

Closing Conference of the Energy and Climate Change Programme

Mapping of shallow geothermal systems in Republic of Croatia – PLIGES, ref. no. 111

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Luka BOBAN

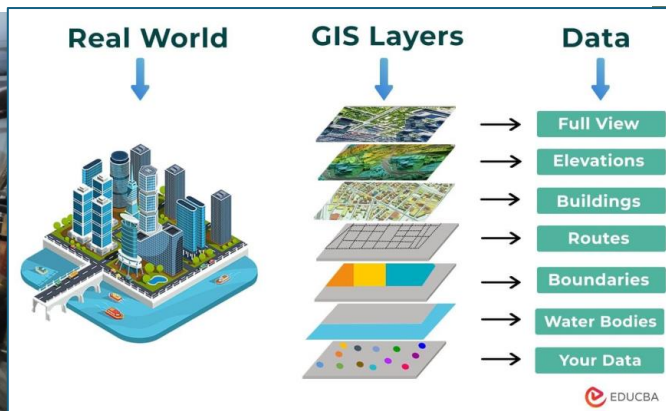


Rovinj, 12.- 13. XI. 2024.



Content

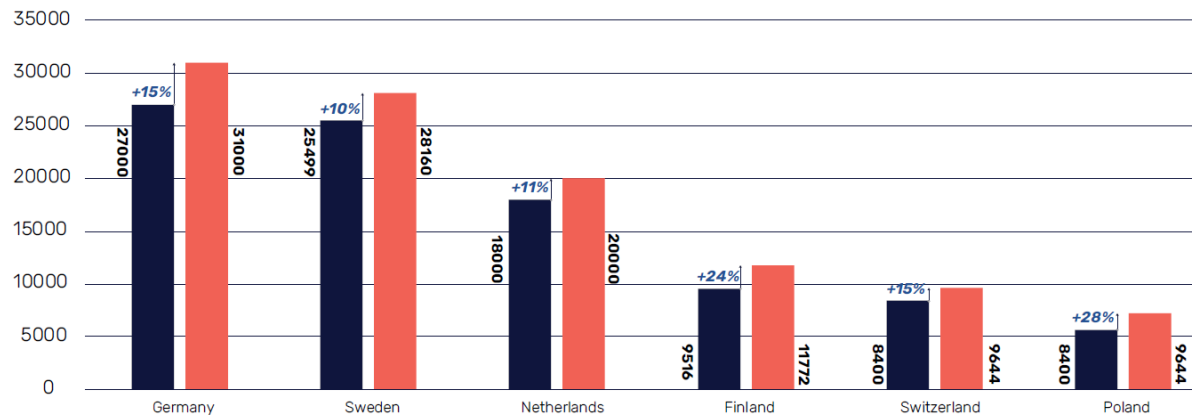
- Introduction: starting point
- Project basic information
- Activities
- Results



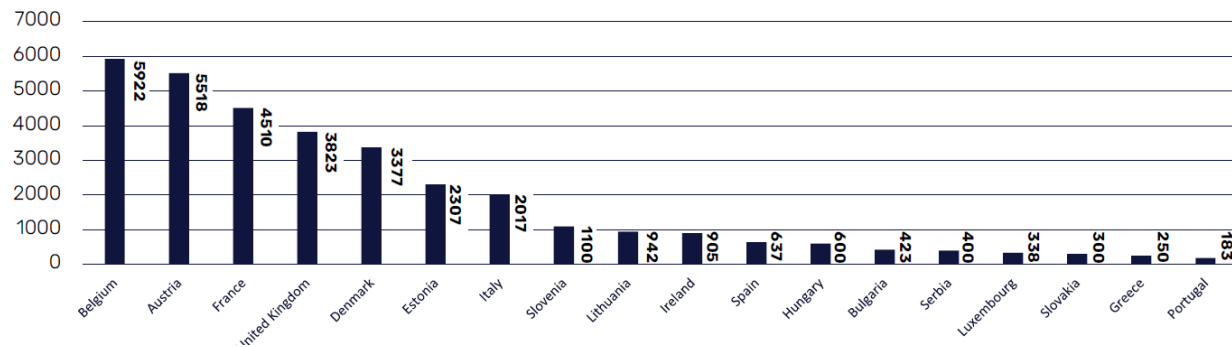
Introduction

Fig. 14 Sales of geothermal heat pumps in Europe (2021-2022) in selected countries highlighting growth rate

Largest European markets



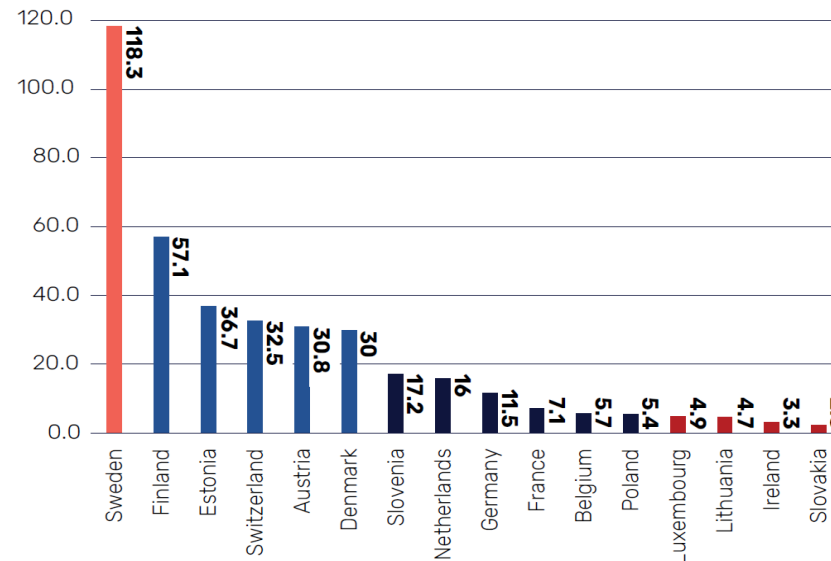
European markets in development



Shallow geothermal systems in Europe

- 141.300 new GSHPs in 2022
- 2,19 mil GSHPs total
- 78 TWh in 2022

Fig. 16 Number of geothermal heat pump systems per 1,000 households



Introduction

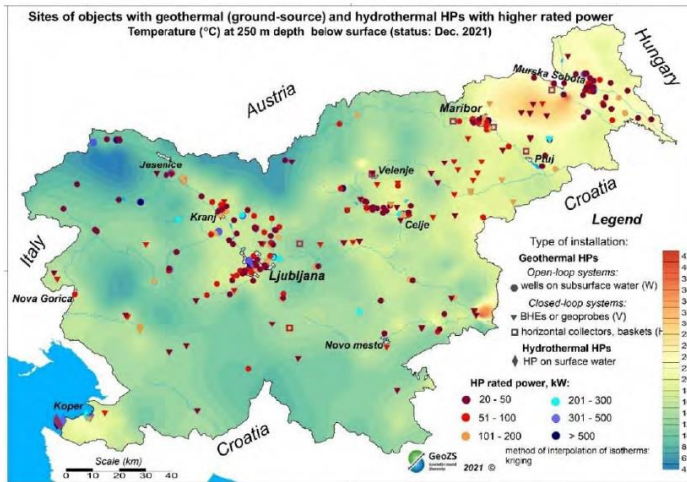
Starting point: non-existing systematic overview of installed systems

- lack of national system for monitoring or control of installed shallow geothermal systems
- total number of systems, installed capacity and produced energy are not known



Country role models

Slovenia



France



Figure 8: Geographical situation of the 22'447 borehole ground source heat pumps declared in April 2022.

Sweden

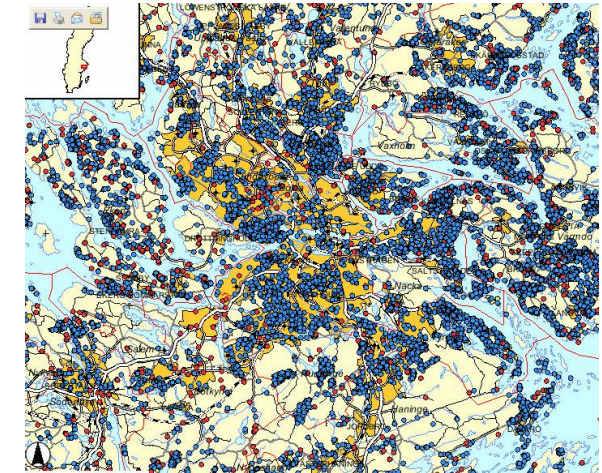


Figure 7: Distribution of 332 installations with collected detailed data on GSHP systems with rated power of at least 20 kW, by type of installation, and 7 known hydrothermal HP unit systems (data collected on a voluntary basis). The isotherms show temperature at 250 m depth.

Basic information

- **Programme:** Energy and Climate Change
- **Call:** Shallow geothermal energy database
- **Project duration:** 15 months (February 2023. until April 2024.)
- **Budget:** 197.950,75 EUR
- **Co-financing rate:** 100%
- **Lead Partner:** Faculty of Mechanical Engineering and Naval architecture, University of Zagreb
- **Partners:** Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb
TT inženjering d.o.o.
- **Web-site:** www.pliges.eu



REPUBLIKA HRVATSKA, MINISTARSTVO REGIONALNOGA RAZVOJA I FONDOVA EUROPSKE UNIJE, Zagreb, Miramarska cesta 22, OIB 69608914212, (u daljnjem tekstu: Upravitelj Programa) zastupano po ministrici Nataši Tramišak, mag. iur.

Fakultet strojarstva i brodogradnje, Sveučilišta u Zagrebu, 10000 Zagreb, Ivana Lučića 5, OIB: 22910368449, (u daljnjem tekstu: Nositelj projekta) zastupan po dekanu prof. dr. sc. Zdenku Tonkoviću

(zajedno dalje u tekstu: ugovorne strane)

sklapaju sljedeći

UGOVOR O DODJELI BESPOVRATNIH SREDSTAVA ZA PROJEKT

„Mapiranje plitkih geotermalnih sustava u Republici Hrvatskoj“
(u daljnjem tekstu: Ugovor)

/referentni broj 111/ (u daljnjem tekstu: Ref. br.)

koji se financira iz EGP financijskog mehanizma za razdoblje od 2014. do 2021. godine u okviru provedbe

PROGRAMA „ENERGIJA I KLIMATSKE PROMJENE“

Basic information

Project goal: Screening of existing shallow geothermal system in Croatia

- establishment of shallow geothermal energy database and framework for its continuous update
- estimation of energy produced by shallow geothermal systems
- development of interactive GIS tool for data overview and data visualisation
- increased capacity and knowledge on the use of renewable shallow geothermal energy in Croatia

Project contributes to Programme's :

Outcome 2: Increased renewable energy production

Output 2.2: Strengthened capacity to manage and promote renewable energy

How project contributes to set programs outcome and output?

- Publicly available database of installed systems
- Increased capacity for the use of shallow geothermal energy – workshops and publications
- Increased visibility of technology and data about it's use

Direct contribution to larger utilisation of available shallow geothermal potential in Croatia!

Project implementation

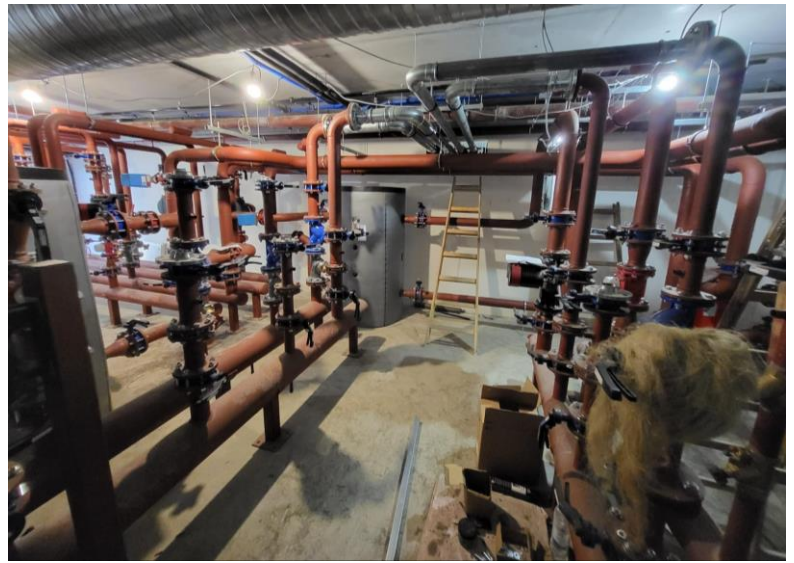
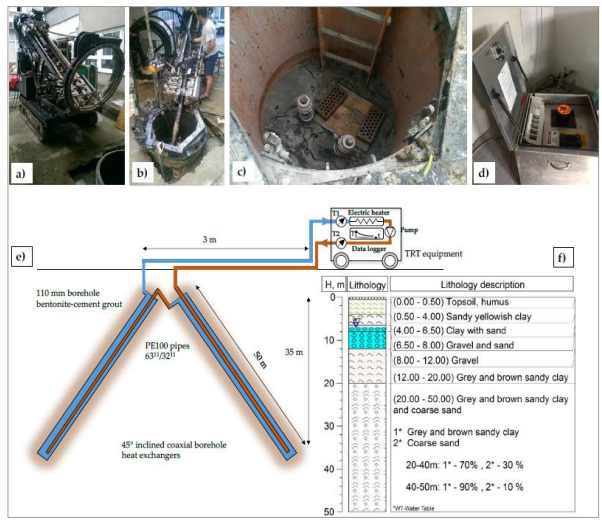
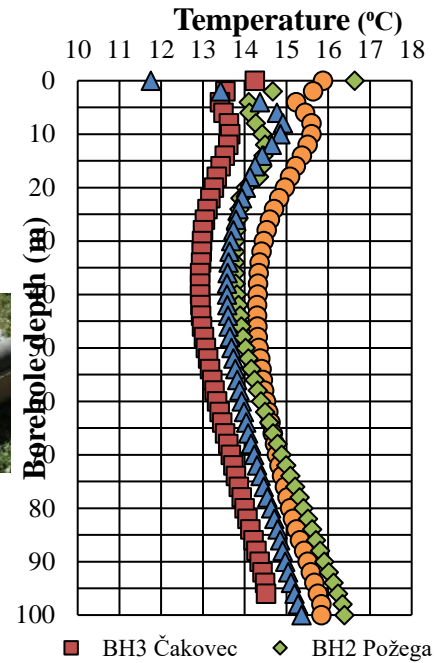
We started with competent consortium

- 2 faculties and one private design company
- partners share strong record in shallow geothermal systems design, research, consultancy and project development
- experts in geology (below ground) and heat pump systems (above ground)
- experience in national and internationally financed competitive calls (IPA, Interreg, Horizon projects etc.)

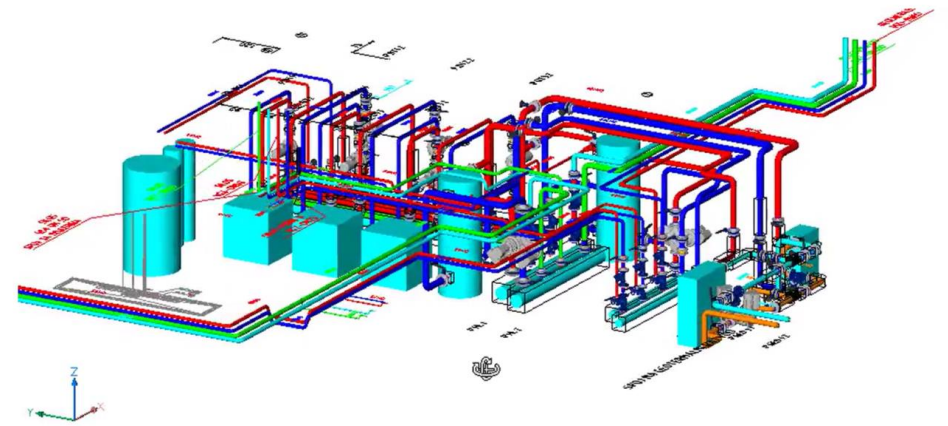


We started with competent consortium

Implemented projects



STROJARNICA



We developed questioner and engaged relevant stakeholders...

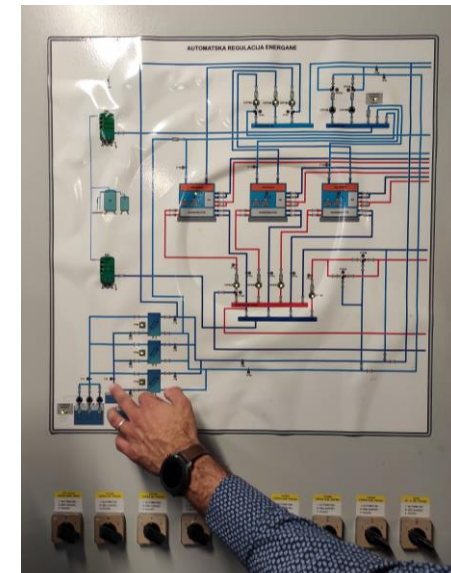
- system designers, installers, drilling companies, regional energy agencies, national legal entity for water management...
- data about HP, heating capacity, type of shallow system, year of operation, temperature regime, type of emitters, location, etc.

Informacije o dizalici topline (ako postoji)					
Neto <u>kondicionirana</u> površina zgrade (m2)					
Broj ugrađenih dizalica topline	Godina puštanja sustava u rad				
Način korištenja dizalice topline (moguće više odabira)	grijanje	hlađenje (aktivno)	Hlađenje (pasivno)	PTV	grijanje bazena
	Ostalo:				
Kataloški učinak dizalice topline*	Grijanje	kW	Hlađenje		kW
Radna tvar dizalice topline					
Temperaturni režim iz dizalice topline	<u>Polaz</u>	Povrat	Vrsta ogrjevnih tijela (moguće više odabira)		
Grijanje		°C	površinsko	radijatori	
Hlađenje		°C	<u>ventilokonvektori</u>	Ostalo:	
Način rada dizalice topline					
	<u>monovalentni</u>	bivalentno-paralelni		Dodatni toplinski izvor:	
		bivalentno-alternativni		Dodatni toplinski izvor:	
Godišnja proizvedena toplinska energija	kWh				
Godišnja privedena gde. energija za rad sustava dizalice topline	kWh				
Godišnji zahvat podzemne/površinske vode (odnosi se na sustave voda-voda)	m3				
Godišnji broj radnih sati sustava	h				

* Prema EN 14511

Opće informacije					
Naziv lokacije		Informacije o lokaciji			
Zemljopisne koordinate (HTRS96)		Vrsta vlasništva	A) privatno B) javno		
Namjena zgrade (opisati)					
Stambena:					
Nadmorska visina		m	Komerrijalna:		
Industrija:					
Ime i prezime		Ostale informacije (energetski razred, godina izgradnje, godina energetske obnove)			
Broj telefona/mobitela					
Adresa					
Grad					
Informacije o plitkom geotermalnom izvoru					
Vrsta izvora topline povezanog s tlom		A) otvoreni	B) zatvoreni	(odabrati)	
A) Otvoreni sustav					
Tip zahvata vode		A) podzemne	B) površinske	(odabrati)	
Vrsta površinske vode		A) jezero	B) rijeka	C) more	(odabrati)
B) Zatvoreni sustav					
Tip izmjenjivača u tlu		A) vertikalni	B) horizontalni	C) <u>košarasti</u>	(odabrati)
Status bušotine		A) aktivna	B) neaktivna	Godina izgradnje	
Temperaturni profil bušotine (ako postoji) / Izmjerena temperatura tla ili podzemne vode					
<u>Litoški</u> profil (ako postoji) / geološki opis lokacije					
Način korištenja izvora					
Podzemna voda		crpni	ponorni	Površinska voda	
Broj zdenaca (bunara)				Dubina zahvata	m
Temperatura vode (godišnja <u>maks./min./prosječna</u>)				Udaljenost zahvata od obale	m
Dubina zdenaca				<u>Međuzmjenjivač</u>	(DA/NE)
Promjer zdenca				mm	Ostalo:
Dubina vode (visina podzemne vode)				m	Godišnji zahvat podzemne/površinske vode (m3)
<u>Međuzmjenjivač</u>		DA/NE	Izdašnost prema projektu (l/s)		
Vertikalni izmjenjivač					
Broj bušotina		Dubina 1 bušotine		m	
Tip izmjenjivača		Toplinski tok po bušotini (prema TRT-u)		W/m	
Specifikacija ugrađene cijevi					
Rezultati TRT-a		λ W/(m K)	R_b mK/W	T_{wb} °C	
Horizontalni izmjenjivač/košarasti					
Površina tla za ugradnju izmjenjivača, m2		Dubina iskopa za polaganje izmjenjivača, m			
Ukupna duljina ugrađenih cijevi u tlo					
m					
Specifikacija ugrađene cijevi					
Radni medij unutar izmjenjivača		Etilen glikol + voda		Udio sredstva za snižavanje temperature zamrzavanja	
		Propilen glikol + voda			
		Etanol			
		Voda			
		Ostalo			

We conducted site visits across Croatia



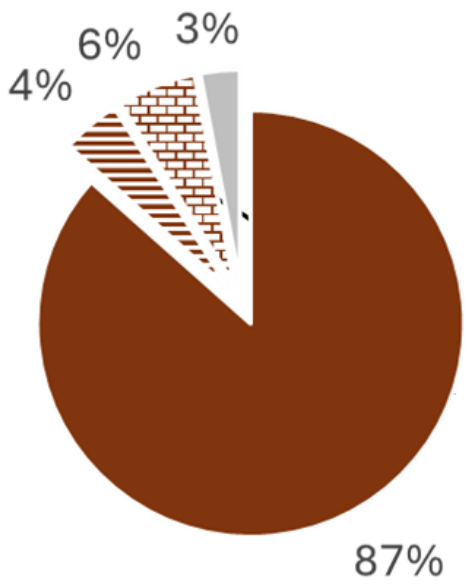
Different types of Ground Source Heat Pumps - GSHPs

Results of survey

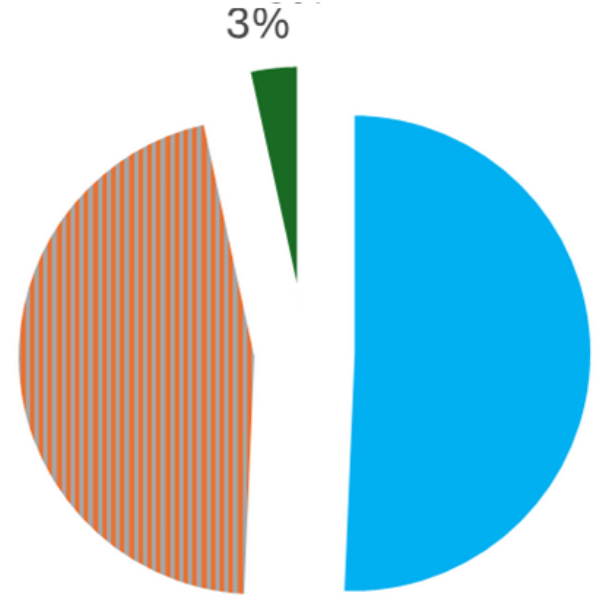
Closed loop - type of GHE

TYPE OF HEAT SOURCE

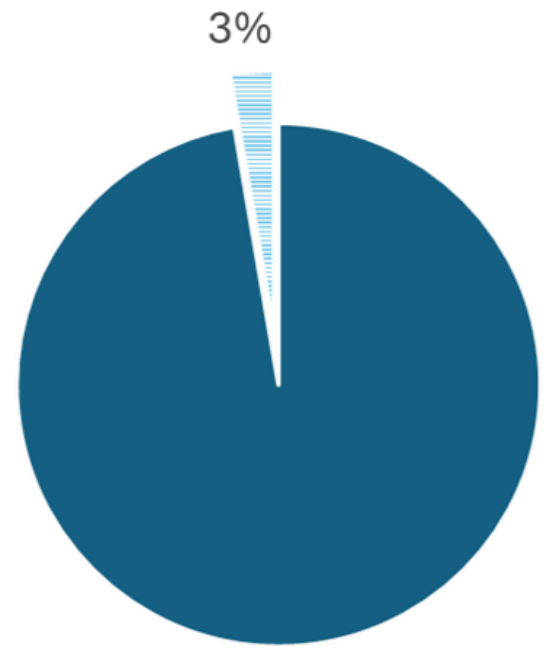
Open source - water intake



46%



51%



- vertical
- ▤ horizontal
- ▤ basket
- N/A

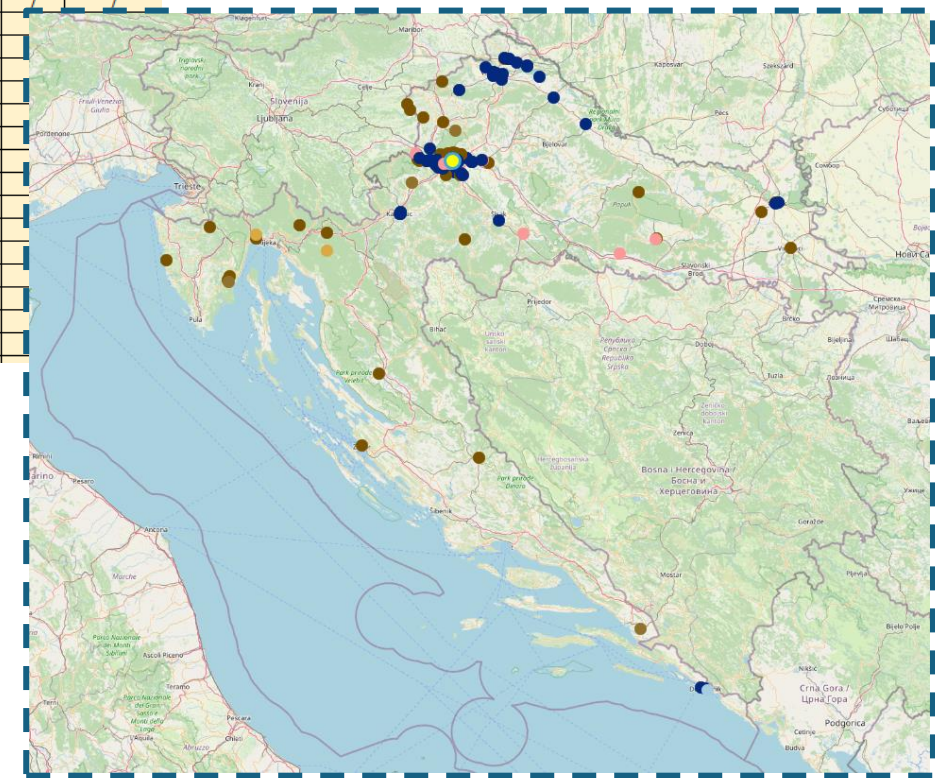
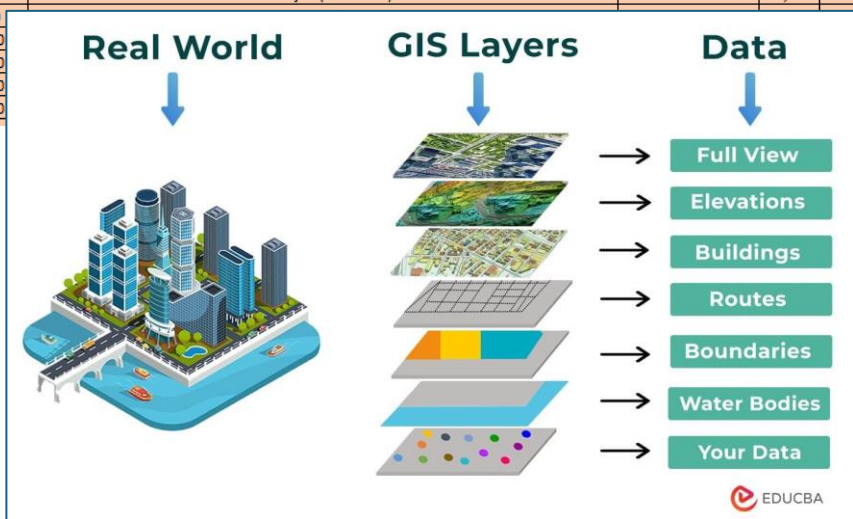
- Closed
- Open
- N/A

- under-ground
- ▤ surface

We consolidated database for GIS application representation

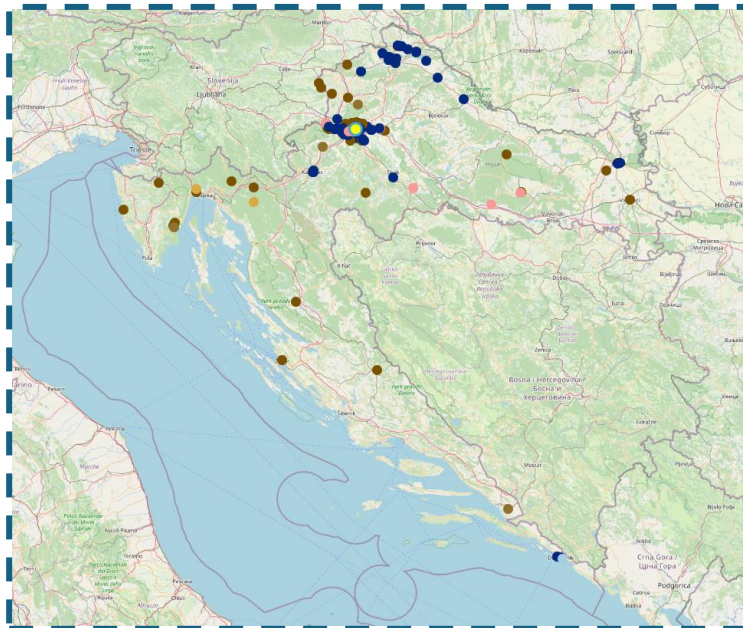
- *GIS - Geographic information system*

Ostalo	Godišnji zahvat podzemne/površinske vode [m3]	Broj bušotina	Dubina 1 bušotine [m]	Tip izmjenjivača/specifikacija ugrađene cijevi	Toplini tok po bušotini (prema TRT-u)				Površina tla za izmjenjivač [m2]	Dubina iskopa za polaganje [m]	Vrsta/promjer cijevi	Ukupna duljina cijevi u tlu	
					lambda [W/m]	otpor [mK/W]	T_tla [°C]	Toplini tok [W/m]				Toplini tok [W/m]	
/	/	1	130	2-U cijev (PE32 mm)	53,33	1,78	0,08	14,19	/	/	/	/	/
/	/	1	100	2-U cijev (PE32 mm)	65	2,35	0,123	13,66	/	/	/	/	/
/	/	1	100	2-U cijev (PE32 mm)	77,15	2,95	0,055	10,73	/	/	/	/	/
/	/	1	100	2-U cijev (PE32 mm)	80,63	1,92	0,105	14,85	/	/	/	/	/
/	/	1	100	2-U cijev (PE32 mm)	74,24	1,6	0,124	14,82	/	/	/	/	/
/	/	1	100	2-U cijev (PE32 mm)	70,811	3,19	0,112	14,97	/	/	/	/	/
/	/	1	100	2-U cijev (PE32 mm)	35,8	2,23	0,13	12,15	/	/	/	/	/
/	/	1	100	2-U cijev (PE32 mm)	63,92	2,11	0,154	16,29	/	/	/	/	/
/	/	3	110	DN32 PE100 RC SDR11	57,6	2,07			/	/	/	/	/
/	/	3	135	1U TC45 PE100 RC SDR11	47,9				/	/	/	/	/
/	/	3	110	2U DN32 PE100 RC SDR11/2U DN32turbo PE100 RC SDR11/1U TC45 PE100 RC SDR11	53,8	1,77			/	/	/	/	/
/	/	53	120	1U TC45 PE100 RC SDR11	61,4				/	/	/	/	/
/	/	4	100	2U D32 SDR11					/	/	/	/	/
/	/	18	100	2-U cijev (PE32 mm)		1,54		13,6	/	/	/	/	/
/	/	30	50					14,1	/	/	/	/	/
/	/	50	100						/	/	/	/	/
/	/	4	100						/	/	/	/	/
/	/	5	100						/	/	/	/	/
/	/	8	100						/	/	/	/	/



GIS interactive application

- Each location described with set of data
- download option in PNG format
- aggregation of data based on location, system type or custom criteria
- open for public



Information about selected objects

Info Vrsta	Zahvat vode	Dozvola za korištenje	Broj crpnih zdenaca [-]	Dubina crpnih zdenaca [m]	Broj upojnih zdenaca [-]	Dubina upojnih zdenaca [m]	Izdašnost prema odobrenom projektu [l/s]	Tip
Vrsta: HERMES								
Zahvat: INTERNATIONAL	podzemne DA		2	15	1	4	20	podzemni
Tip i Status: Elektrostrojarska škola - Varaždin	podzemne DA		1	15	1	12	5.4	podzemni
Tem: Druga Gimnazija - Varaždin	podzemne DA		1	12	1	12	15	podzemni
Dozv: Srednja strukovna škola - Varaždin	podzemne DA		1	15	1	15	13.5	podzemni
Tem: Strojararska škola - Dubi	podzemne DA		1	15	1	12	7.8	podzemni
Broj: Opća bolnica - Dubi	podzemne DA		3	15	3	15	68	podzemni
Izda: Centar za rehabilitaciju - Dubi	podzemne DA		1	12	1	12	7.5	podzemni
Udal: /								
Broj: /								
Dubina: /								
Ukupna dubina BIT-a [m]: 600								
Tip izmjenjivača/specifikacija ugrađene cijevi: 2-U cijev (PE32 mm)								
Toplinska provodnost [W/(mK)]: /								
Toplinski otpor [mK/W]: /								



Strengthening capacity to manage shallow geothermal

- 2 project workshops (Osijek and Zagreb)
- 1 roundtable (Labin)
- available workshop materials on project web site



Dissemination of results

- International scientific conference SDEWES 2023, Dubrovnik
- 4th Heat pump thematic congress 2023, Zagreb
- national conference *Energija iz dubina*, 2023, Zagreb
- national technical journal EGE 5/2023



Project results

- number of identified systems in database:
 - 157
- estimated production in MWh/year from geothermal energy:
 - 68.212 MWh
- estimated annual CO2 emissions reduction:
 - 11.731 tonnes
- web based GIS application set up
- prepared and published:
 - Guidelines for application of geothermal heat pumps
- 3 workshops/round tables
- 4 project presentations in journals, conferences and roundtables



Outlook beyond project...

- increased visibility of technology
- increased competences of involved stakeholders
- improved knowledge of project team members on shallow geothermal energy utilisation in Croatia
- new tools strengthen the position of technology on the heating market contributing to wider use of renewable energy-based heating system





HVALA NA PAŽNJI!

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web: www.pliges.eu



ttinzenjering d.o.o.
za projektiranje i građenje