# HEATSTORE WEBINAR SERIES

## HOW TO DEVELOP UNDERGROUND THERMAL ENERGY STORAGE (UTES) PROJECTS?

Learnings from the European HEATSTORE project

Host: TNO, The Netherlands

**7, 14, 21, 28 Sept. and 5, 12 Oct. 2021 | all 15-16 h (CEST)**

Register on www.heatstore.eu

# HEATSTORE WEBINAR SERIES 2021

## All webinars are at 15 – 16 h CEST

Tuesday 7 Sept. (Holger Cremer, TNO): Challenges in Underground Thermal Energy Storage (UTES)

Tuesday 14 Sept. (Thomas Driesner, ETH Zurich): Advances in subsurface characterization and simulation

Tuesday 21 Sept. (Koen Allaerts, VITO): Integrating UTES and DSM in geothermal district heating networks

Tuesday 28 Sept. (Florian Hahn, Fraunhofer IEG): Abandoned coal mines – promising sites to store heat in the underground

Tuesday 5 Oct. (Bas Godschalk, IF Technology): The ECW Energy HT-ATES project in the Netherlands

Tuesday 12 Oct. (Joris Koornneef, TNO): The role of UTES in the future EU energy system – a moderated table discussion.

heatstore High Temperature Underground Thermal Energy Storage

GEOTHERMICA

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# HEATSTORE

- HEATSTORE = GEOTHERMICA ERA-NET co-fund project
- 16.3 M€ | 23 partners in 9 EU countries
- 6 demonstration sites, 8 case studies.
- Coordination: TNO Netherlands Organization for Applied Scientific Research)

heatstore High Temperature Underground Thermal Energy Storage

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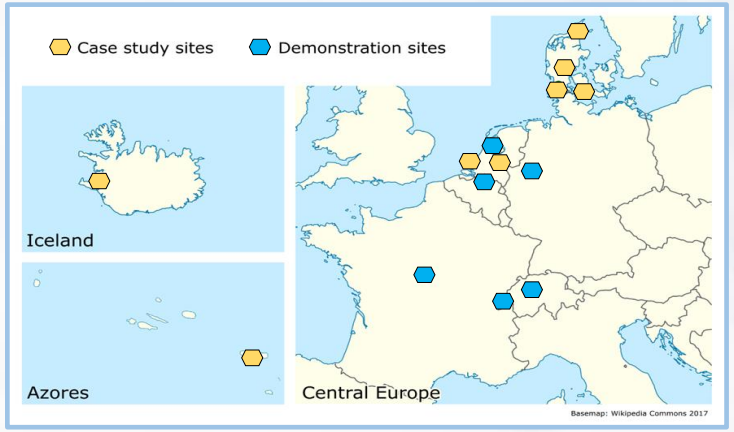


- **Best practice guidelines:** Design & System integration | Business models | Regulatory framework | Stakeholder perception & engagement | Monitoring technical, economic and environmental performance

- Proof and operation of UTES and DSM technologies

Fast track market uptake

Model & design validation

Characterization of UTES

Modelling sub-surface dynamics

Heating system integration & design optimisation

Demonstration

System performance monitoring

- **Roadmap Europe**: Technical future potential UTES and DSM in Europe | New business models | Stakeholder engagement | Roadmap for fast track uptake

**Design** → **Demonstration** → **Replication and scale-up**

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# HEATSTORE – 28 Sept. 2021

# Abandoned coal mines – promising sites to store heat in the underground

- Isabella Nardini (Fraunhofer IEG): Convenor & Opening
- Florian Hahn (Fraunhofer IEG): The MTES project in Bochum, Germany
- Lukas Oppelt (TU Bergakademie Freiberg): Green energy from abandoned mines – status quo and project results of VODAMIN II and GeoMAP

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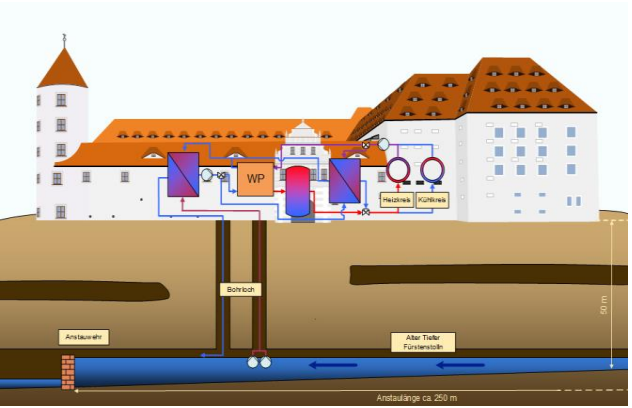
TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

technische THERMO DYNAMIK

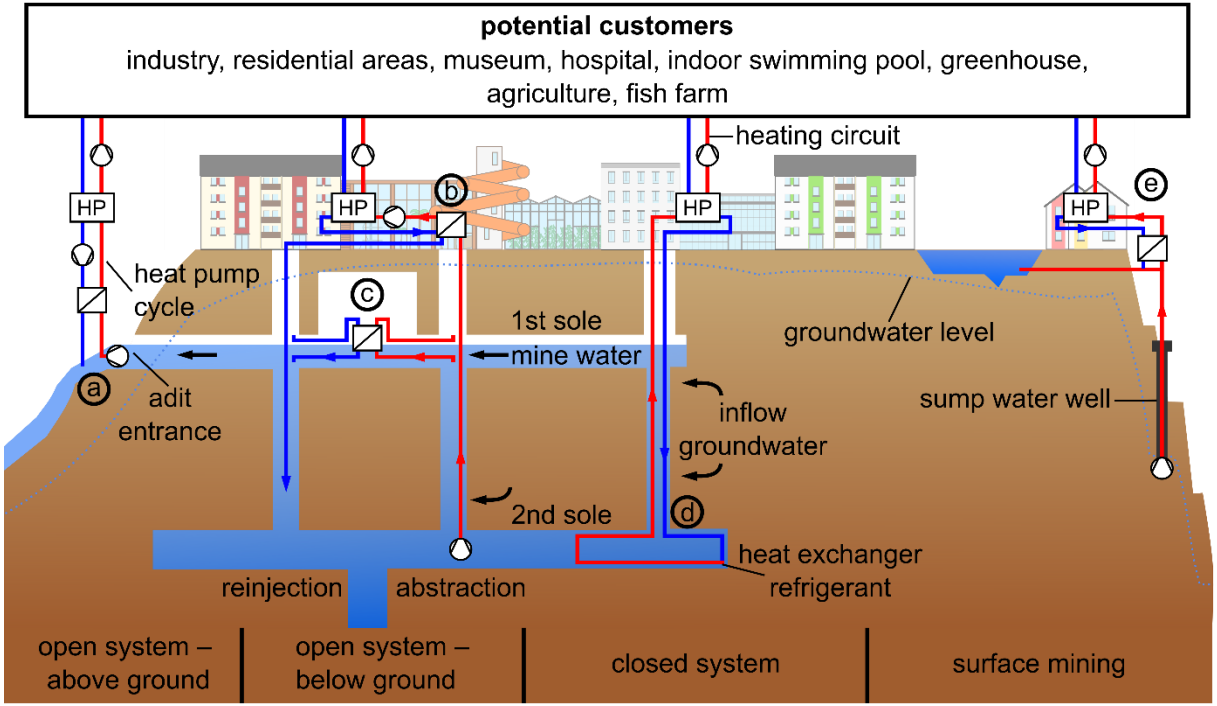
# Green energy from abandoned mines – status quo and project results of VODAMIN II and GeoMAP




Lukas Oppelt, Thomas Grab, Sebastian Pose, Tobias Fieback

**Abandoned coal mines – promising sites to store heat in the underground,** 28.09.2021

# Technical realisation possibilities



# Projects

Europäische Union. Europäischer Fonds für regionale Entwicklung. Evropská unie. Evropský fond pro regionální rozvoj.

SN CZ Ahoj sousede. Hallo Nachbar. Interreg V A / 2014 – 2020

## MareEn

**10/2021 – 12/2022**

- Utilization concept for mine water geothermal energy in the Lugau/Oelsnitz mining area
- Investigation of grid-connected energy supply and heat storage
- Information for the public

## GeoMAP

**01/2019 – 06/2021**

- Influence of water chemistry on plant operation
- Exchange of experience

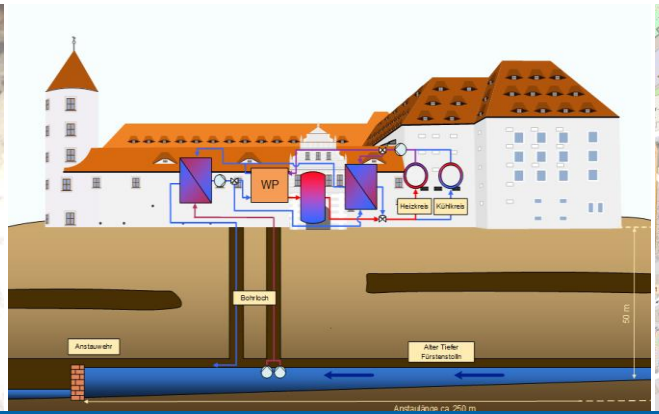
## Vodamin II

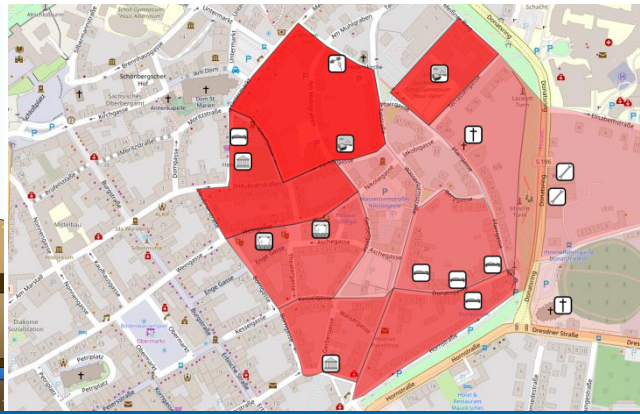
SN-CZ

**06/2016 – 10/2020**

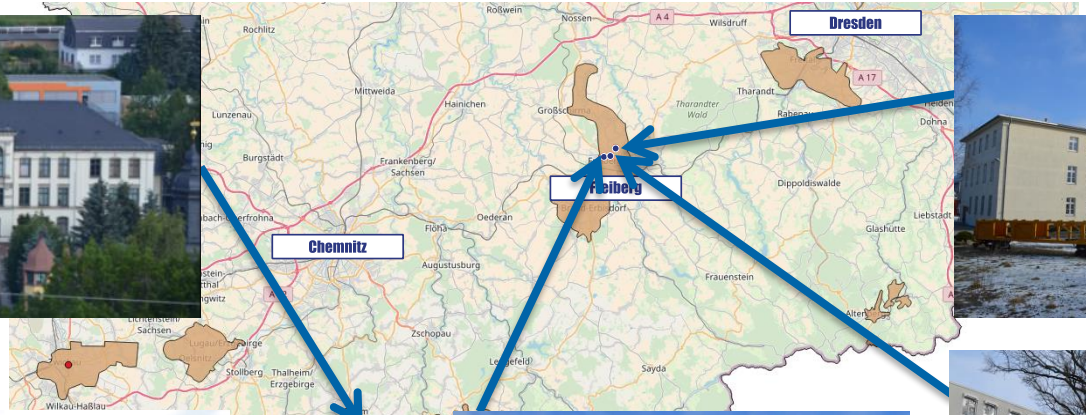
- Potentials and challenges of geothermal mine water utilization
- Influence of water chemistry on plant operation

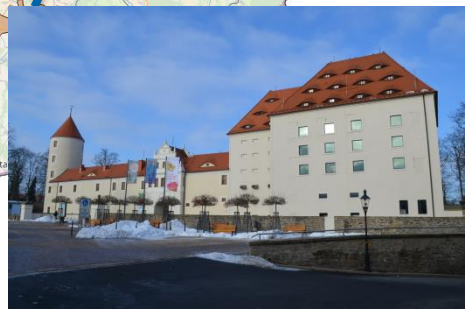
# Monitoring results and potentials



# Monitoring of existing plants



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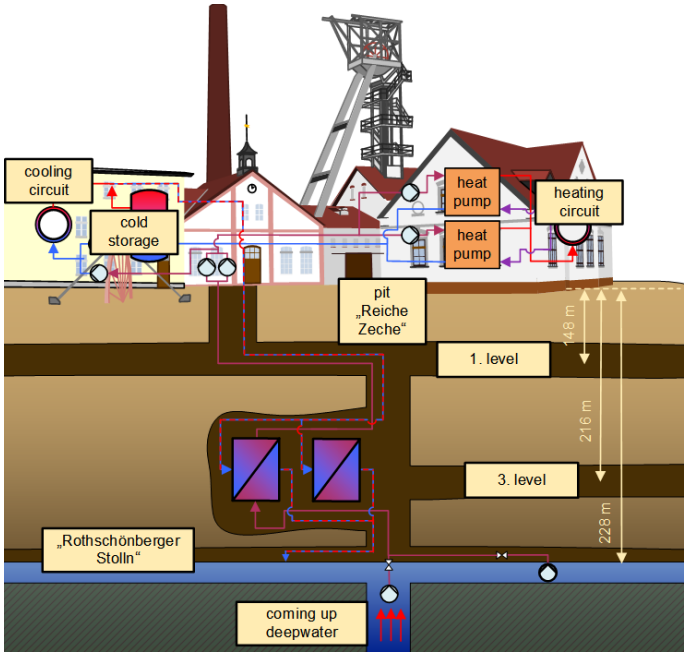
# „Reiche Zeche“ Mine Freiberg




- In Operation since : 2013

19 °C

175 kW

14 °C

100 kW

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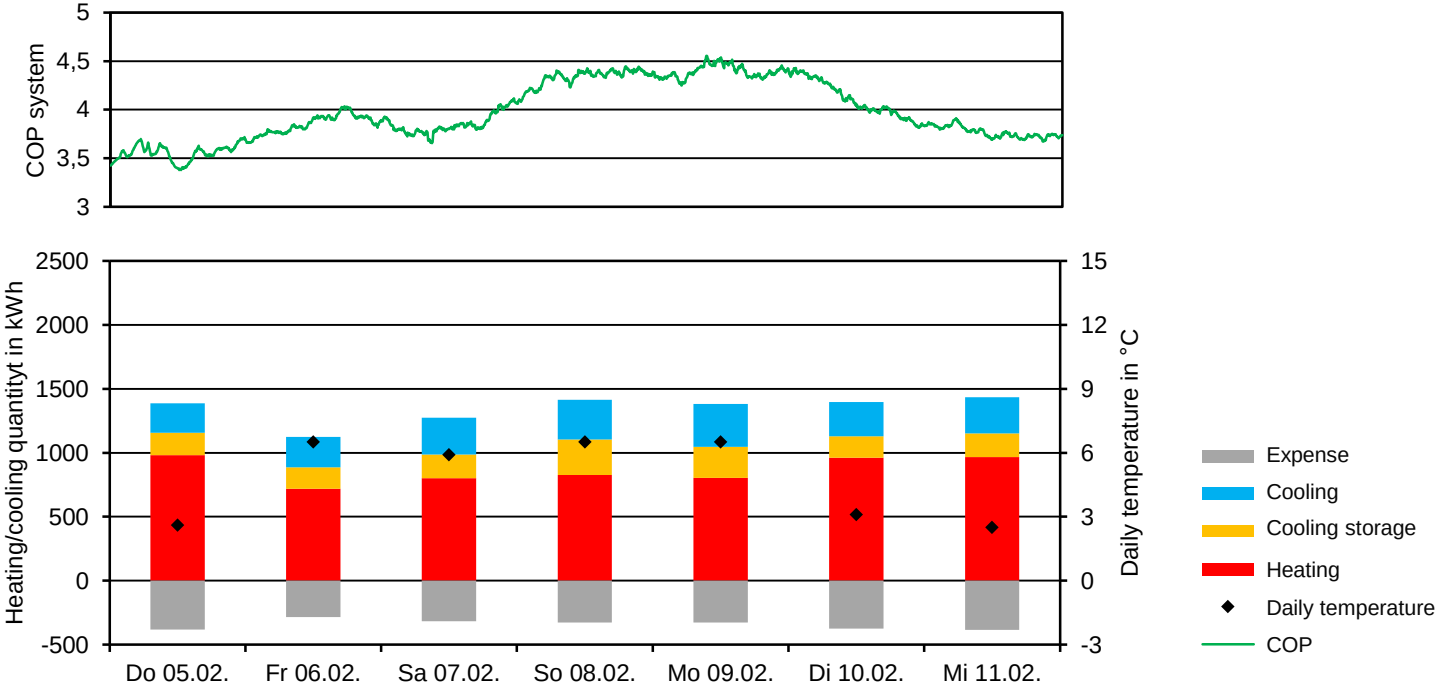
## „Reiche Zeche“ Mine Freiberg – winter week



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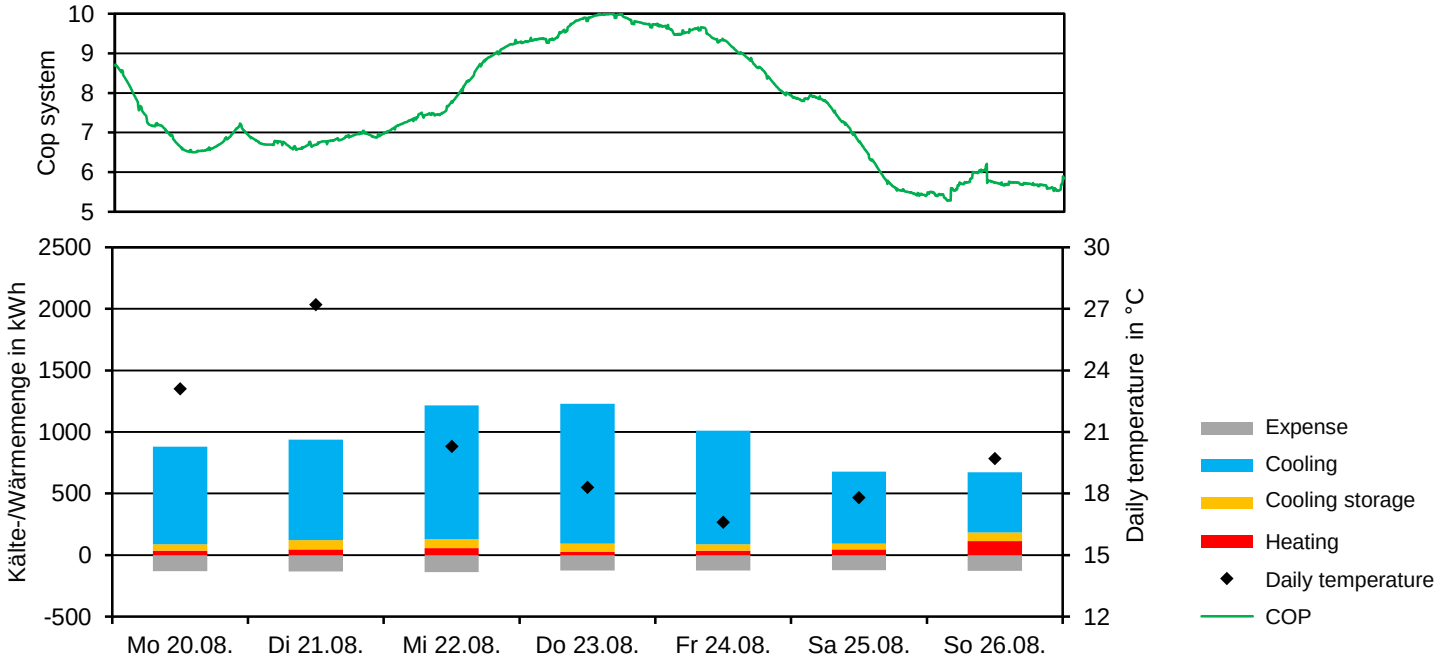
## „Reiche Zeche“ Mine Freiberg – summer week



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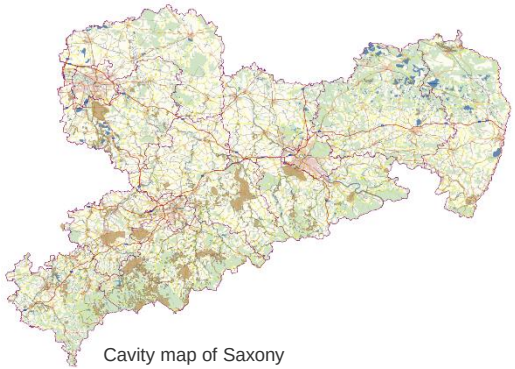
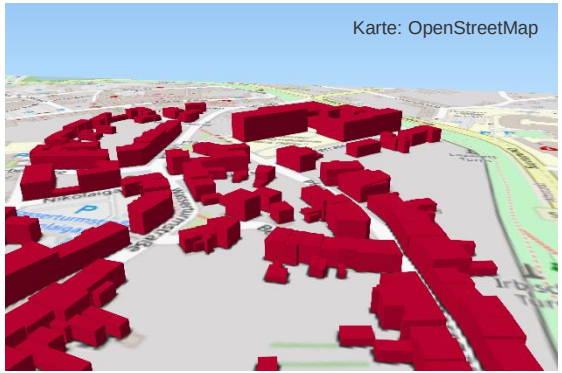
## What heat is available?

- Capture / Researching mine water temperatures and volume flows
- Calculation of theoretical heat quantity



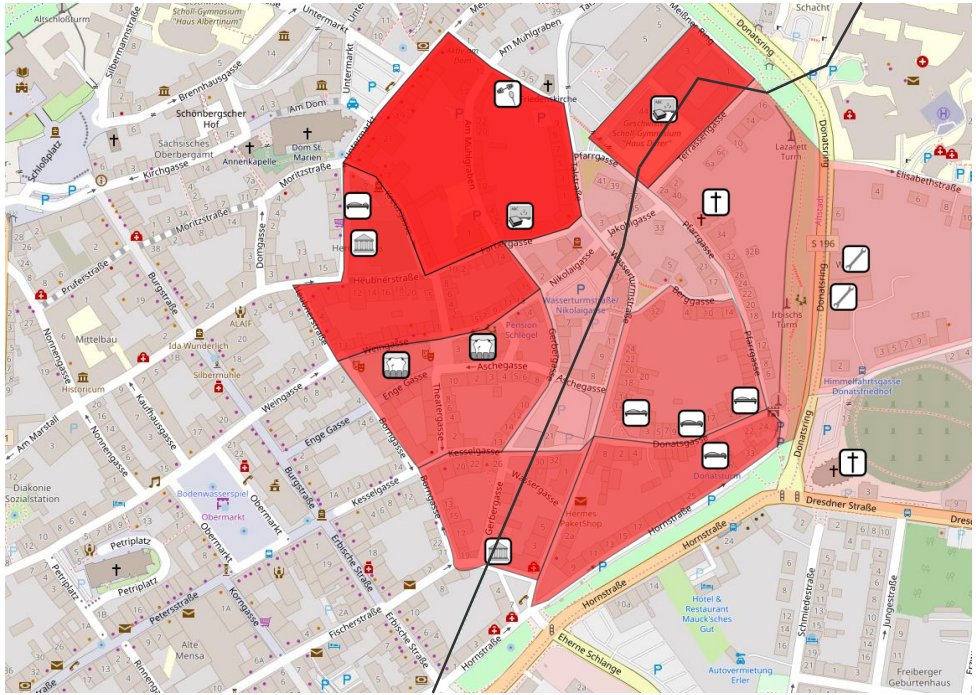
Cavity map of Saxony

## Which heat demand is available?




- Use of the digital 3D city model (GeoSN, dl-en / by-2-0) → Heated Area
- 2 Scenarios for Heat Demand

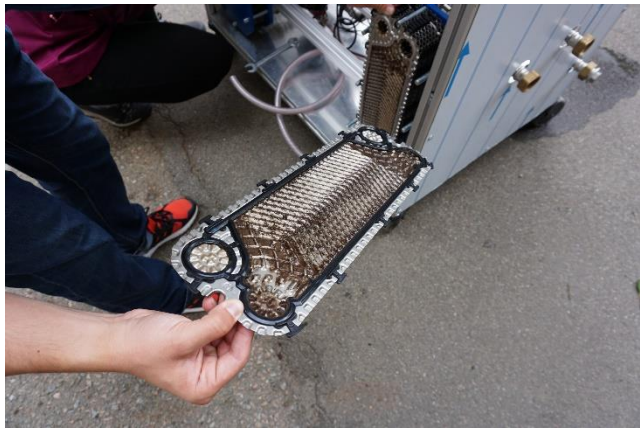
# Potentials in Saxony and Northern Bohemia



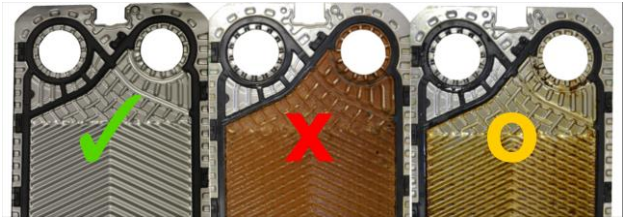

Karte: OpenStreetMap

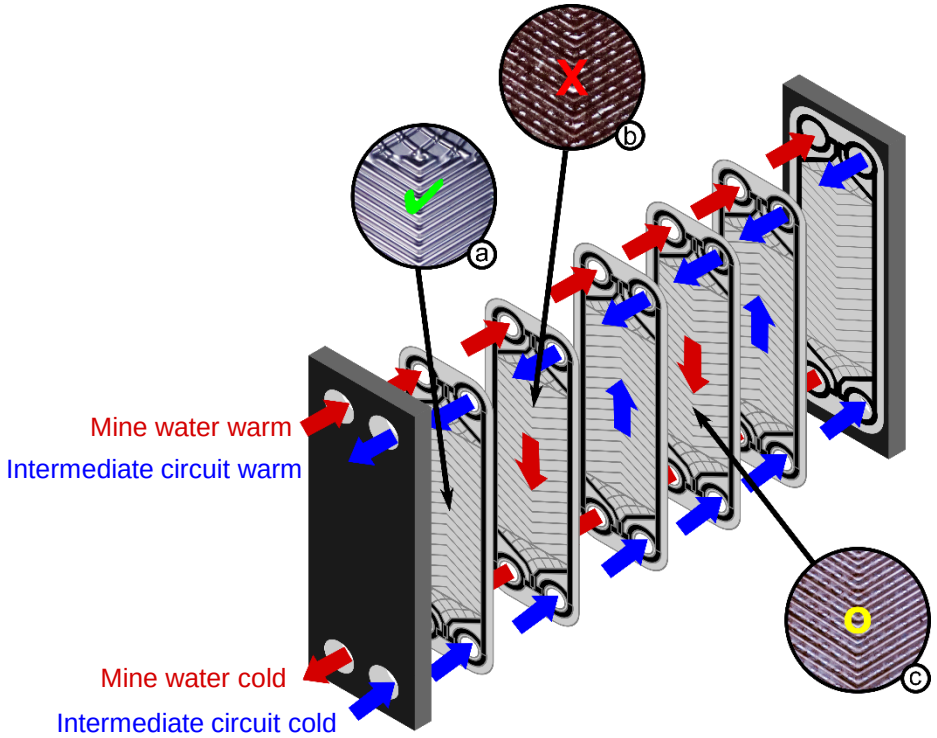
- Total heat demand studied area:≈ 83.4 GWh / a / 47.8 GWh/a
- High demand in areas with schools
- Rothschönberger Stolln: T≈ 11 °C
- Annual Potential: ≈ 102 GWh /a (coefficient of performance = 4) (assumption: cool water 5 K)

# Problem definition fouling and mobile test rig

# Influence of water chemistry on plant operation



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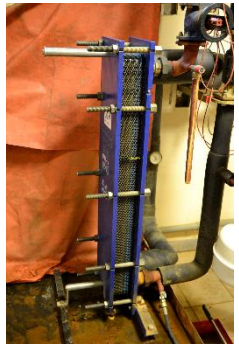
# Problem of the Investigation on Real Plants

- Limited accessibility
- Partial load operation in the summer months as well as the transitional period
- Partly no Suitable sampling Possibility
- Dependence on plant operators for maintenance and inspection

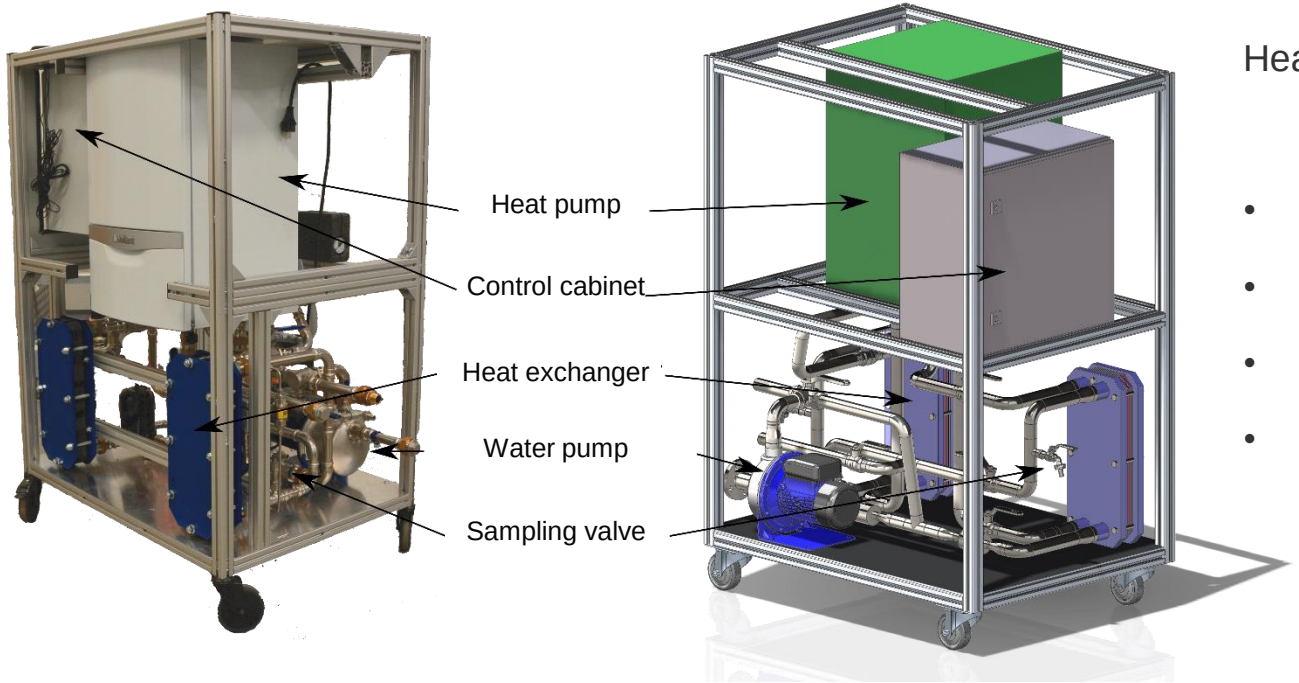
Freiberg Hospital

Mine Ehrenfriedersdorf



Secondary School Ehrenfriedersdorf

# Mobile Mine Water Test Rig

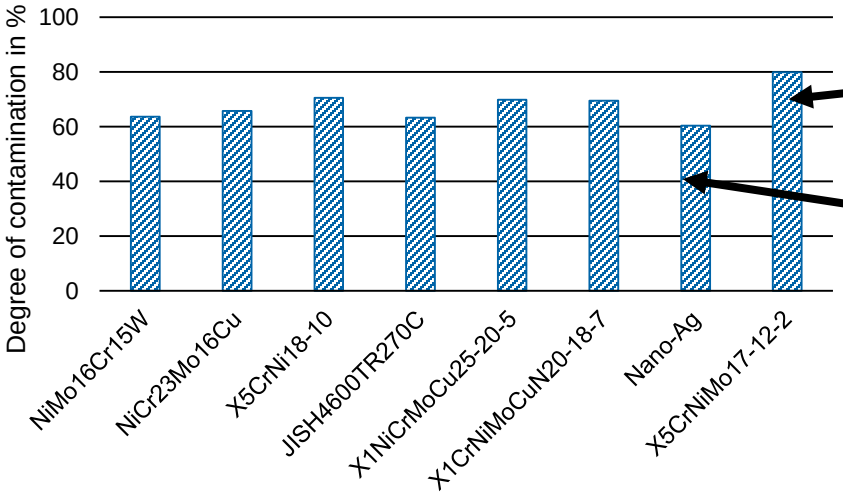


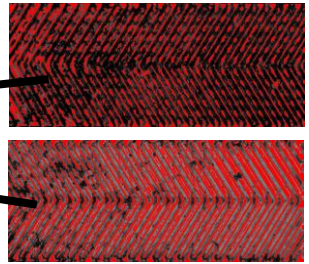

## Heat pump VWS 36/4.1

- up to 4 kW heating capacity
- -10 - 30 °C Source temperature
- 230 V supply voltage
- Compact design 80x100x150 cm

# Mobile mine Water Test Rig

- 1st series of tests in summer 2020 at pumping station in Mariánské Radčice, MR1 (CZ)
- 8 different materials / coatings investigated



**Contermination Level**

1. Clean area = red
   Soiled area = black
2. Contermination degree=

$$\frac{\text{Polluted area total}}{\text{Surface}}$$

| Material Number | Nomenclature |
|---|---|
| 1.4401 | X5CrNiMo17-12-2 |
| 2.4819 | NiMo16Cr15W |
| 2.4675 | NiCr23Mo16Cu |
| 1.4301 | X5CrNi18-10 |
| 3.7025 | JIS H4600 TR270C (Titan) |
| 1.4539 | X1NiCrMoCu25-20-5 |
| 1.4547 | X1CrNiMoCuN20-18-7 |
| 1.4401 | X5CrNiMo17-12-2 (Nano-Ag-Coating) |

# Mobile Mine Water Test Rig

- Current: 2nd test series in Ehrenfriedersdorf (Saxony)
- Comparison to the results in Mariánské Radčice

Many thanks to Zinngrube Ehrenfriedersdorf for providing the location.

# Summary

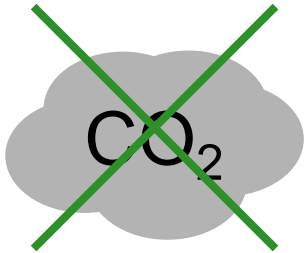
- Each mine is unique
- High initial investment → power ↑
- Compliance with mining law (BBergG, §3)
- High water elevation → High costs
- Chem. composition of mine water (fouling)

## Energetic:

+ Large volume, heat quantities
+ No seasonal fluctuations
+ Possible in all climatic zones
+ Low risk of discovery

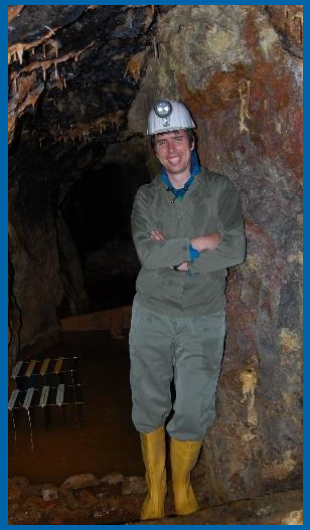
## Ecological:

+ Renewable energy source
+ Reduction greenhouse gases and air pollution




## Economic:

+ Reuse of decommissioned infrastructure (e.g. synergies during refurbishment)
+ lower energy costs (stable/calculable)



# Thank you for your interest!

More inforamtions:
geothermie.
iwtt.tu-freiberg.de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MareEn

GeoMAP

Vodamin II SN-CZ

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