Geologische Bundesanstalt

XSIR

C. STEINER[1], M. FUCHSLUGER[1], G. GOETZL[1] and A. REHBOGEN[2]

[1]Geological Survey of Austria

[2]Salzburg Institute for Regional Planning and Housing

Harmonized web-based information system for shallow geothermal energy use in Austria

Featuring new methods for resource mapping

EGU 2021, 29 April 2021

Harmonized web-based info-system for shallow geothermal energy use in Austria

Project: „Green Energy Lab – Spatial Energy Planning“ (GEL-SEP)

SPATIAL ENERGY PLANNING

Funded by: Austrian Research Promotion Agency (FFG)

Project lifetime: 2018 – 2021

Goal: Development of **Heat-Atlas** – Showing heating supply (including **shallow geothermal energy**) and heating demand and providing a sound basis to integrate heat in private and public planning processes

Project website: http://www.waermeplanung.at/

Project partners:

- AEE - INSTITUT FÜR NACHHALTIGE TECHNOLOGIEN
  Ansprechpartner: Franz Mauthner & Ingo Leusbrock
- E7 ENERGIE MARKT ANALYSE GMBH
  Ansprechpartner: Walter Hüttler & Gerhard Hofer
- RESEARCH STUDIOS AUSTRIA STUDIO ISPACE
  Ansprechpartner: Ingrid Schardinger & Markus Biberacher
- TECHNISCHE UNIVERSITÄT GRAZ INSTITUT FÜR WÄRMETECHNIK
  Ansprechpartner: Thomas Mach
- TECHNISCHE UNIVERSITÄT WIEN ENERGY ECONOMICS GROUP
  Ansprechpartner: Lukas Kranzl
- STADTGEMEINDE ZELL AM SEE
  Ansprechpartner: Silvia Lenz
- ENERGIEAGENTUR STEIERMARK GMBH
  Ansprechpartner: Christian Sakulin
- GRAZER ENERGIEAGENTUR GMBH
  Ansprechpartner: Ernst Meißner
- SIR - SALZBURGER INSTITUT FÜR RAUMORDNUNG UND WOHNEN
  Ansprechpartner: Alexander Rehbogen
- UIV URBAN INNOVATION VIENNA GMBH
  Ansprechpartner: Waltraud Schmid
- AMT DER SALZBURGER LANDESREGIERUNG
  Ansprechpartner: Gerhard Löffler
- AMT DER STEIERMÄRKISCHEN LANDESREGIERUNG
  Ansprechpartner: Dieter Preiss
- BAUDIREKTION DER STADT SALZBURG
  Ansprechpartner: Franz Huemer
- ENERGIEREGION WEIZ-GLEISDORF GMBH
  Ansprechpartner: Christian Hütter
- GEMEINDE BERGHEIM
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  Ansprechpartner: Gerhard Freinbichler
- STADT GRAZ - STADTBAUDIREKTION
  Ansprechpartner: Kai-Uwe Hoffer
- STADT GRAZ - UMWELTAMT
  Ansprechpartner: Wolfgang Götzhaber
- STADTGEMEINDE KAPFENBERG
  Ansprechpartner: Sabine Christian

Invitation to upcoming webinar

Spatial Energy Planning

MUSE GeoERA GEO-ENERGY

Managing Urban Shallow Geothermal Energy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166

„Novel approaches in shallow geothermal resource mapping“

2 projects Geocond and GEL-SEP present their approaches for shallow geothermal resource mapping

Date: 10 May 2021. 3:00 pm – 4:30 pm (CET)

Program:

3 pm*	***Opening of the webinar and welcome address***
	Adela Ramos Escudero (University of Catagena) & Burkhard Sanner (UbeG GbR): Large scale, pan-European resource mapping – results from the EU project GEOCOND”
	Martin Fuchsluger (Geological Survey of Austria): The application of g-functions in shallow geothermal resource mapping
	Q&A round and joint discussion
4:30 pm	***End of the webinar***

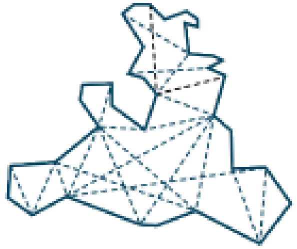
*all times in CET (Vienna – Berlin – Paris)

Register to the workshop via e-mail to gregor.goetzl@geologie.ac.at until 10 May 2021, 2 pm (CET).

The workshop is free of charge and powered by MUSE and Geocond

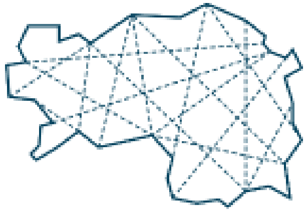
Shallow geothermal energy in the Heat-Atlas

New harmonized methods to determine **resources** and **possible limitations** in selected pilot areas:



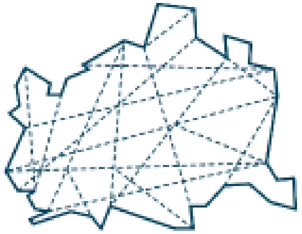
SALZBURG

Pilot area:
Area of permanent settlement



STYRIA

Pilot areas:
Graz
Kapfenberg
Energieregion Weiz-Gleisdorf
Oststeiermark



VIENNA

Pilot area:
City of Vienna

Methods developed by:

- **Geological Survey of Austria** (borehole heat exchanger, groundwater heat exchanger)
- **Friedrich-Alexander Universität Erlangen** (surficial heat exchangers)

Shallow geothermal energy in the Heat-Atlas

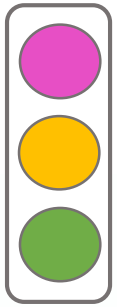
Two main categories:

1) Possible limitations of use

„What might limit the use of SGE?“

Specific queries

Traffic light map



Generally not possible

Detailed information necessary

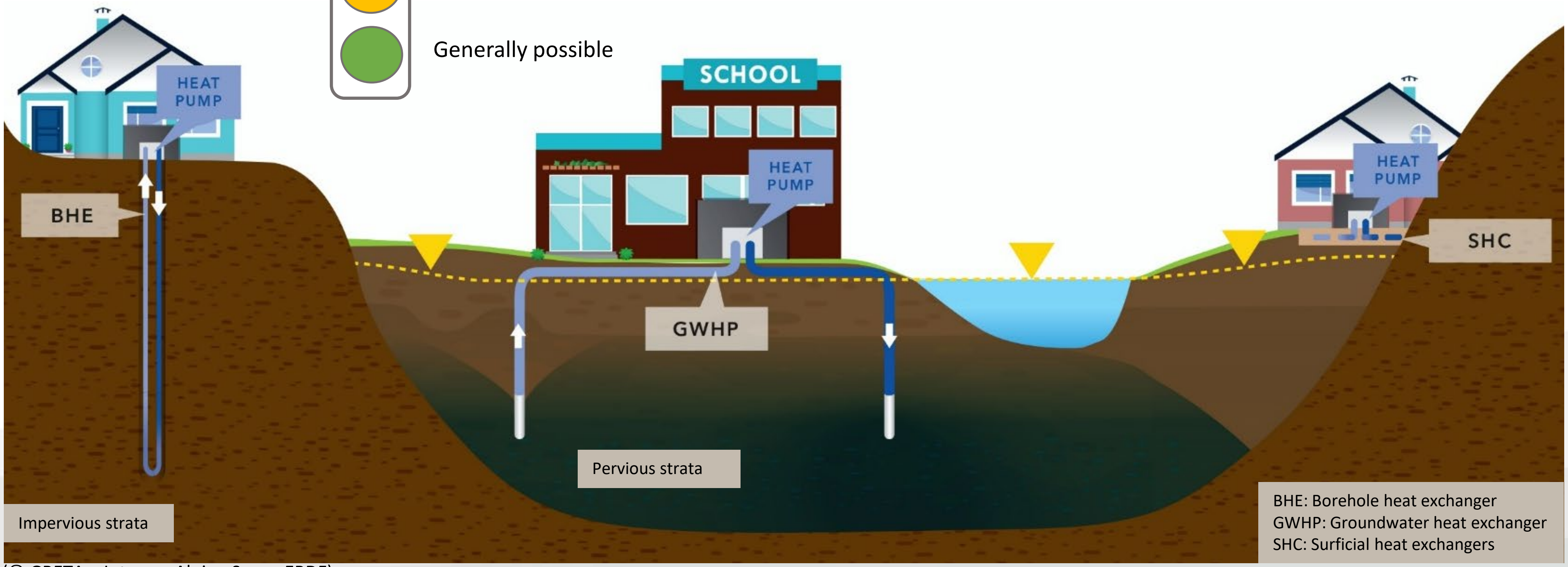
Generally possible

2) Energy resources

„What is the (hydro)geological setting and how much energy is available?“

Specific queries

Ressource maps



(© GRETA – Interreg Alpine Space ERDF)

Tools in the Heat-Atlas

TOOL 1: Ressource maps and traffic light maps

Map viewer

- Overall ressources independent of properties
- Summary of all possible limitations of use

TOOL 2: Location specific query

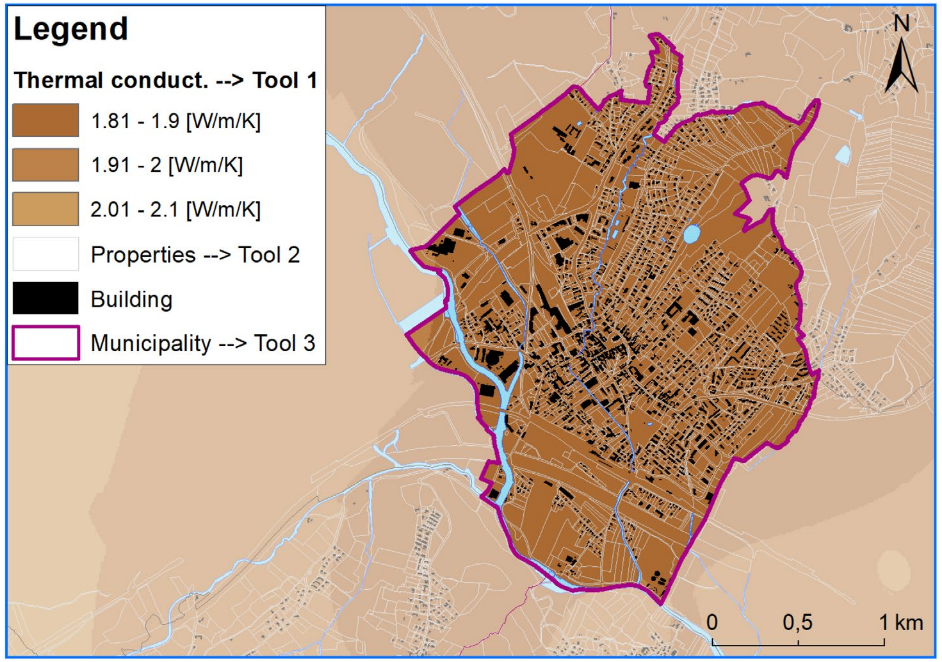
Automatically generated PDF-report

- Restrictions and remarks for the use of shallow geothermal energy
- Resources available at the property
- Comparison of resources with the heating/cooling demand of the property → amount of coverage
- Important (hydro)geological information

TOOL 3: Regional analysis for city districts or municipalities

Automatically generated PDF-report

- Suitability of the area
- Overall ressources available
- Amount of coverage



Different spatial resolutions for the tools.

Important:
All tools are developed for GWHP, BHE and SHC.

TOOL 1: Traffic light maps – All systems

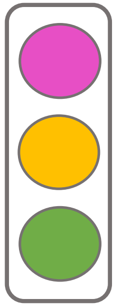
Step 1: Colouring the possible limitations of use

Step 2: Combination of all possible limitations to traffic light map

Possible limitation of use
Water protection and conservation areas
Nature protection
~~Limitation of drilling depth~~
Confined groundwater body
Landslides
Rocks bearing inflammable gases
Potentially carstified rocks
Multiple groundwater storeys
Existing drinking water wells
Existing production and infiltration wells of thermal groundwater heat exchangers
Any existing groundwater use
Contaminated areas
Problematic chemistry of groundwater
Rocks susceptible to dissolving
Rocks susceptible to swelling
Flooding areas
Hazard zone plan
Potentially contaminated areas
Surface water
Mining areas and artificial cavities
Protected historical buildings
Archaeological relevant areas

Orange colored limitations are included in the traffic light map. Grey colored limitations feed only into the queries (tool 2 and 3).

Traffic light map

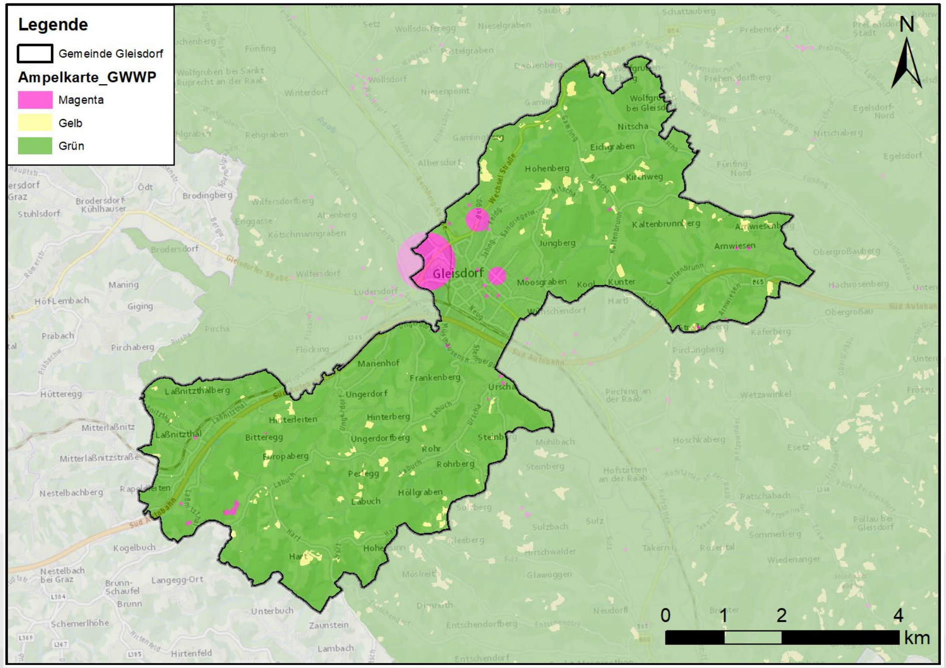


Generally not possible

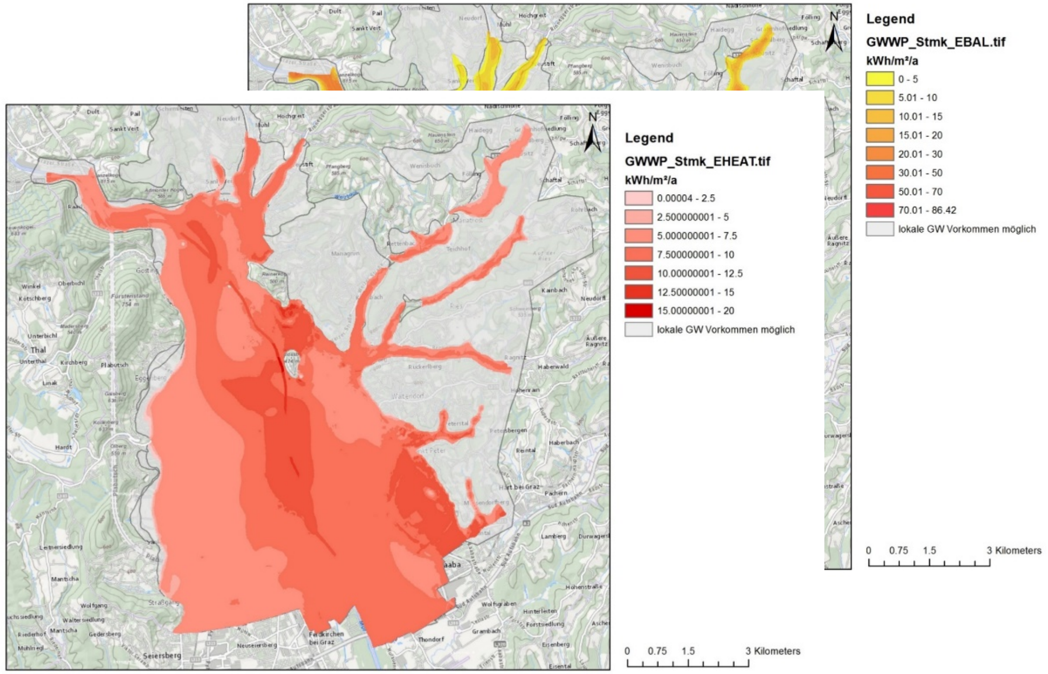
Detailed information necessary

Generally possible

Example of a traffic light map.
Shows always the strongest color (magenta over yellow over green).



TOOL 1: Resources – Groundwater heat exchanger



Example of resulting energy content maps for Graz.

Tool 1: Resource maps

Goal of tool: Overview of resources

Wholistic approach -> Outputs are based on energy content

Calculation of energy content for 2 modes of operation:

Mode of operation	GW-Temp limit	Life time	Heat flows
Unbalanced heating and cooling	5 -18 °C	20 years	Considered
Balanced heating and cooling	5 - 18 °C	1 years	Not relevant

INPUT

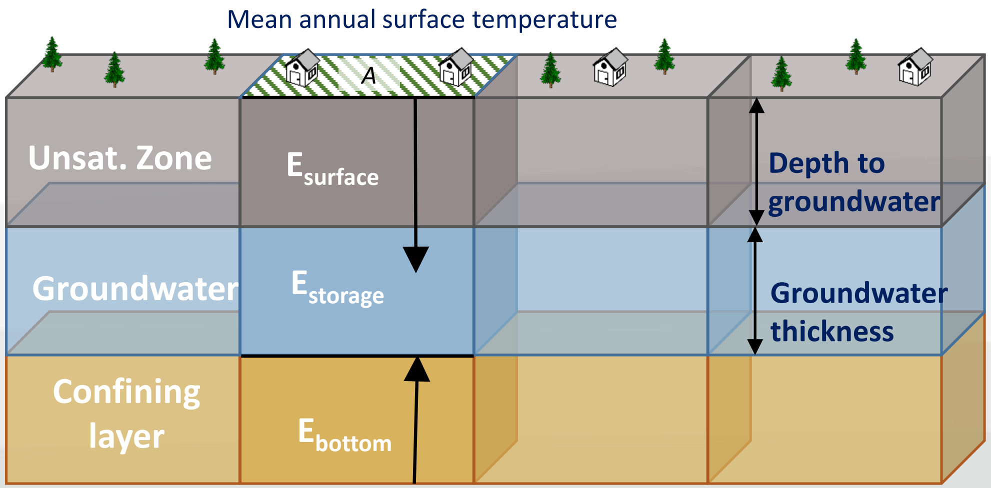
Hydrogeological parameters (as rasters):
- Outline of suitable groundwater body
- GW-thickness
- GW-temperature (mean)
- Depth to GW level

System-related parameters
- Usable temperature range (5-18 °C)
- Life time (20 years)
- Geometrical doublet factor (0.75)
- Parameters to estimate heat flow from surface and bottom

OUTPUT maps

Energy content
- Heating and cooling (standard operating hours) in **kWh/a/m²**
- Balanced mode of operation (Heating = Cooling)

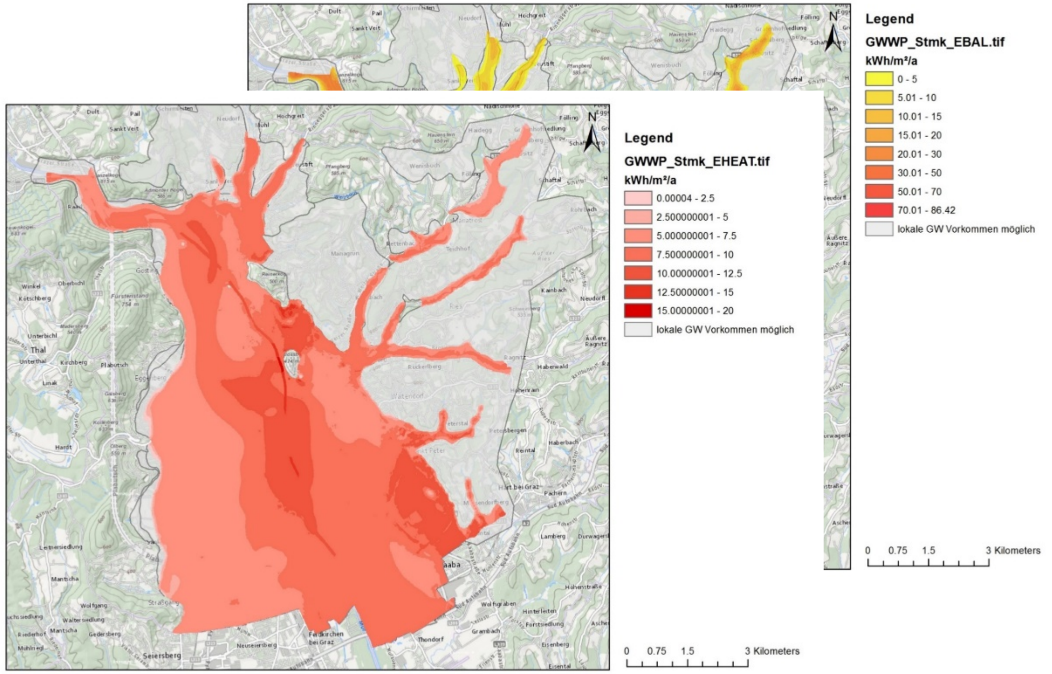
Power map for single well doublet
- Unbalanced heating and cooling (standard operating hours) in **l/s**
- Balanced mode of operation (Heating = Cooling)



TOOL 1: Resources – Groundwater heat exchanger

Tool 1: Resource maps

Goal of tool: Overview of resources and comparison of locations



Example of resulting energy content maps for Graz.

RESULTS

Note:
Black result parameters will be shown as maps

Hydrogeology

- Outline of suitable groundwater body
- GW-temperature [°C]
- GW-thickness [m]
- Depth to GW level [m]

Climate

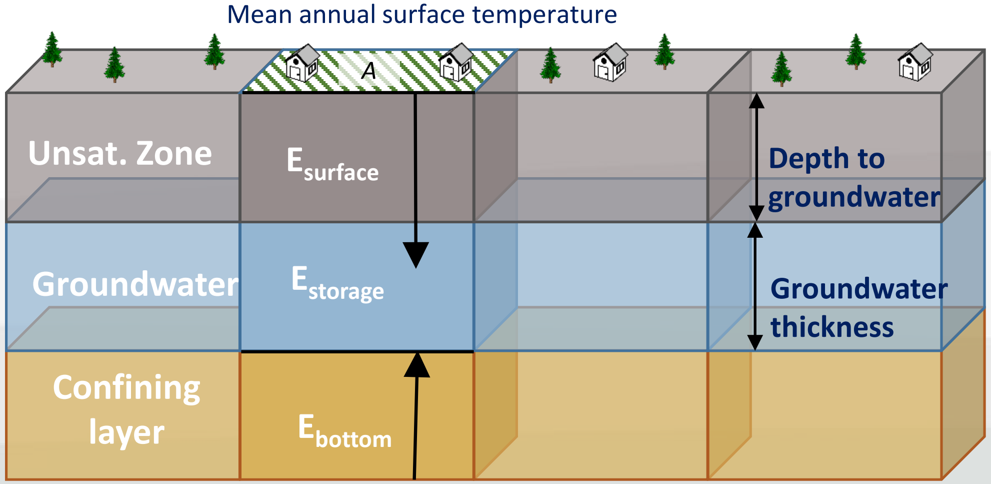
- Standardized operating hours for heating and cooling [h]

Specific capacity

- Maximum pumping rate [l/s]

Specific energy content

- Heating and cooling with standard operating hours [kWh/m²/a]
- Balanced mode of operation [kWh/m²/a]



TOOL 2: Groundwater heat exchanger

TOOL 2 – Location specific query

Goal of tool: Resources and limitations on the property

Property

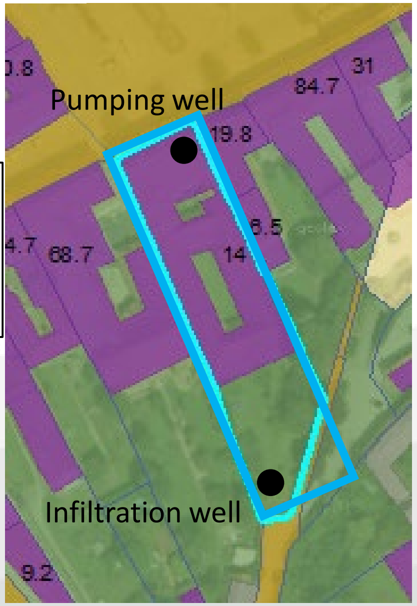
Total space	1851 m²
Free space	753 m²
max. difference between wells	94 m

Demand of building

Power for heating	14 kW
Power for cooling	3.6 kW
Annual heating consumption	33.7 MWh/a
Annual cooling consumption	1.2 MWh/a
SPF of heat pump, est.	2.5

Maximum pumping rate is determined based on free space available at the property

→ Output as text and figures in PDF-report



Hydrogeology (Tool 1)

GW temperature min/max	10.8 °C/12.8 °C
hydraul. conductivity	0.0001 m/s
Hydraulic gradient	0.008 m/m
GW thickness, est.	3.4 m
GW depth, est.	5.1 m

Resources

Pumping rate	**0.4 l/s**
Temperature shift - heating	5 K
Temperature shift - cooling	5 K
Power for heating without/with COP	8 / 13 kW
Power for cooling without/with COP	8 / 6 kW
Coverage of demand for heating	**93 %**
Coverage of demand for cooling	**166 %**

Limitation of use

(Tool 1) Detailed information is necessary due to:

Water conservation area on the property

Additional information for planning, installation and operation respectively:

Risk of scaling of iron or manganese. Analysis of the groundwater chemistry is recommended.

TOOL 1: Borehole heat exchanger

TOOL 1 – Resource maps

Goal of tool: Overview of resources

Geology

- Thermal conductivity [W/m/K]
- Underground temperature [°C]

Note:
Black result parameters will be shown as maps

Climate

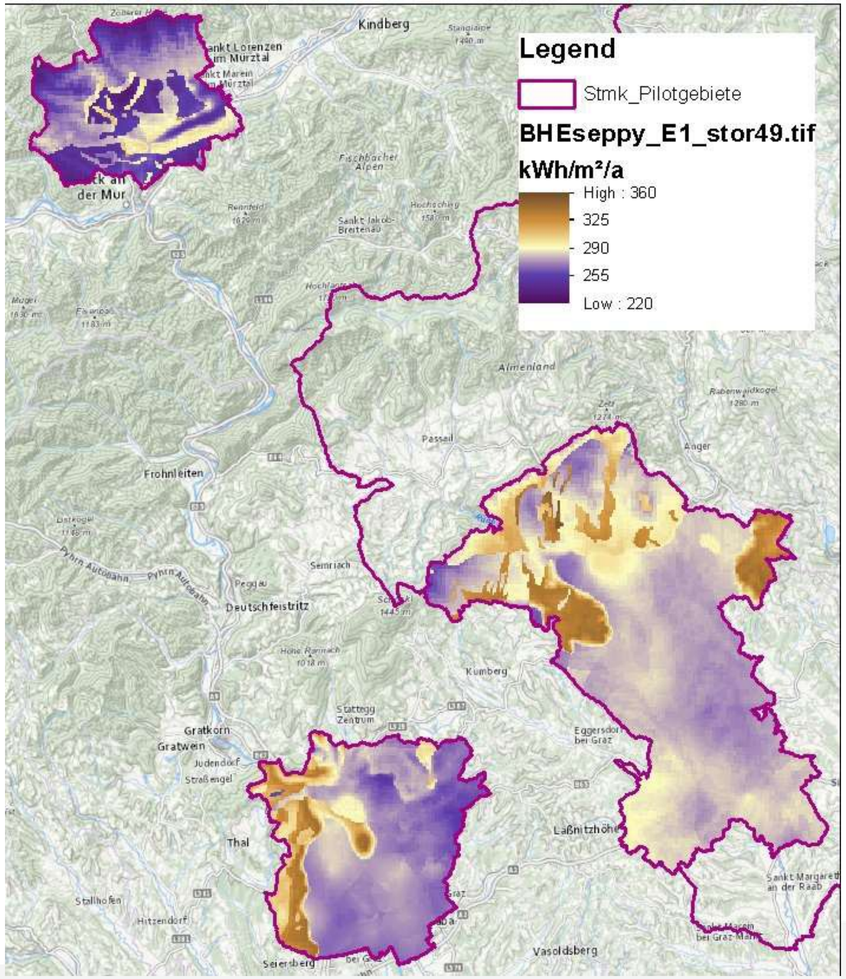
- Standardized operating hours for heating and cooling [h]

Specific capacity – Singular BHE

- Heating and cooling with standard operating hours [W/m]
- Balanced mode of operation [W/m]

Specific energy content – BHE field

- Heating and cooling with standard operating hours [kWh/m²/a]
- Balanced mode of operation [kWh/m²/a]



Parameters of the system, constant:

- Depth of BHE (100 m)
- Temp.limits brine (-1.5 to 25 °C)
- Period of use (20 years)
- Borehole thermal resistance (0.75 K/W/m)

TOOL 2: Borehole heat exchanger

TOOL 2 – Location specific query

Goal of tool: Resources and limitations on the property

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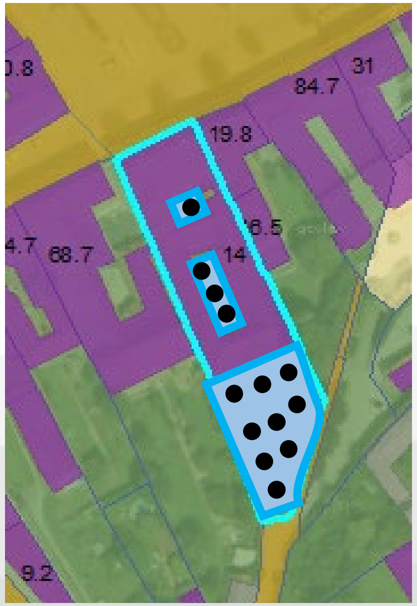


Geology

Thermal conductivity 0-100 m	1.9 W/m/K
Surface temperature	10.9 °C
Underground temp. 0-100 m	11.9 °C

Basic resources tool 1

Singular BHE	32.7 W/lfm

Requirements to meet demand

Number of BHEs	5 pieces
Length of BHEs	110 m
Capacity (10 m distance of BHEs)	25.3 W/lfm
Demand of space	236 m²

Resources at the property

Number of BHEs at free space	11 pieces
Capacity (10 m distance of BHEs)	22.9 W/lfm
Coverage of demand	**217 %**
Total capacity available	**30 kW**
Annual energy content available	72 MWh/a

Limitation of use

(Tool 1) Use of BHE is generally not possible due to:

Water protection area on the property

TOOL 3: Groundwater heat exchanger

TOOL 3 – Regional query

Goal of tool: Total resources in city district

- Integration of energy content (Tool 1) over selected area [GWh/a]
- Suitability of area (=Groundwater availability and no limitations/detailed information)
- Amount of coverage (Energy content vs. demand in %)

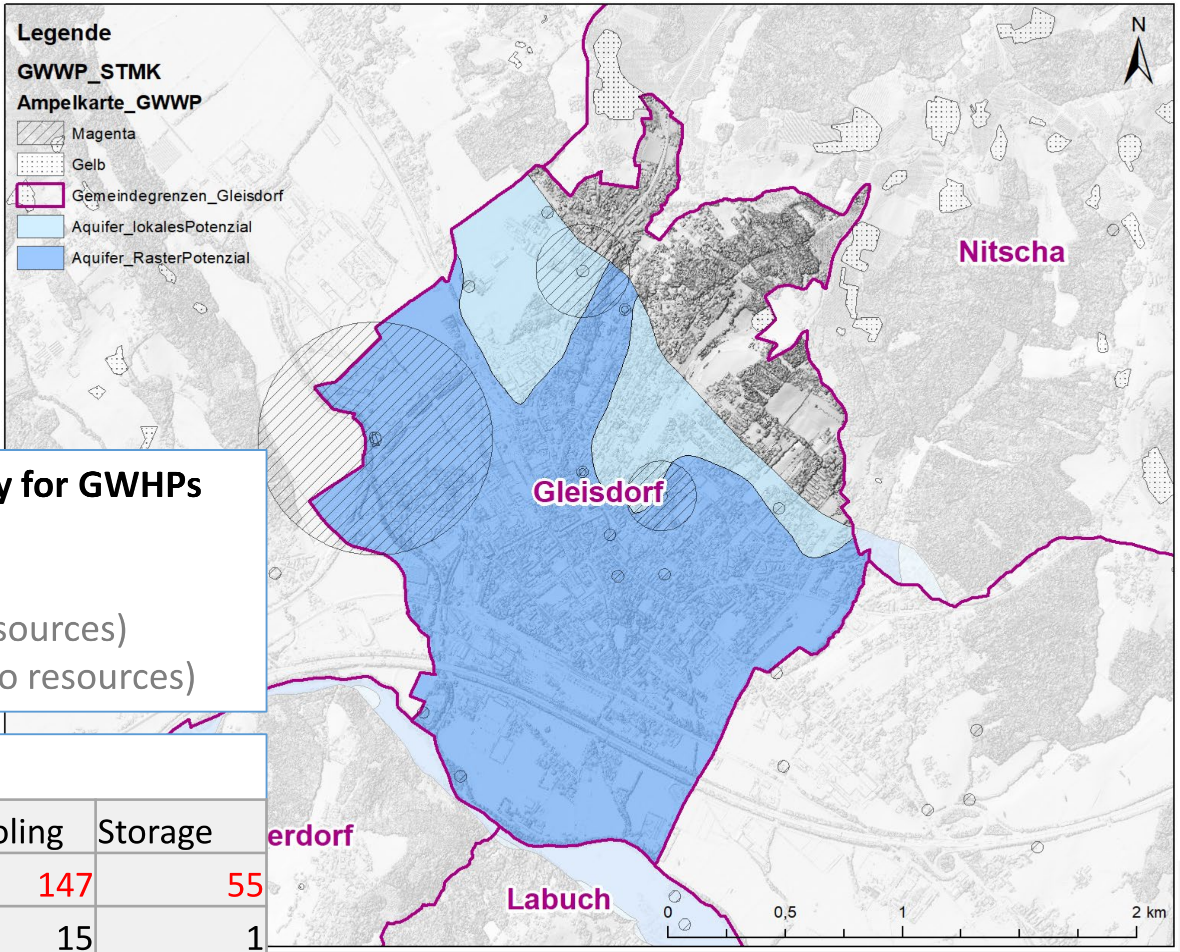
→ Output as text and figures in PDF-report

Suitabiliy of municipality for GWHPs

55 % Very well suitable
12 % Well suitable
20 % Not suitable (no resources)
13 % Protection areas (no resources)

Energy content [GWh/a]	Heating	Cooling	Storage
Gleisdorf	24.0	23.1	45.3
Nitscha	0.2	0.2	0.2
Ungerdorf	2.1	2.9	2.7
Labuch	2.3	2.6	4.4
Laßnitzthal	3.1	4.9	3.3

Amount of coverage [%]	Heating	Cooling	Storage
Gleisdorf	29	147	55
Nitscha	1	15	1
Ungerdorf	31	519	41
Labuch	30	460	57
Laßnitzthal	29	593	30



Example of figure shown in regional report.

Invitation to upcoming webinar

SPATIAL ENERGY PLANNING

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Managing Urban Shallow Geothermal Energy

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