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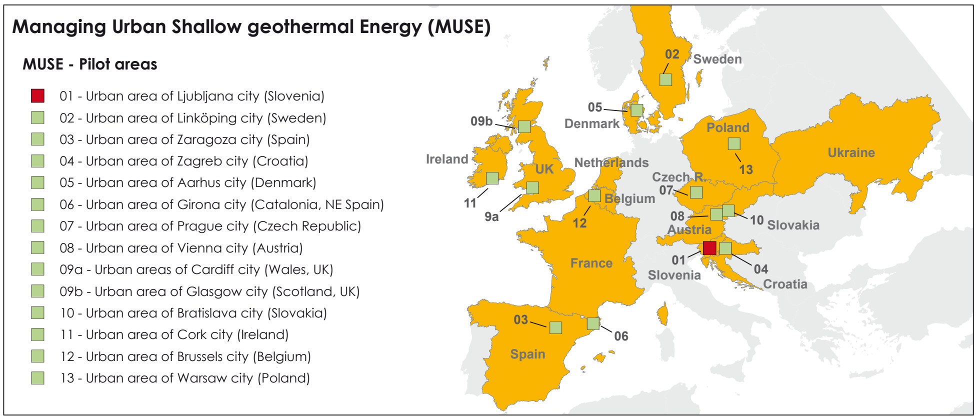
SI/WP4/D4.1/FS01/2018

MUSE

Pilot area information



Ljubljana pilot area is one of the most urbanised and developed areas in Slovenia. At the moment coal and biomass powered district heating system covers most of densely populated area and distributes heat to 74 % of all households. Natural gas is the complementary source of heating. The share of geothermal energy use for heating and cooling is very low. Rough estimate of total amount of installed capacity for geothermal heating is 2,554 kW, and for geothermal cooling 670 kW, respectively, while approximate produced energies from ground source heat pumps are 2.9955 GWh for heating and 0.3534 GWh for cooling, respectively.

The central flat landscape of the area (altitude 295 m a.s.l.) is composed of permeable gravel and sand beds with significant quantities of groundwater which is the main resource exploited for the public water supply of the city of Ljubljana. The basement of Quaternary aquifer consists of Carboniferous and Permian rocks of which hills and hilly hinterland are mainly composed.

Pilot Area	Ljubljana
Task (MUSE)	T-4.2
Country	Slovenia
Area (km²)	Pilot Area - 65 km² Municipality - 275 km²
Total number of inhabitants (date)	289 500 (2018) (Municipality)
Inhabitants per km²	1053 (Municipality)
Level of urbanization	Unknown
Elevation range (m a.s.l.)	265 -320m

Climatological settings

HDD/CDD data according to EUROSTAT method	
Heating degree days (HDD); [baseline reference values]; (period for data calculations)	2551 [15/18] (2017)
Cooling degree days (CDD); [baseline reference values]; (period for data calculations)	218 [21/24] (2017)
Length of the heating season (days)	218 (3 successive days at 9 p.m. T<12 oC, ARSO)
Length of the cooling season (days)	Unknown

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

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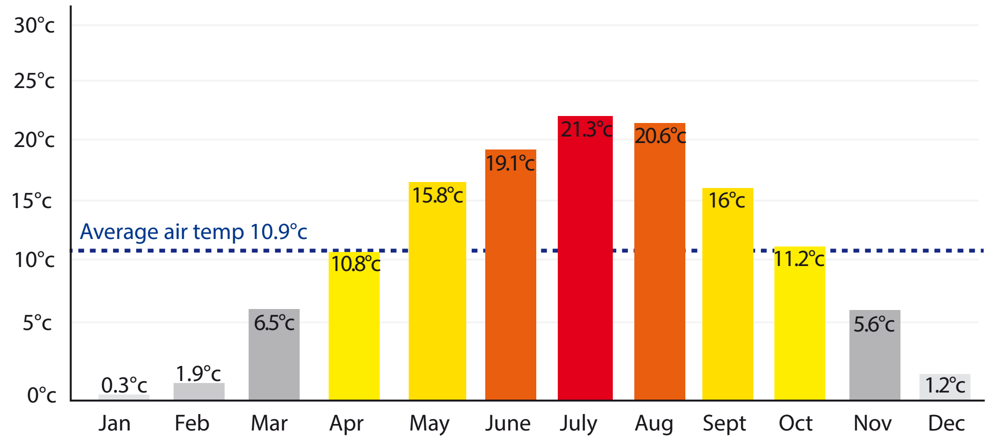
Average monthly and annual air temperature



Market situation

Number of SGE installations in pilot area	OLS V-CLS H-CLS	84 (EST) 50 (EST) 20 (EST)
Current growth rate	Heat production	9%
Estimated share of open loop systems		60%
Estimated share of closed loop systems		40%
Estimated total share of shallow geothermal methods in the heating market	Unknown	<1%
<u>Other SGE technologies</u>: 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)		6.6% (2017)

Economic boundary conditions

Estimated average installation costs for shallow geothermal systems (€/kW output) [1]	
Open loop systems	1000
Closed loop systems	1200
Estimated average heating costs (€/<u>kWh</u>)	
Open loop systems	0.036
Closed loop systems	0.039
Drilling cost range per meter (€/m) for Open Loop	187
Drilling cost range per meter (€/m) for Borehole Closed Loop	52

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Regional geological and hydrogeological characteristics

General Geology
Bedrock Age: Carboniferous and Permian
Bedrock lithology: schistose mudstone, quartz sandstone, and conglomerate
Quaternary: Pleistocene and Holocene fluvial sediments consist of coarse channel deposits (gravel and sand, 45%), silt and clay with gravel (36%), and fine sediments (silt and clay, 5%), the remaining material (14%) is composed of conglomerate—gravel cemented by calcium carbonate.
The Ljubljana Basin is located in the transition zone between three active fault systems 1) Dinaric Fault System on SW, consistent of NW-SE-striking dextral faults, 2) Periadriatic Fault System on N, consistent of E-W- to NW-SE-striking dextral faults and 3) belt of Sava Folds on E, consistent of E-W-striking reverse faults and folds.

Hydrogeology
Target aquifer: Quaternary fluvial deposits (highly permeable).
Groundwater flow is in general directed from the north western toward the eastern part of Ljubljansko polje alluvial plain. Groundwater flow velocity is high, estimated to be up to 20 m/day. Coefficient of hydraulic conductivity is in general in the order of magnitude of 10–2 to 10–3 m/s.
Depth to water table: increases with distance from the river, from a few meters (near the river on the lower terrace) up to 25 to 30 m.
Aquifer thickness: (0-100m)

Thermogeology
Groundwater temperature: (Ave, Min Max range) 12.5 oC, (9-14.5 oC)
Zone of Seasonal Fluctuations (typically upper 15-20m below surface)

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

March 2019 – March 2020 MUSE monitoring period.

Monitoring (March 2019 – October 2020)

Testing and implementing developed joint methods for assessing conflicts of use associated with SGE (September 2019 – September 2020)

Evaluation of existing regulation measures and application of the developed methods and management concepts for SGE (September 2019 – September 2020)

Analysis of potential hazards and interferences od SGE use and integration these aspects into strategies and actions for integrated groundwater management (March 2020 – March 2021)

Reference

Janža M. 2017. Management of the groundwater resource beneath the city of Ljubljana. Procedia Engineering 209: 100–103.

Janža M, Lapanje A, Šram D, Rajver D. 2017. Challenges of sustainable use of groundwater resources in an urban area (Ljubljana case study). In: Posavec K and Markovi T (eds) Groundwater Heritage and Sustainability: 44th Annual Congress of the IAH. Dubrovnik.

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Janža M. 2015. A decision support system for emergency response to groundwater resource pollution in an urban area (Ljubljana, Slovenia). Environmental Earth 61 Sciences 73: 3763–3774.

Jamnik B, Janža M, Prestor J. 2012. Project INCOME: developing a comprehensive approach for Slovenian aquifer management. Water21

Description of Ljubljana pilot area

https://www.interreg-central.eu/Content.Node/GeoPLASMA-CE/D.T3.1.1-report-partC-Ljubljana-fin.pdf

Contact

Managing Urban Shallow geothermal Energy
Project number GeoE.171.006

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