BrineRIS

Brines and mine water geothermal energy - a green energy source for different heat sinks

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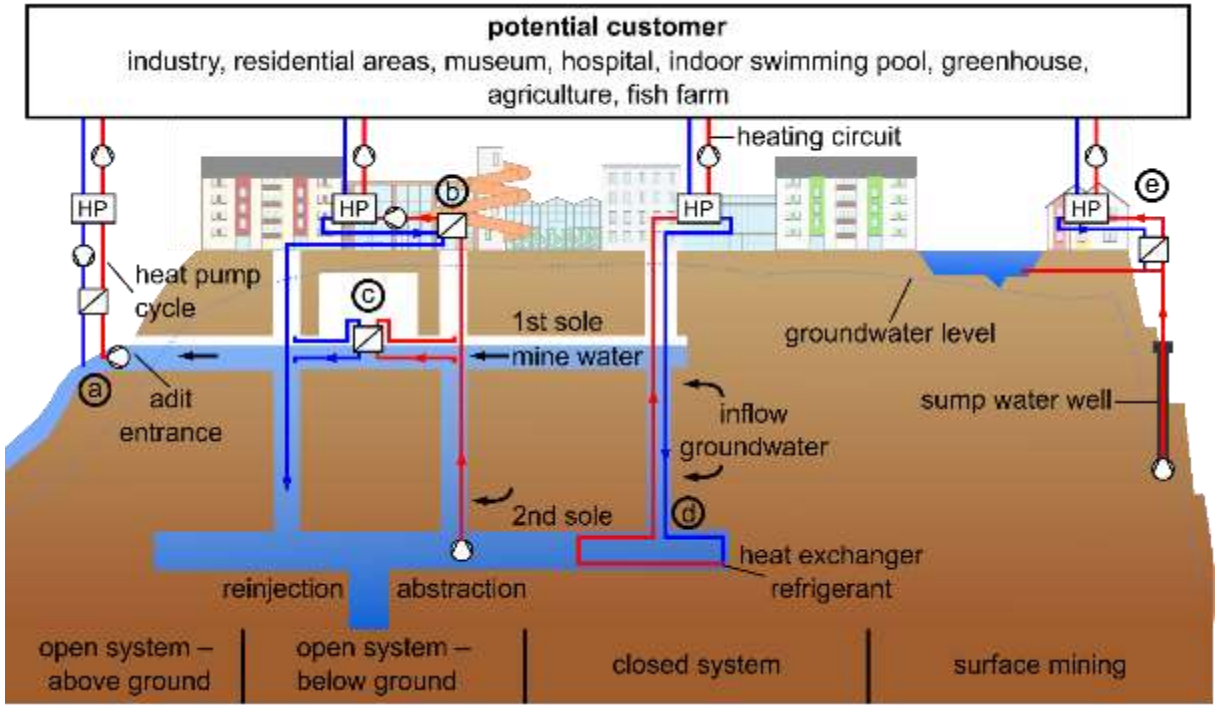
Mine water – in generally



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Mine water – in generally

- **Water in surface or underground mines**
  - **Chemical and biological composition depends highly on mined resource, surrounding rock, dwelling time of the water, flowting conditions …**
  - **Size of water body**
  - **temperature rises with depth of mine**
  - **Drainage occur mostly filtered into naturally accruing water reservoirs**

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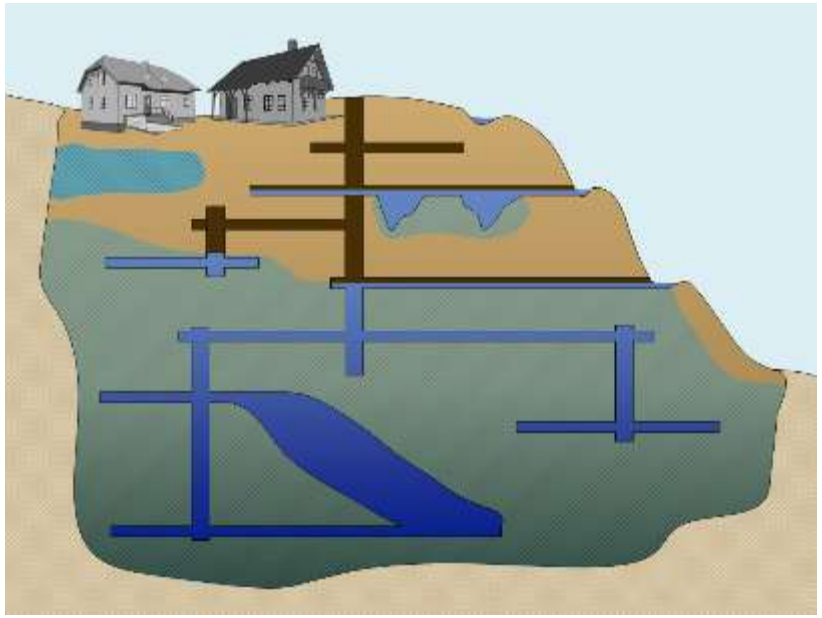
Mine water – in generally

- **Warm water**
  - ➢ **10 - 30°C in upper layers of mine water**
  - ➢ **In general large hollow spaces/ water bodies**

- **Large volume of useable water**
  - ➢ **100 mio. m^3 of mine water are annualy pumped too the surface in the Ruhr area [1]**
  - ➢ **Water chemistry**
- **Explotation**
- **Distribution**
- **Utilisation**



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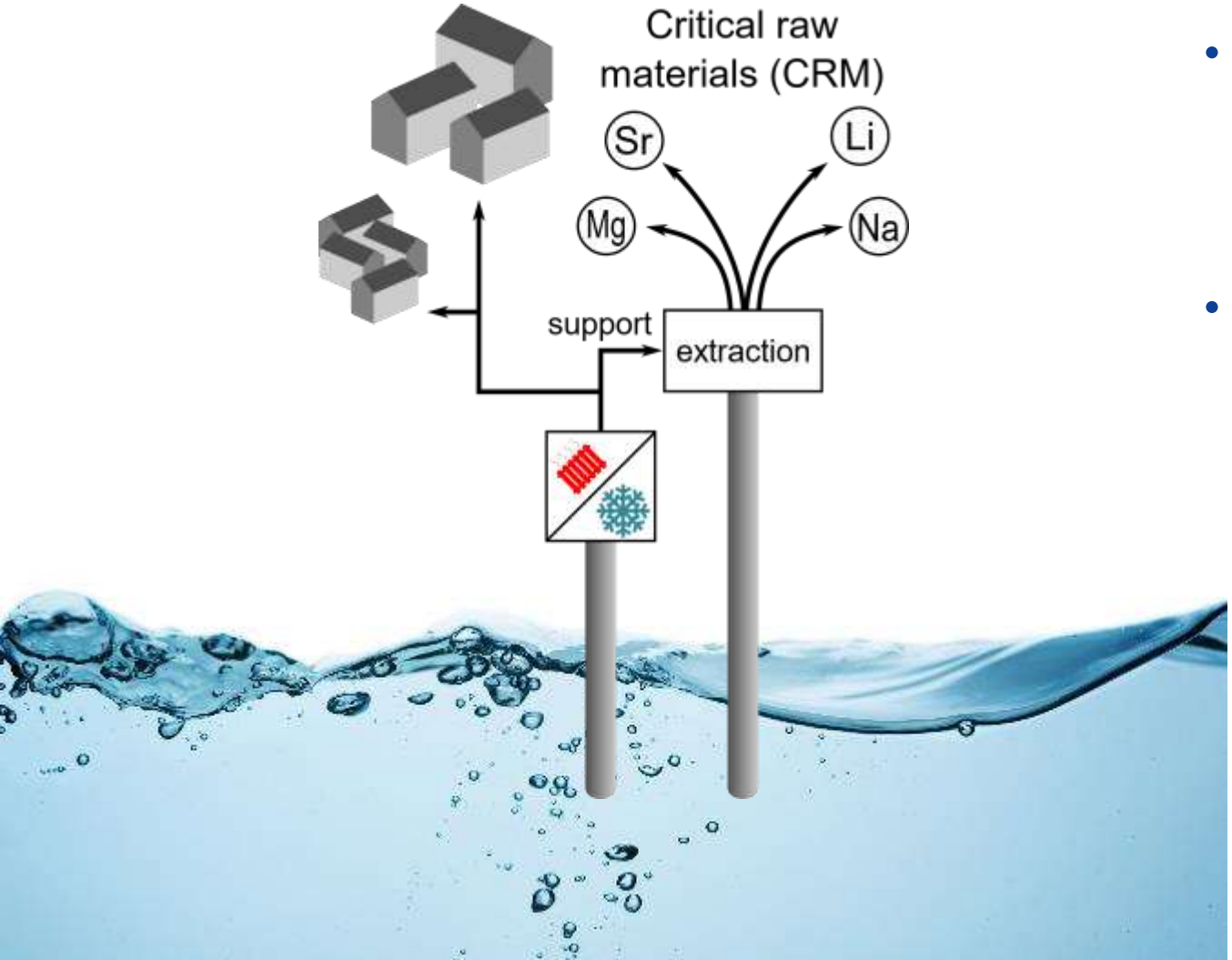
Brines – in generally



- **Potential resources on economical interest**
  - **Material utilization (raw materials)**
  - **Physical utilization (heat)**
- **Utilization**
  - **Supporting process heat in industrial sites**
  - **Direct heating and cooling supply for infrastructure**

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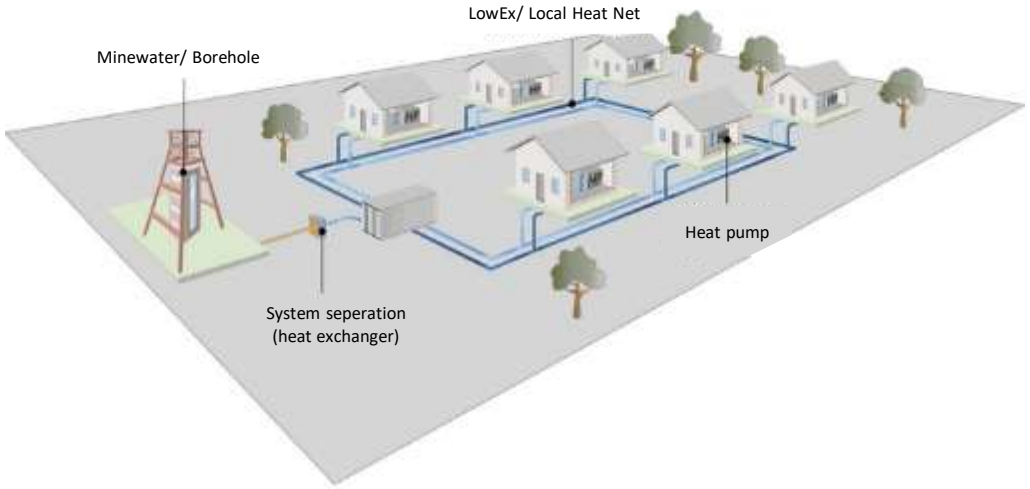
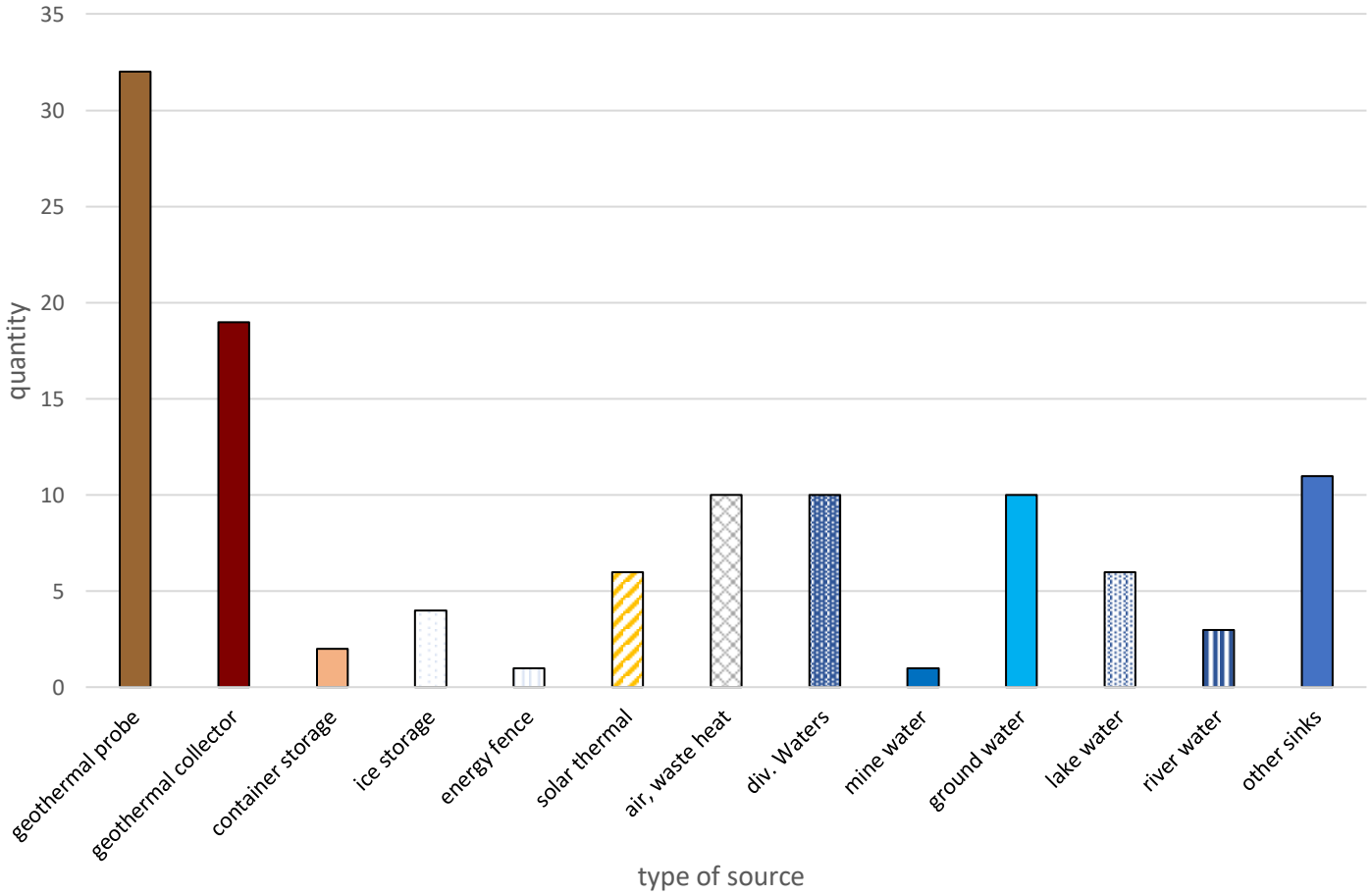
District cooling/ Quarter solutions



[1]



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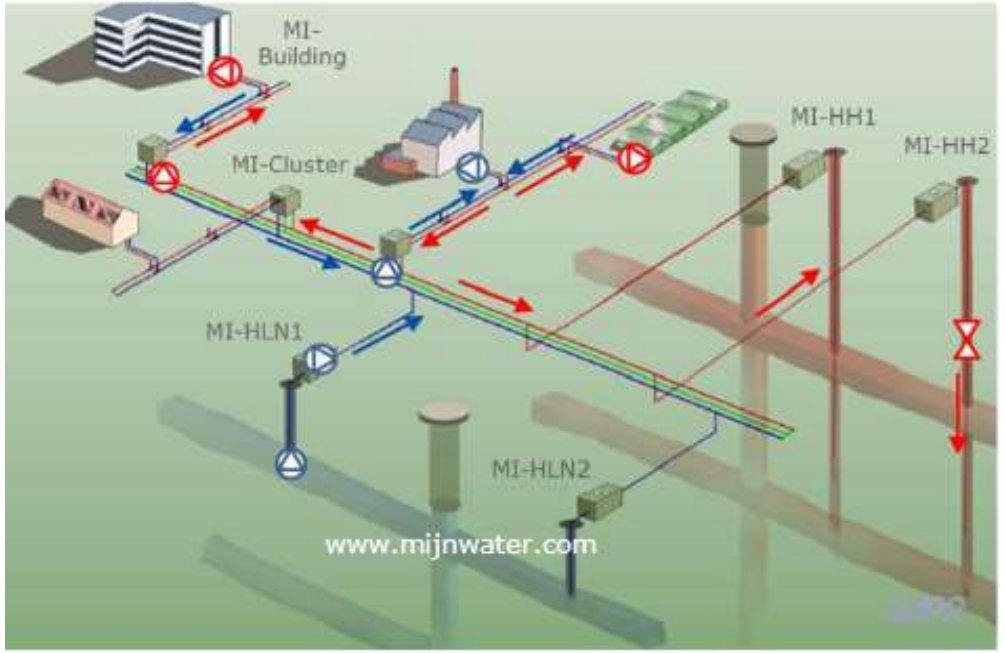
District cooling/ Quarter solutions

Heerlen

- Mine water from a former coal mine
- Operating since 2008
- Two-wire feed
- Heating: 35-37°C (825 m) return run 29°C
- Cooling: 17°C (250 m) return run 15°C
- Connectet area 800.000 m² (2018)

[4, 5]



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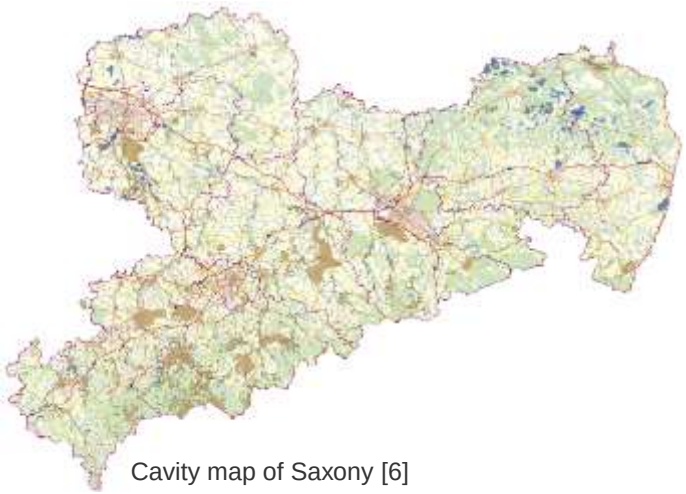
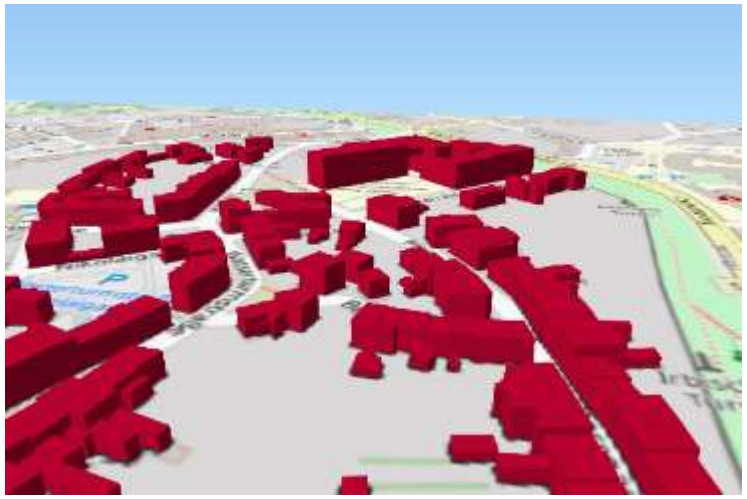
District cooling/ Quarter solutions

- **What heat is available?**
- **Capture / Researching mine water temperatures and volume flows**
- **Calculation of theoretical heat quantity**



Cavity map of Saxony [6]

- **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**

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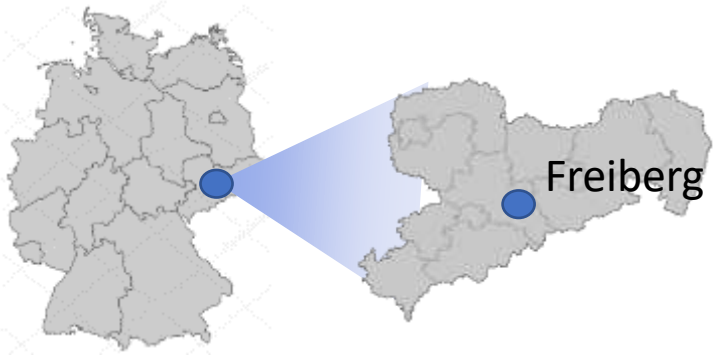
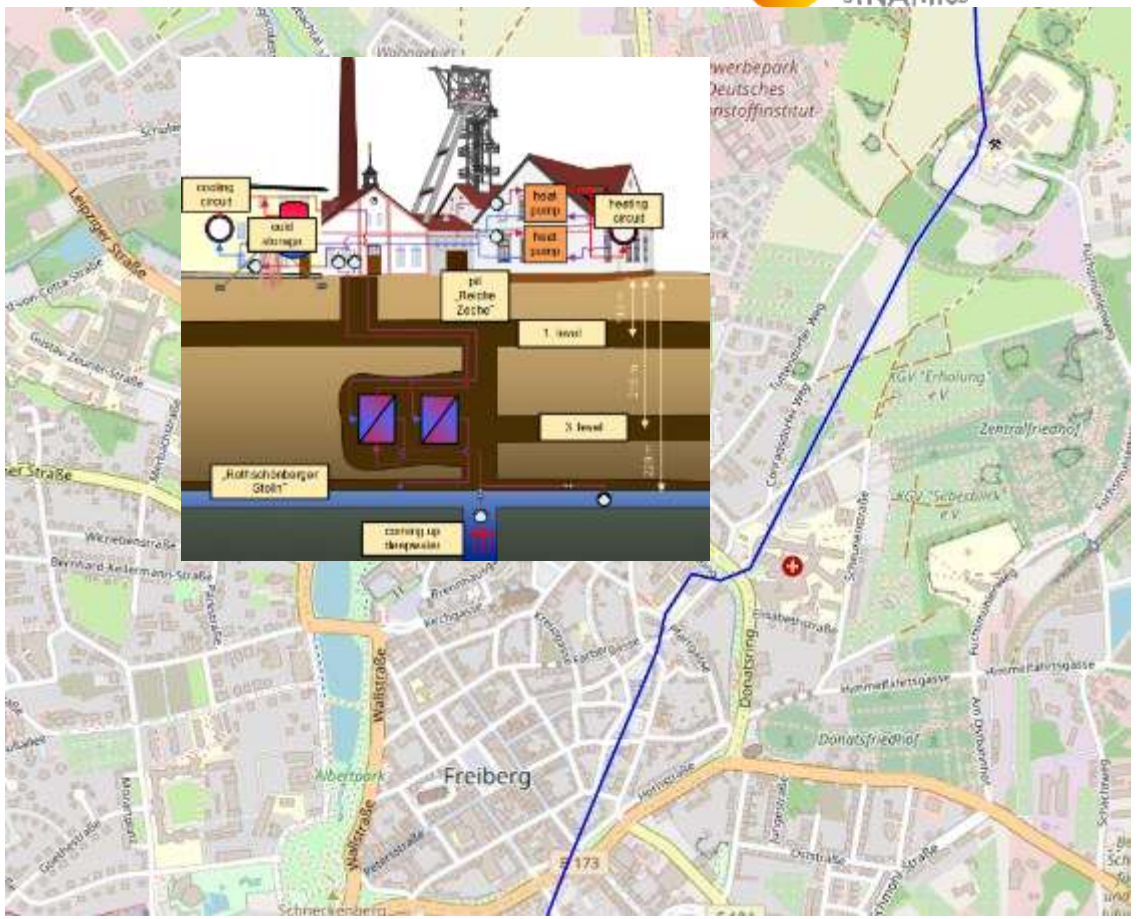
Existing plant/ Freiberg „Reiche Zeche“

- **Huge volume of useable water**
  - ➢ **Volume 1500 - 1700** $\frac{m^3}{h}$
- **Warm water**
  - ➢ **Rothschönberger Stolln 14 °C**
  - ➢ **Coming up deepwater 19 °C [13]**





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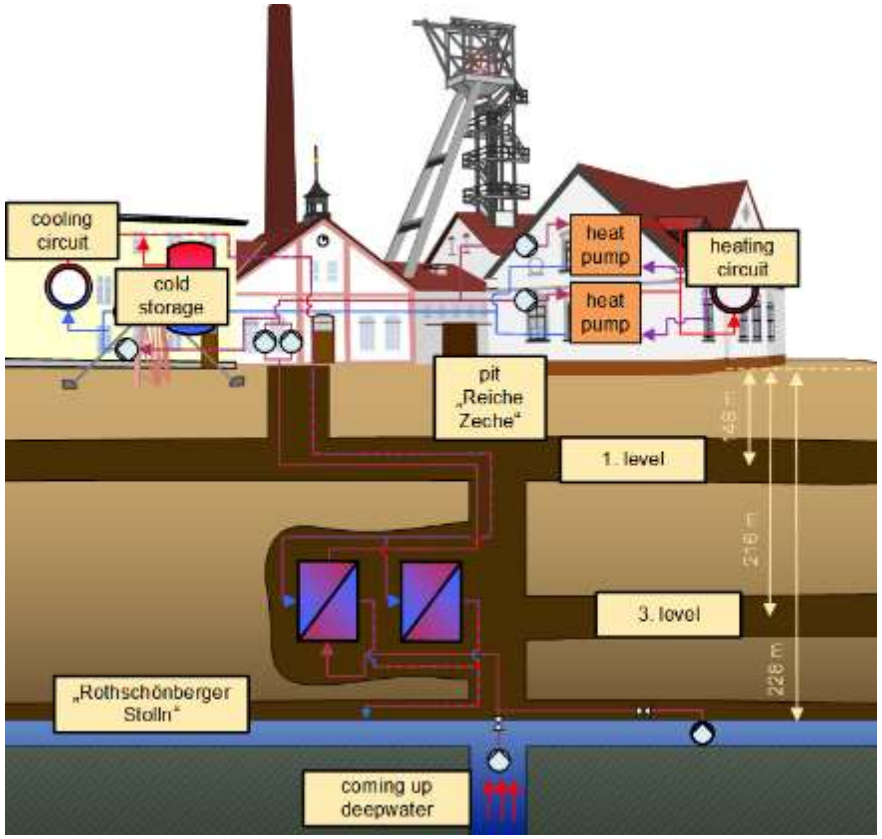
Existing plant/ Freiberg „Reiche Zeche“

- **Reiche Zeche Freiberg**



➢ **Operation since: 2013**

19 °C

175 kW

14 °C

100 kW

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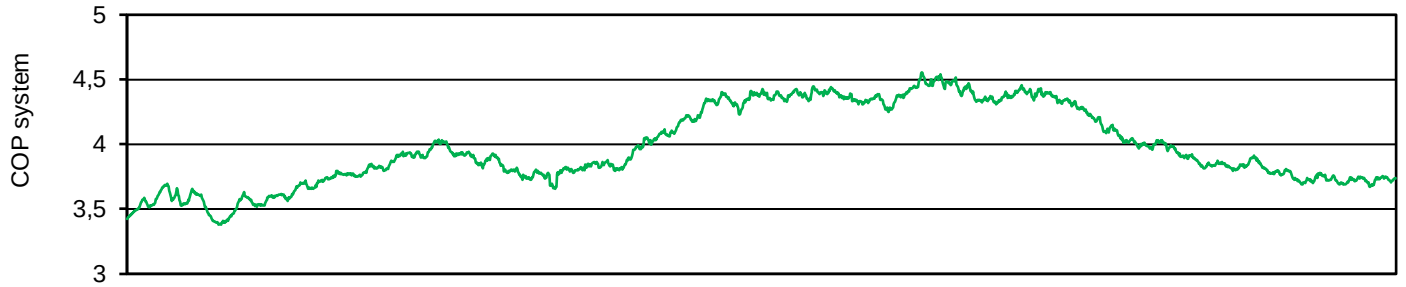
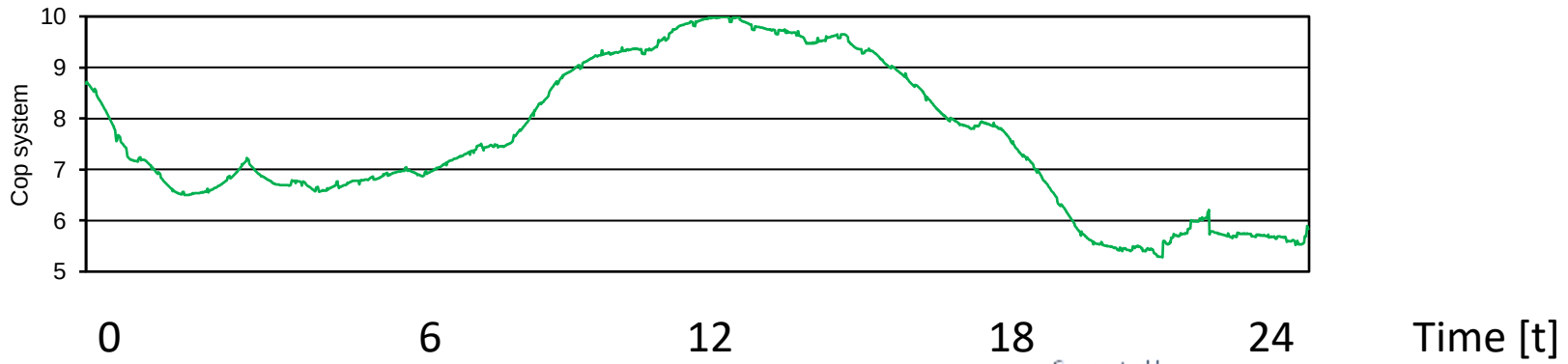
„Reiche Zeche“ Mine Freiberg

winter week



summer week



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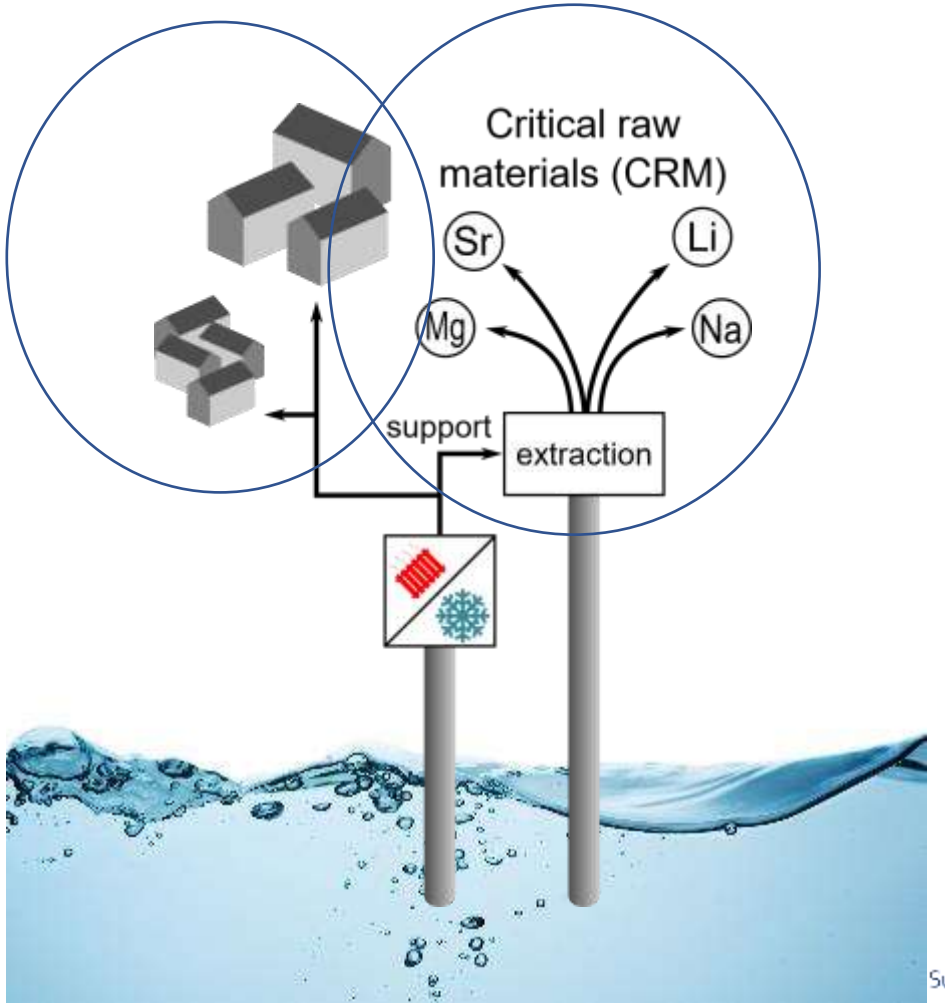
Brine - a source for

Heat

- Direct heating and cooling supply for
- Districts and Quarter solutions



Heat

- Supporting process heat in industrial sites
- Direct heating and cooling supply for infrastructure

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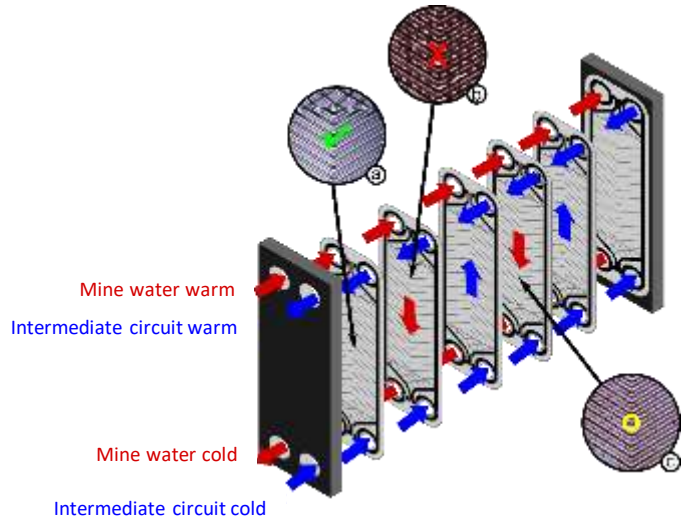
heat recovery

- **Evaluate the potential of brines for heating and cooling, e.g. to support recovery processes**
  - **temperature levels**
  - **heat exchanging systems**
  - **Fitting applications for heating and/or cooling**
- **Displaying the potentials on a map**
  - **Shape, aspects and image is not clear so far**



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Partner – Staff involved

Dr. Thomas Grab

Leader of working group: Prodecural material and process data

Use of mine water, evaporation and condensation processes, film distribution and falling film evaporation on structured surfasces, wetting of surfaces, heat transport with thermosiphons, energetic plant monitoring, scientific diving

MBA Timm Wunderlich

Research associate

Use of mine water, energetic plant monitoring, solar-powered buildings, development of energy utilisation concepts, economic and ecological calculations, communication

M.Sc. Lukas Oppelt

Research associate

Use of mine water, energetic plant monitoring, heat transfer, solar-powered buildings, development of energy utilisation concepts, economic and ecological calculations, simulation of energy systems

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Sources

[1] Bundesverband Geothermie, https://www.geothermie.de/bibliothek/lexikon-der-geothermie/n/nahwaermenetz.html [Zugriff am: 22.04.2022].

[2] Martin Pehnt (ifeu-Institut für Energie-und Umweltforschung Heidelberg GmbH)): Wärmenetzsysteme 4.0-Endbericht – Kurzstudie zur Umsetzung der Maßnahme „Modellvorhaben erneuerbare Energien in hocheffizienten Niedertemperaturwarmenetzen“ (2014).

[3] Franziska Bockelmann; Markus Peter; Henning Roggenkamp: future:heatpump II Erweiterung und Ausbau des Vordimensionierungsprogramms WP SOURCE-Steinbeis Innovations Zentrum SIZ Energie Plus – Präsentation-Abschlussworkshop future:heatpump_II im Rahmen der Workshopreihe „Niedertemperaturwärmequellen Potentiale und effiziente Nutzung“, online, 26. April 2022.

[4] Mijnwater: Minewater Circular Energy Network of The Future, 2021, https://mijnwater.com/en/ [Zugriff am: 30.03.2022].

[5] Op ‘t Veld, P.; Demollin Schneiders, E.: The Mine Water Project Heerlen, the Netherlands low exergy in practice Ausgabe 2007.

[6] Oberbergamt Sachsen, Hohlraumkarte Sachsen; Staatsbetrieb Geobasisinformation und Vermessung Sachsen (GeoSN), Dresden, 2017, https://geoportal.sachsen.de/cps/metadaten_portal.html?id=6006540e-fbb1-4b41-8e3e-cd20ff71cf6f

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Expertises

renewable energy source

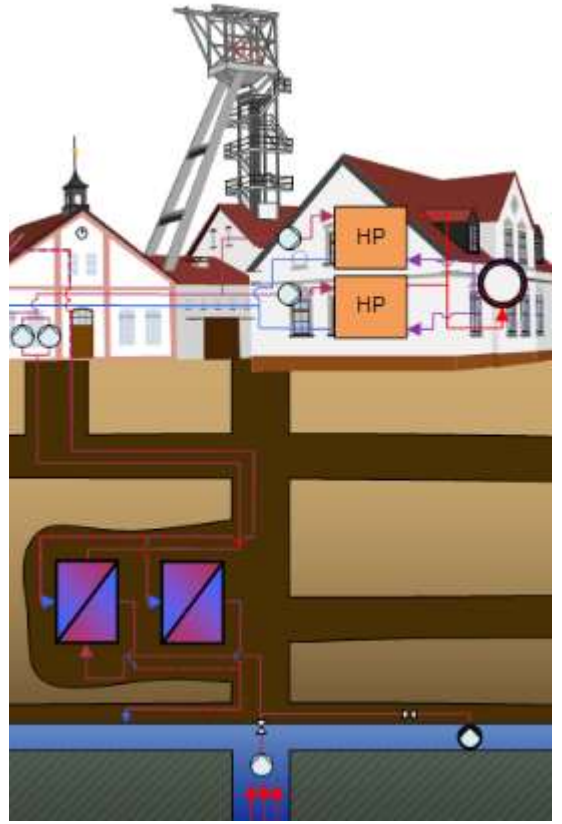
- solarthermal
- geothermal
- Seathermal
- Mine water geothermal

Potential analyses

- potentials renewable energy
- Development of quarter solutions

energy self-sufficient buildings

- monitoring
- technology- / concept comparison



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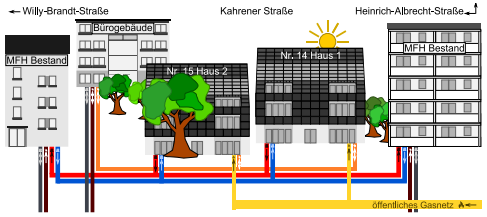
Expertises



Conecting from buildings

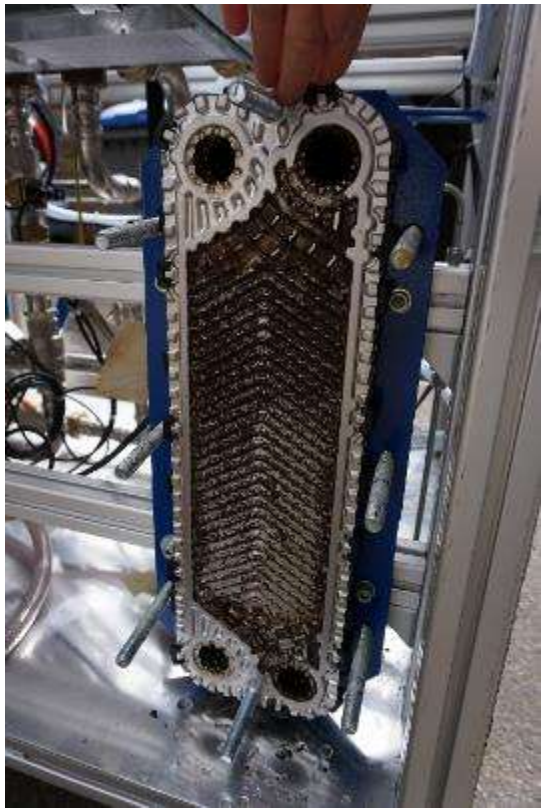
- networking potential
- monitoring

Fouling

- Otimication of plate heyt exchangers
- In-Situ tests with a mobile test rig

Surface waters

- 3D-scan from Water bottom and buildings



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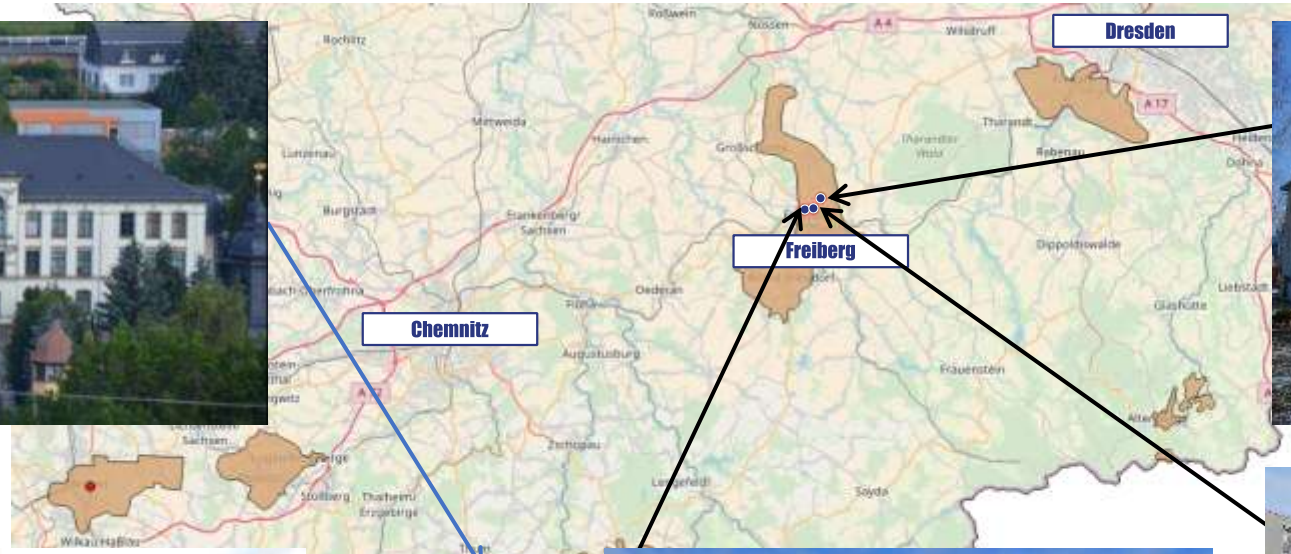
mine water geothermal plants



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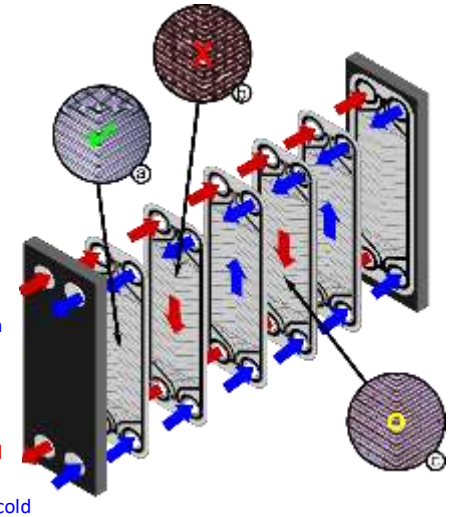
Influence of water chemistry on plant operation

- Mine waters contain organic / inorganic partially dissolved / undissolved substances
- Chemism depends on the location
- Plant causes formation of often stable layers (fouling)
  - Crystallization Fouling
  - Particle Fouling
  - Reaction fouling
  - Corrosion fouling
  - Bio fouling



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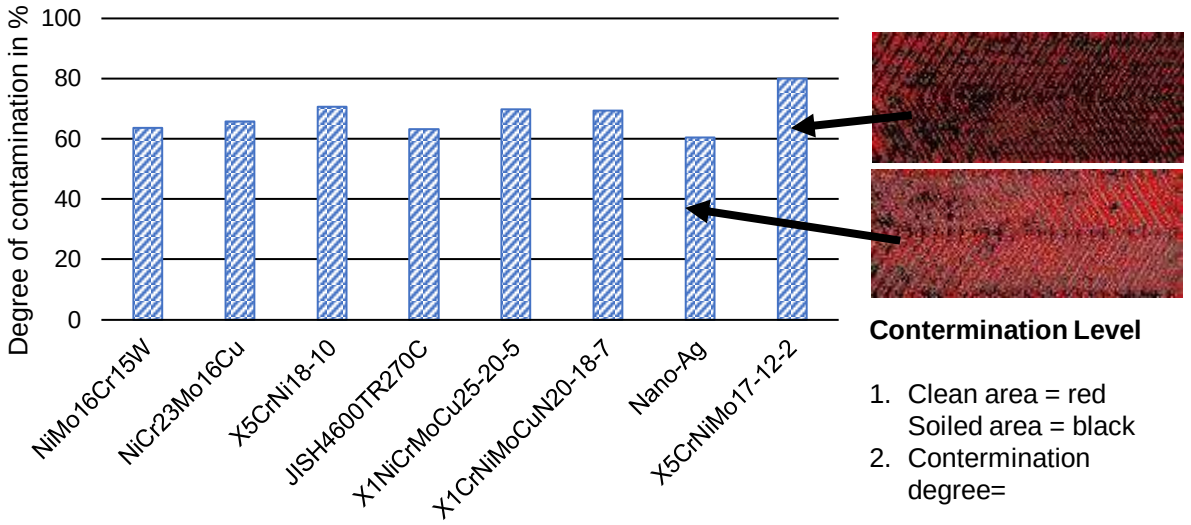
Focus on mine water geothermal energy

- **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)

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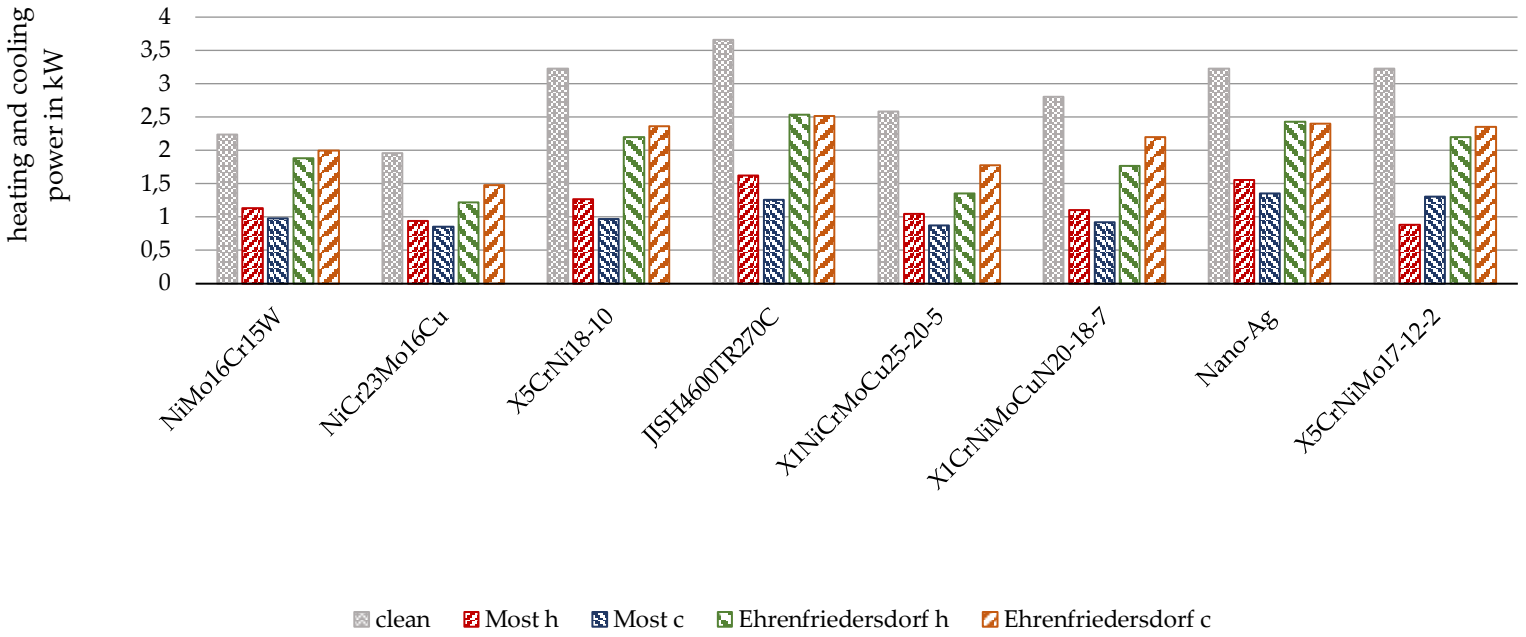
Focus on mine water geothermal energy

- **2nd test series in 2022 in Ehrenfriedersdorf (GER)**
- **3rd test series recently completed on MR1**



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1.4547	X1CrNiMoCuN20-18-7
1.4401	X5CrNiMo17-12-2 (Nano-Ag-Coating)

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