

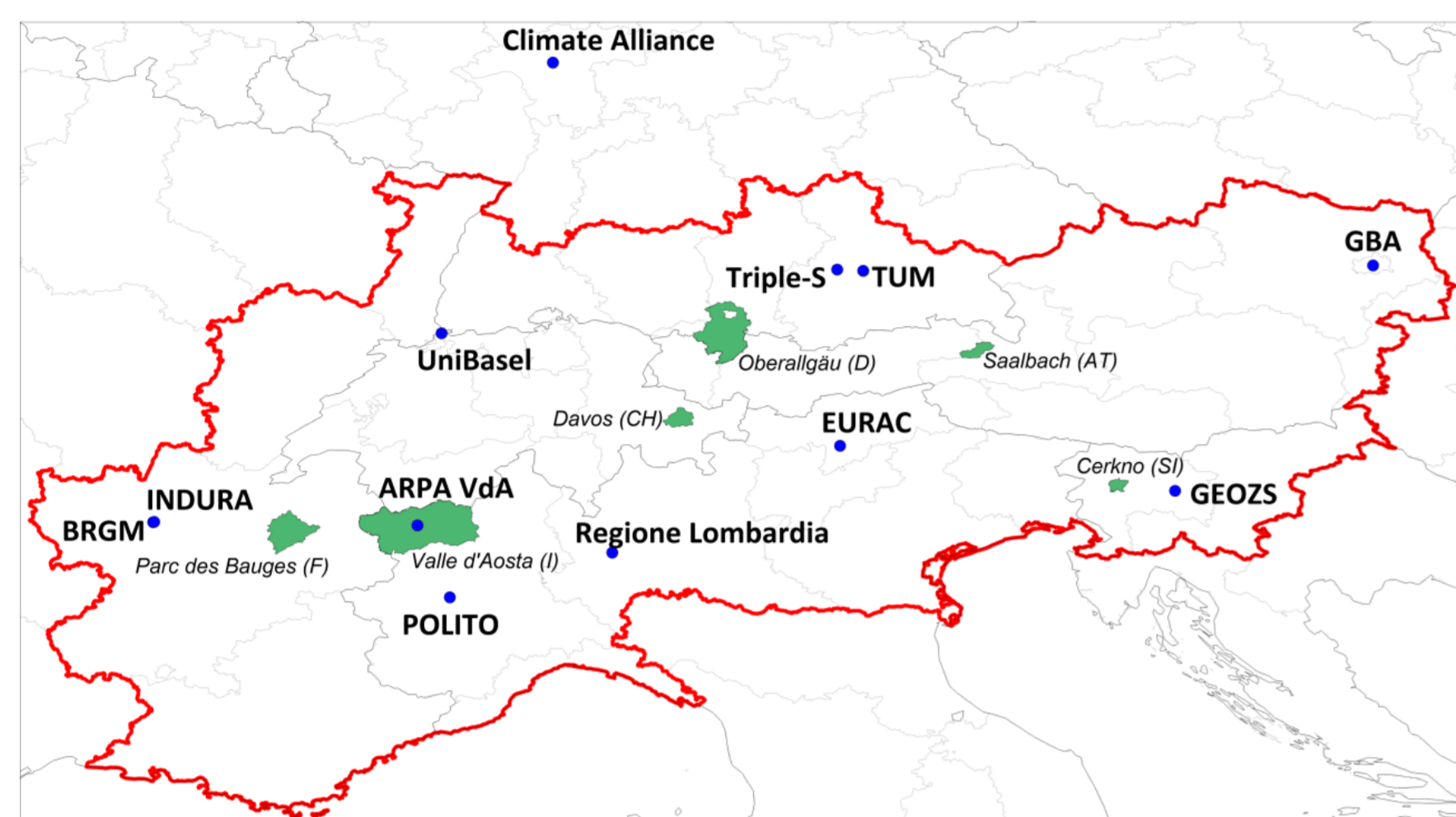
Shallow geothermal energy potential of Pilot area CERKNO

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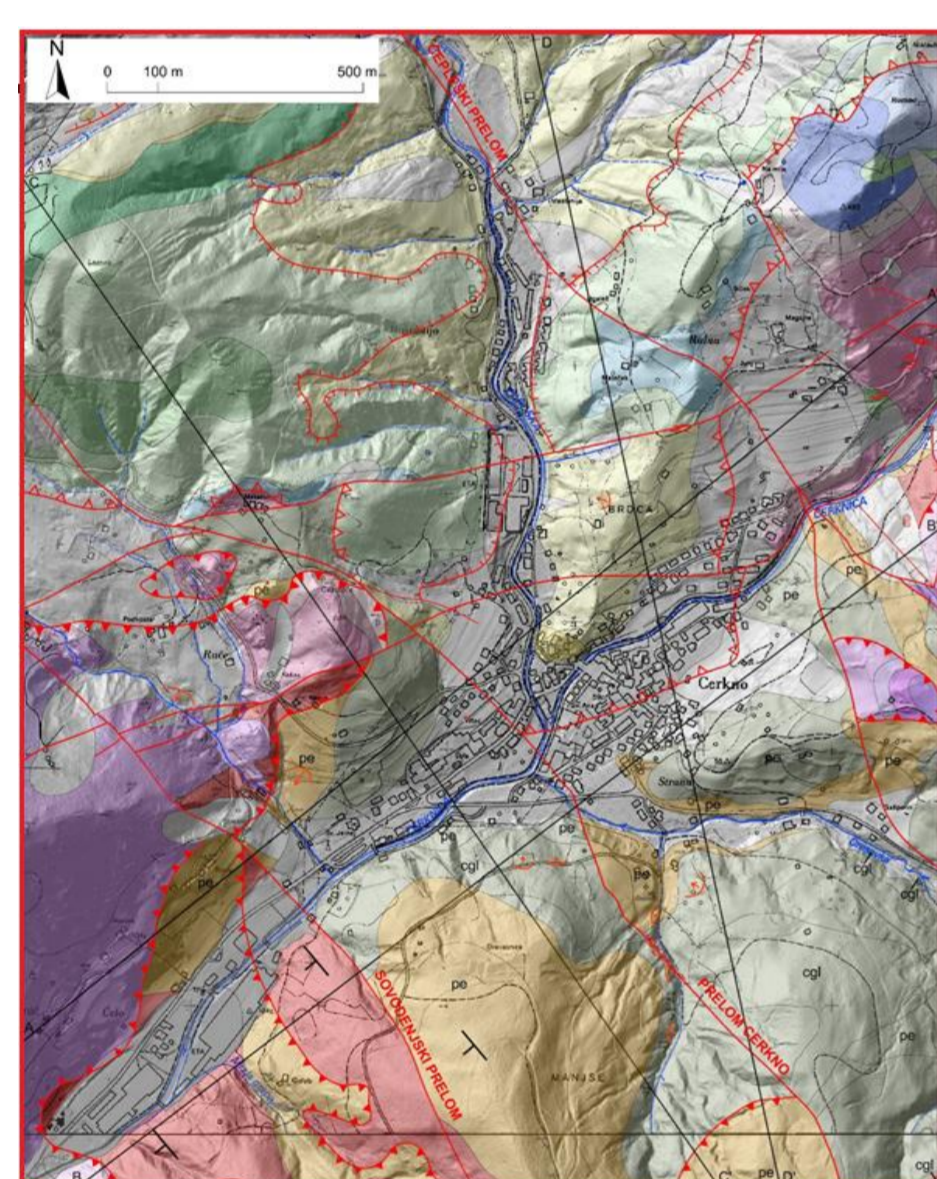
General overview

Municipality of Cerklje ob Krki lies in the Littoral region of Slovenia and consists of 30 dispersed settlements, covering 133 km². It is a typical remote Alpine municipality with 4,588 inhabitants (2018). The town is situated in a narrow valley, surrounded by mountainous area and dispersed mountain hamlets. For the considered number of buildings (1,888 records), the total estimated thermal demand is equal to 49,9 GWh/year.

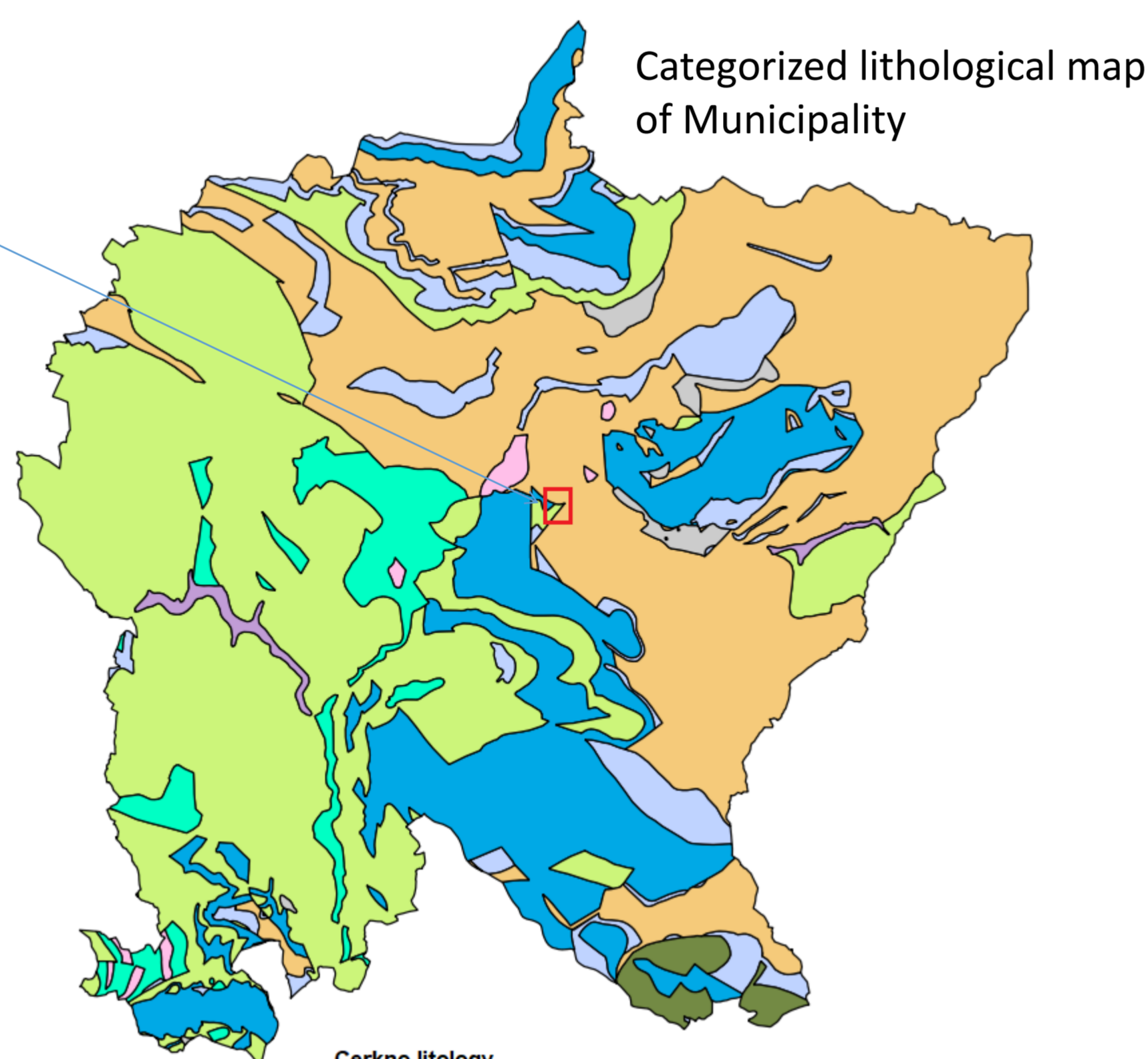


Geological and hydrogeological features

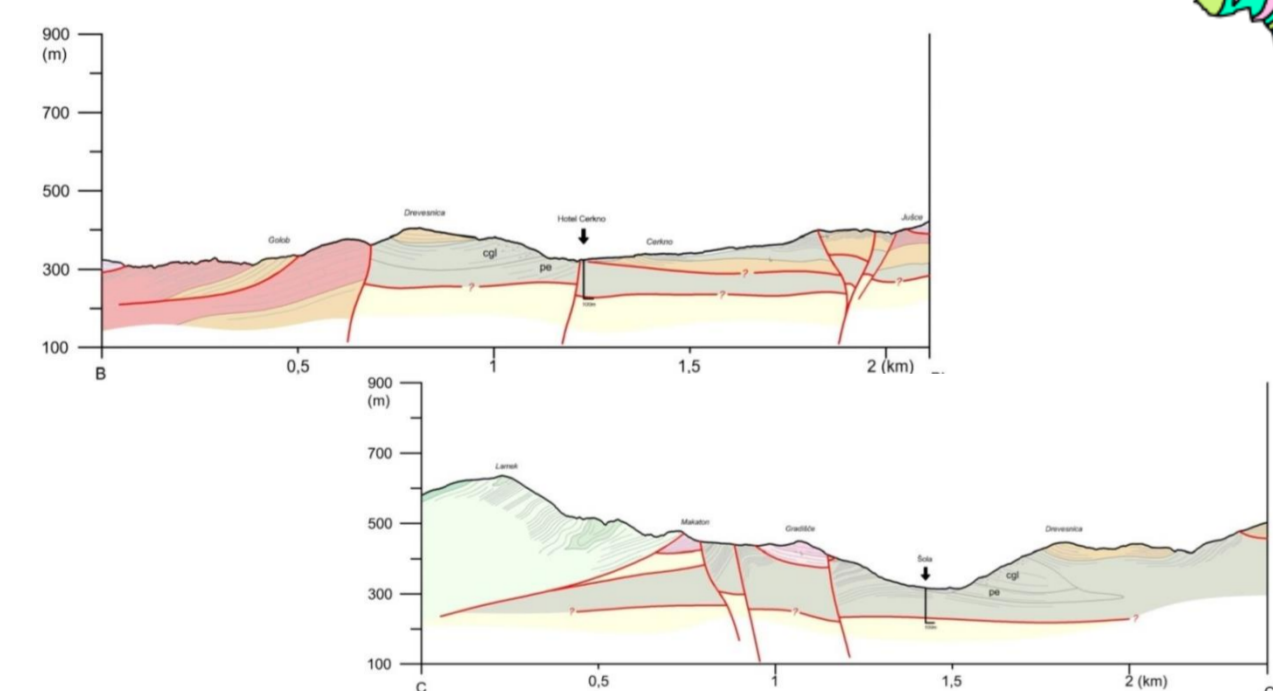
- Rocks that compose the wider area of Cerklje ob Krki belong to two main tectonic units – External Dinarides and Southern Alps.
- Different deposits are characterized by very large stratigraphic range - from Paleozoic sedimentary rocks to Quaternary deposits.
- During Cenozoic the area passed through strong tectonic deformations due to collision between the Adria microplate and the European plate.



Detailed geological mapping



Categorized lithological map of Municipality



Cerklje ob Krki lithology

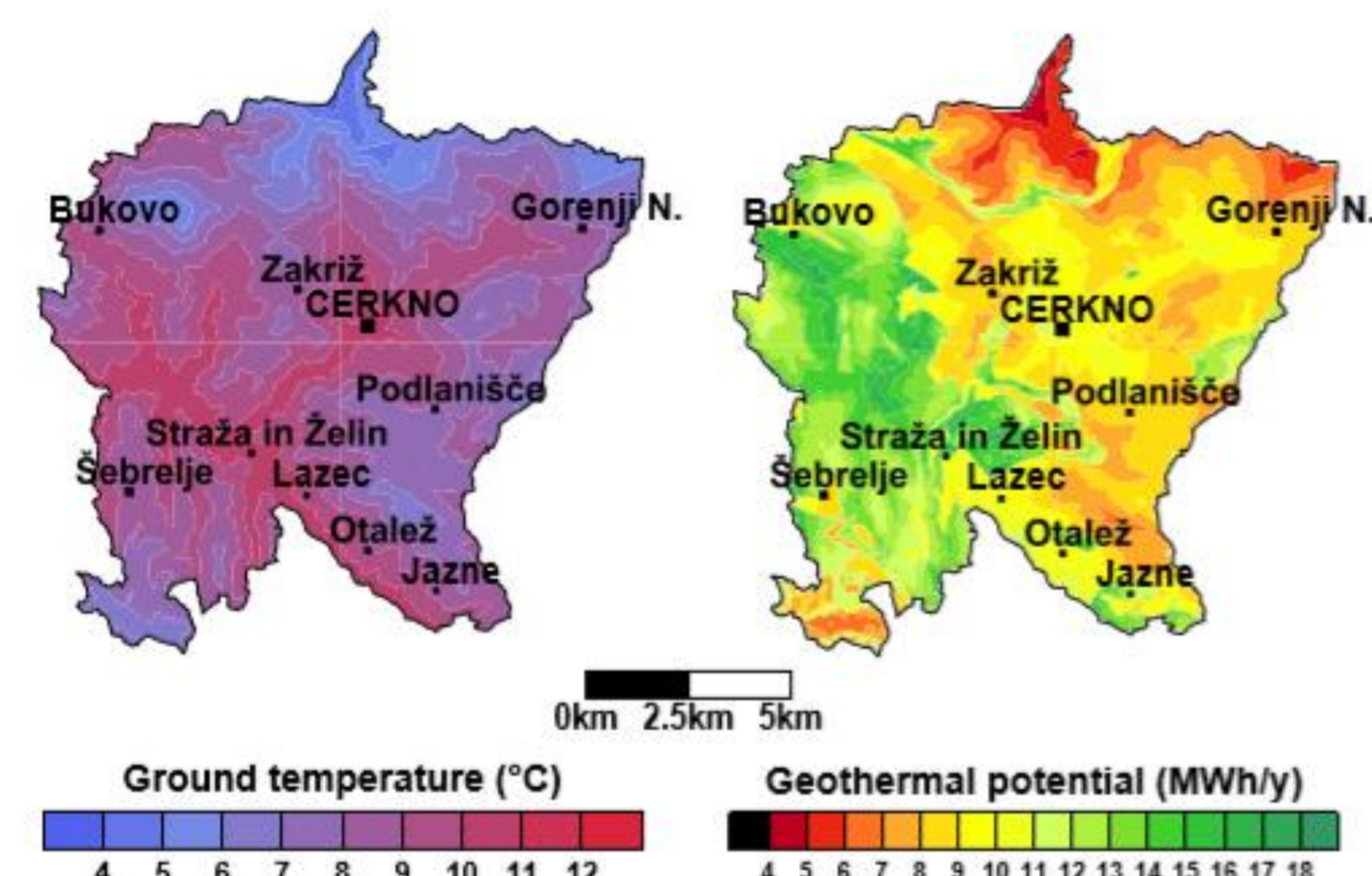
- Limestone
- Limestone and clastic rocks
- Dolomite
- Dolomite and clastic rocks
- Mixed carbonate and clastic rocks
- Volcanic rocks and tuff
- Coarse-grained volcanoclastic rocks
- Saturated gravel and stones (alluvium)
- Unsaturated gravel and stones (slope sediments)

- The area mainly constitutes of minor aquifers with local and limited groundwater resources. Only extensive dolomite layers (W part of municipality) may be classified as moderately productive aquifers.
- Layers that are characterized by a varied geological composition are usually insufficiently productive for the use of open loop systems.
- Thus, more convenient and accessible choice for the use of SGE is installation of closed-loop BHEs.
- Despite the fact that these layers often form aquitards, groundwater flow may appear at the subsurface and springs can be encountered in discharge area.
- Constraints for the use of SGE in Cerklje ob Krki may occur in water protection zones and areas of natural risk and special geological conditions (e.g. karst areas, evaporites, landslides...).

Shallow geothermal energy potential

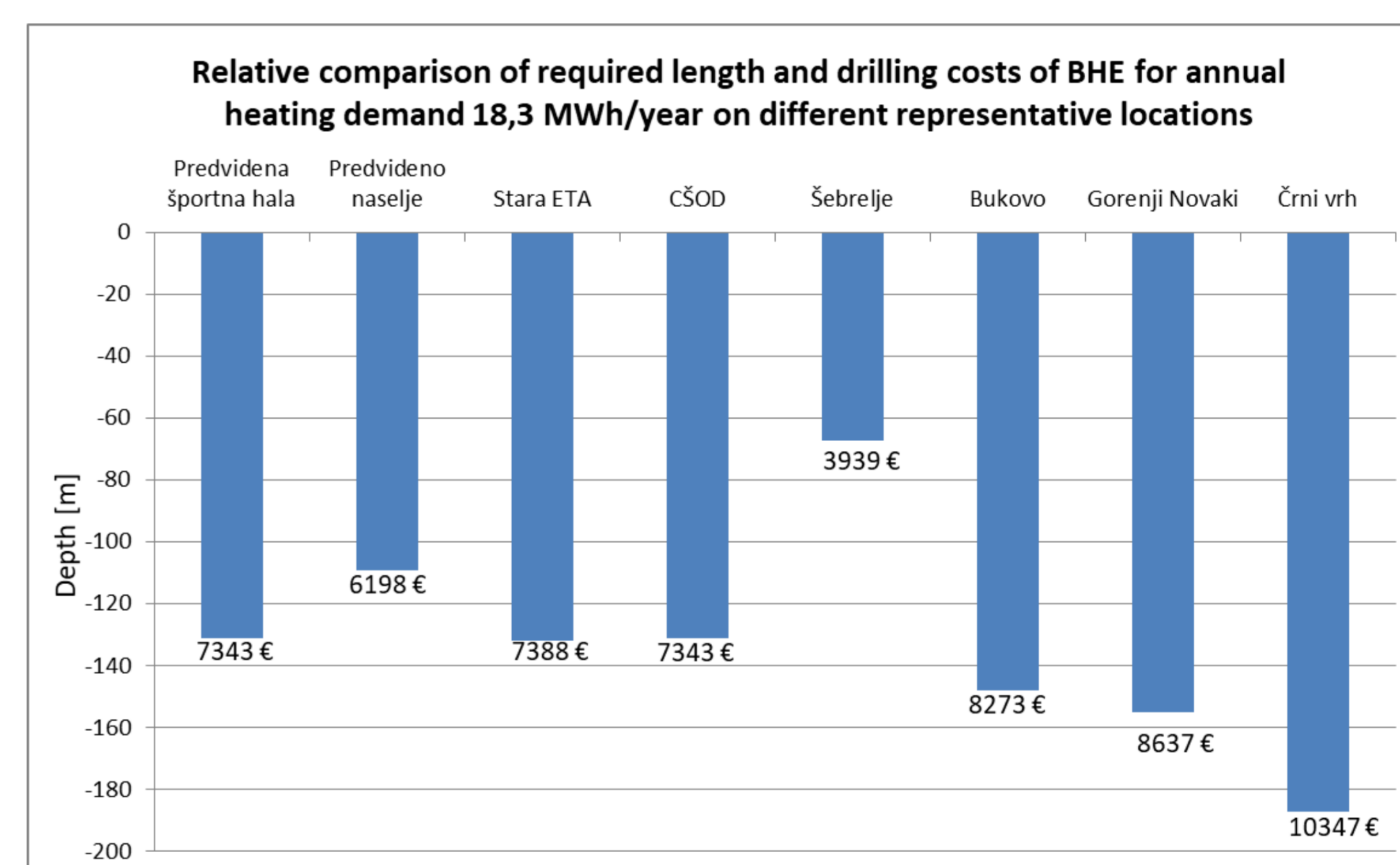
Figures show mean ground surface temperature and geothermal energy potential calculated using G-pot method.

An example: If we use 2300 litres of oil with an old oil boiler with a 70 % efficiency this equals 16 MWh. Approximately one quarter of this energy comes from the heat pump and the remaining 12 MWh is generated from shallow geothermal energy, i.e. borehole. In the areas which are in green, a 100 m deep or shallower borehole would be enough, in other parts the borehole would have to be deeper, depending on the location. One deep borehole, however, can be replaced with several shallower ones.



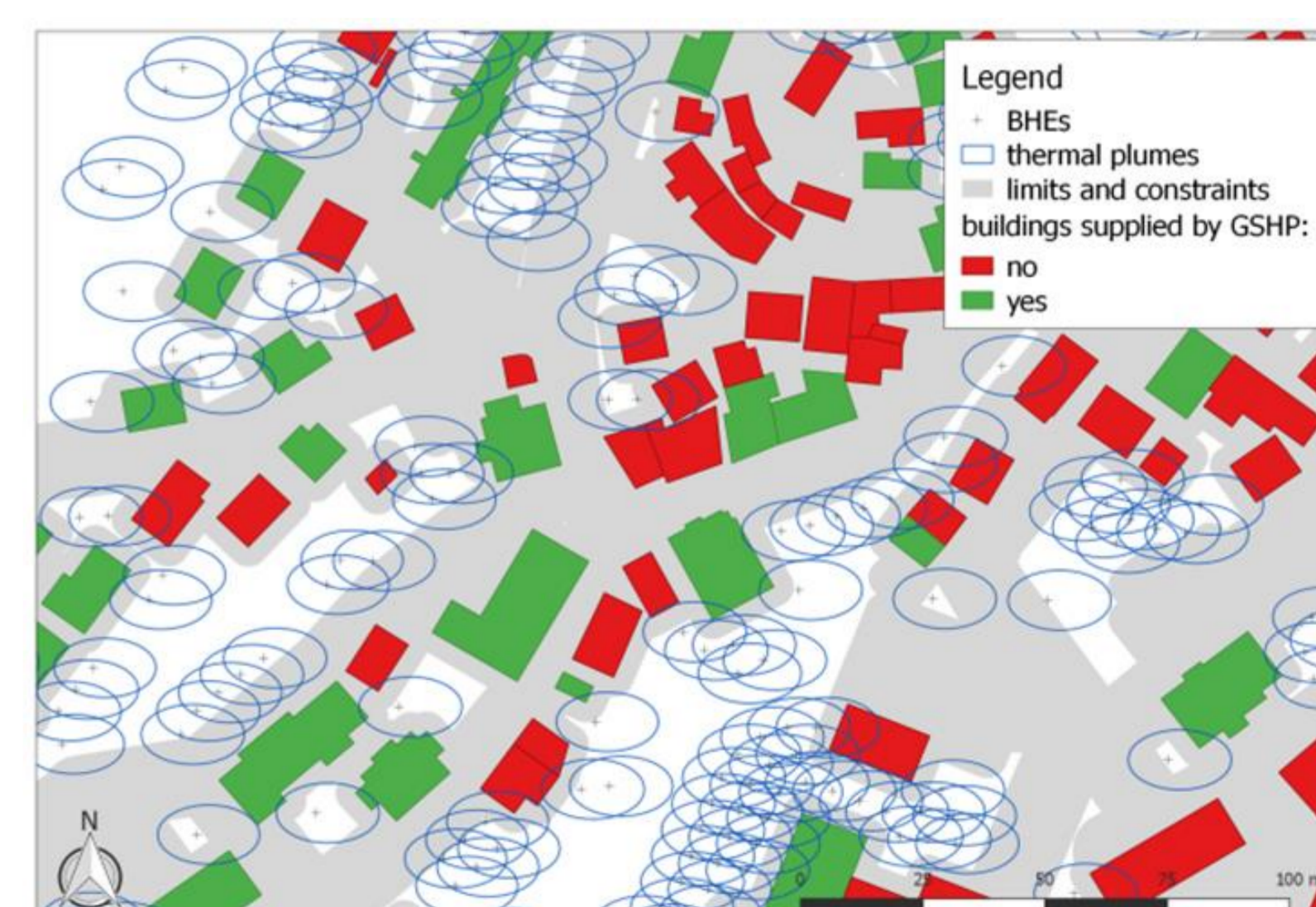
Relative comparison of required BHE length and drilling costs for different locations was performed with EED software. Input data:

- Estimated geothermal parameters for each location
- Annual energy demand: 18.3 MWh/year (no cooling)
- Peak heat power: 8.3 kW in heating season
- Fluid temperature constraint: T_{min} = -3 °C
- Actual drilling costs



Implementation into energy plans

It is estimated, that as much as 88.4% of the annual energy demand can be covered by the installation of BHEs in the Cerklje ob Krki settlement. With all the new expertise a new Local energy concept (LEC) is about to be written.



The objective of the existing LEC is to increase the use of geothermal and solar energy by 3% until 2020. In accordance with estimated SGE potential, the goal for the next planning period may be set more ambitiously. Additionally, the use of NSGE is proposed in combination with wood biomass, as it is the most available renewable source of energy in the area.