Grids Coal Regions in Transition

M.Sc. Florian Hahn 20<sup>th</sup> November 2023

### Research Institution for Energy Infrastructures and Geothermal Systems IEG Facts and figures

- Foundation as an independent institution as of 01.12.2019
- Locations in the German coal regions
- Employees: ~200
- 6 business units with 24 competence centres
- Coordination of the <u>Fraunhofer hydrogen network</u> (32 institutes)
- Directorate: Prof. Dr. Rolf Bracke & Prof. Dr. Mario Ragwitz







#### **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 geothermal or water wells and storing the heat in the groundwater and in the formation around it.



#### **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.



#### Pit Thermal Energy Storage

Hot water is stored in very large (multiple) excavated basins with an insulated lid. Sides and bottom are typically covered by a polymer-liner, but can also be made of concrete.



#### 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.



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





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Former main shaft (1954)



Nightingale visitation colliery in Witten, Germany (wooden beam construction)



### HEATSTORE Fraunhofer IEG Site in Bochum

Technology quarter of the Ruhr University Bochum (PUSH IT demo site)

Bochum University of Applied Sciences

Fraunhofer IEG

JEG Colliery

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Studienkreis Bochumer Bunker e.V.

Recherchen und Genehmigungen Wilfried Maehler

Bautechnik und Dokumentation Dipl.-Ing. Michael Ide







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### HEATSTORE Bochum Research and Drilling Rig (BoReX)

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### HEATSTORE Proof of Concept

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### Operation during the summer





### Operation during the winter





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## Project Mark 51°7 Bochum 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. Minewater
  - Funding Interreg D2Grids
  - 60% of Investment
  - Minewater installation and wells
  - Demonstrator Energy Center







Initiative for

Coal Regions in Transition



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BOCHUM

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BOCHUM

### Project Mark 51°7 Bochum Access mine water use



**Interreg** North-West Europe D2Grids

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Drilling concept:

- Singular drilling location
- Cold well vertical drilling
- Hot well directional drilling



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## Project Mark 51°7 Bochum Drillings and pumptest

für Wirtschaft

und Energie

Bundesministerium Interreg North-West Europe D2Grids

💹 Fraunhofer

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- Geothermal wells 1.
  - The first drilling (GT-02) was completed on 28.01.2022
  - The second drilling (GT-01) was completed on 09.03.2022

#### 2. Well-test

- Pumps tests were executed in March 2023
- Postponed due to approval procedure for pump tests

#### *Results of pump tests (48 hours):*

- Hydraulic capacity + 150 m3/h
- Acceptable drop of water level during production
- Almost no rise of water level during injection hot well

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- Anomaly injection cold well
- Hot mine water 27,6 °C (assumption:  $\geq$  30°C)
- Cold mine water 16,4 °C (assumption:  $\geq$  18 °C)



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## Mine Water Potential in NRW

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#### Eternity benefits from industrial burdens!









# Thank you for your attention

# Questions?

M.Sc. Florian Hahn Storage and Underground Systems Post-mining Exploitation (lead)

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