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LIFE CLIMATE PATH 2050

The framework for evaluation of technical and economic potential in heat pump-based new district heating systems

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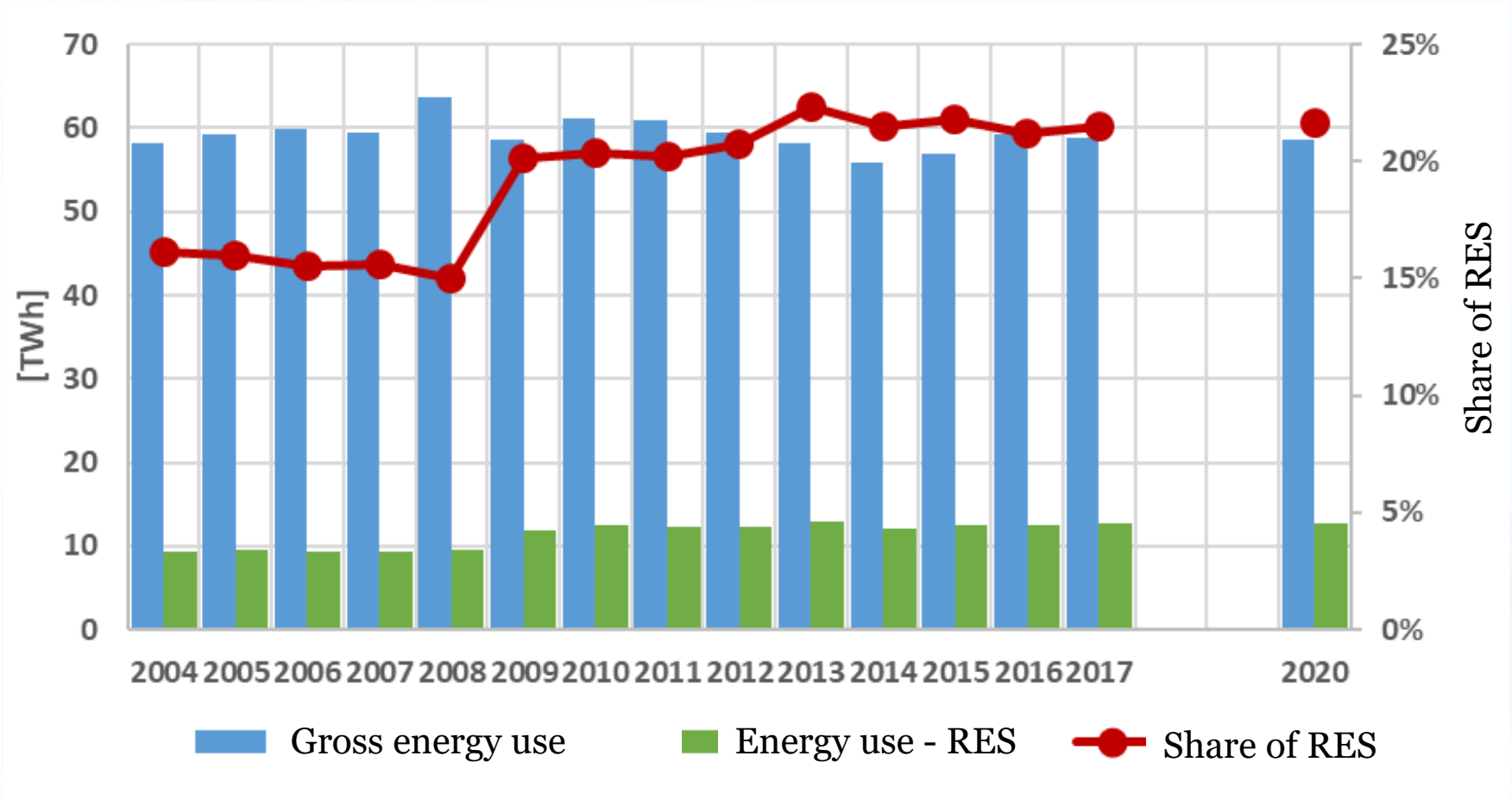
Outline

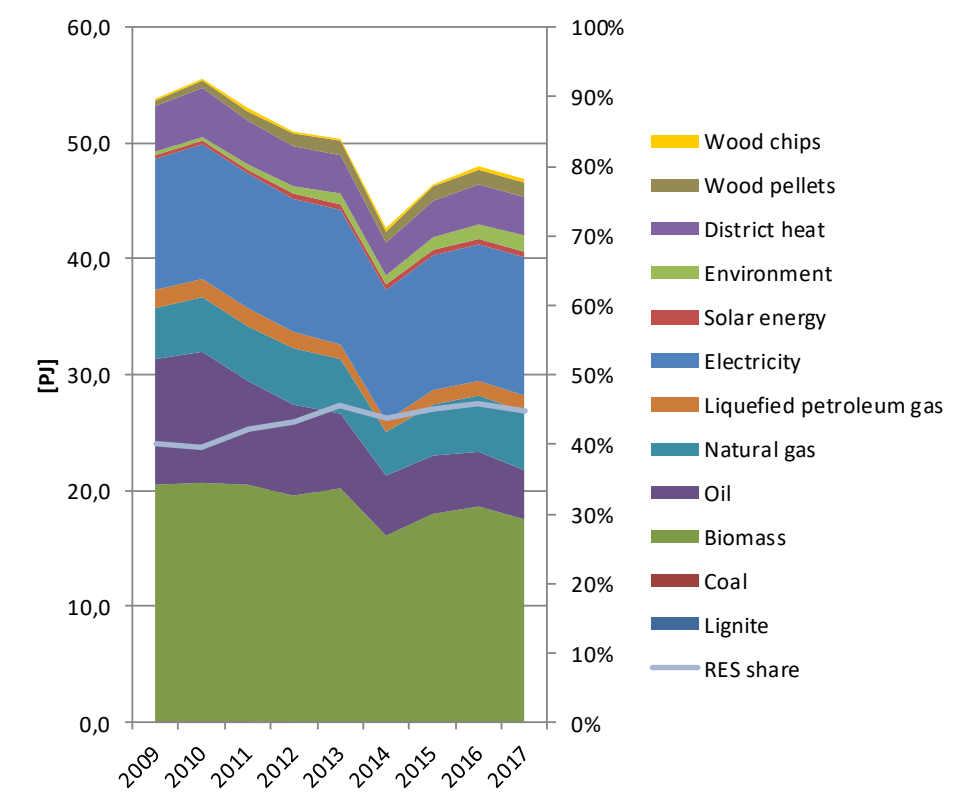
- Road to low carbon energy systems: Where are we?
- Energy status in Slovenia
- The methodology and original work
- Development of shallow geothermal energy potential model
- Development of new DH area model
- Role of shallow geothermal energy in transition to low carbon energy systems
- Conclusions

Road to low carbon energy systems: Where are we?



Energy status in Slovenia: HOUSEHOLDS

- Residential sector represents **23% of final energy consumption;**
- 20,9% reduction compared to 2009;
- **45% share of renewable energy sources** in 2017;
- Wood fuels prevail among consumed energy sources;
- The **shift** in the **heating systems replacement structure** was very different between dense and sparsely populated areas.
- Increase of geothermal and solar thermal energy technologies in the past years.

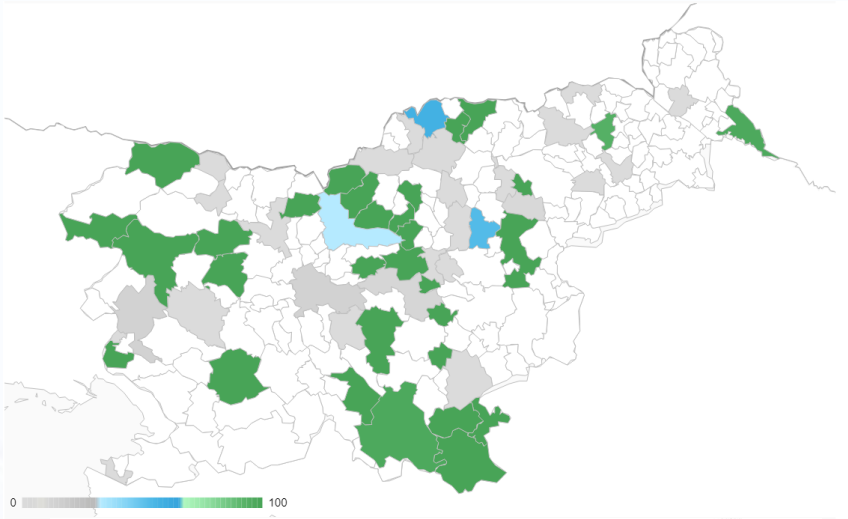


Energy status in Slovenia: DISTRICT HEATING

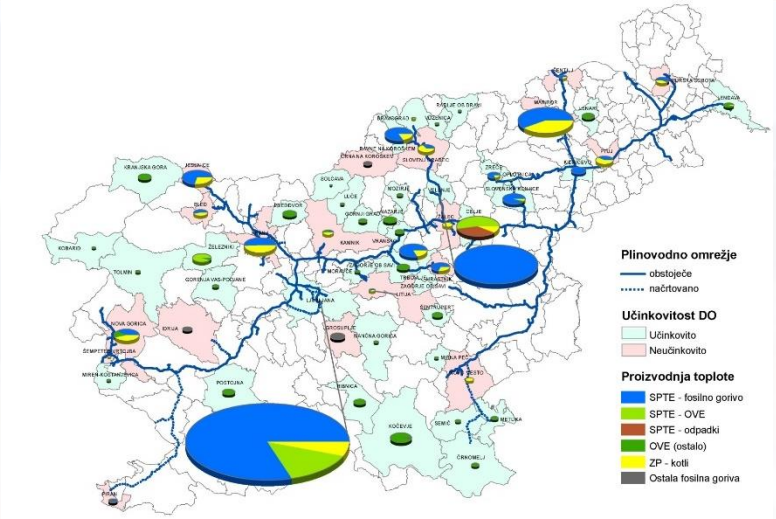
- **96 district heating** (DH) **systems** in Slovenia supplies energy, 27 are 100% renewable.
- DH system development is characterized by two aspects:

  (1) improving the efficiency of systems, and

  (2) increasing the diversity of sources for the production of heat.
- By deploying the 4th generation of DH systems, the cost-effectiveness of decarbonisation will be additionally ensured.



Share of RES in DH systems



Structure of heat production

Original work

- **cost-effective new DH area model** that determines new DH areas where heat could be supplied in a cost-effective manner;
- **framework of shallow geothermal energy potential assessment** that takes into account:
    - actual heat demand and ground properties on site,
    - thermal interference of neighbouring systems and
    - economic aspect.

The approach

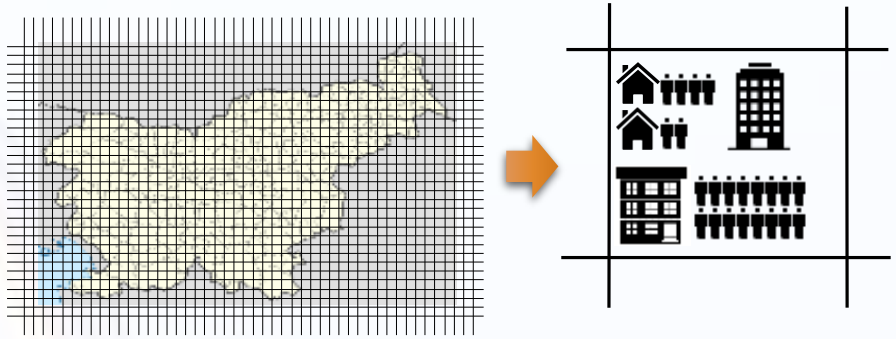
ENERGY NEEDS

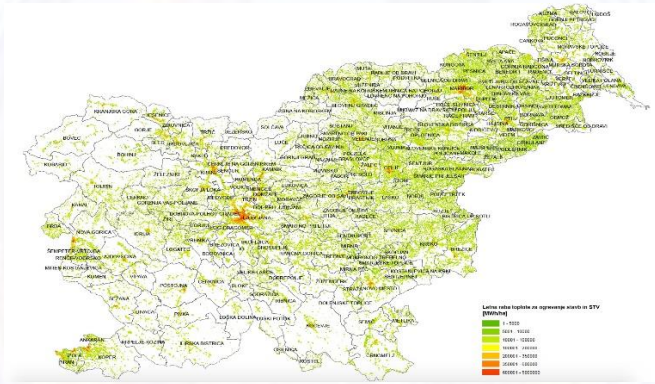
EXISTING DH INFRASTRUCTURE

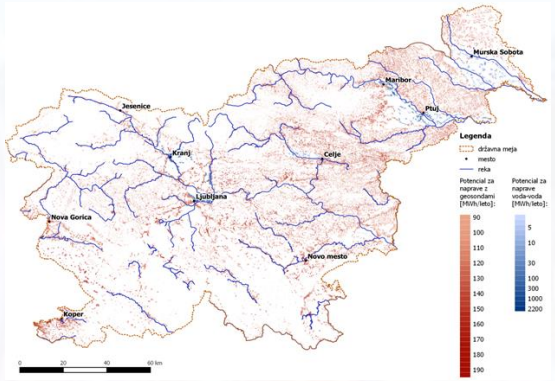
DEVELOPMENT OF SHALLOW GEOTHERMAL ENERGY POTENTIAL MODEL

DEVELOPMENT OF IDENTIFICATION OF NEW DH AREA MODEL

THE ANALYSIS OF TECHNICAL AND ECONOMIC POTENTIAL







1.2 million buildings and 92 millions m² analysed

Development of shallow geothermal energy potential model - aspects

Aspects taken into account:

Constraints:

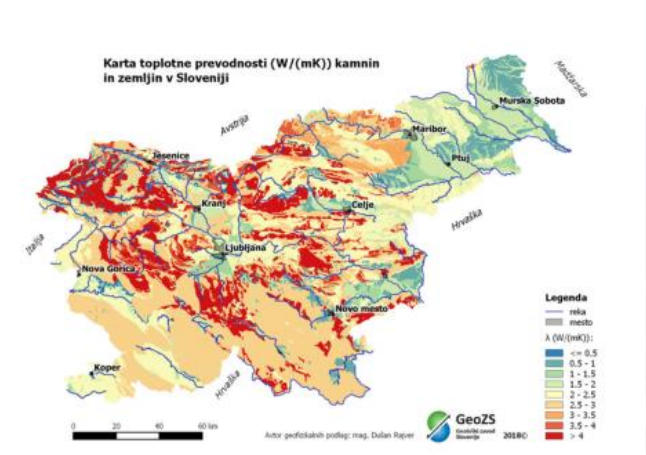
1. Exclusion areas: water protection areas, artesian aquifers
2. Warning areas: aquifers, groundwater just below the surface, emerges of gas, avalanches, higher karstification, etc.

Factors:

1. Ground surface temperature
2. Thermal conductivity of rocks and soil
3. Density of geological layers
4. Volume heat capacity

Economic:

i. Ground-coupled and groundwater heat pump systems
ii. Capture of energy with BHE and with groundwater systems
iii. Yearly maintenance costs and lifetime of technology



Development of shallow geothermal energy potential model - main advantage

The model:

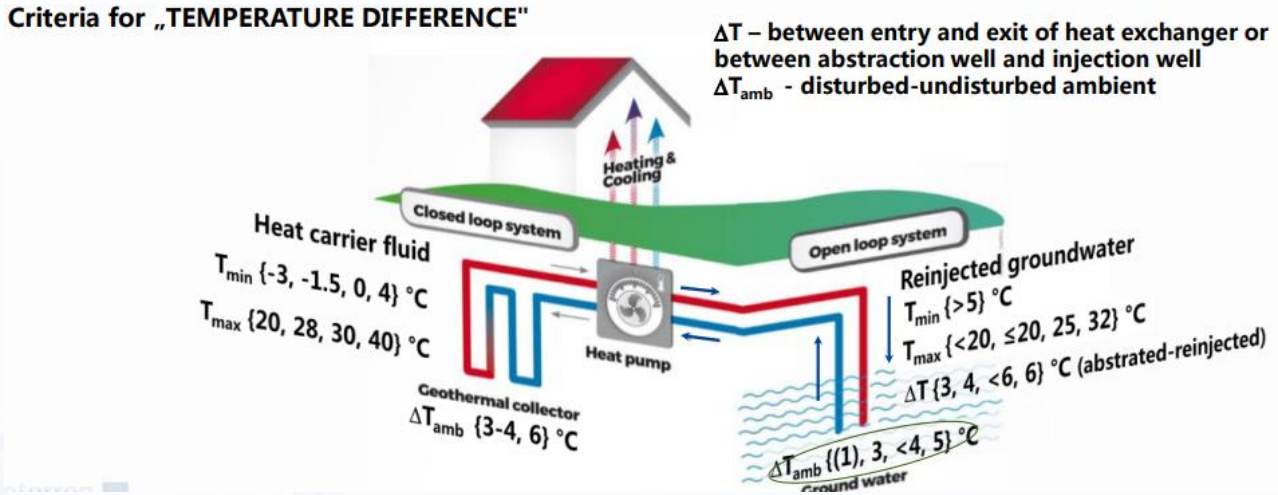
1. *checks how much energy needs to be extracted from the ground according to the building's demand* and
2. *accounts for thermal interference between neighbouring systems and the long-term impact on natural conditions.*

Development of identification of new DH area model - methods

- Areas with **potential**:

  HEAT DENSITY > 100 MWh/ha

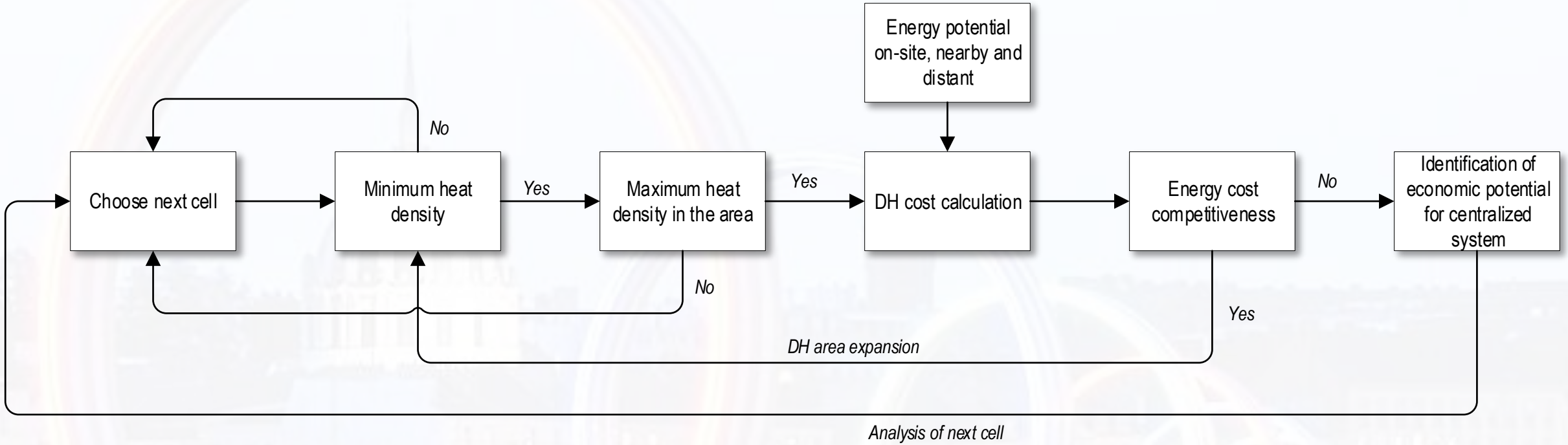
- **DH area size**: Areas where DH energy price competitiveness in ensured.
- **Economic feasibility**: investment, distribution, O&M (methodology by Heat Roadmap Europe 4, D2.3)
- **Competitiveness**: LCC comparison with the cheapest and “clean” technology available in dense (HP air-water) and sparsely (HP air-water and biomass boiler) populated areas
- Level of **detail**: **100 x 100m area**



versus

and/or

Development of identification of new DH area model - algorithm

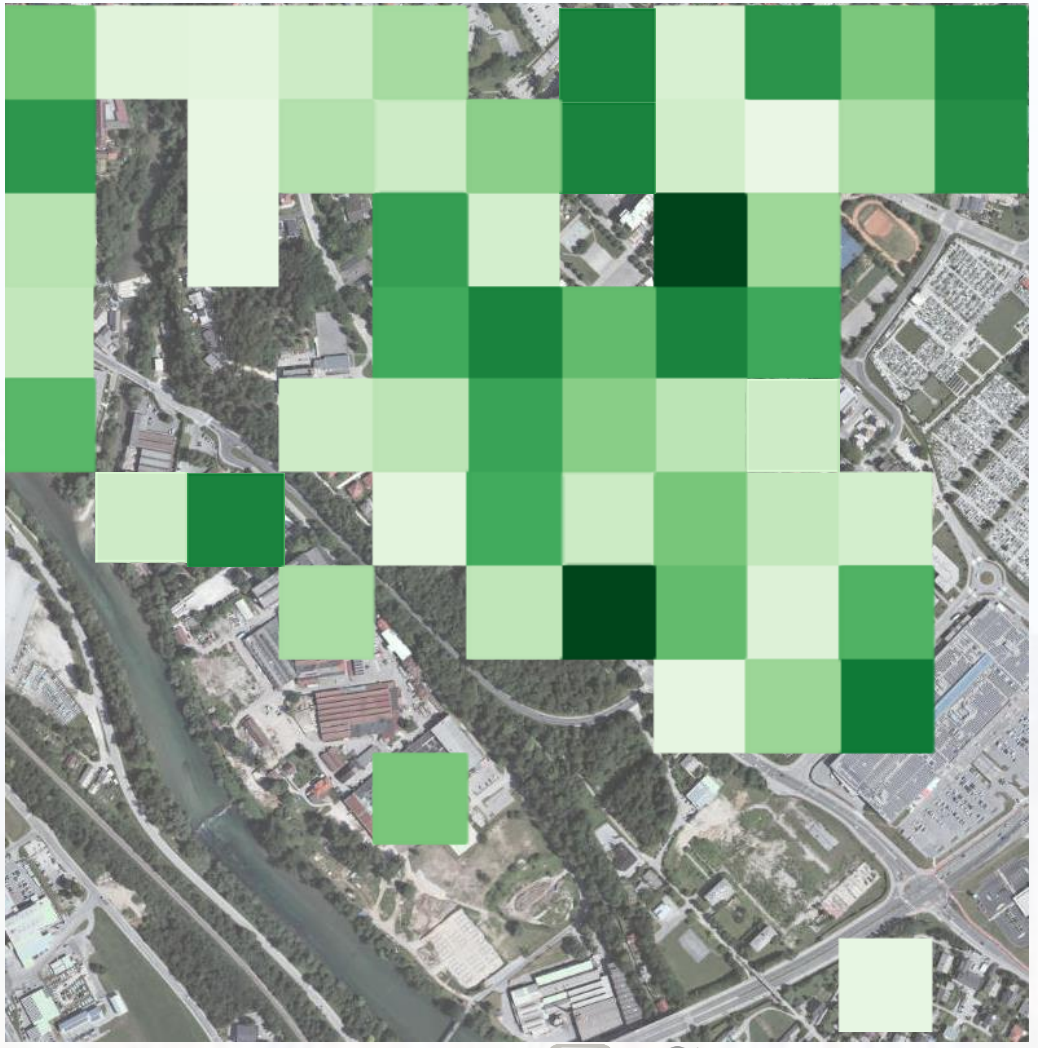


Development of identification of new DH area model - practical case

Area of a city in Slovenia

Heat demand

Area where new DH system would be ecomically feasible



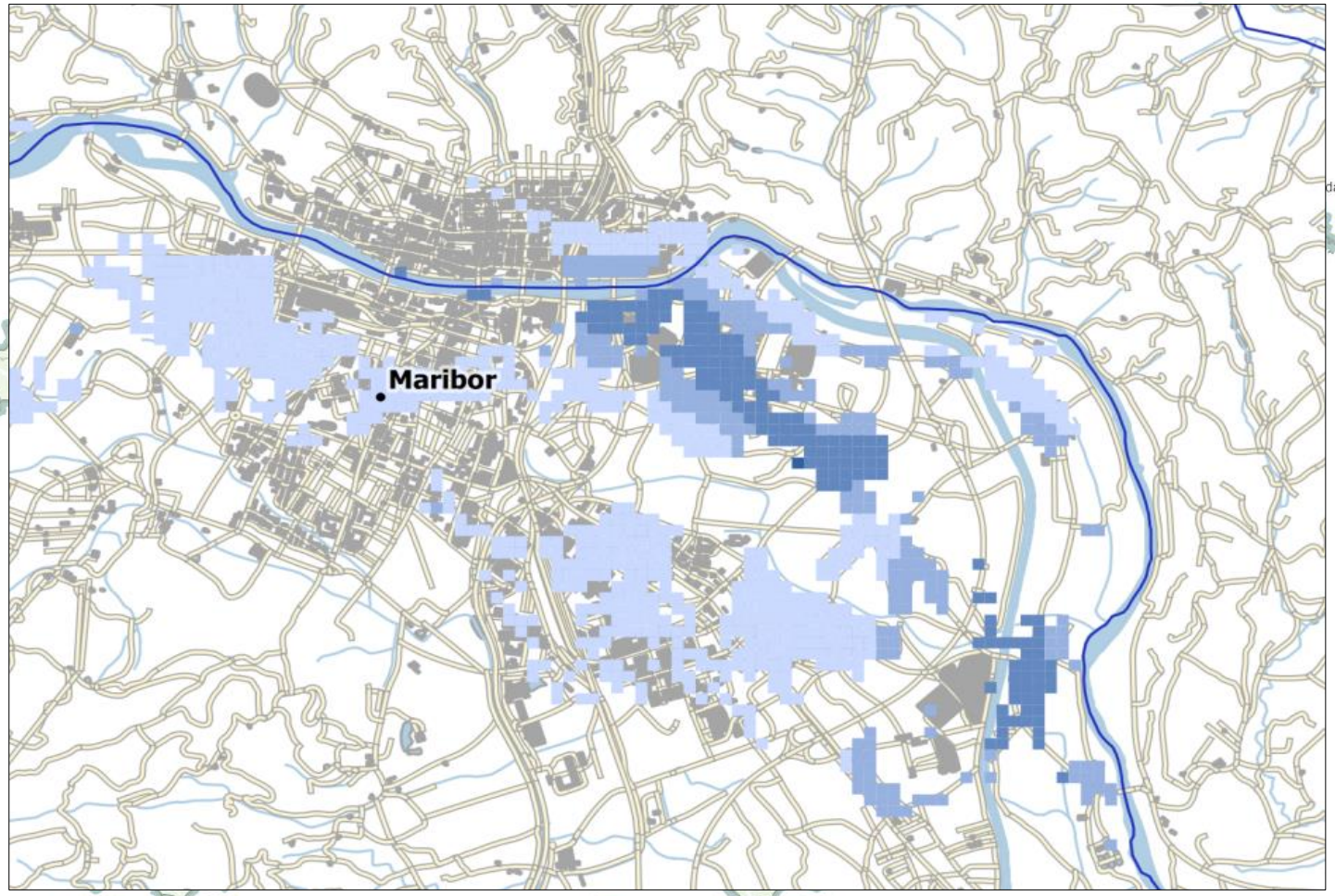
Results

Potential for new DH and micro DH areas in Slovenia is:

Area	Unit	Technical potential	Economic potential for shallow geothermal systems	Heat demand
DH	TWh/a	45.17	0.1	2.6
Micro DH	TWh/a	4.36	0.9	2.4

Recent studies show that in order to exploit more shallow geothermal energy, systems could be sequentially bound together (on a bigger scale) and thus the exploitation of it could be further boosted.

New DH areas and other findings



The approach revealed:

- new areas where DH systems would be economically feasible today and in 2050,
- due to dispersed settlement it is unlikely the buildings will be supplied heat by DH in 45% share (EU average) in the total share of energy use,
- the amount of geothermal energy that could supply base loadpower to existing DH systems,
- the economical feasibility od geothermal systems as decentralized systems.

Conclusion

- Heat pumps technology has been gathering pace as one of the main heating systems in new buildings as well as replacement for old, fossil boilers.
- Technical potential for **new DH areas** is substantial – almost 50 TWh/a.
- **54% of technical DH potential** in Slovenia **remains untapped**.
- The future of shallow geothermal energy systems lies **predominantly in individual heating systems**.

Conclusion

- Economic potential for new centralized systems using shallow geothermal energy is 1 TWh/a, but could rarely be used as the only source for heat production, due to **limited energy capture from shallow grounds.**

- Where possible, shallow geothermal energy can contribute from 2% to 25% of energy for heat production in analysed **existing fossil fuel based DH systems**, thus making shallow geothermal energy suitable for supplying **base load power in an economical manner**.

Thank you!

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