FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Bavarian Research Alliance

29.06.2020
VIRTUAL ENERGY DAY

Very Shallow Geothermal Energy: A Sleeping Giant of the Energy Revolution

#GeothermalRevolution

SUSTAINABLE ENERGY WEEK
An initiative of the European Commission

ENERGY DAYS
ENERGY FOR THE EUROPEAN GREEN DEAL
#EUSEW2020

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WELCOME!

SUSTAINABLE ENERGY WEEK

An initiative of the European Commission

ENERGY DAYS

ENERGY FOR THE EUROPEAN GREEN DEAL

#EUSEW2020

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AGENDA

- Presentation | Dr Ammerl 15

Possibilities of grants in the context of R&D of renewable energies in the age of Europe's Green New Deal

- Presentation | Dr Bertermann 50

Very Shallow Geothermal Energy - A Sleeping Giant of the Energy Revolution

- Discussion/Q&A 25
- Closing Remarks 05

SUSTAINABLE ENERGY WEEK
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ENERGY DAYS
ENERGY FOR THE EUROPEAN GREEN DEAL
#EUSEW2020

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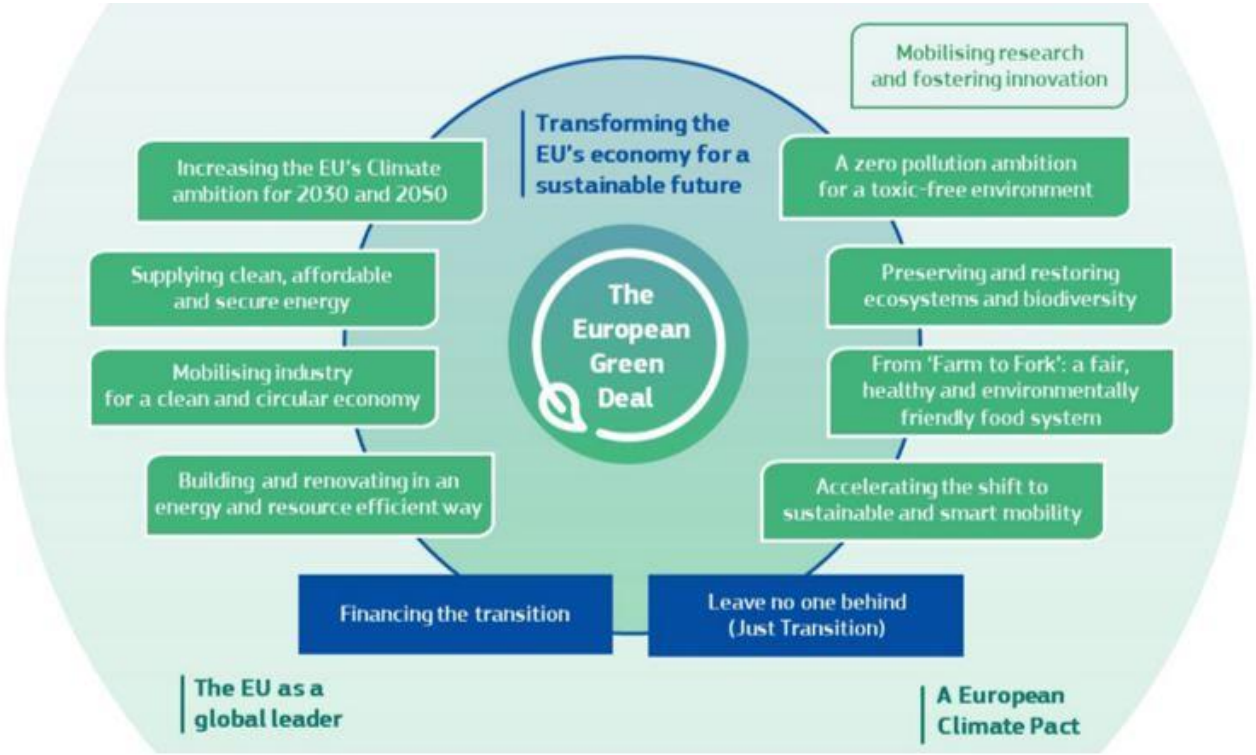
TECHNICAL ISSUES

- Please include your name/surname and institution
- Please activate your camera
- Please mute your mic
- Use the chat

SUSTAINABLE ENERGY WEEK
An initiative of the European Commission

ENERGY DAYS
ENERGY FOR THE EUROPEAN GREEN DEAL
#EUSEW2020

R&D&I funding for renewable energies in the age of Europe´s Green New Deal

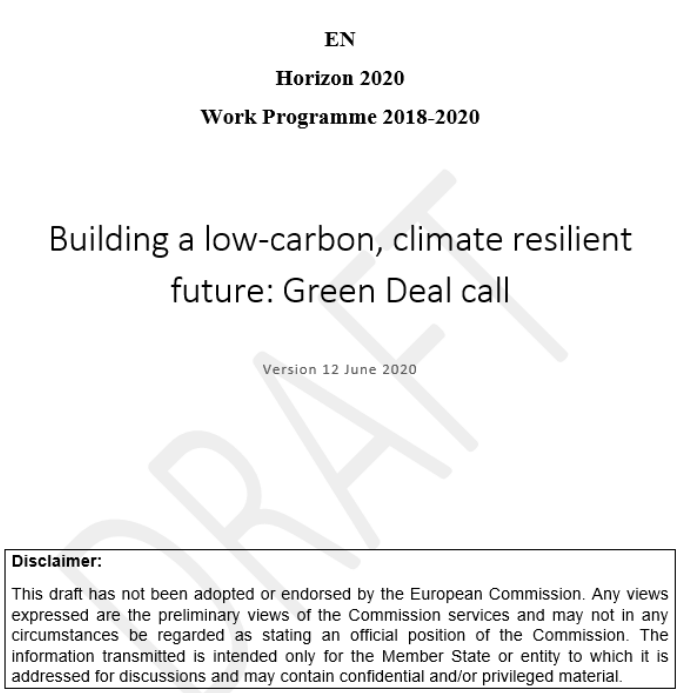


The elements of the European Green Deal (Source: European Commission)

- **Roadmap** for making the EU's economy sustainable
- **Growth strategy** that transforms the Union into a modern, resource-efficient and competitive economy

Thomas Ammerl (BayFOR, Unit Environment, Energy & Bioeconomy)
ammerl@bayfor.org; @BayFOR_UEB

Bulding a low-carbon, climate resilient future: Green Deal call



EN

Horizon 2020

Work Programme 2018-2020

Building a low-carbon, climate resilient future: Green Deal call

Version 12 June 2020

DRAFT

Disclaimer:

This draft has not been adopted or endorsed by the European Commission. Any views expressed are the preliminary views of the Commission services and may not in any circumstances be regarded as stating an official position of the Commission. The information transmitted is intended only for the Member State or entity to which it is addressed for discussions and may contain confidential and/or privileged material.

Area 2: Clean, affordable and secure energy

LC-GD-2-1-2020: Demonstration of innovative critical technologies to enable future large-scale deployment of **offshore renewable energy technologies.**

Wind, solar, wave and/or tidal resources (Baltic Sea, North Sea, Atlantic Ocean, Mediterranean Sea and the Black Sea)

Offshore renewable energy power generating systems; Grid infrastructure; Power to X /storage systems

EUR 20-40 million (TRL7, RIA)

Thomas Ammerl (BayFOR, Unit Environment, Energy & Bioeconomy)
ammerl@bayfor.org; @BayFOR_UEB

LC-GD-2-2-2020 Develop and demonstrate a 100 MW electrolyser upscaling the link between renewables and commercial/industrial applications

- European long term decarbonisation strategy (LTS) **“A Clean Planet for All”**
- Key role of **hydrogen** in decarbonising hard-to-abate sectors, such as industry, cement, steel, and also contributing to decarbonisation of heavy duty and long distance transport.
- The scope of this project is to install and operate a **100 MW electrolyser** to produce renewable hydrogen, as energy carrier.
- Development, installation and operation a 100 MW electrolyser for managing and using efficiently renewable energy (electricity and heat), water, Hydrogen and Oxygen flows
- Other activities will consist of **economic, safety and environmental assessments**
- Mandatory knowledge **sharing activity**
- Technological, operational, environmental, cost competitiveness and study **impacts**
- IA

Thomas Ammerl (BayFOR, Unit Environment, Energy & Bioeconomy)
ammerl@bayfor.org; @BayFOR_UEB

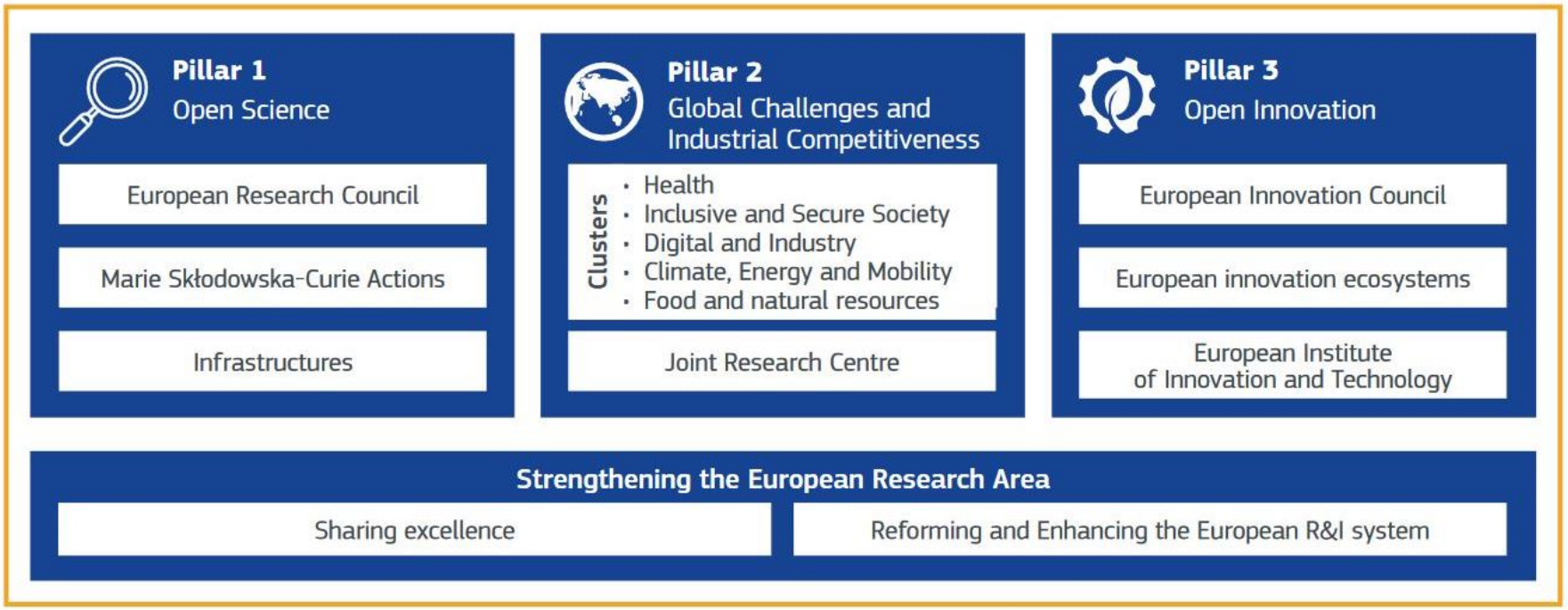
Area 4: Energy and resource efficient buildings

LC-GD-4-1-2020: Building and renovating in an energy and resource efficient way

- **Priority:** design and construction of new or retrofitting of existing buildings as zero-emission, positive energy powerhouses within sustainable green neighbourhoods
- **At least two** (residential and non-residential, new and/or retrofitted) large-scale, real-life **demonstrations** of promising technology, process and social innovations, in different regions of Europe.
- **Multiplication** of such buildings allows the creation of green neighbourhood **"living labs"** (including social housing and non-residential buildings such as hospitals, schools, public buildings, commercial buildings, etc.) + scalability design, Citizen awareness raisings
- Sustainable, innovative zero-emission and more cost and energy efficient, **RES power generation** in the buildings combined with urban service facilities (e.g. charging facilities, Energy storage systems) and HVAC technologies
- From TRL 5/6 to TRL 7/8 at the end of the project (EUR 15 to 20 million)

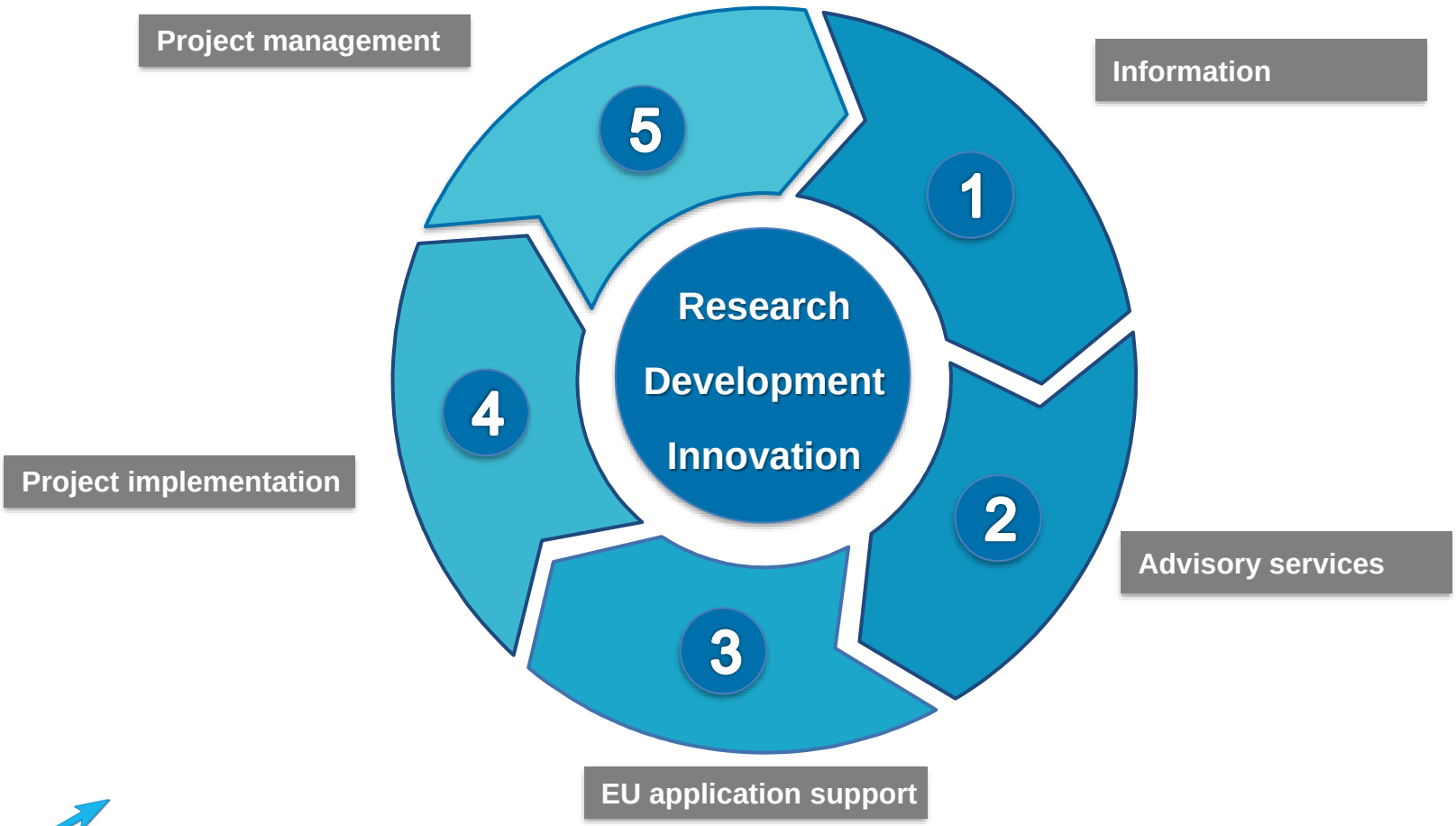
Horizon Europe – Built on three pillars

Preliminary programme structure:



Source: European Commission

BayFOR as a „Full Service Provider“



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Very Shallow Geothermal Energy - A Sleeping Giant of the Energy Revolution

Working Group: Shallow Geothermy Energy | FAU Erlangen

Speaker: Dr David Bertermann

Friedrich- Alexander-University Erlangen-Nuremberg

- Chair of Geology
  - Working Group Shallow Geothermal Energy

Deep Geothermal Energy

from 400 m

Shallow Geothermal Energy

until 400 m

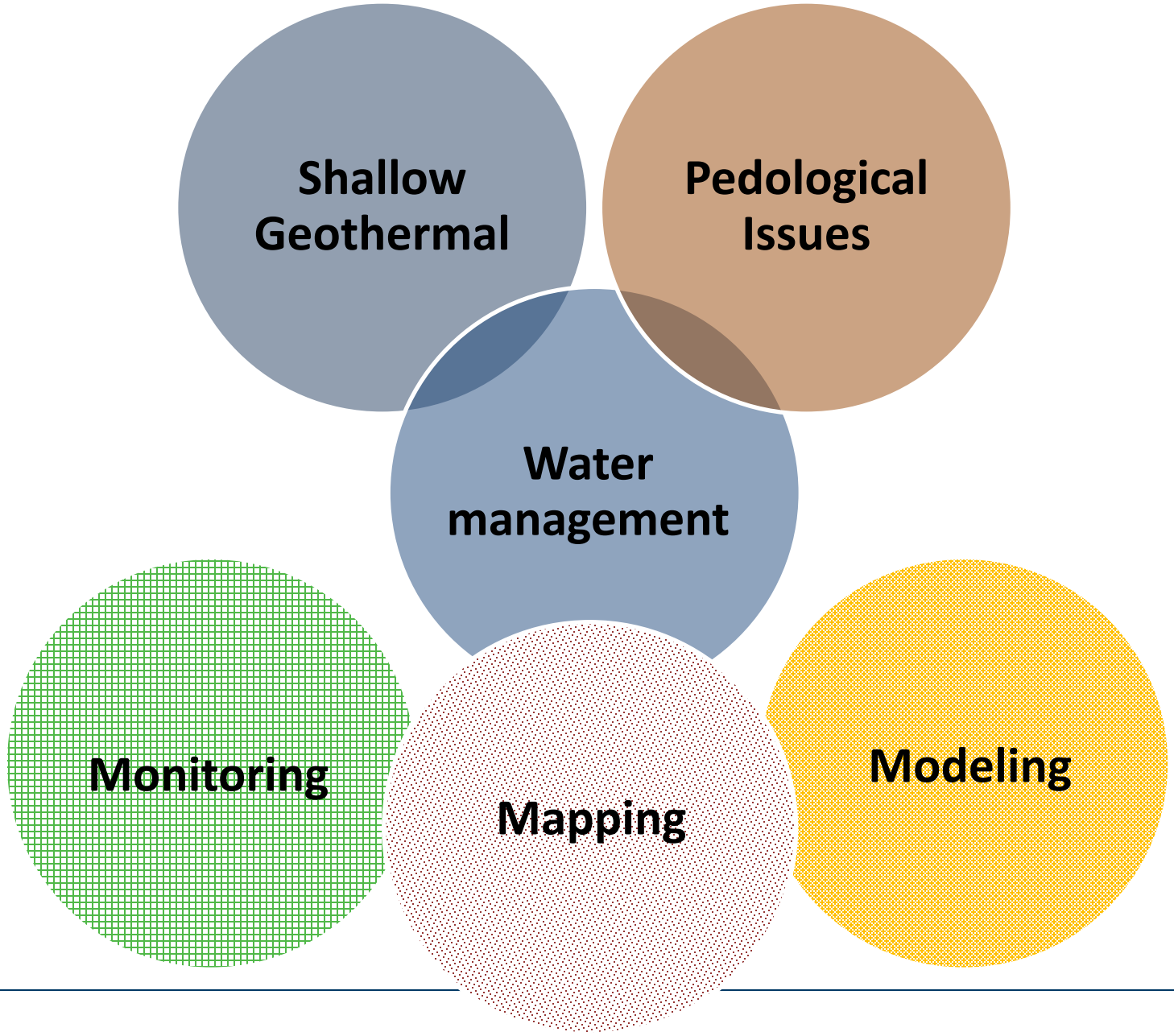
Interdisciplinary Team:

- Geology
- Geography
- Physics / Thermodynamic
- Chemistry
- Mechatronics
- Political Science
- …

“What are your research topics”

Shallow Geothermal
Pedological Issues
Water Management

3


Shallow Geothermal
Pedological Issues
Water management
Monitoring
Mapping
Modeling

Aim - to answer the question:

Why and how is (Very) Shallow Geothermal Energy a Sleeping Giant of the Energy Revolution?

The Energy Revolution & The Green New Deal

- A large part of the energy consumed by a private household is used for heating: 70 to 80 percent
- If Europe wants to become climate-neutral by 2050, near-surface geothermal energy can do much of the work!

Outline

I. Principles of the utilization of shallow geothermal energy as a relatively simple form of sustainable energy

II. Mapping of potentials – why? (ThermoMap)

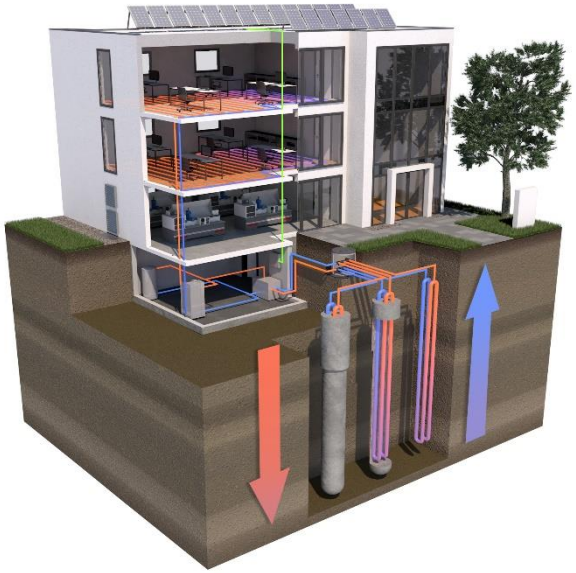
III. Integration of geothermal energy for refurbishing buildings (GEO4CIVHIC)

IV. District Heating and Cooling Systems coupled with shallow geothermal energy (ZIM)

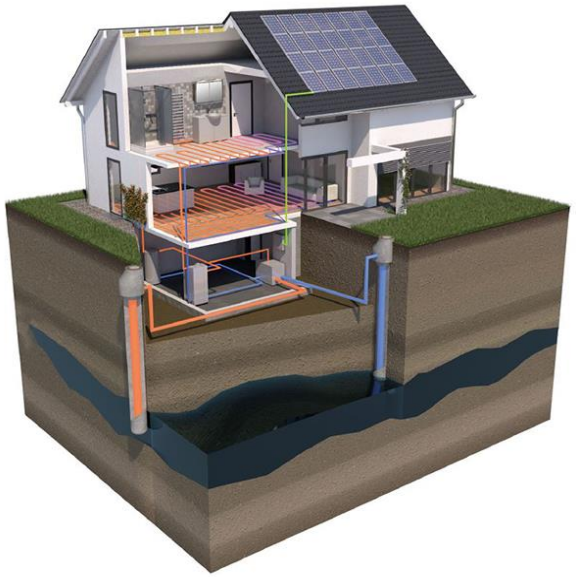
I.

Principles of the utilization of shallow geothermal energy as a relatively simple form of sustainable energy

Vertical energy systems



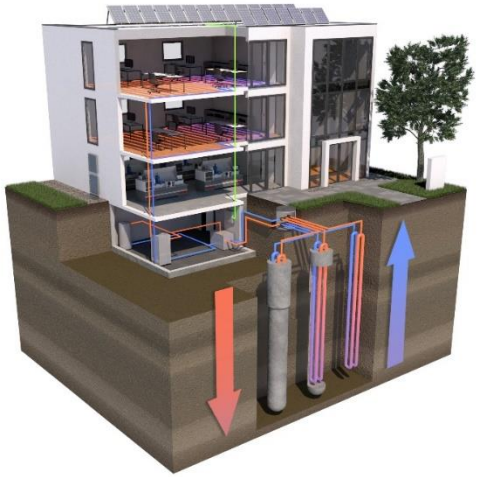
Geothermal probe



Groundwater heat pump

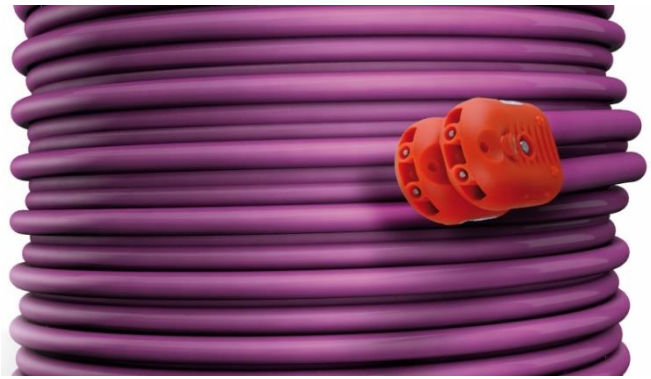
https://www.erdwaermegemeinschaft.de/wie-funktioniert-erdwaerme/

Vertical - System components



Heat exchanger - Probes

- Single-U
- Double-U
- Special forms



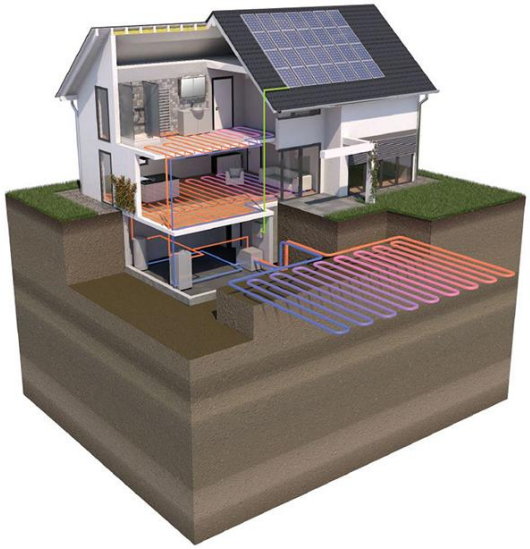
https://www.frank-gmbh.de/de/Produktgruppen/Geothermie/pex-Erdwaermesonde.php

https://www.jansen.com/de/plastic-solutions-kunstoffsysteme/produkte/geothermie/erdwaermesonden/jansen-powerwave.html

Vertical - System components

Vertical - System components

Horizontal energy exchange - collector



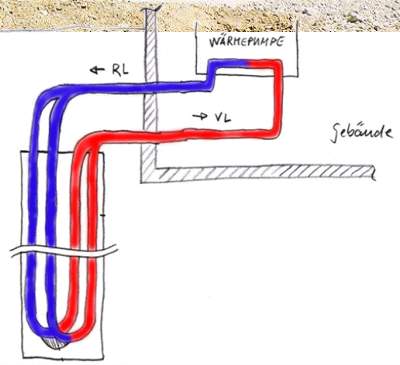
Geothermal heat Surface collector

Special forms

https://www.erdwaermegemeinschaft.de/wie-funktioniert-erdwaerme/

Horizontal energy exchange - collector

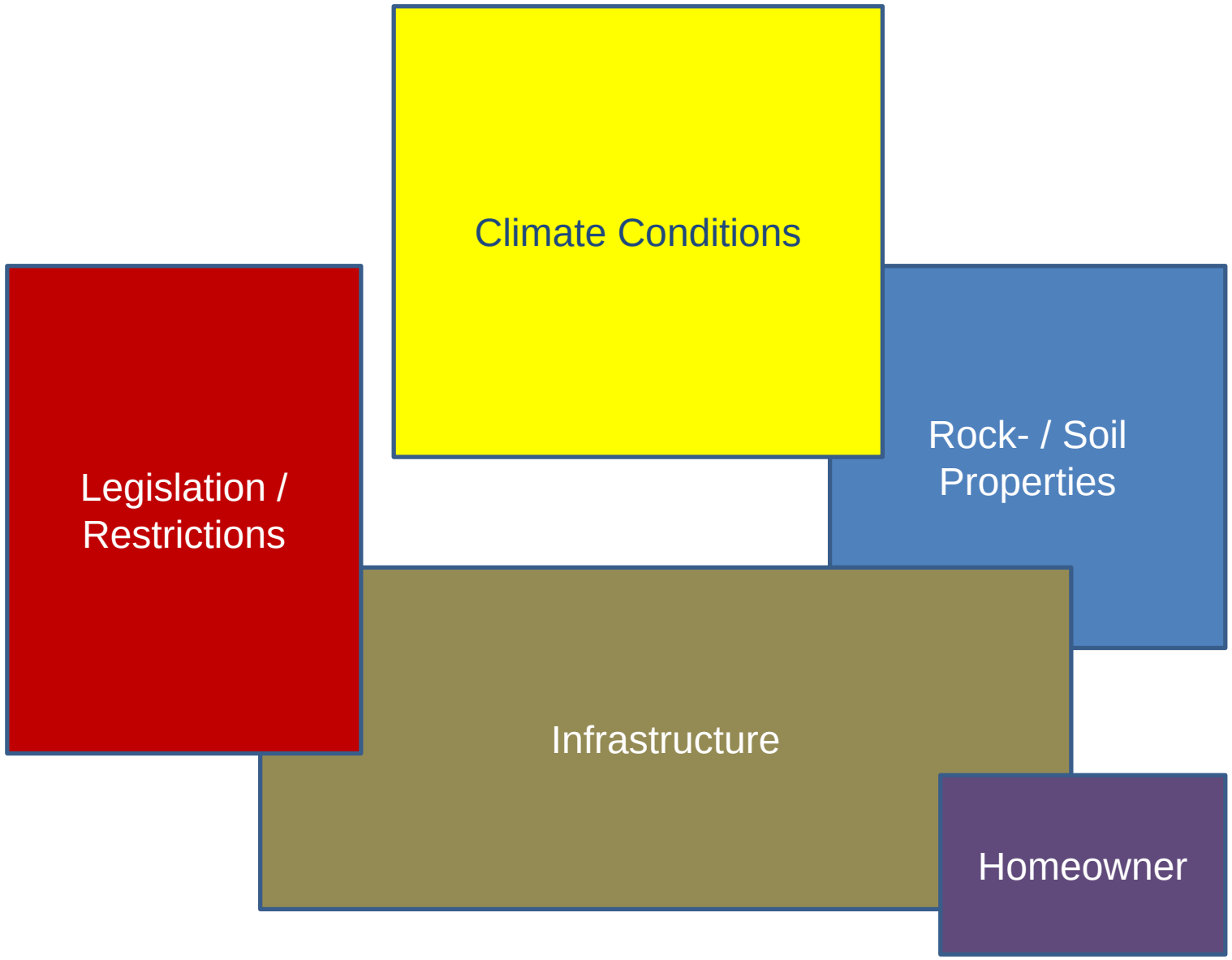
Connection - Building



ThermoMap

II.

Mapping of potentials – why?


Climate Conditions
Legislation / Restrictions
Rock- / Soil Properties
Infrastructure
Homeowner

Shallow geothermal systems

Vertical systems (e.g. probes)

- Planning documents:
  - Geological maps
  - Country specific information systems, e.g. in Germany (federal state specific information systems - IOG- Bavaria)

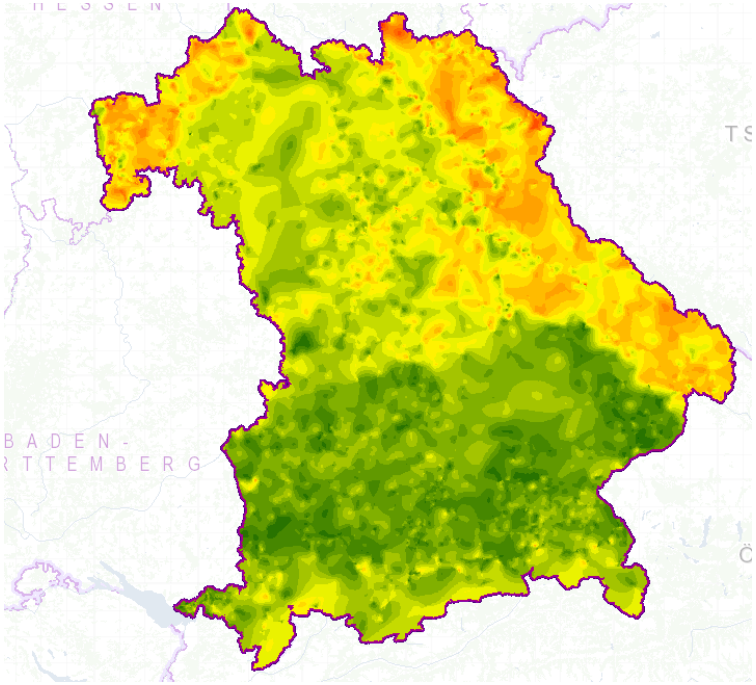
- Suitable transformation of geological data sets to thermal extraction potential
  - Low influence of seasonal variations
  - Specific parameters (e.g. thermal heat conductivity) of consolidated rock material are well known

Horizontal systems (e.g. collectors)

- Planning documents hardly available
  - Low research activities
  - High heterogeneity on small-scale level for the different parameters

- Estimation of the thermal extraction potential is rather difficult
  - High influence of seasonal variations
  - Strongly influenced by pedological parameters

How can potentials be depicted - vertically?



https://www.lfu.bayern.de/geologie/

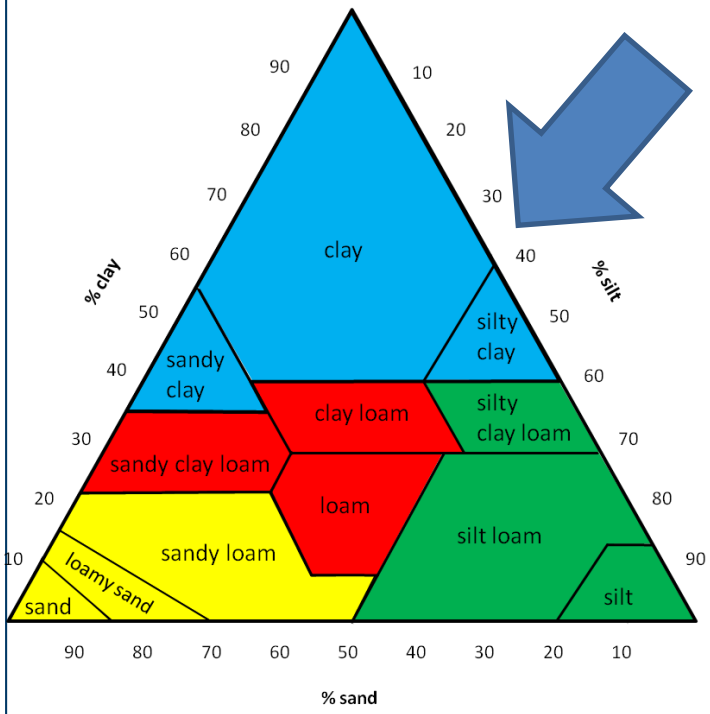
Situation for horizontal systems?

No universal and pan-European collector-based estimation system for the very shallow geothermal potentials exists.

EUROPEAN COMMISSION

ThermoMap

Pedological parameters



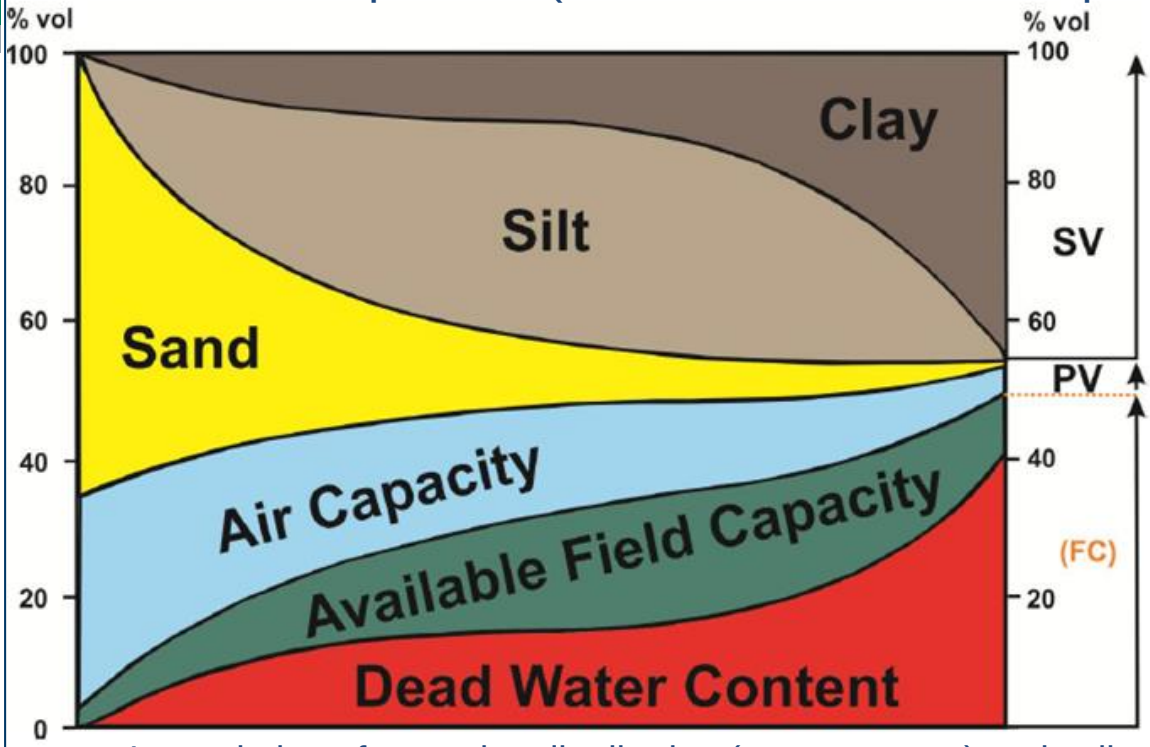
Modified USDA soil texture triangle at class level according to Berry et al. (2007)

- **Grain size / texture**
- Bulk density
- Water content
- (mineral composition)

Grain size / texture

The grain size distribution (texture) → basic information for the estimation of vSGP

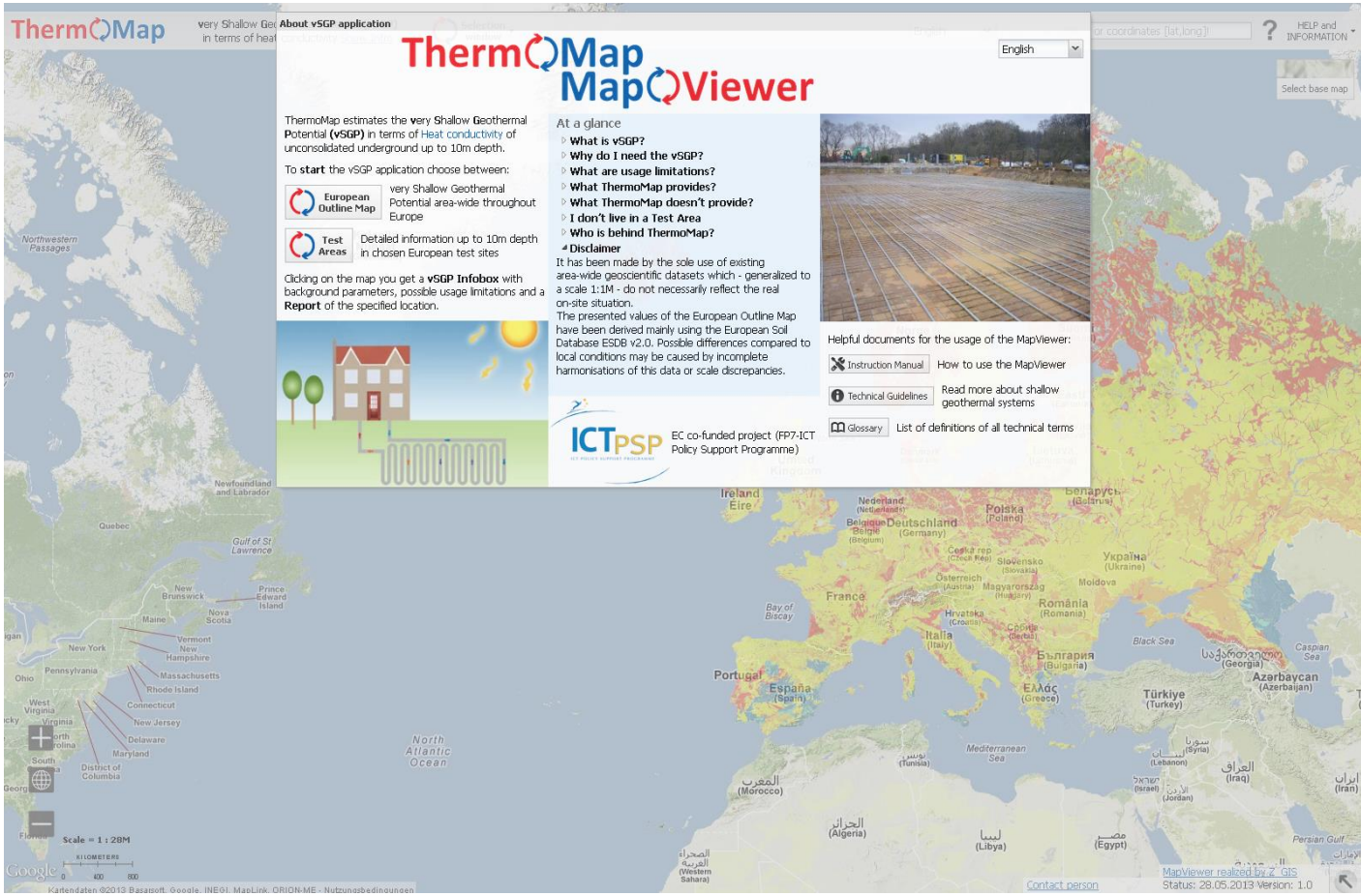
- Pore size distribution (→ texture-characteristic water content)
- Mineral composition (→ texture-characteristic proportion of quartz)



Interrelation of pore size distribution (water content) and soil texture (grain size distribution) (modified after Kuntze et al. 1994)

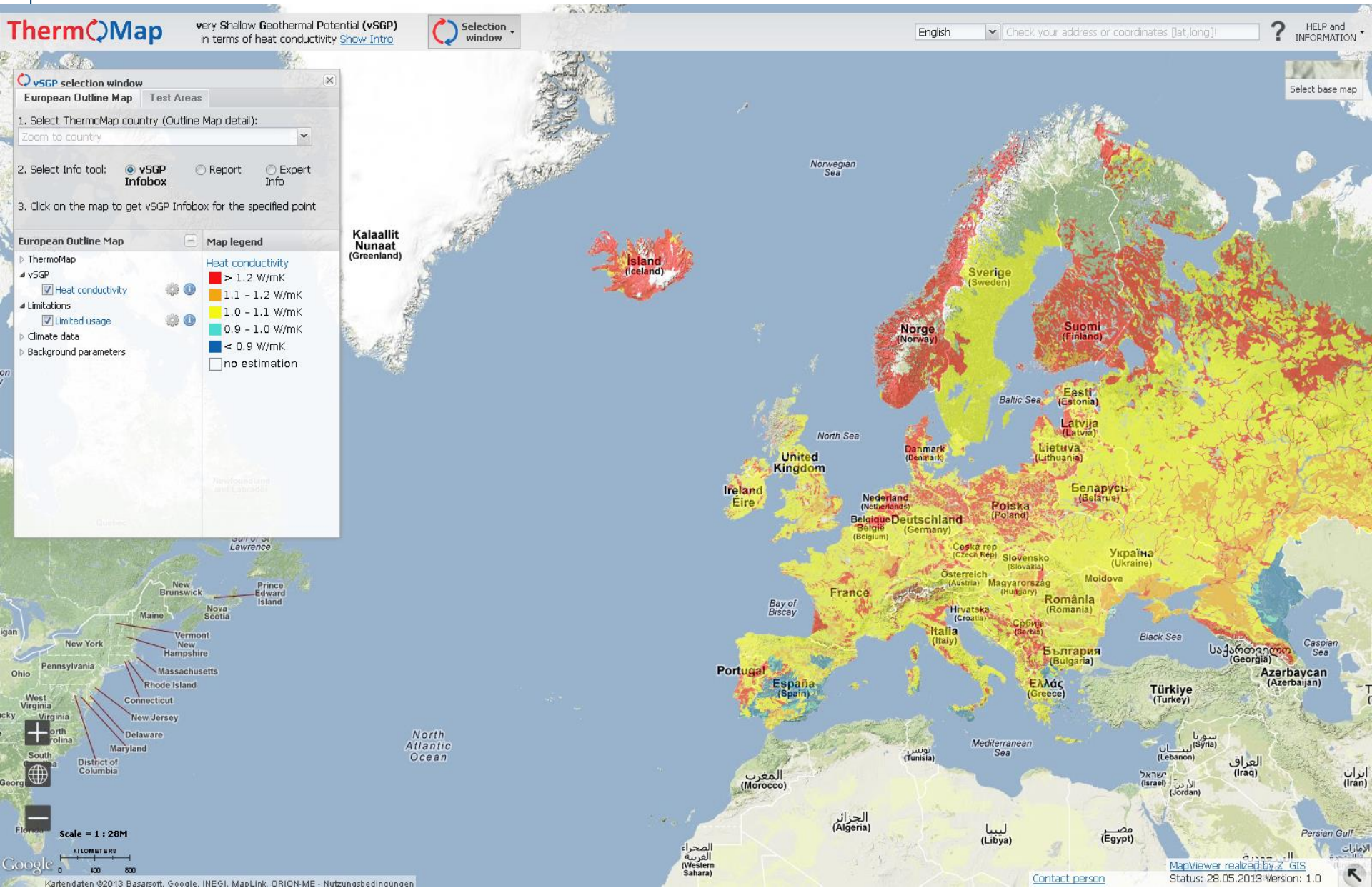
How can potentials be depicted - horizontally?

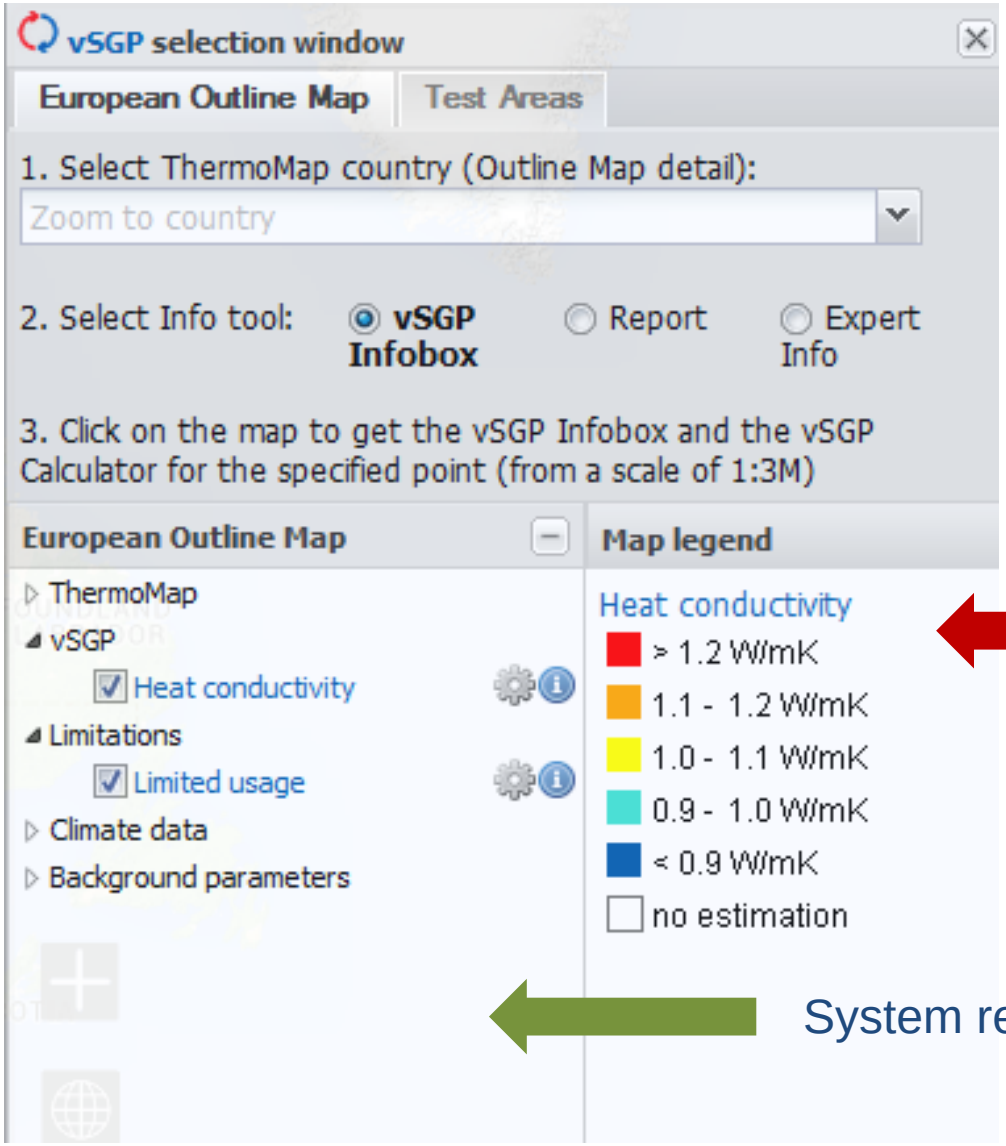
Link MapViewer 2.0:
www.thermomap.eu



https://www.thermomap.eu/

European Outline Map



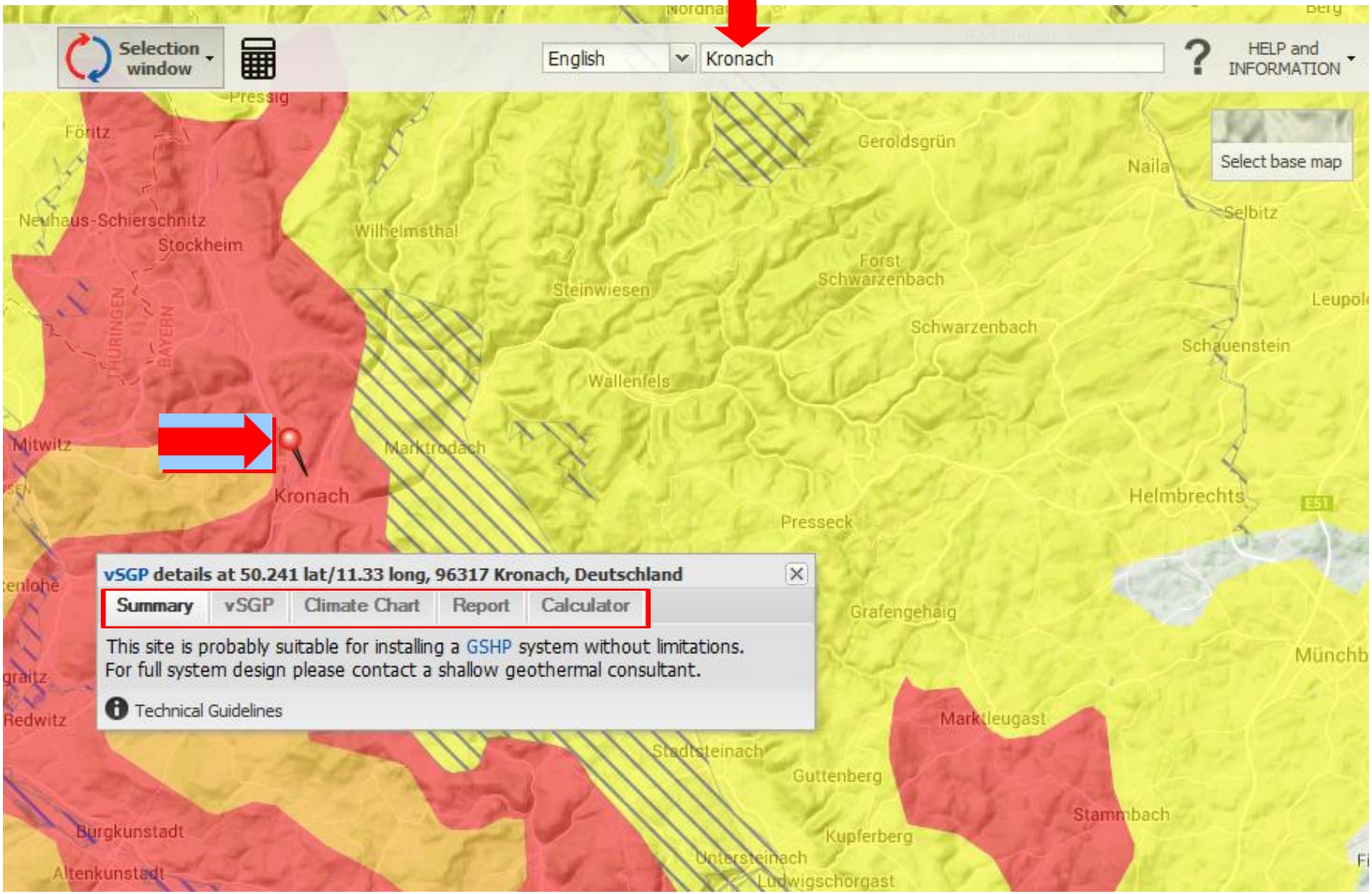


Heat conductivity (5 classes)

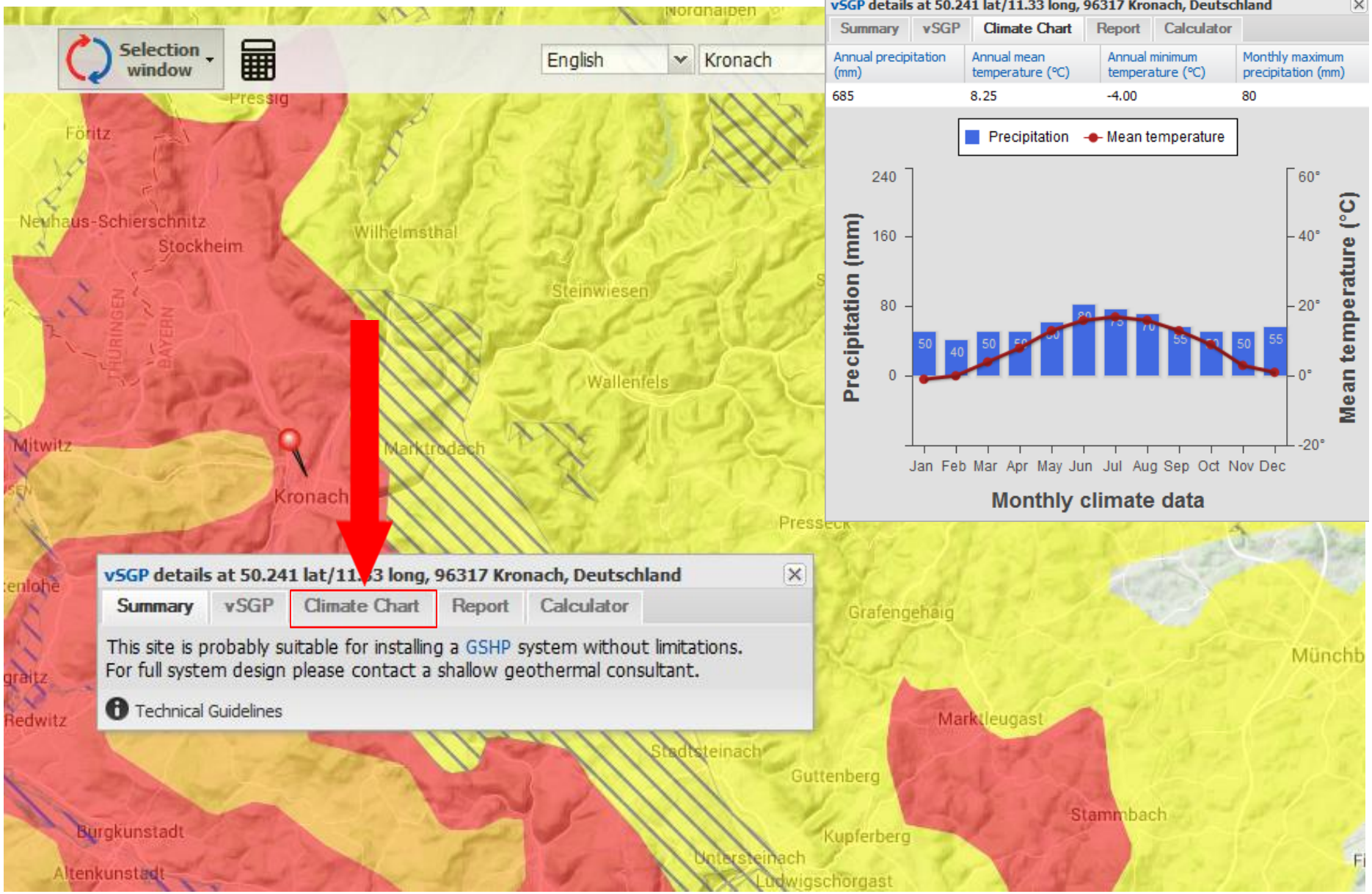
System relevant parameters

https://www.thermomap.eu/

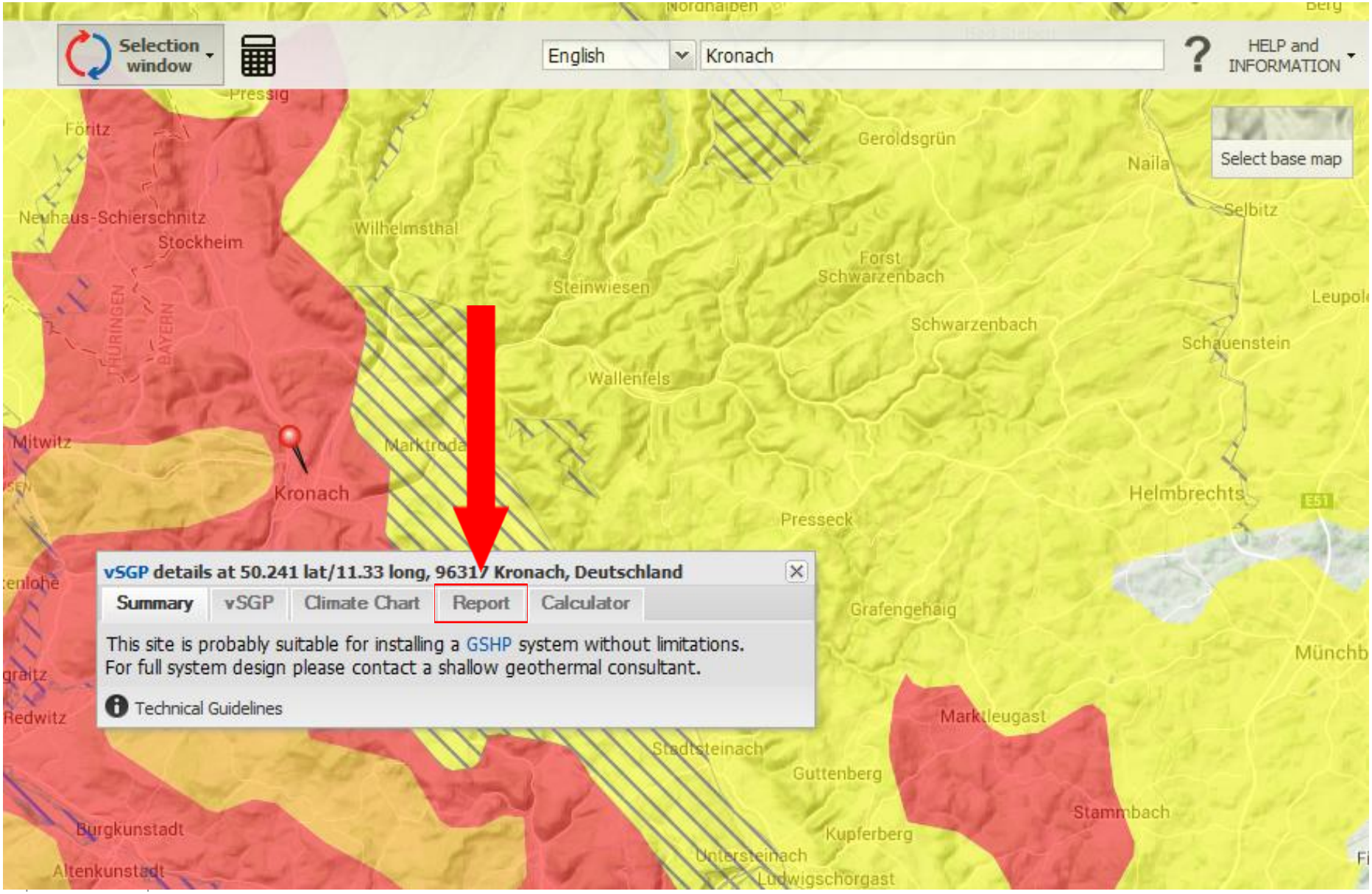
Select a address



Climate conditions

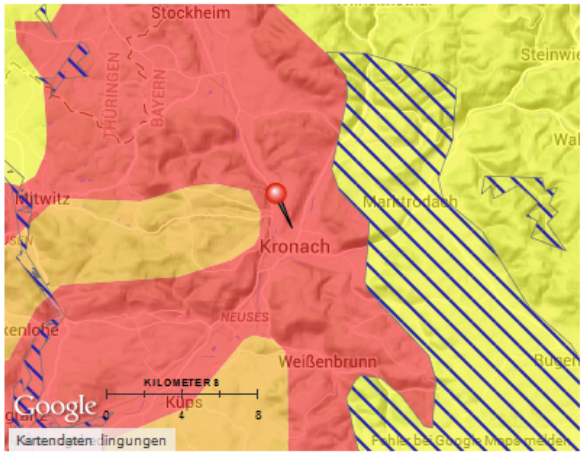


Print a report



Address and location:
96317 Kronach, Deutschland
50.2415° latitude and 11.3297° longitude

ThermoMap



Heat conductivity
- > 1.2 W/mK
- 1.1 – 1.2 W/mK
- 1.0 – 1.1 W/mK
- 0.9 – 1.0 W/mK
- < 0.9 W/mK
- no estimation
- limited usage

Overview maps of the chosen location

Disclaimer
The sole responsibility for the content lies with the authors. It does not necessarily reflect the opinion of the European Commission which doesn't accept responsibility for any use of the information contained herein. The data sources and processings are the ThermoMap partner's responsibility: **PLUS: Paris-Lodron Universität Salzburg.**

Introduction

The values presented within this Report are generally based on the outcomes of the EU co-funded project ThermoMap (Project number CIP ICT PSP 250446, Website: http://www.thermomap-project.eu/).
The key aim of the ThermoMap project was to develop an efficient estimation system for the creation of pan-European superficial geothermal potential maps as a supportive and informative planning tool for installing (very) shallow vertical and horizontal geothermal installations. For this purpose it has made use solely of existing geoscientific datasets and information which do not necessarily reflect the real on-site conditions with regard to all available parameters.

Possible limitations of usage

Based on the available data it can be stated that the chosen site is not located in a protection zone.
The topographical analysis revealed a slope, which is less than 15°. Therefore, when installing a (very) shallow geothermal system, no issues with the venting and installation procedure should occur.
The determined dominant soil type according to the acknowledged WRB classification system is here Podzol. With this type of soil in principle no restrictions regarding a sustainable and efficient installation and operation of a (very) shallow geothermal system are known.

Climatic conditions

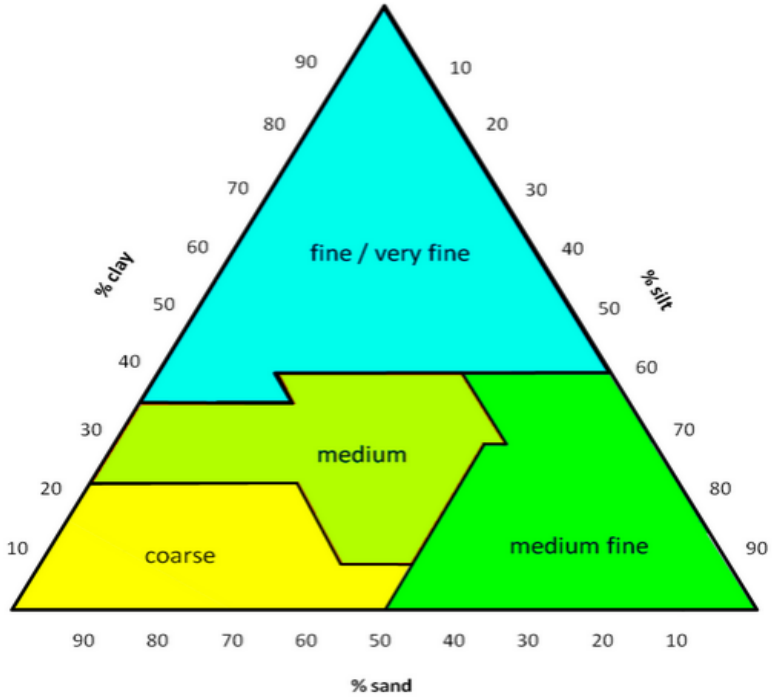
The climate data, averaged over several years, results in a mean annual air temperature of **8.25 °C** whereas the minimum annual air temperature is **-4.00 °C**. The amount of the annual precipitation is **685 mm**. The maximum monthly precipitation of **80 mm** occurs in the month(s) of **June**. This implies **humid conditions** for the chosen area.

EU project ThermoMap - European Outline Map
Location Information Sheet for the very Shallow Geothermal Potential from 01/04/2015

Address and location:
96317 Kronach, Deutschland
50.2415° latitude and 11.3297° longitude

ThermoMap

ESDAC soil texture classification



Soil properties

In general, unsaturated conditions of the soil matrix were assumed for the estimation of the very Shallow Geothermal Potential (vSGP).
The dominant **grain size** distribution according to the ESDAC soil texture classification is **coarse** (see Figure above for the ESDAC classes with estimated separates of sand, clay and silt).

Geothermal situation

The thermal **heat conductivity** of the soil matrix is defined essentially by its texture, water content and bulk density. At the chosen site the values can range from **0.89 W/mK** to **1.21 W/mK**. On the basis of **humid conditions** a value of **1.21 W/mK** is probable. These values were calculated by use of the KERSTEN (1949) formulas. For this, an appropriate predefined value had to be assumed for the **bulk density** which describes the relation between mass and volume. In this case the applied value is **1.3 g/cm³**.
The analysis of these geoscientific parameters indicate that the chosen location is **highly suitable** for the utilisation of the very Shallow Geothermal Potential (vSGP) in terms of heat conductivity without any limitations. For full system design, more detailed data for an installation and operation of a GSHP system is necessary. Therefore, please get in contact with a relevant geothermal consultant for further planning.

III.

Integration of geothermal energy for refurbishing buildings (GEO4CIVHIC)

GEO4CIVHIC Project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 792355

EU-Project

Decision tool which technology at which location?

→ Historical buildings/
→ current stock

Europe wide

Focus

Cost reduction for GEOTHERMAL SYSTEMS for RETROFITTING CIVIL AND HISTORICAL BUILDINGS

Barries

Today the **main barriers** in the application of shallow geothermal installations in the built environment are:

- **higher upfront investments**
- **cost effective and environmentally friendly drilling**;
- **need to change H&C terminals** in **historical buildings**
- **low levels of awareness, reluctance to risks and/or lack of experience** amongst the designer and operators.

- Reduce costs
- Easier installation process
- More attractive

Focus

The main goal of GEO4CIVHIC is to develop and demonstrate more easy to install and more efficient GSHEs

- drilling machine innovations dealing with the built environment
- design of the GSHE
- heat pumps and other hybrid solutions suitable for retrofitted buildings

Figures

Project number: 723916

Project duration: 4 years

Total project budget: 8,143,120.97 €

Project budget financed: 6,841,960.75 €

Coordinator: *Adriana Bernardi*
National Research Council
Institute of Atmospheric Sciences and Climate
(CNR – ISAC)

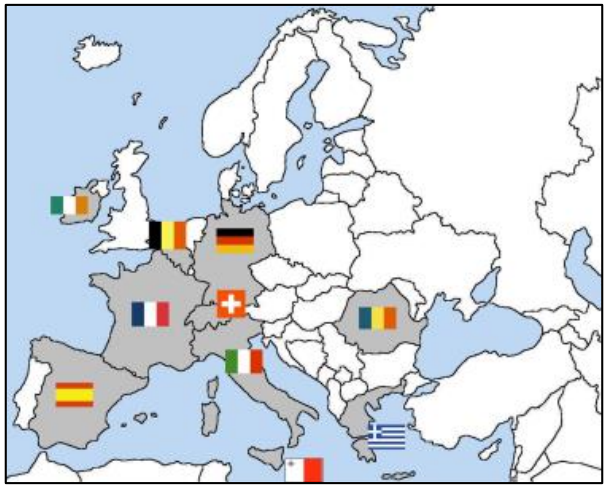
a.bernardi@isac.cnr.it

Partner

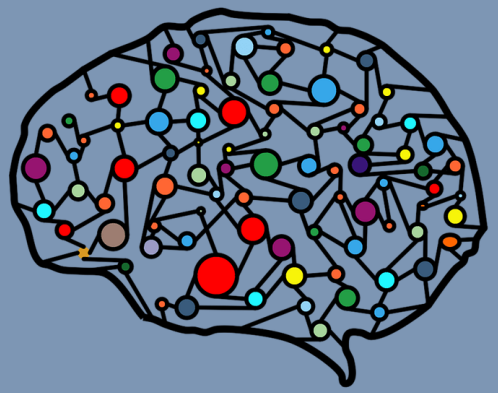
- Industry
- Research
- SMEs
- NGO

19

No.	PARTICIPANT ORGANISATION NAME		COUNTRY
1	Consiglio Nazionale delle Ricerche ISAC (Coord) & ITC	CNR	Italy
2	Università degli Studi di Padova – DG&DII	UNIPD	Italy
3	Universidad Politécnica de Valencia	UPV	Spain
4	R.E.D. srl Research and environmental devices	RED	Italy
5	Terra GeoServ Ltd	GEOSERV	Ireland
6	Galletti Belgium NV (HiRef as affiliated partner)	GALLETTI	Belgium
7	FUNDACIÓN TECNALIA RESEARCH AND INNOVATION	TECNALIA	Spain
8	ThyssenKrupp Infrastructure GmbH	TKI	Germany
9	UNESCO Regional Bureau for Science and Culture in Europe	UNESCO	France
10	Friedrich-Alexander Universitaet Erlangen-Nuernberg	FAU	Germany
11	Romanian Geoexchange Society	RGS	Romania
12	Centrefor Renewable Energy Sourcesand Saving	CRES	Greece
13	Hydra srl	HYDRA	Italy
14	UBEG DR ERICH MANDS U MARC SAUER GBR	UBeG	Germany
15	Geo-Green sprl	GEOGREEN	Belgium
16	Pietre Edil srl	PIETRE	Romania
17	Solintel	SOLINTEL	Spain
18	Din l-Art Helwa	DLH	Malta
19	Scuola universitaria professionale della Svizzera italiana	SUPSI	Switzerland

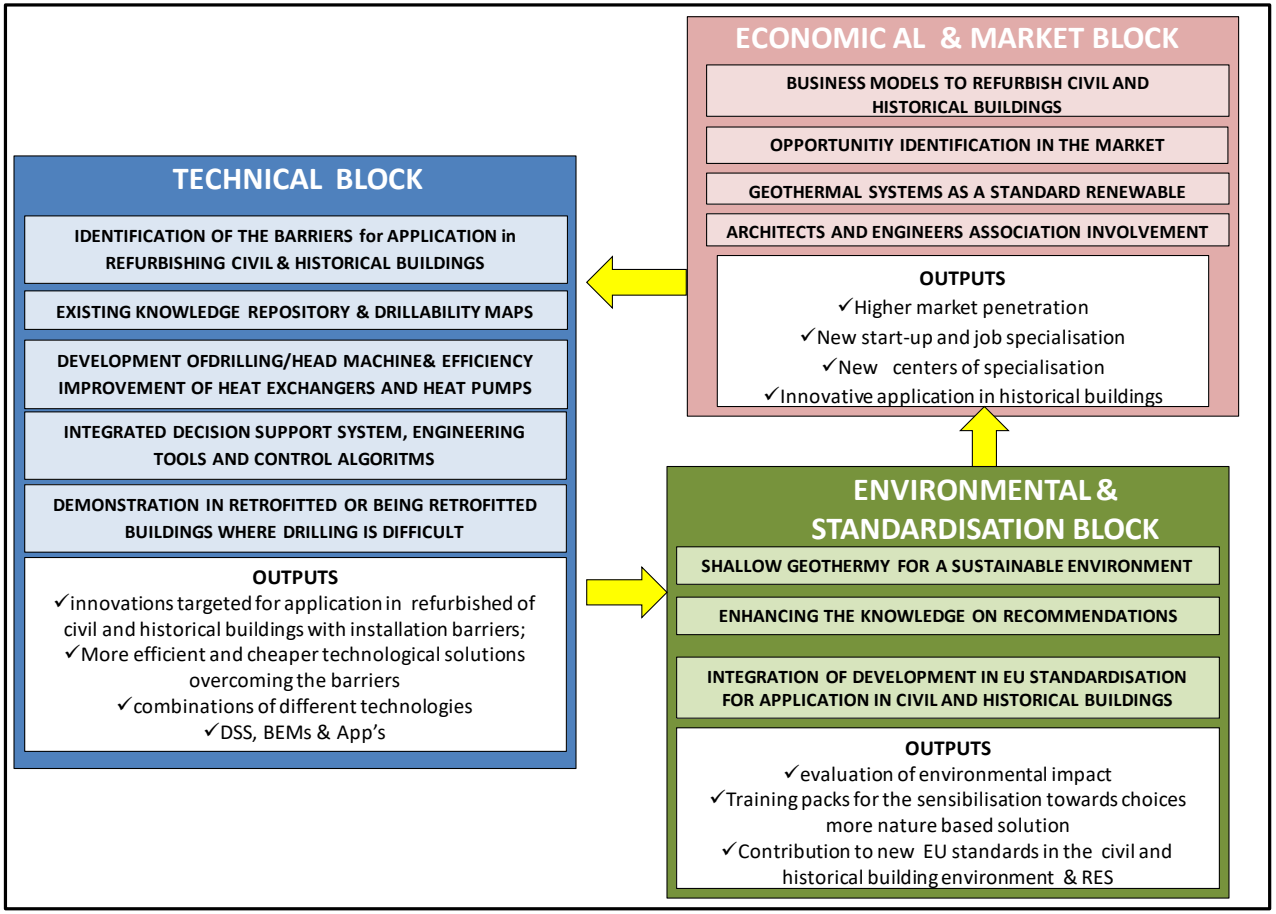


Structure

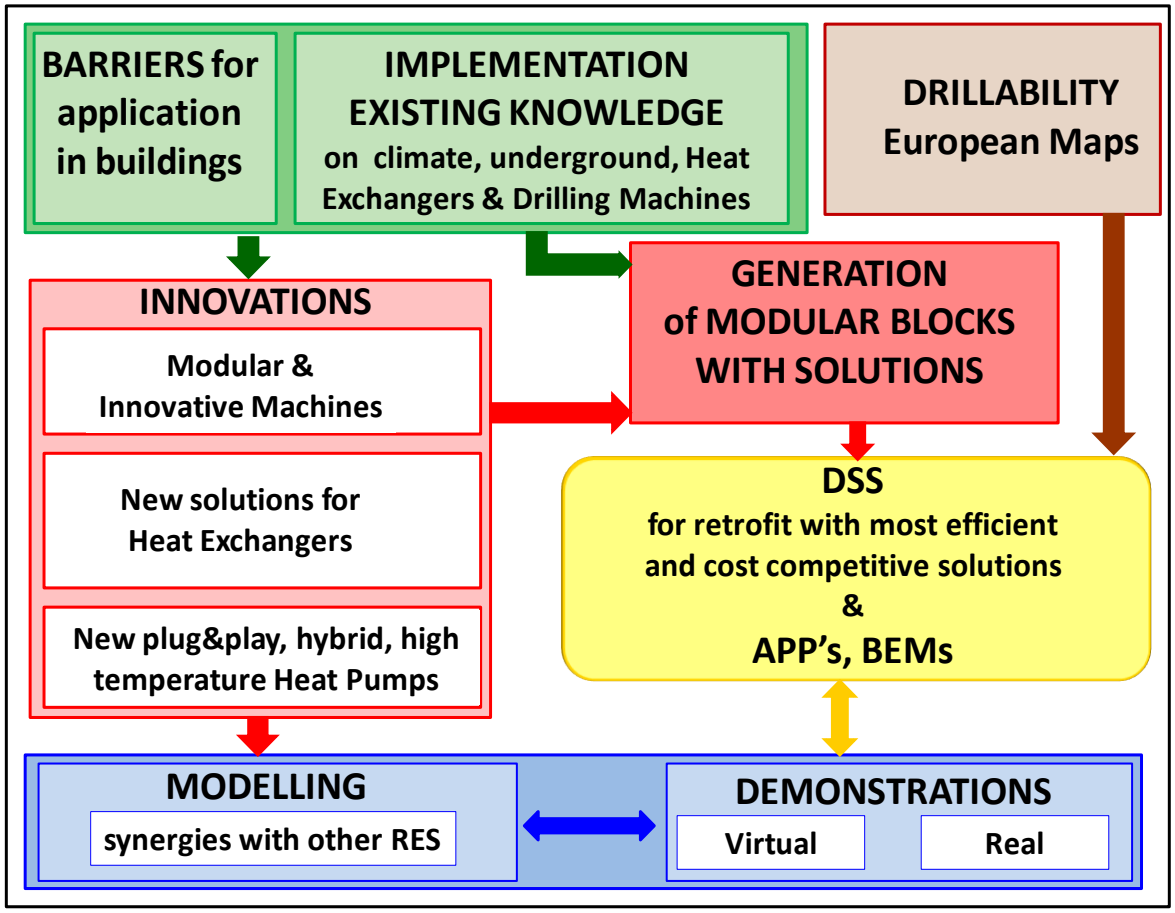


- 3 Blocks
- 9 WPs

The GEO4CIVHIC activities are organized in three Blocks

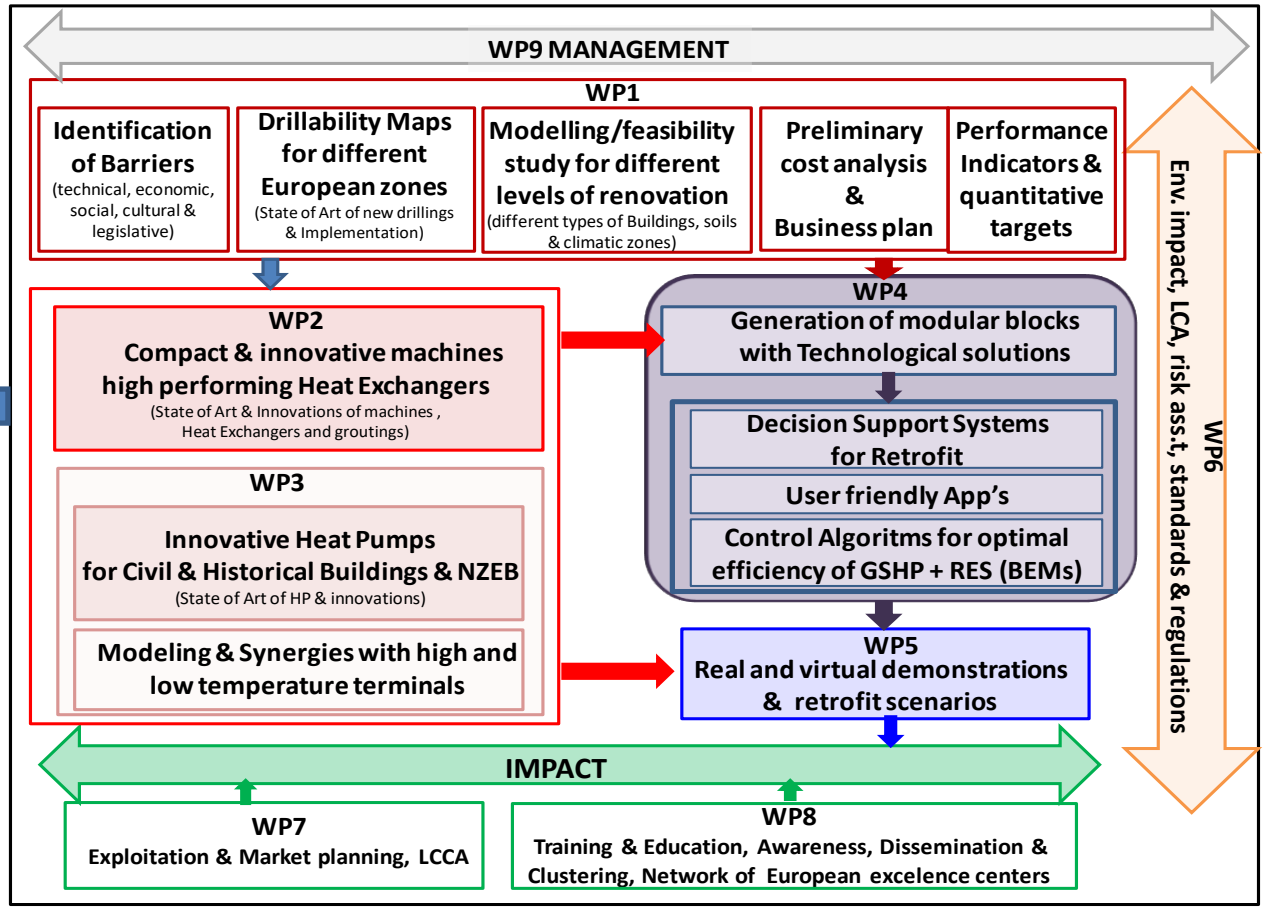


The GEO4CIVHIC block diagram – technical approach



The GEO4CIVHIC – WP Structure

Example



T.2.7 - Evaluation of existing very shallow and horizontal solutions

Easy to install → less restricted

Task leader: FAU

Participants: Geoserv Red

The Steinhäuser System – Solution for single retro-fitted houses

“Soil Cain Saw”

The Steinhäuser System – Solution for single retro-fitted houses

Installation

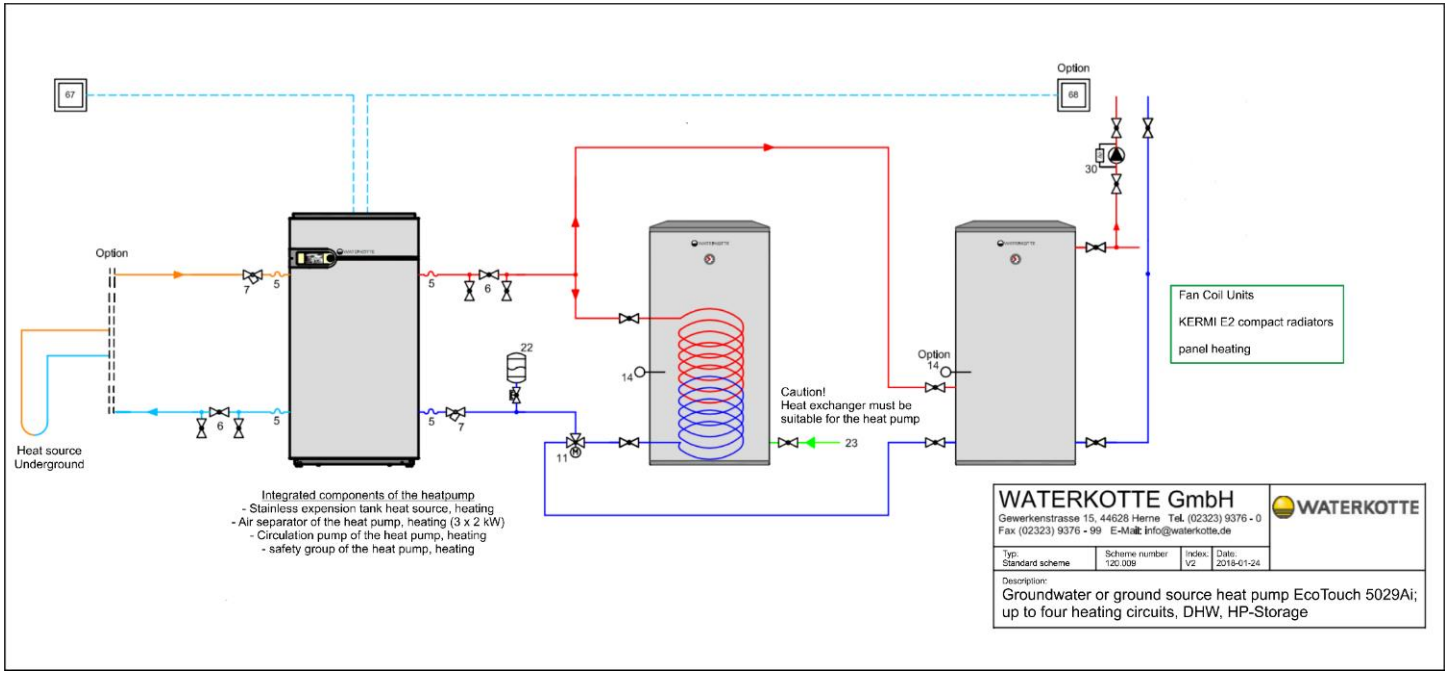
The Steinhäuser System – Solution for single retro-fitted houses

Installation

The Steinhäuser System – Solution for single retro-fitted houses

Installation

The Steinhäuser System – Solution for single retro-fitted houses



Test-side

Case study sites

To demonstrate the project developments and innovation in a cascade at 4 different real case study sites and 12 virtual sites

Different building types in different climate zones

www

https://geo4civhic.eu/

SOIL2HEAT
Oberflächennahste Geothermie & Kalte Nahwärme 4.0

IV.

District Heating and Cooling Systems coupled with (very) shallow geothermal energy (ZIM)

ZIM
Zentrales Innovationsprogramm Mittelstand

Information – 1 phase

Research Network – Soil2Heat

- Coordinator (scientific/administrative)
- FAU budget (first phase) 180.000 Euro
- Duration: January 2019 – December 2019

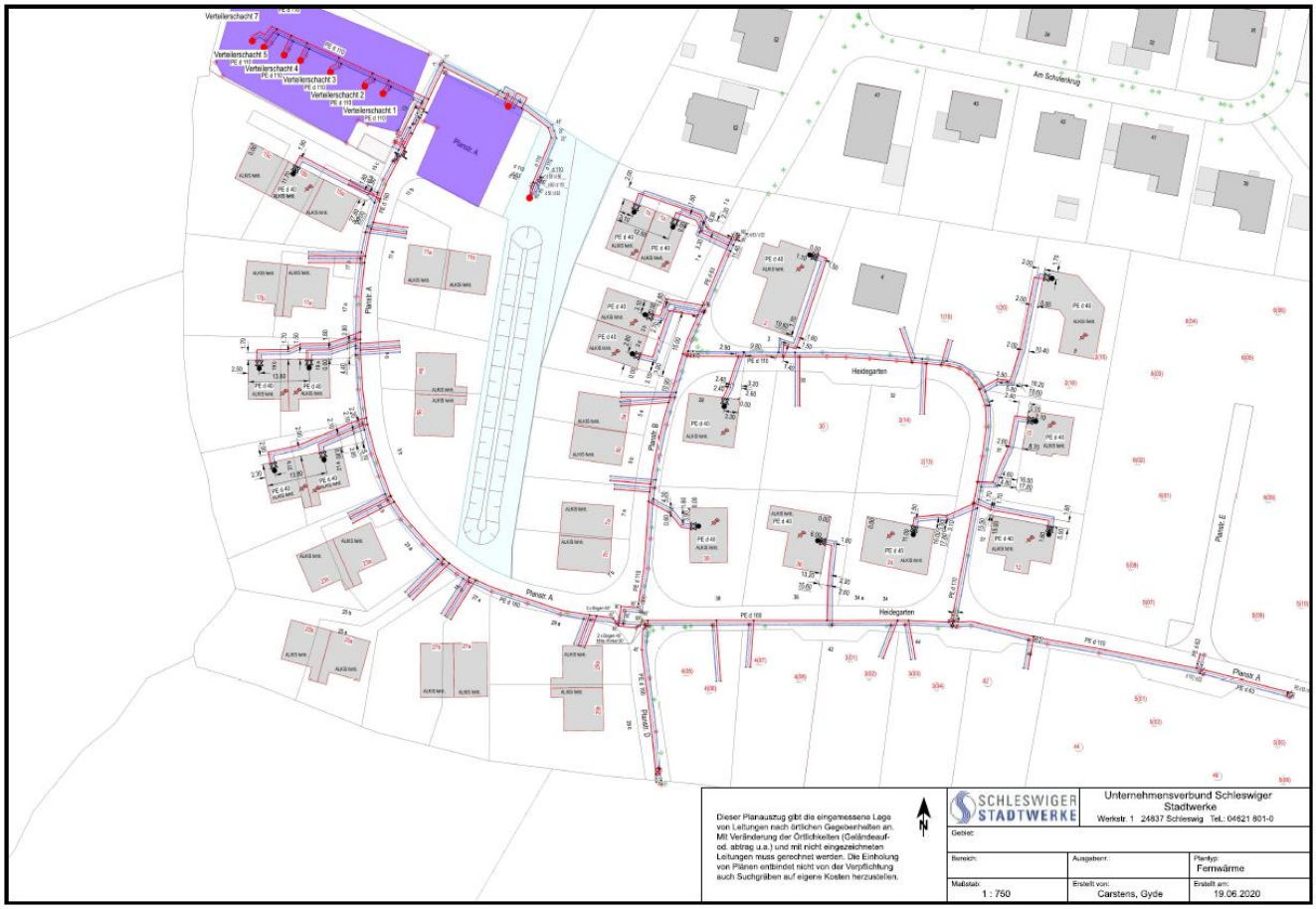
→ **Generating ZIM Project together with SMEs**

Cold district heating net (collector-based)

SCHLESWIGER STADTWERKE

Stadtwerke Eckernförde

Stadtwerke Rendsburg



Cold district heating net (collector-based)

SCHLESWIGER STADTWERKE · Stadtwerke Eckernförde · Stadtwerke Rendsburg

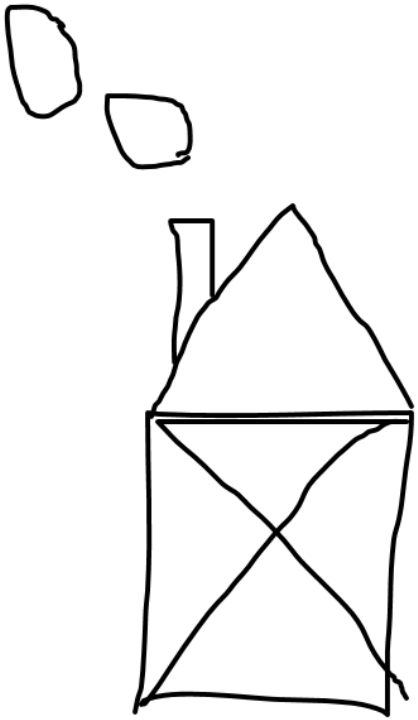
The “distribution net” acts also as a collector

www.Soil2Heat.de

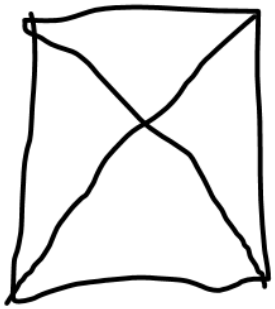
Summary

1. simple technology, which is easy to use
2. Carbon free (in symbiosis with renewable power source)
3. No land consumption
4. Amortization of investment costs, hardly any running costs - social factor
5. Technology Europe-wide and universally applicable (rural and urban areas)
6. Sleeping Giant for the Energy Revolution & the Green New Deal

Vision



2020



2030

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Questions?

If you have any questions – feel free to ask …

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Thank you

GeoZentrum Nordbayern

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