GeoPLASMA-CE – Final Conference
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The current and possible future role of shallow geothermal energy in Austria – Country Update Austria

Gregor Goetzl (Geological Survey of Austria)

Agenda

1) The current role of shallow geothermal energy in Austria
   - Systems and definitions
   - Overview of the geothermal market in a European context
   - Current developments and the role of shallow geothermal in Austrian strategies

2) Barriers and future opportunities for the use of shallow geothermal (in Austria)
   - Based on market observations and strategies
   - Based on the current legal framework
   - Based on the GeoPLASMA-CE stakeholder survey (Austria in a central European context)

3) Towards a strategy for fostering the use of shallow geothermal energy (in Austria)
   - Measures and actions to be taken (focus urban area of Vienna)

Systems and definitions

No standardized definition for SGE systems in Austria

- Depth range 0 to 300 m.b.s. (Mining Act, MinroG)
- Uppermost aquifer (depth level <50 m.b.s and temperature < 20 degC)
- Use of GSHP for heating (temperature <30 degC)

Main concepts used in Austria

- Borehole heat exchangers (75% - 80%)
- Groundwater use (~15%)
- Horizontal collectors (5% - 10%)

Innovative concepts in Austria

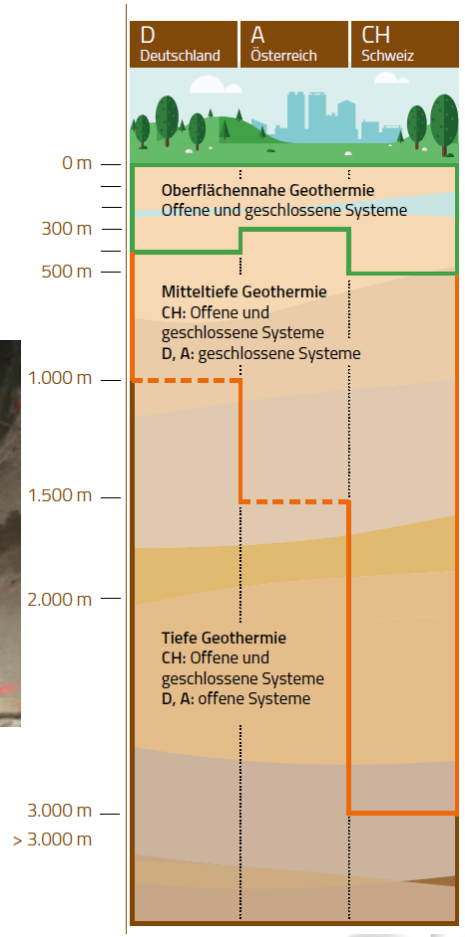
- Energy extraction at railway and underground tunnels ("Tunnelthermie")

Heat extraction at the underground line U2 in Vienna
© R. Markiewicz, 2008

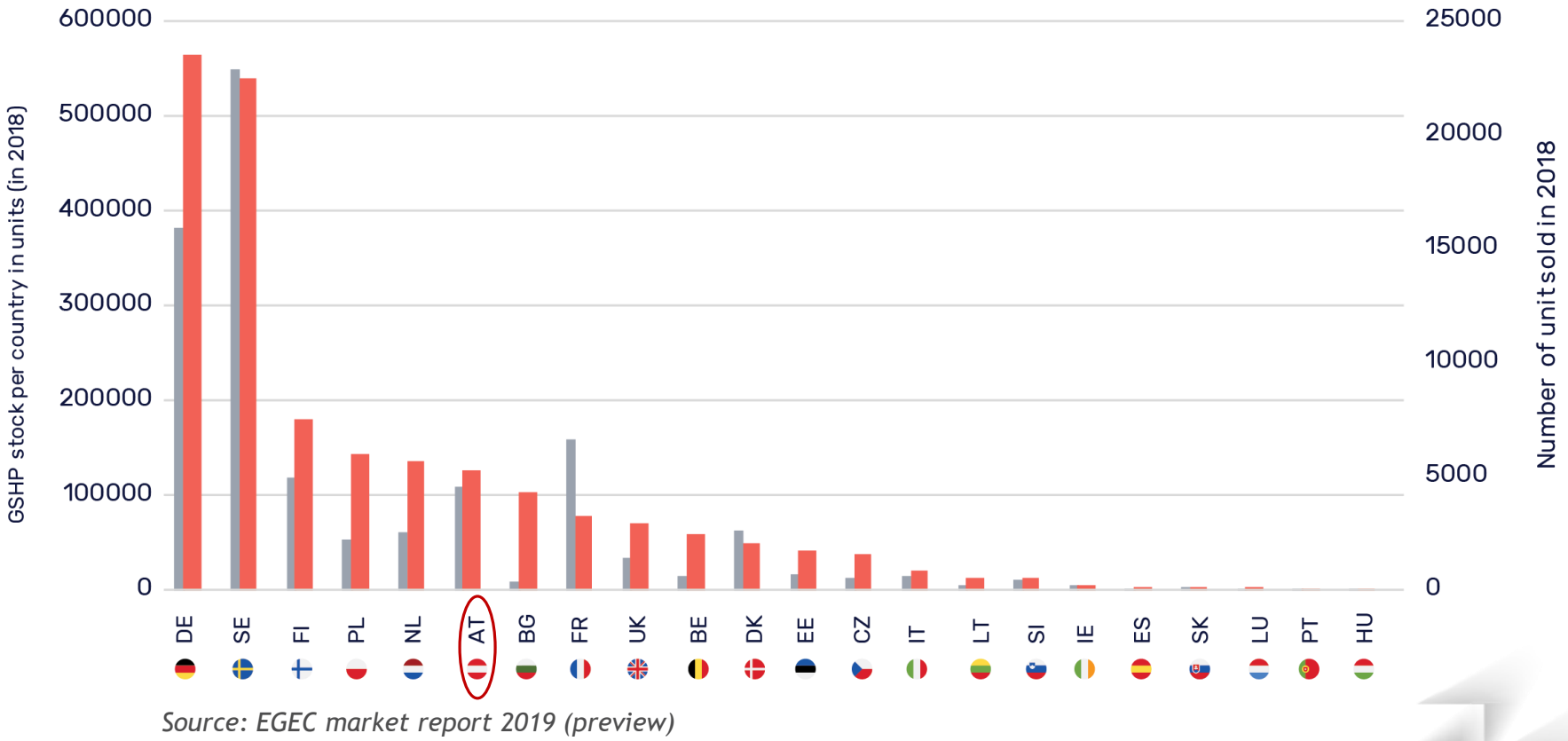
Type of use

- Heating is dominating, followed by free cooling
- Seasonal heat storage at its beginning

Definition of geothermal systems in comparison between Germany, Austria and Switzerland



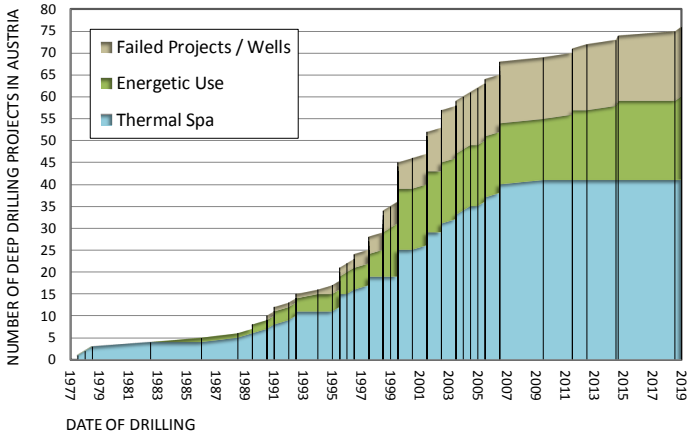
Austria in an European context



Source: EGEC market report 2019 (preview)

Overview of the geothermal market in Austria

Deep geothermal (hydrogeothermal)

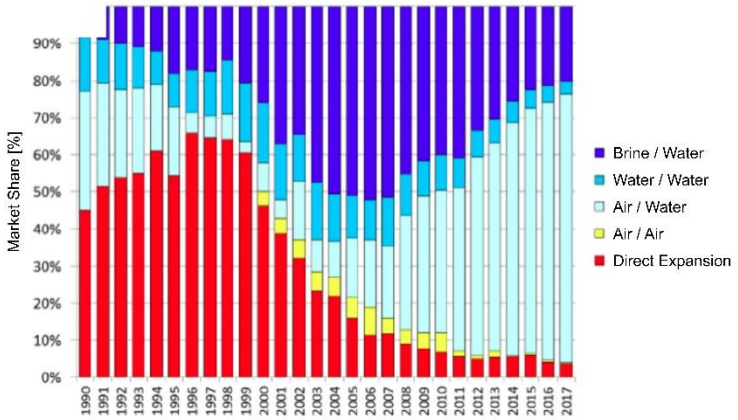


The development of geothermal wells, source: Goldbrunner & Goetzl, 2019

Use	Capacity	Production
Electricity	1.2 MW_{el}	2.7 GWh_{el}
Direct Heating	92.7 MW_{th}	294,3 GWh_{th}

Installed capacities and annual production 2018 (Goldbrunner & Goetzl)

Shallow geothermal (GSHP)



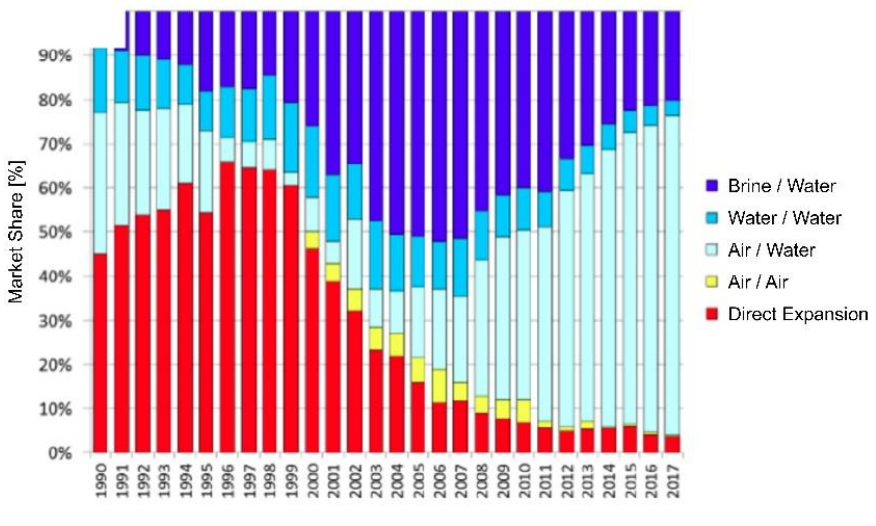
Annual heat pump sales in Austria, source: Biermayr et al, 2018

Use	Capacity	Production
GSHP	~ 1,000 MW_{th}	~1,500 GWh_{th}
Estimated annual growth	53 MW_{th}/yr (~5% referring to GSHP, ~2% referring to total ambient heat use)	

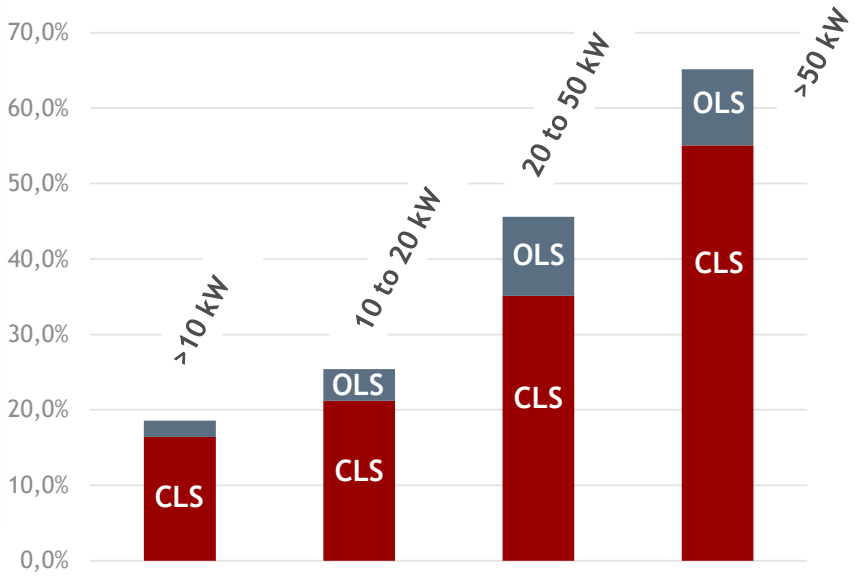
Installed capacities and annual production 2018 (Goldbrunner & Goetzl)

THE CURRENT ROLE OF SHALLOW GEOTHERMAL ENERGY IN AUSTRIA

The development of the shallow geothermal market



Development of GSHP at the domestic heat pump market (Biermayr et al, 2018)



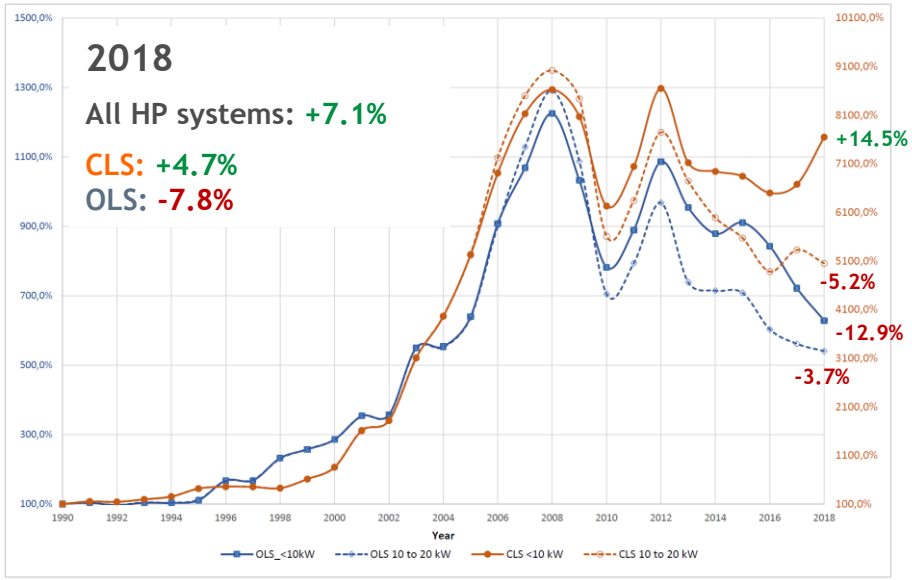
Share of GSHP at the domestic heat pump market with regard to unit scales in 2017 (derived from Biermayr et al, 2018)

Key observations

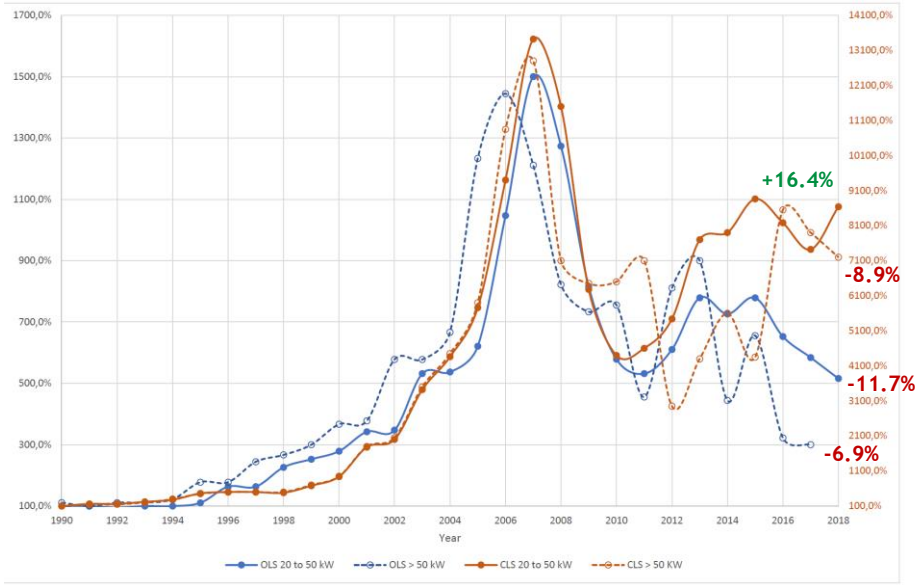
- The overall HP marekt is dominated by air based systems (~75%), an units up to 20 kW
- GSHP are still relevant for large scale units (>20 kW)
- Groundwater based HP systems are affected by negative market developments
- Low market growth 2% - ~5%

The development of the shallow geothermal market

Normalized GSHP market sales 1990 – 2018 (<20 kW units)



Normalized GSHP market sales 1990 – 2018 (>20 kW units)



Conclusions

- Small scale units decoupled from growing HP market in 2012 (possible increase in <10kW CLS units)
- OLS increasingly marginalized (fade-out)
- Large scale CLS (>20 kW) increase share

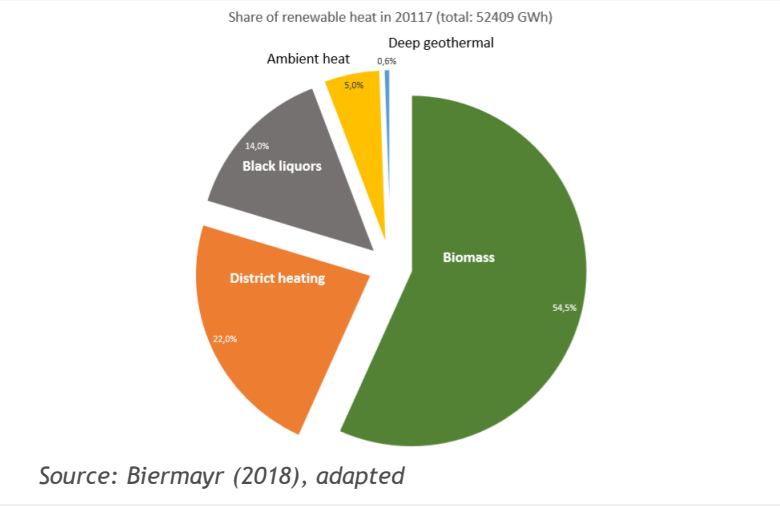
Sales characteristics of the domestic GSHP market in 2017 (derived from: Biermayr et al, 2018 & Fanninger, 2007)

The share of GSHPs among RES in Austria

- Relation 1:6 between deep- and shallow geothermal heat production in Austria
- Domestic HP market dominated by air based HP systems

Renewable heating in Austria[1]

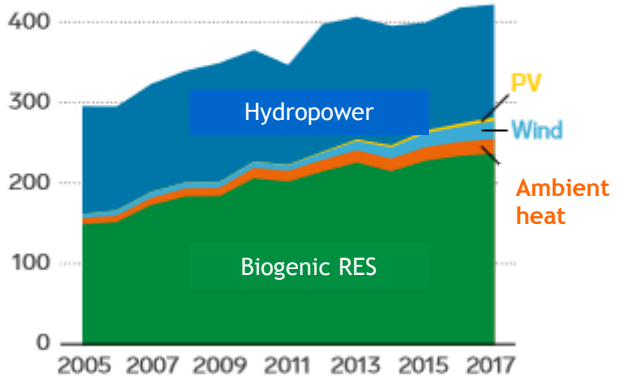
- Total share of RES: 33.5% (no. 4 in EU)
- Share of RES in electricity production: 72.6% (no. 1 in EU)
- Share of RES in heating & cooling: 33.3% (no. 10 in EU)



Source: Biermayr (2018), adapted

[1]Referring to the gross energy consumption, source: BMNT (2018)

Production of renewables in Austria
(development 2005 – 2017 in PJ)



Source: BMNT (2018), edited

Key conclusions

- Renewable heating market driven by biomass
- Estimated share of GSHP in total renewable heating sector: 1.8% (deep geothermal: 0,6%)
- Current growth rate (~2%) will not lead to a significant role of GSHP in the Austrian market

The role of shallow geothermal in Austrian strategies

#mission2030, draft energy- and climate plan 2021 – 2030

(national level)

- **GSHP not explicitly mentioned as option**
- Enhanced use of ambient heat
- Enhanced use of highly efficient HP systems
- Decarbonization and substitution of fossil energy sources (phase out of oil based heating systems)

Energy and climate strategies (Smart City Strategy 2014, Energierahmenstrategie 2017)

(Vienna)

- **GSHP mentioned as option (generic way)**
- Enhanced share of RES (goals: 2030 - 20%, 2050 - 50% of total energy consumption)
- Diversification and use of on-site heating sources
- Introduction of energy plans linked to building construction laws
- Urban heat island strategy, free cooling

Key conclusions

- Deep geothermal energy considered for renewable heat production and heat storage (national level)
- Shallow geothermal energy barely considered due to low temperature level and low awareness
- Cooling strategies barely defined as a climate change mitigation measure

BARRIERS AND FUTURE OPPORTUNITIES

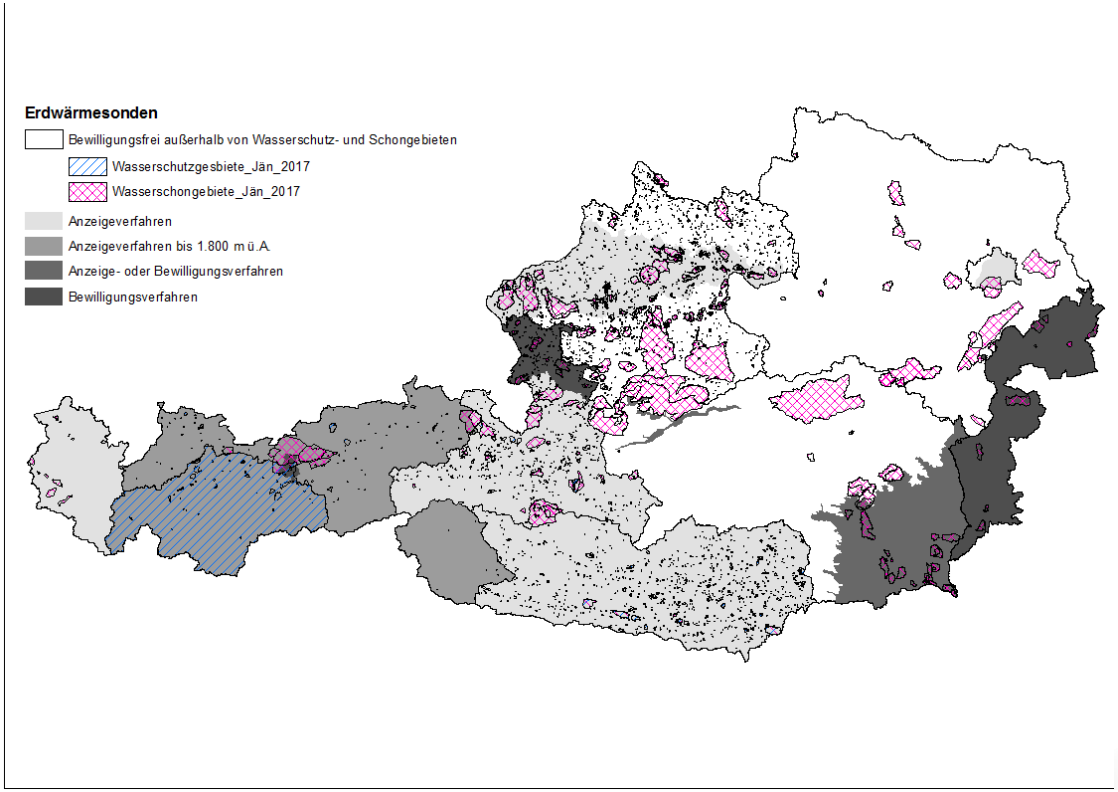
Referring to the current legal framework

Deregulation of the Water Act (WRG 1959) in 2013: **no permission for closed loop systems required except for areas of sensitive groundwater bodies**

- Regions with artesian groundwater bodies
- Settlements without central drinking water supply
- Areas must be made public by regional authorities
- Simplified notification procedure in sensitive areas (response time of 3 months for authorities)

Consequences

- Incomplete information on existing installations and lacking access to subsurface information
- Heterogeneous interpretation of sensitive groundwater regions by regional authorities!



Definition of sensitive groundwater regions and the implication for licensing closed loop systems (source: GRETA project)

U… Urban areas, **R**… Non-urban areas

BARRIERS AND FUTURE OPPORTUNITIES

Identified barriers and opportunities in Austria

Interreg CENTRAL EUROPE — European Union, European Regional Development Fund

GeoPLASMA-CE

Based market analyses and 9 stakeholder interviews

	Supporting the use (market development) of SGE	Hindering the use (market development of SGE)
Internal influencing factors (given by the technology itself)	**STRENGTH** e.g. low emissions, possibility of cooling	**WEAKNESS** e.g. high investment costs
External influencing factors (given at your pilot area)	**OPPORTUNITY** e.g. significant air pollution due to solid fuels	**THREAT** e.g. complex licensing procedure, low awareness of the public or decision makers

BARRIERS

- Low share (25%) at domestic HP system, dominated by small scale units
- Low market growth (2%-5%) inside the renewable heat market in Austria
- **Low awareness and visibility**
- Low temperature level (**U**)
- Austrian government supports biogenic energy sources
- Heterogeneous interpretation of Water Act
- No claims available and application of the principle of “first come first served” (**U**)
- **Complex licensing procedures compared to other RES**
- Lack of interest groups and platforms
- High investment costs

OPPORTUNITIES

- **Enhanced use of large scale HP units**
- Decarbonization and substitution of fossil oil (**R**)
- Diversification of energy sources (**U**)
- **Urban heat island strategies (U)**
- Limitations in biogenic heating supply (capacities, economic efficiency)
- Introduction of integrative management approaches (simplification of procedure for small scale units and regional management concepts for open loop systems) (**U**)
- Seasonal heat storage (BTES)

U… Urban areas, **R**… Non-urban areas

TOWARDS A STRATEGY FOR FOSTERING THE USE OF SHALLOW GEOTHERMAL ENERGY (IN AUSTRIA)

Goals and success indicators

- Identify and define relevant sectors of application and introduce innovation to mitigate negative trends
- Raise awareness of decision makers: Include shallow geothermal into the Austrian climate and energy strategy for 2021 – 2030
- Establish shallow geothermal as a key heating and cooling source in urban / sub-urban areas
- Promote low impact solutions: use of closed loop systems, balanced use
- **Success indicator: Annual growth rate of installed capacities / annual production >5%**

U… Urban areas, **R**… Non-urban areas

Proposed measures

- ✓ Implement interest groups and platforms
- Facilitate access to information: market statistics, web information systems
- Foster (public) investments in large scale units: demonstrators and pilots
  - ➢ Public buildings (educational centers)
  - ➢ Low temperature heating and cooling grids

Campus of Vienna University of Economics, 3 MW open loop system for heating and cooling (source: https://www.wien.info/en/sightseeing/architecture-design/wu-campus)

Low temperature heating and cooling grid "Viertel Zwei Plus" (source: https://www.wes-la.de/de/projekte/stadtentwicklung-viertel-zwei-plus-wien-at)

Proposed measures

- ✓ Implement interest groups and platforms
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- Foster (public) investments in large scale units: demonstrators and pilots
  - ➢ Public buildings (educational centers)
  - ➢ Low temperature heating and cooling grids
  - ➢ Application of GSHPs in existing buildings

Example SMART block Geblergasse (Vienna)

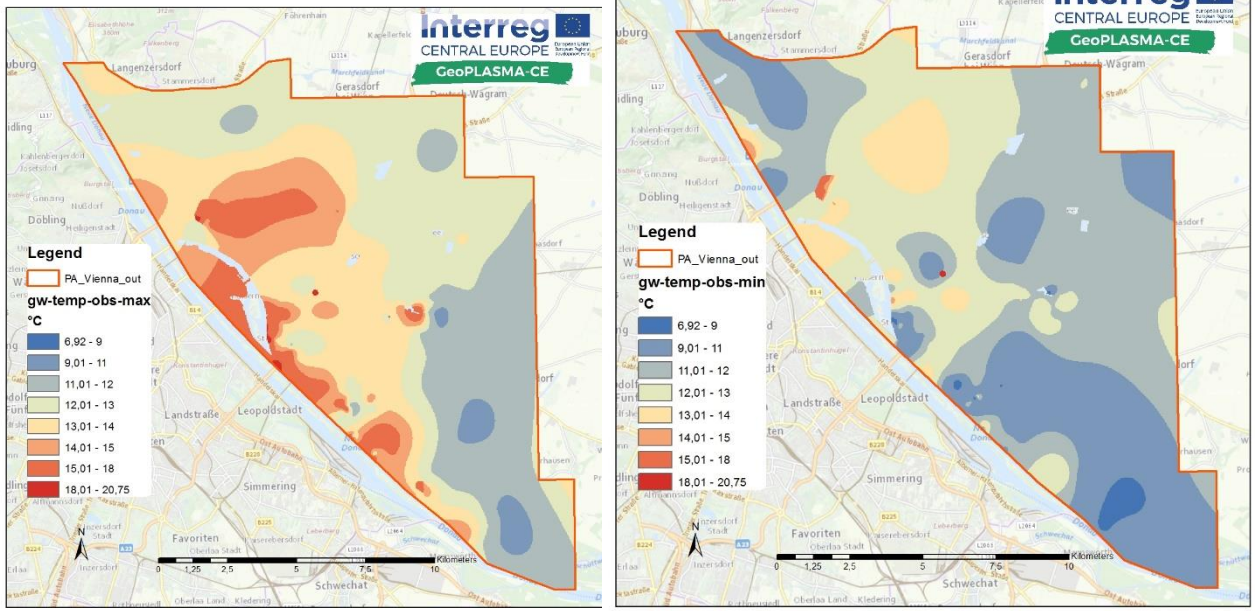
Implementation of a low temperature heating and cooling grid at a building block from the 1900s in a densely settled area of Vienna (source: https://www.sefipa.at)

Installation of borehole heat exchangers in the yards of the building blocks (source: https://www.sefipa.at)

Proposed measures (2)

- Include shallow geothermal energy into energy planning
  - New buildings and urban development areas: complementary to district heating
  - Existing buildings: complementary to district heating to substitute gas supply
  - Link energy planning to urban heat island mitigation plans: geo-cooling, seasonal heat storage (shift of paradigm of SGE use from source to storage)
  - Feed excess heat into district heating systems

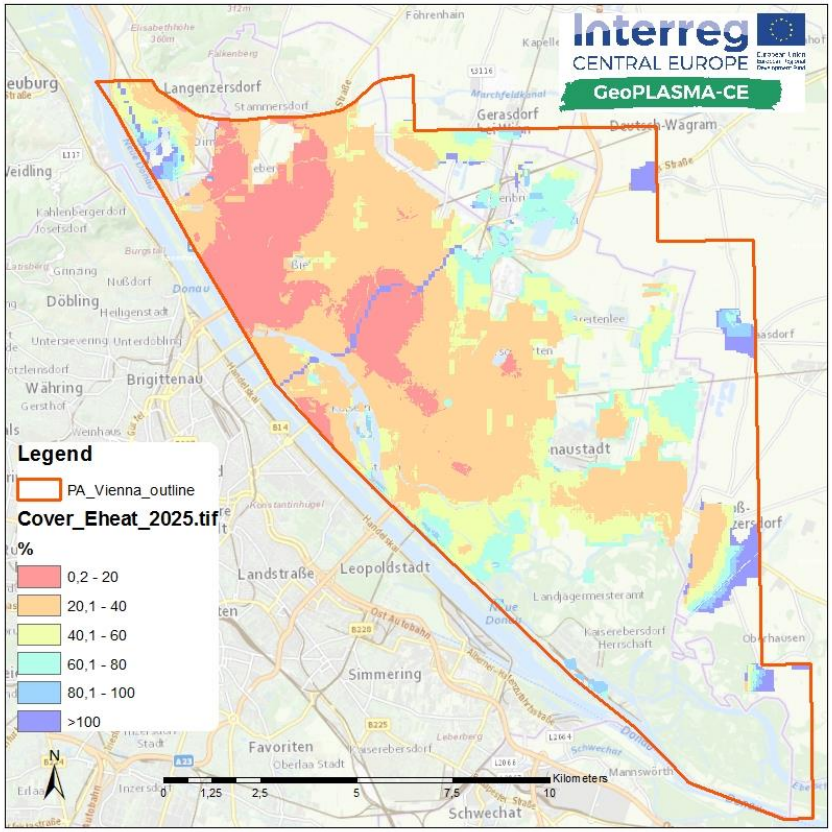
Excess heat estimated >500 Gwh/yr!



Groundwater temperature map for Vienna at the peak of the heating- and cooling season(source: GeoPLASMA-CE)

Proposed measures (3)

- Introduce integrative management approaches linked to incentives
  - Simplify procedures for small scale units (definition of small scale not existing)
  - Shift private use to borehole heat exchangers (raise awareness of resource limitations of open loop systems)
  - Privilege communal use of large scale open loop systems
  - Introduce monitoring initiatives and harmonize monitoring procedures (different approaches for small- and large scale installations)
  - Include summation effects into licensing process
  - Investment incentives for efficient heat pump systems and sustainable large scale uses



Heating supply map for open loop systems in Vienna (source: GeoPLASMA-CE)

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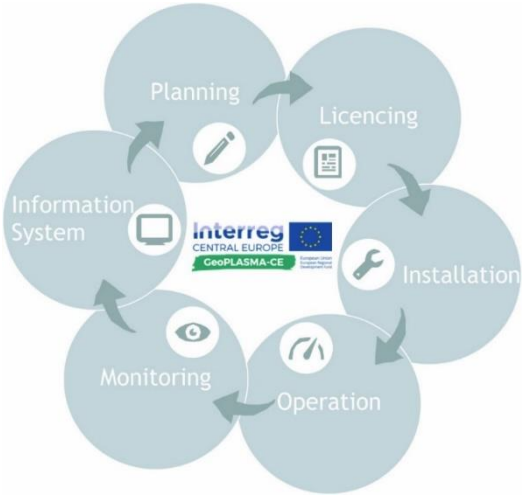
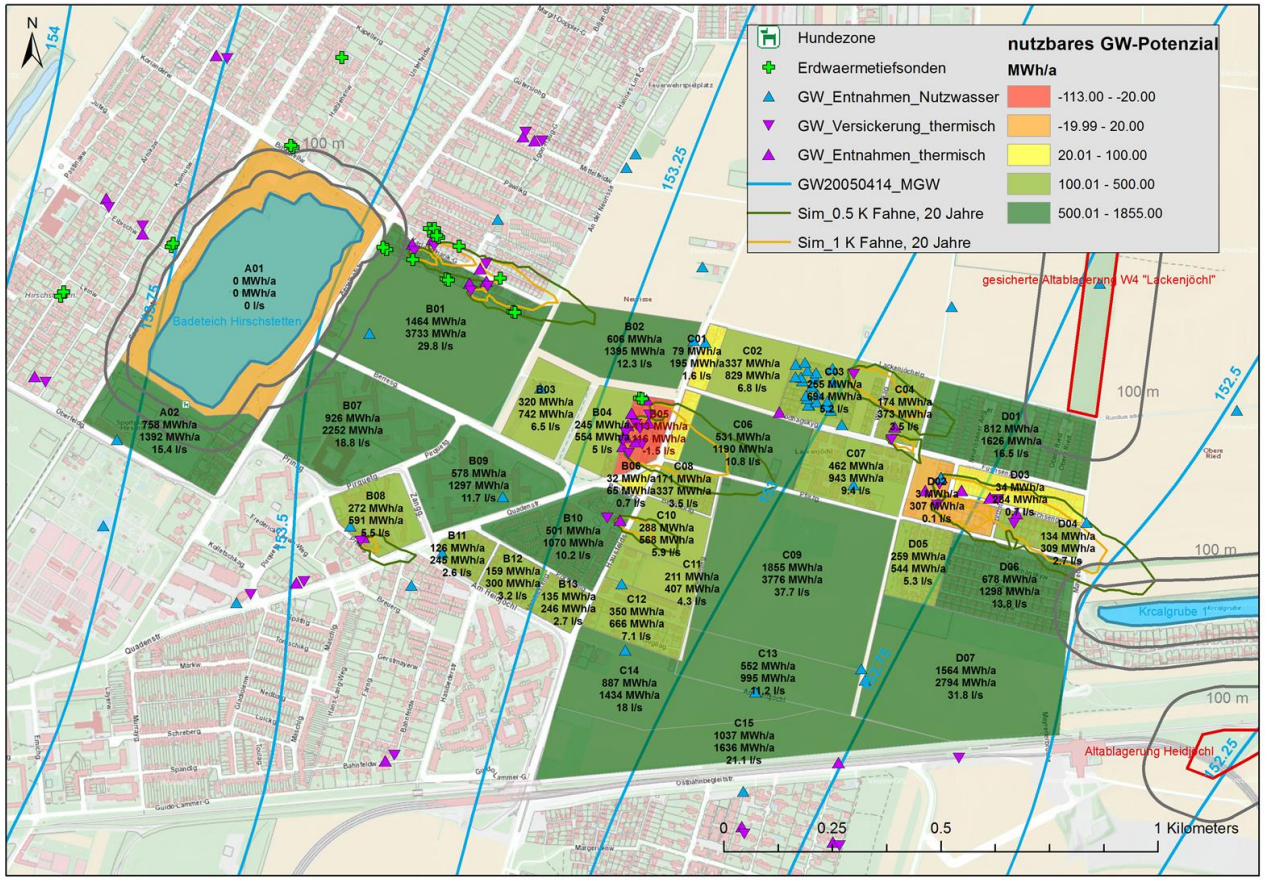
BARRIERS AND FUTURE OPPORTUNITIES

Referring to the current legal framework

Principle of “first come first served” versus “integrative management” approaches



- Link resource planning and monitoring to living web based information systems
- Consider summation effects where relevant (urban settlements, presence of aquifers)
- Facilitate small scale OLS and CLS use



Integrative map for planning the use of open loop systems in an urban development area in Vienna (source GeoPLASMA-CE)

U… Urban areas, **R**… Non-urban areas