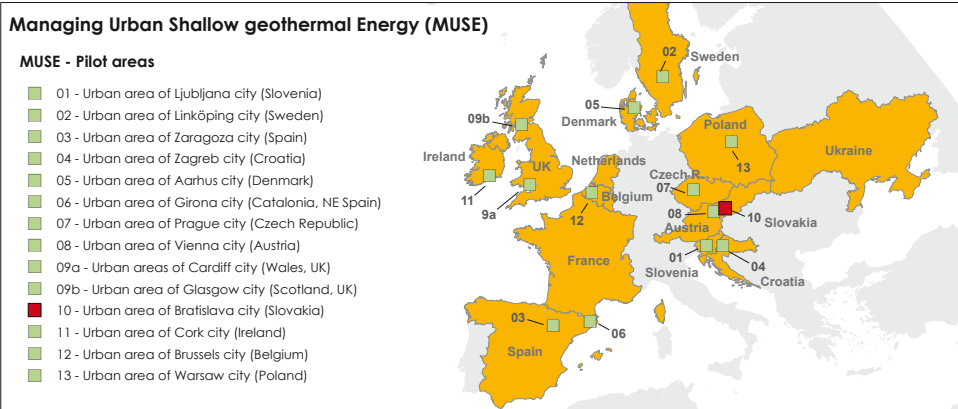


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SK/WP4/D4.1/FS10/2018



Pilot area information



The chosen pilot area for Slovak Republic is capital city Bratislava. The market with shallow geothermal energy is growing. Due to the current regulation (within Water Act., Geological Act.) there is still gap in management and monitoring of the shallow geothermal energy sources (its influence to the groundwater warming and the urban heat island).

With a population of about 450,000, it is one of the smaller capitals of Europe but still the country's largest city.[1] The area of the city is 367 km². The greater metropolitan area is home to more than 650,000 people. Bratislava is in southwestern Slovakia, occupying both banks of the River Danube and the left bank of the River Morava. Bordering Austria and Hungary, it is the only national capital that borders two sovereign states.[2] Elevation varies from 126 m a. s. l. (m above the sea level) to 514 m a. s. l. with average value of 134 m a. s. l. Part of the city area is covered by Male Karpaty Mts.

The forest in city administration covers cca 30 km², but in total forest covers more than 50 km².

Bratislava has a moderately continental climate [3] with mean annual temperature (1990–2009) of around 10.5 °C, average temperature of 21 °C in the warmest month and –1 °C in the coldest month and precipitation spread rather evenly throughout the year [4].

Recently, the transitions from winter to summer and summer to winter have been rapid, with short autumn and spring periods. Snow occurs less frequently than previously [3]. Extreme temperatures (1981–2013) – record high: 39.4 °C,[5] record low: –24.6 °C. Average annual precipitation is 565 mm.

The geothermal energy is defined in connection to the deep geothermal sources, the definition is established in legal regulation, though regulation is via permission of water withdrawal (geothermal water is by definition groundwater with temperature over 20°C). In Slovakia shallow geothermal energy market is growing both for purpose of heating and cooling. Though relevant data are still missing.

Pilot Area	Bratislava
Task (MUSE)	T-4.11
Country	Slovakia
Area (km ²)	367 km ²
Total number of inhabitants (date)	429,564 (2017)
Inhabitants per km ²	1169
Level of urbanization	55%
Elevation range (m a.s.l.)	126 - 514

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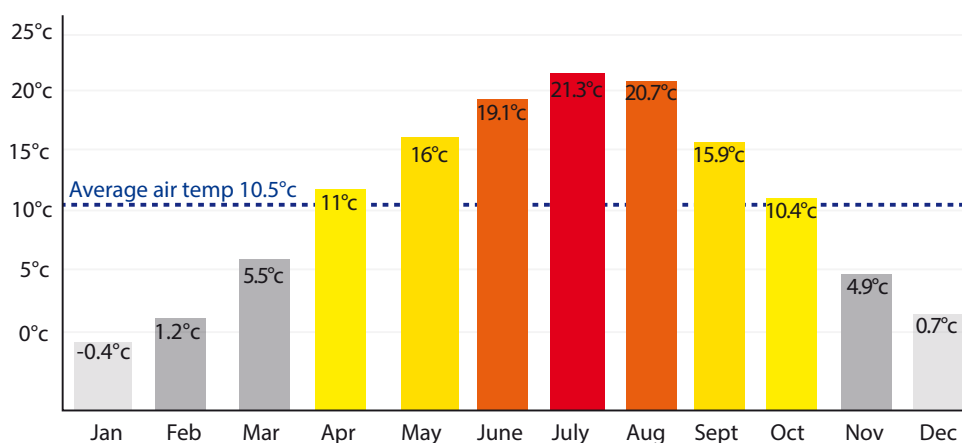
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Climatological settings

HDD/CDD data according to EUROSTAT method	
Heating degree days (HDD); [baseline reference values]; (period for data calculations)	3152 [15/18]
Cooling degree days (CDD); [baseline reference values]; (period for data calculations)	
Length of the heating season (days)	
Length of the cooling season (days)	

Source of data: Eurostat. <https://ec.europa.eu/eurostat/data/database>

Average monthly and annual air temperature



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⇒ Market situation

Number of SGE installations in pilot area	OLS V-CLS	300 (EST) Total Estimation on OLS and VCLS
Current growth rate	No. of Installations	5% p.a. (2017-2018) (EST)
Estimated share of open loop systems		>60% (EST), OLS are obliged to apply for permission/file the report to the Ministry of Environment for the pumping over 0,5 l/s
Estimated share of closed loop systems		< 40% (EST) (CLS are not accounted by government)
Estimated total share of shallow geothermal methods in the heating market	OLS V-CLS H-CLS	≤1 % (EST)
Other SGE technologies: Eg. Inter-seasonal heat storage schemes or energy piles	Unknown	
Estimated total share of RES in the heating energy market (%) (specify local or national values)		11,7% (2016) [10] Other information source 9,9 % (2016)

⚠ Economic boundary conditions

Estimated average installation costs for shallow geothermal systems (€/kW output) ¹	
Open loop systems	800 - 1500 €/kW
Closed loop systems	1500 – 2000 €/kW
Estimated average heating costs (€/kWh)	
Open loop systems	0.05 – 0,08 €/KWh (EST)
Closed loop systems	0.05 – 0,08 €/KWh (EST)
Drilling cost range per meter (€/m) for Open Loop	50 – 150 €/m + casing and backfill ca. 10 – 30 €/m
Drilling cost range per meter (€/m) for Borehole Closed Loop	50 – 150 €/m



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Regional geological and hydrogeological characteristics

From the geological point of view, the area is created by core mountains (with crystalline core and sedimentary envelope) Malé Karpaty Mts. Lowland belongs to the Vienna basin and the Danube basin with sedimentary fill of Neogene and Quaternary sediments. From the lithological point of view, the area has great variety in rock types and sediments that creates different condition for water recharge and ground water circulation, as well as geothermic conditions important for shallow geothermal heat pumps installation.

From hydrogeological point of view all kinds of aquifers according to the type of permeability are present. There are fissured crystalline hard rocks, karstified Mesozoic aquifers and porous aquifers of different stratigraphy and permeability value.

The Quaternary sediments have sufficient thickness and effective porosity and create background for water sources with high yield and good quality of the water. The Danube river deposits (gravels and sands – alluvium in the area between Devín and Bratislava) show thicknesses between 2 and 18 meter. The direction of groundwater flows, as well as of groundwater levels are connected to the Danube river and its deviation channel. The Petržalka area (right side of the Danube river) is characterized by a smaller thickness of fluvial gravels and sands (around 10 - 20 m) with good permeability. The fluvial sediments in Cunovo area have the highest mean values of the transmissivity coefficient in Slovakia, with values of hydraulic conductivity of up to 4. 10⁻² m.s⁻¹. The average thickness of groundwater body is 100 m and the mean permeability coefficient of 4. 10⁻³ m.s⁻¹ (Malik et al., 2000).

Summary of works and timeline

Main Objectives	
✓	Evaluation and characterization of geology/ hydrogeology / thermal conditions
✓	SGE assessment resources (for OCS and/or CLS) / and evaluation of UTES-BTES)
✓	Study of conflicts of use (OLS / GWL - OLS/CLS). Hazards/interferences, effects on sub-surface
	Strategies and actions for management and local energy plans
Relation of foreseen tasks	
✓	Data collection (TRT, DTRT, rock samples, GWL, T-profile's etc)
✓	New field works (TRT/geophysics /new samples and lab etc)
✓	Monitoring existing SGE/GWL/T etc)
	Mapping (in general terms)
✓	2D/3D Modelling (in general terms)

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Detailed summary of works at the Pilot Areas and brief timeline

The pilot case study is situated in the urban area of Bratislava, in the southwest of the Slovak Republic. The activities will focus on the monitoring of thermal, hydraulic and chemical regime of shallow aquifers. The results will be used to evaluate possible conflicts of use between drinking water supply and SGE use, installed systems and potential conflicts of use.

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<http://www.domy-kosice.sk/tepelne-cerpadlo>

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Managing Urban Shallow geothermal Energy
Project number GeoE.171.006

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