

Introduction to the COST Action Geothermal-DHC

…and its relevance for decarbonizing the heating and cooling sector

Gregor Goetzl (Chair CA18219) – Geothermal energy: Present, Future and Development Strategies – 16 June 2022

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of the European Union

GEOTHERMAL
DHC
Towards Decarbonized
Heating and Cooling!

Outline of the presentation

Guiding questions

- How can geothermal energy be used in heating and cooling networks?
- Why choosing geothermal energy for heating and cooling networks?
- What needs to be done to foster the use of geothermal energy in heating and cooling networks?
- How can the COST Action support the integration of geothermal energy and what does it offer to you?



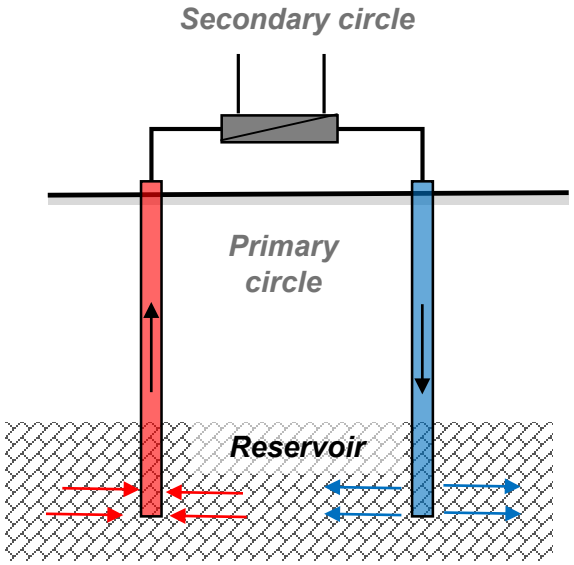
Successfull well test in Vienna – thermal water trapped at 95°C
Picture: Peter Keglovic (2021)

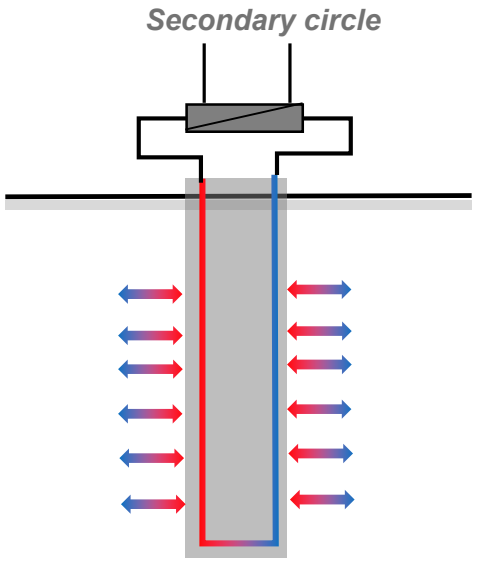
What is geothermal energy and how can it be used?

Extraction of geothermal energy requires a subsurface heat exchanger

Open loop system

- Fluid exchange with the subsurface
- Requires natural or artificial reservoir
- Heat exchange via thermal advection – higher conversion efficiency
- Systems: Groundwater heat exchangers, hydrogeothermal systems, enhanced geothermal systems





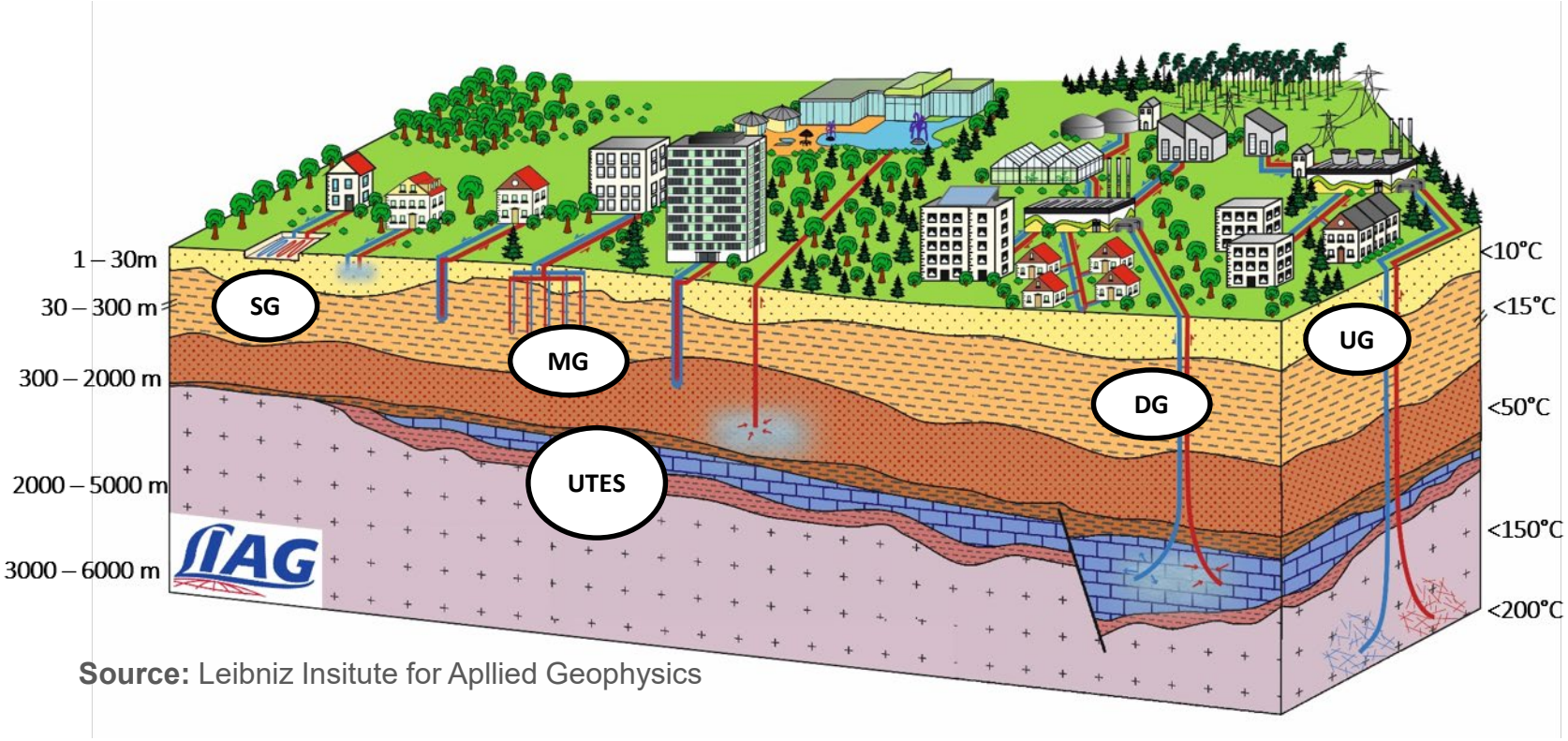
Closed loop system

- No fluid exchange with the subsurface
- Can be placed everywhere unless installation is not forbidden
- Heat exchange via thermal conduction – lower conversion efficiency
- Horizontal loop systems, borehole heat exchangers, engineered solutions (e.g. Eavor loop – in testing)

Note: Same concepts can be applied for heat storage!

What is geothermal energy and how can it be used?

The technological spectrum of geothermal energy use in heating and cooling networks



Source: Leibniz Insitute for Apllied Geophysics

Technological concepts

SG: Shallow geothermal
(TRL 7 - 9)

MG: Medium depth geothermal
(TRL 8 - 9)

DG: Deep geothermal
(TRL 8 - 9)

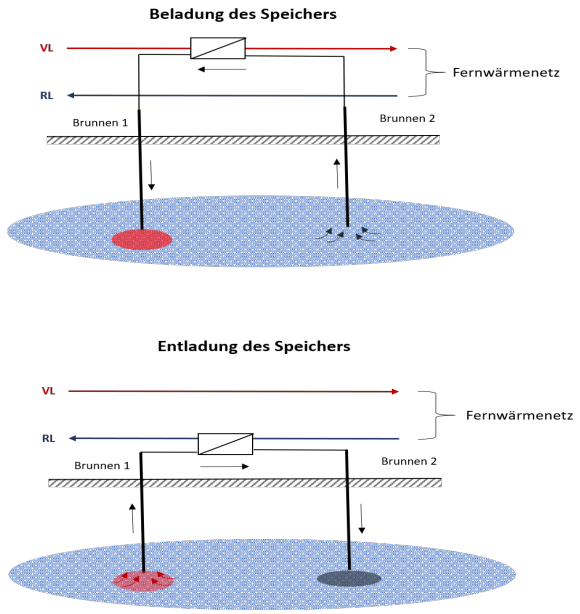
UG: Unconventional geothermal
(TRL ≤7)

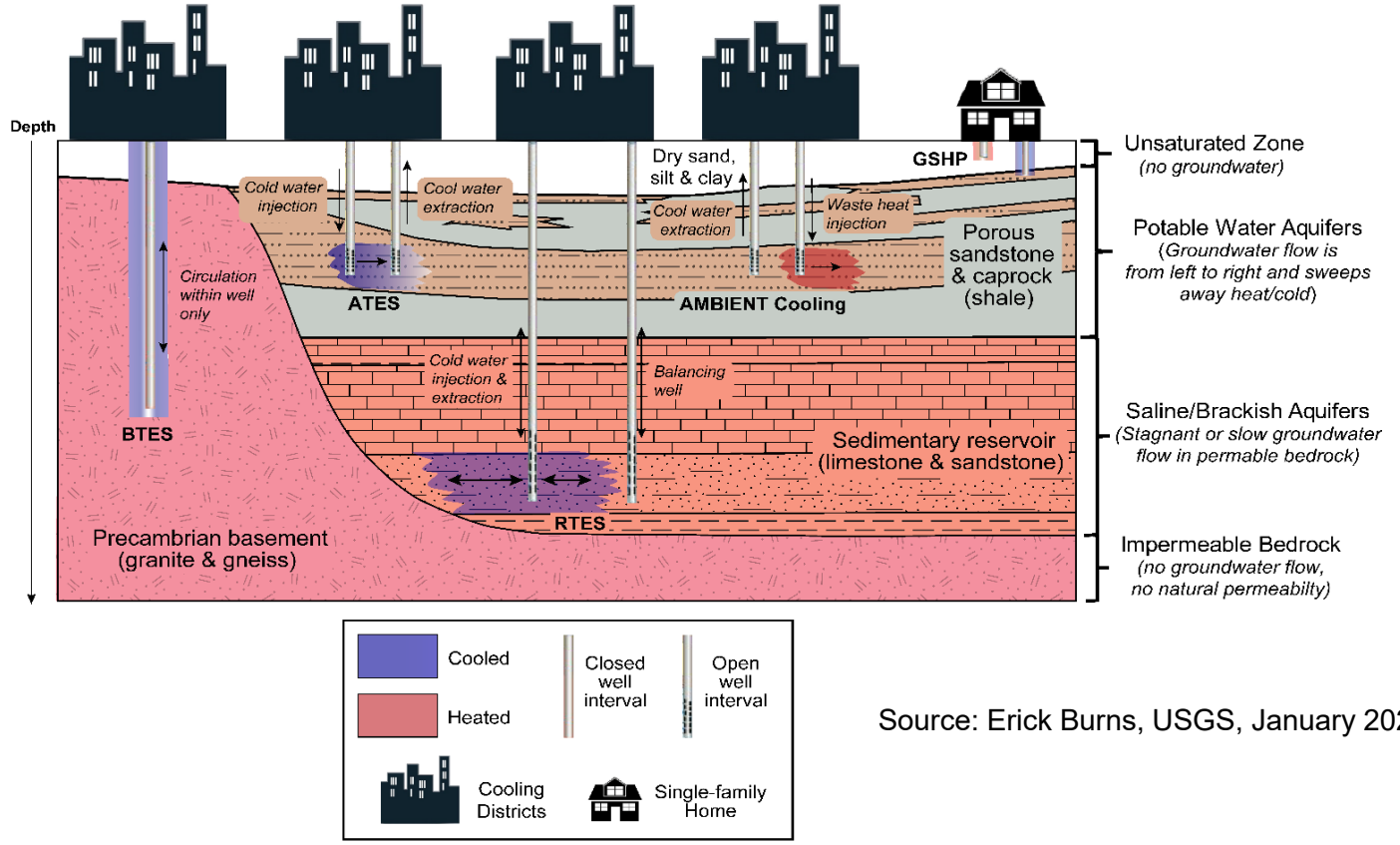
UTES: Underground thermal energy storage
(TRL ≤7-8)

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What is geothermal energy and how can it be used?

Note that all geothermal technologies can be used for underground heat storage (UTES)

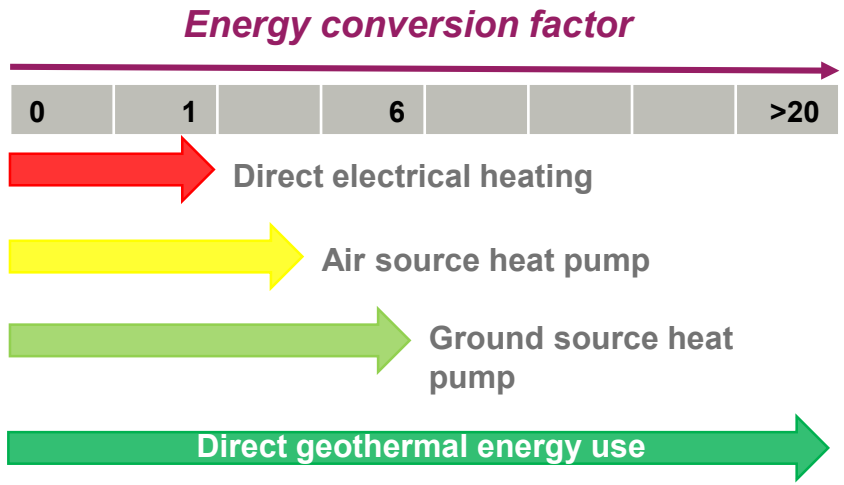




Source: Erick Burns, USGS, January 2022

Why choosing geothermal energy for heating and cooling networks?

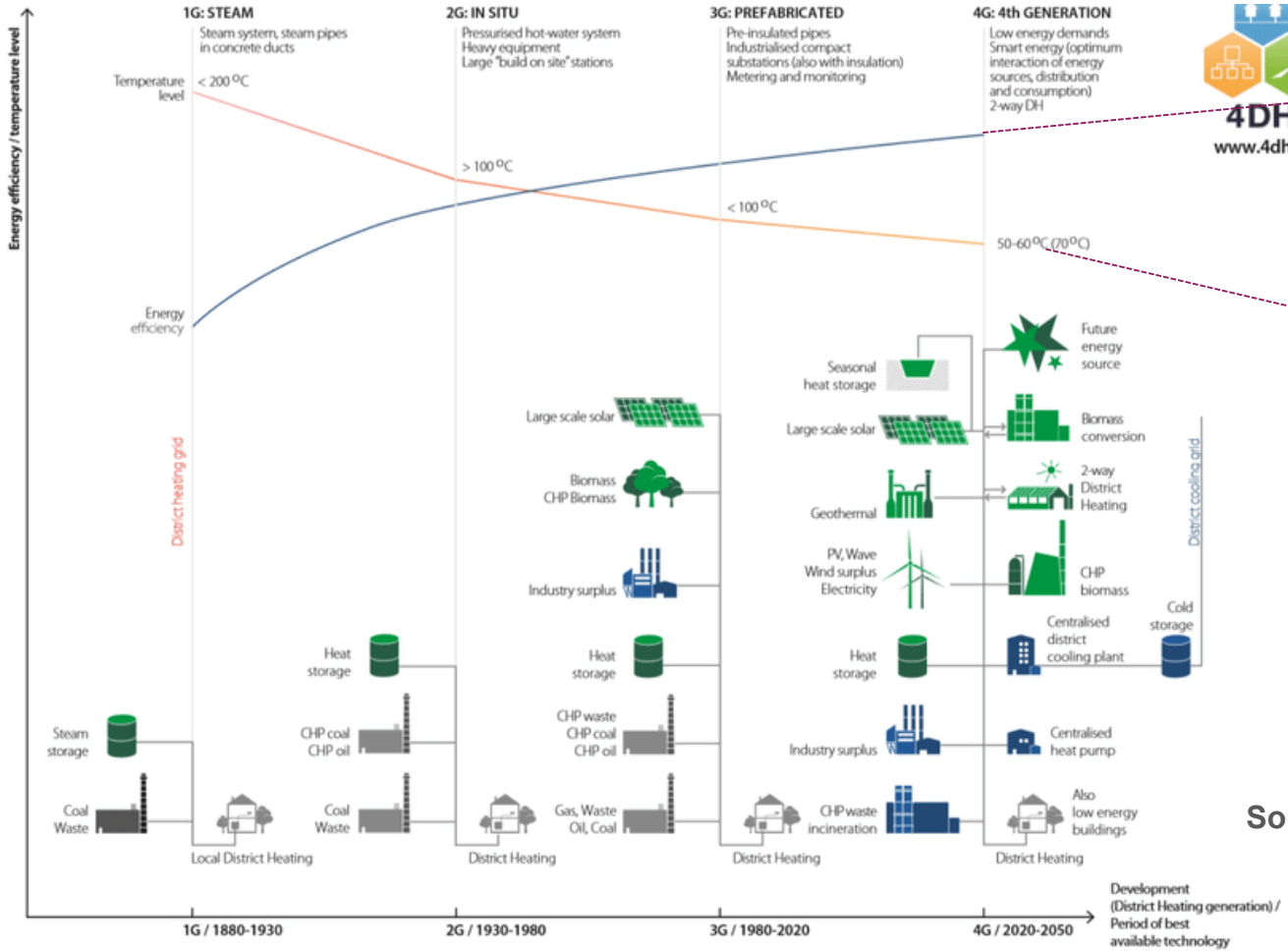
- Geothermal energy is environmental and climate friendly – no GHG emissions in primary circuit if installed correctly, no dust or noise
- Geothermal does not need to be imported – no geopolitical implications
- Geothermal energy saves surface space – energy system shifted to the subsurface
- Geothermal energy is highly efficient – low primary energy consumption due to use of natural heat
- Geothermal offers stable conditions – constant loads, predictable OPEX
- Geothermal offers heat storage and sector coupling
- Geothermal offers a wide range of solutions for at moderate temperature levels



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Geothermal-DHC

The development of heating and cooling networks



4DH
www.4dh.dk

5G (since 2010)

„Anergy Grids“
„Low-Ex Grids“
„LT HC Grids“

<30°C

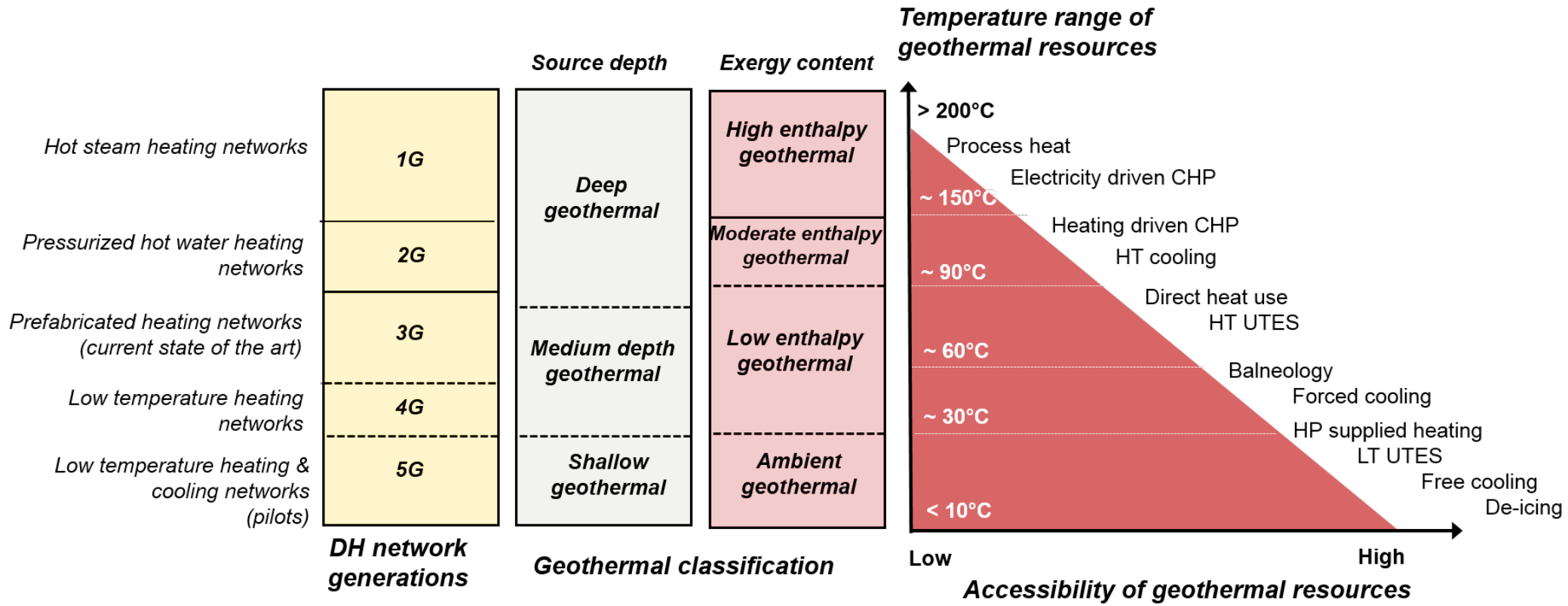
- Decentralized heat pump supply
- Use of low temperature waste heat and ambient heat
- Shallow geothermal (ambient geothermal) provides storage and energy balance

Source: www.4dh.dk
2022

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The match between geothermal technologies and DHC networks

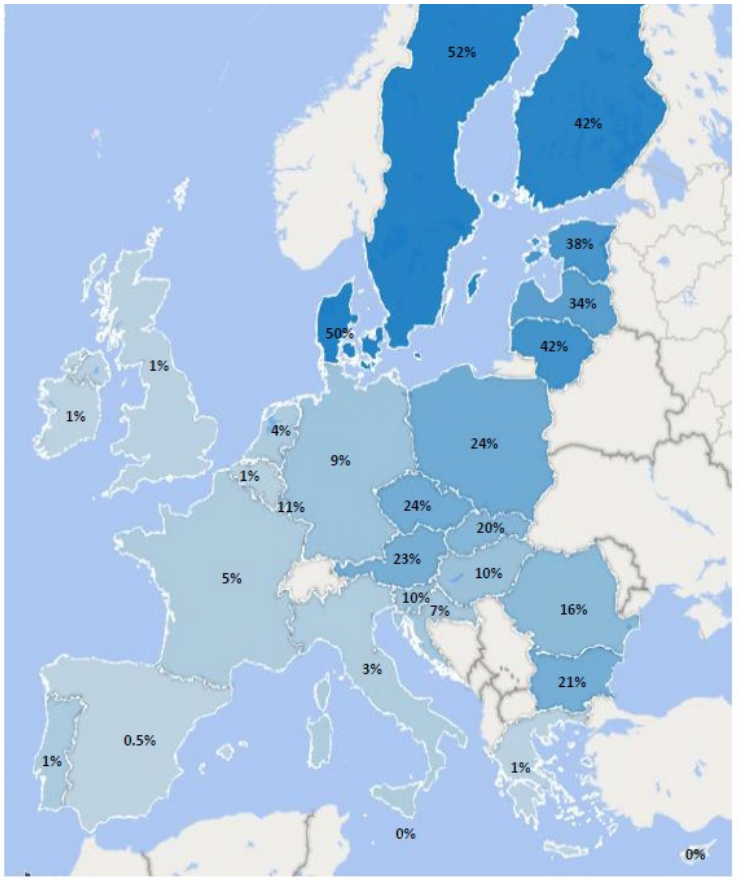


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Geothermal-DHC

Geothermal district heating and cooling facts

- First geothermal heating network established in 1334 (Chaudes Aigues, France)
- Share of district heating in the EU ~12% (Kavvadias et al. 2019)
- Strong share of DH system in Nordic countries
- Low share in western and southwestern European countries
- Higher share in eastern European countries



Share of DH networks inside the heating market in Europe
Source: Heat Road Map Europe project (https://heatroadmap.eu)

Figure 2-5. District heating share in final energy demand for space heating and domestic hot water in EU-28 in 2015. Data from [1]

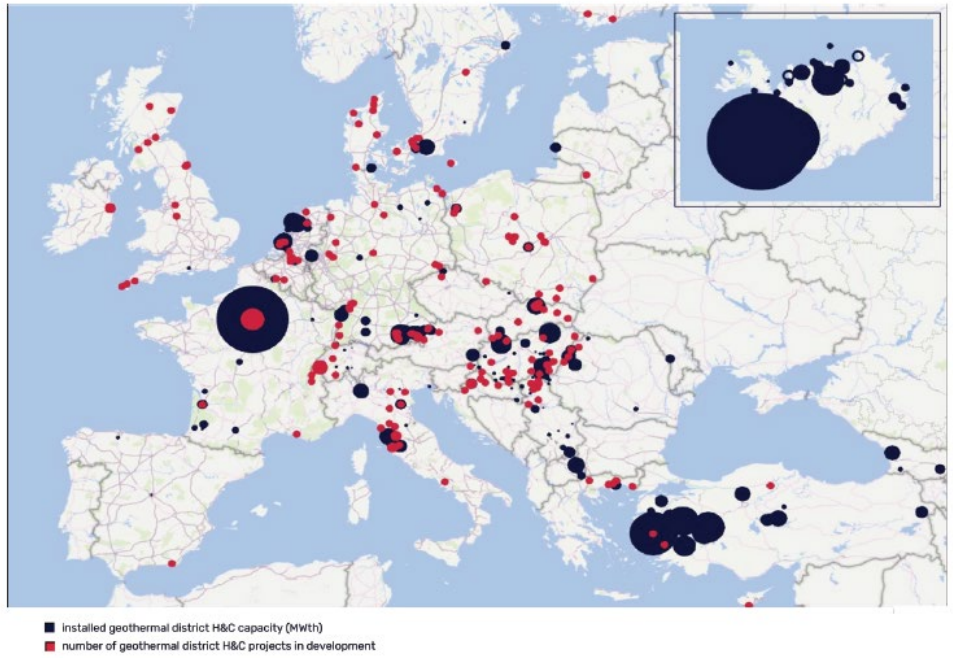
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Geothermal heating and cooling networks in Europe

Market characteristics

- Europe (EU, non-EU): 350 geothermal direct use systems in operation +232 projects (40% in construction phase) in development (source: EGEC, 2021)
- 2 GWth installed capacity in geothermal DHC – average system size ~8.6 MW_{th}
- 40 to 50 geothermal 5G DHC grids existing in Europe (Buffa et al (2019)
- Total share of geothermal in district heating sector ~1% (Werner, 2017
- Share of geothermal inside the H&C sector: 2%-3%

Fig. 13 | Map of geothermal district heating and cooling in Europe

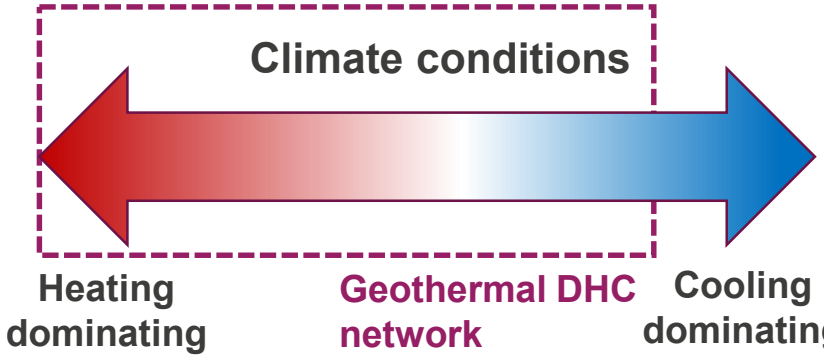


Direct geothermal energy use in heating networks in Europe
Source: EGEC Geothermal Market Report 2021

New typologies and concepts for geothermal in HC networks

Learning from shallow geothermal energy use

- ~40 to 50 geothermal 5G DHC grids existing in Europe (Buffa et al (2019)
- LT DHC networks support multivalent concepts, where geothermal plays an important role



64% linked to geothermal!

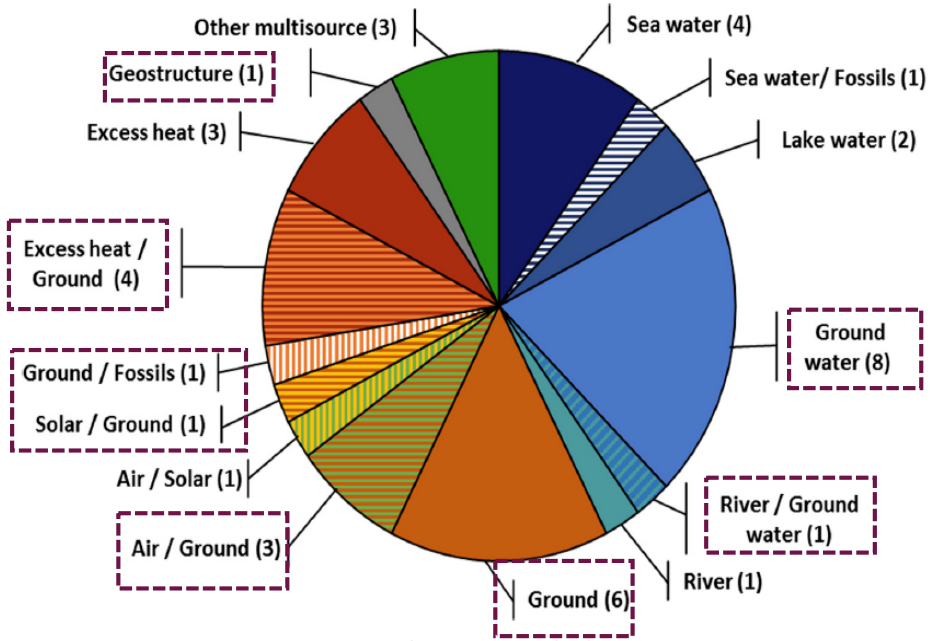


Fig. 4. Surveyed 5GDHC case studies by source.

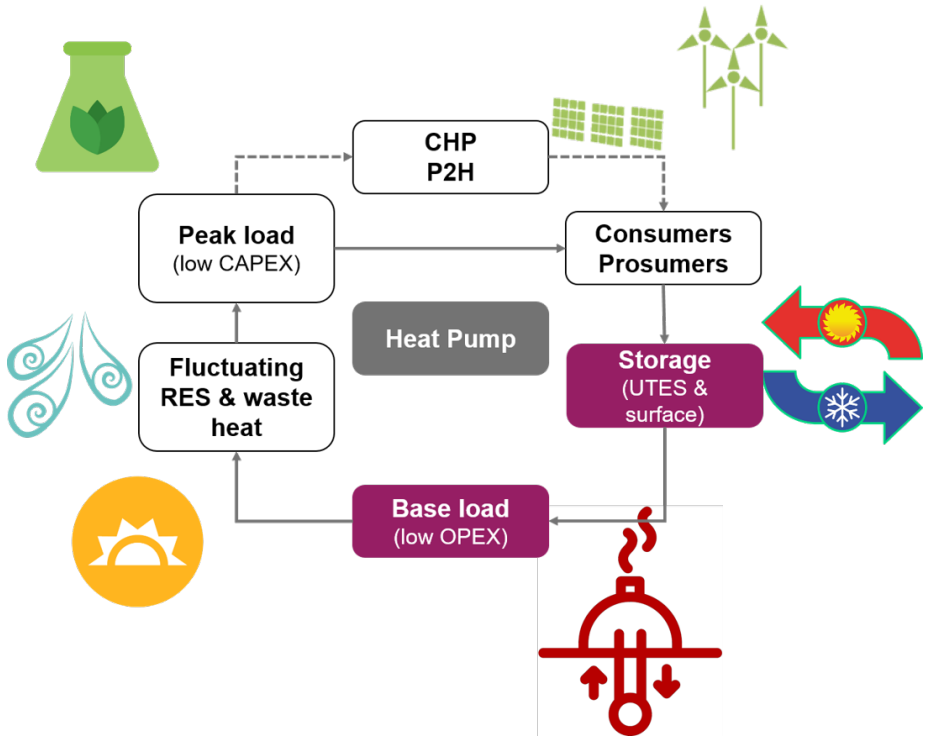
Source: Buffa et al. (2019)

New typologies and concepts for geothermal in HC networks

Promote new typologies for multivalent geothermal DHCs

Basic considerations of the Geothermal-DHC concept

- Establish a c**ounter concept to an increasing electrification of the H&C sector** (including the generation of green gas)
- Give priority to exergy optimization and using on-site heating and cooling sources – low consumption of primary energy sources
- Geothermal plays a two-fold role (base load + storage)
- Heat pumps represent “moderators” of de-centralized, unstructured **market places for heat and cold** to reduce the dependency on temperature levels
- High energy carriers supply peaks, used for stabilizing and back-up



Right: General scheme of a multivalent HC network supplied by geothermal energy

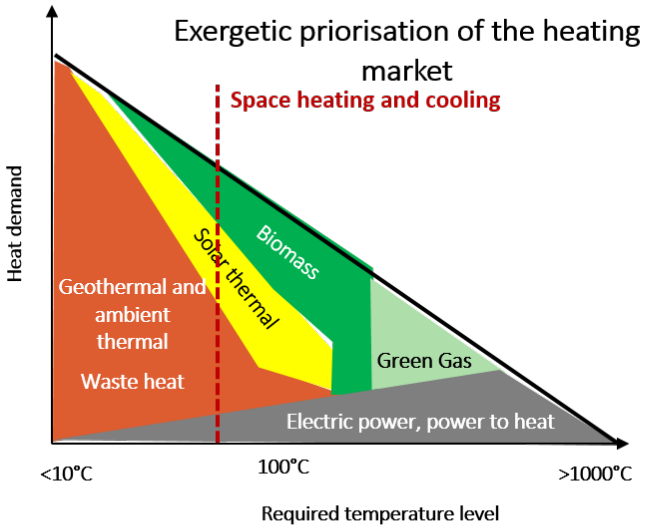
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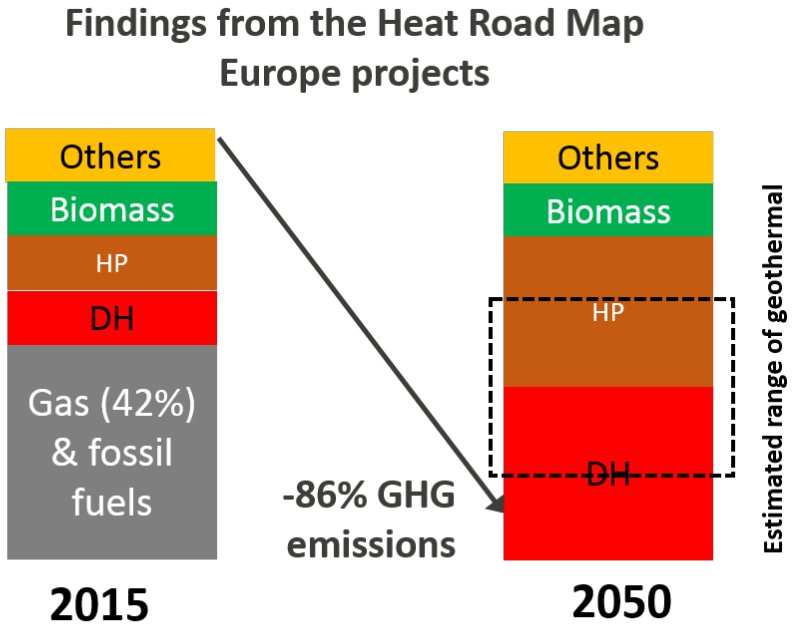
Geothermal-DHC

*Roadmaps towards or vision of **30%** in **2030** and **50%** in **2050***

- **2030**: 30% share of DHC inside H&C sector (currently ~12%)
- **2030**: 30% share of RES inside the DHC sector (currently ~20%)
- **2030**: >10% geothermal inside DHC supply (currently <1%)

- **2050**: 50% share of DHC inside H&C sector
- **2050**: 50% geothermal inside DHC sector





Geothermal-DHC addresses new and retrofitted DHC networks!

Main challenges

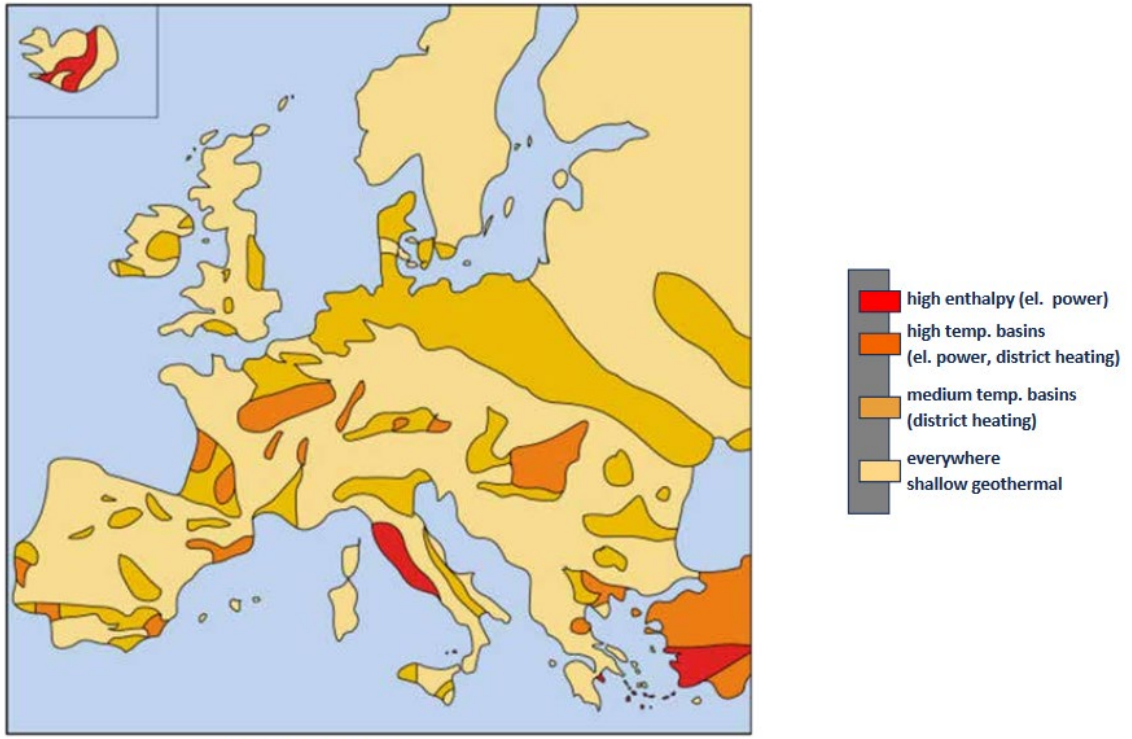
For a better integration of geothermal energy in heating and cooling networks

- The resources are there – we need to identify the right technological solutions for being replicable across Europe

EU project GeoDHC *„25% of the European population can be supplied by direct geothermal energy use“*

… reduce the dependency on specific geological conditions

Figure 3. Main geothermal provinces of Europe (source: EGEC)



Source: GeoDH project (http://geodh.eu/)

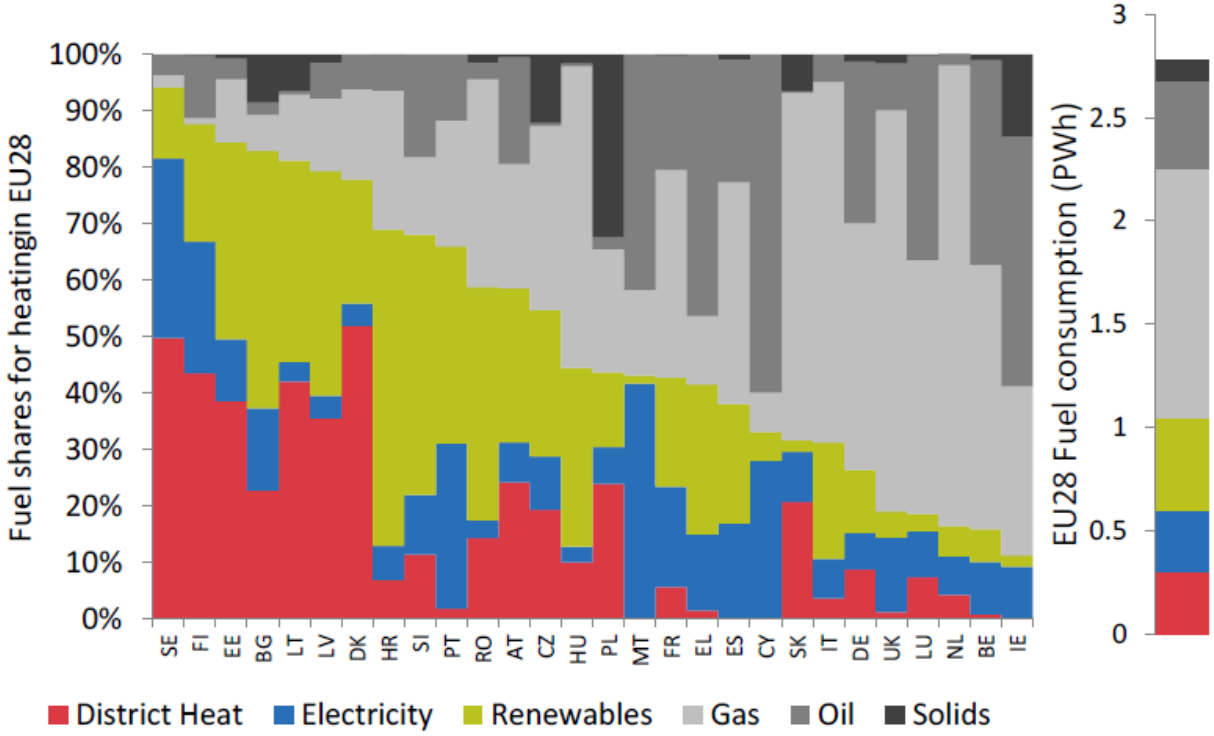
Main challenges

For a better integration of geothermal energy heating and cooling networks

- Define concepts for replacing individual boilers through geothermal energy supplied HC networks
- Identify solutions to replace large capacity CHP plants in existing DH networks

… reduce temperature levels in networks

… adapt network topopgrapies – from trees to meshes



Fuel consumption for space heating in the EU in 2015
Source: Kavvadias et al. 2019

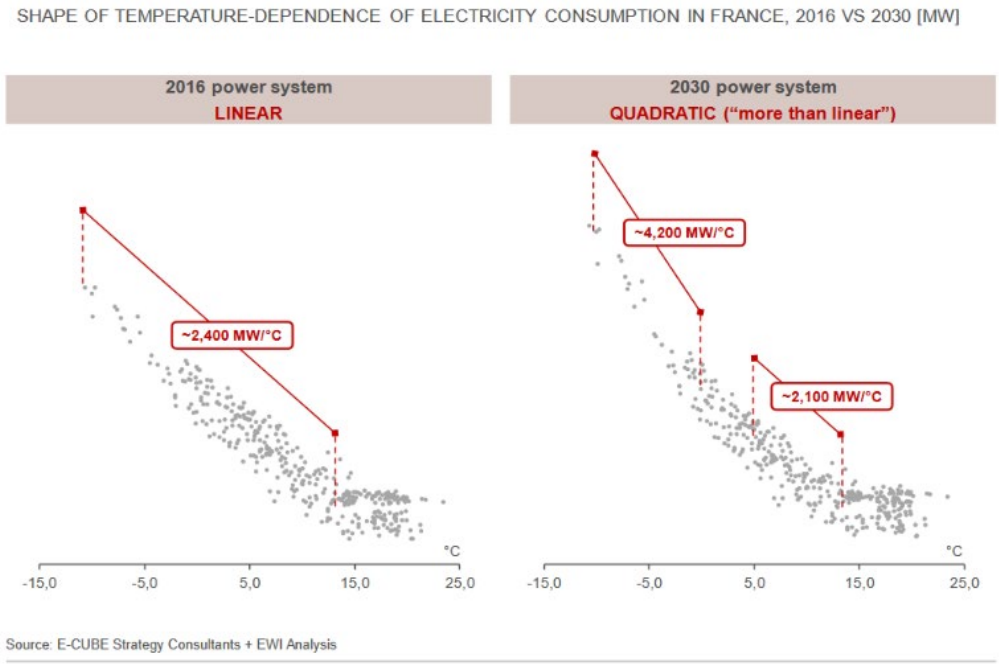
Main challenges

For a better integration of geothermal energy in heating and cooling networks

- The ongoing debate about the “electrification” of the HC sector
- The low level of awareness among decision makers and ambivalent public perception

… increase the visibility and confidence in geothermal energy based solutions

… make geothermal an affordable and easily adpative solution



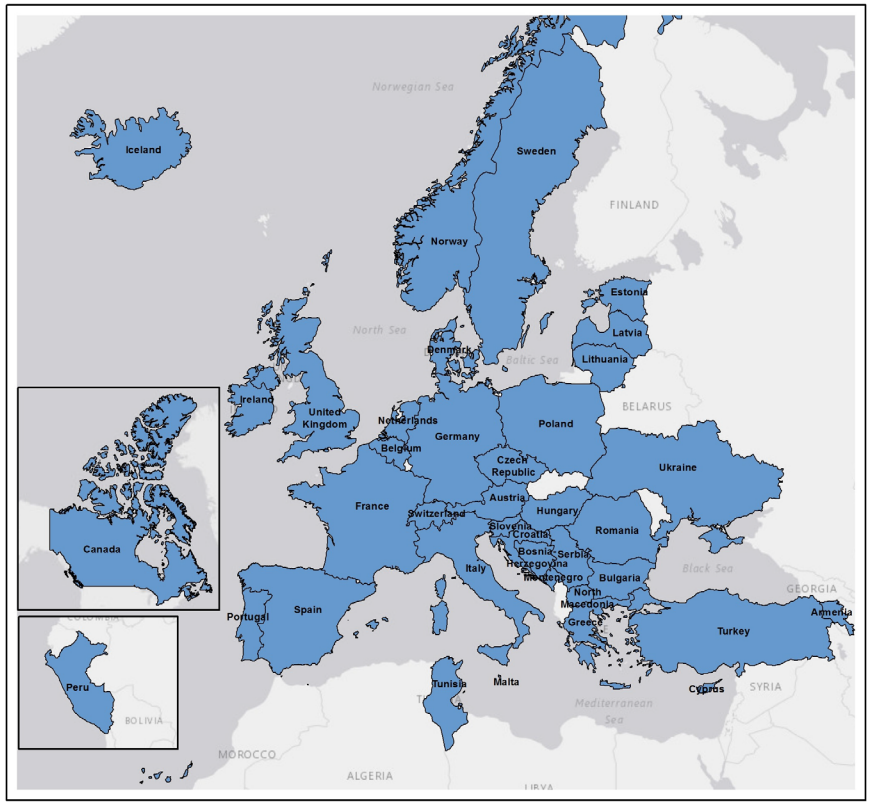
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The COST Action CA18219 Geothermal-DHC

Research network on the integration of geothermal energy in decarbonized heating and cooling networks

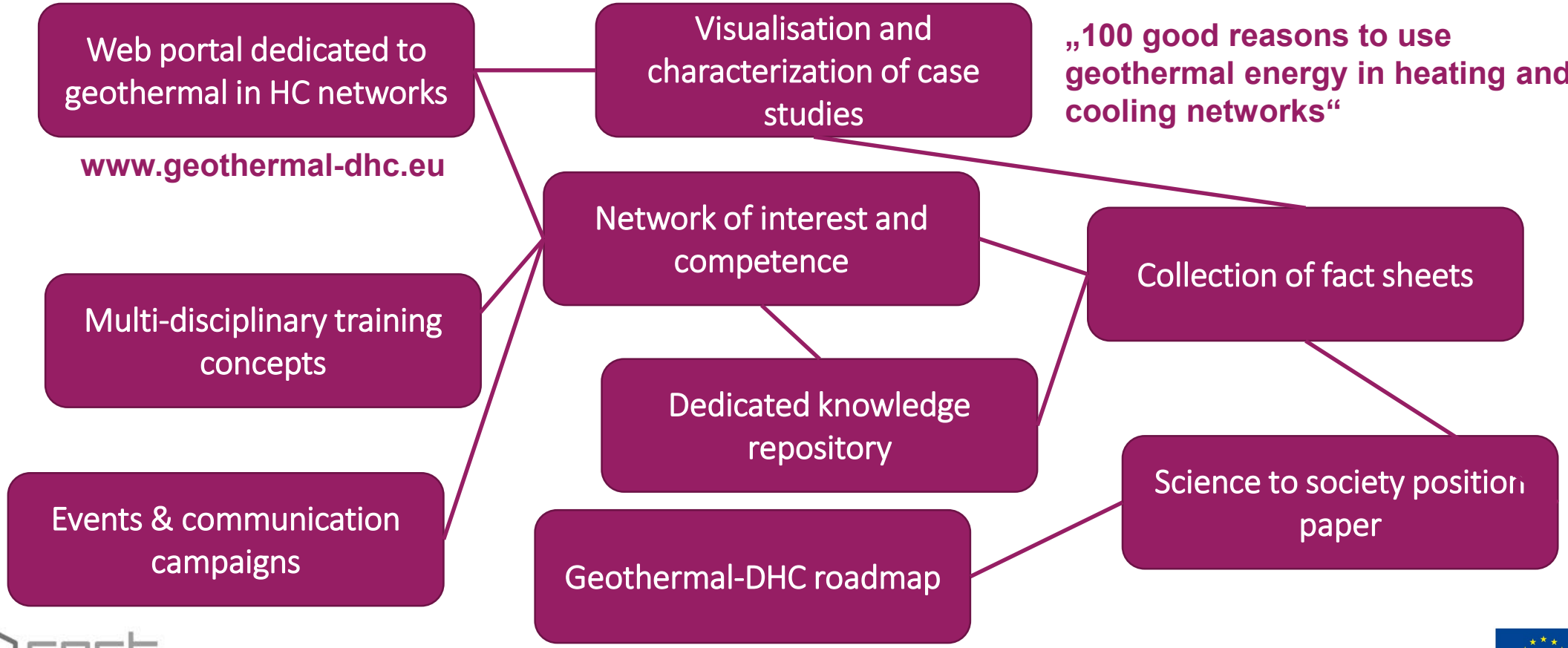
- Funded by COST, running time 2019 – 2023/2024
- Currently ~140 researchers from 35+ countries
- Open access network – travel support for scientific capitalization based on voluntary contribution
- Chairs: Gregor Goetzl (Austria), Dejan Milenic (Serbia)



Initialize a scientific competence and interest hub for the use of geothermal energy in heating and cooling networks in Europe!

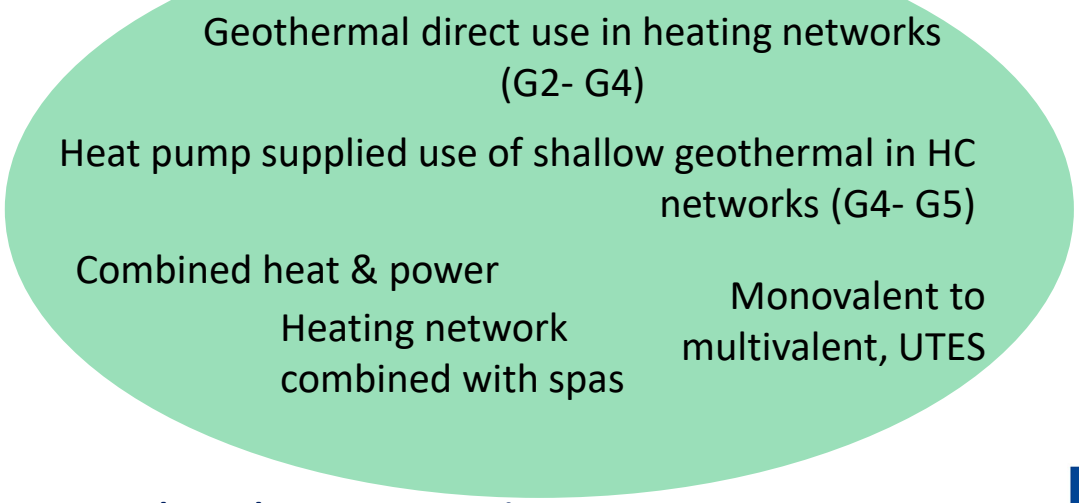
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The aimed outputs of CA18219 Geothermal-DHC



"100 good reasons for using geothermal energy in heating and cooling networks"

- Initiative launched by the COST Action Geothermal-DHC to collect case studies of geothermal energy use in heating and cooling networks across Europe
- Self sustaining web based GIS tool showing the locations and key characteristics of geothermal energy use in heating and cooling networks



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How could you support Geothermal-DHC?

- Support our surveys and fact finding missions – inform us about your requirements and expectations to make geothermal energy use in HC networks more attractive
- Support our communication campaigns and involve the network for questions to be answered in your strategic planning
- Help us to increase the visibility and impact of geothermal energy solutions in your country, respectively in Europe

Contact the Geothermal-DHC participants from your country or CA18219@geologie.ac.at for your requests

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Invitation to the first Geothermal-DHC regional cluster workshop

"Geothermal energy – unleashing the potential of supplying district heating and cooling networks in the Baltics"



Register here

Date and time of the workshop: 30th of September 2022, 09:00 am – 16:00 am (CEST)

Location: Riga, Latvia

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Thank you

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Acknowledgements

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