Institut “Jožef Stefan”
Center za energetsko učinkovitost

SEKCIJA 1A - Soproizvodnja, obnovljivi viri, energija iz odpadkov, akumulacija energije

Gašper STEGNAR
Stane MERŠE
Damir STANIČIĆ

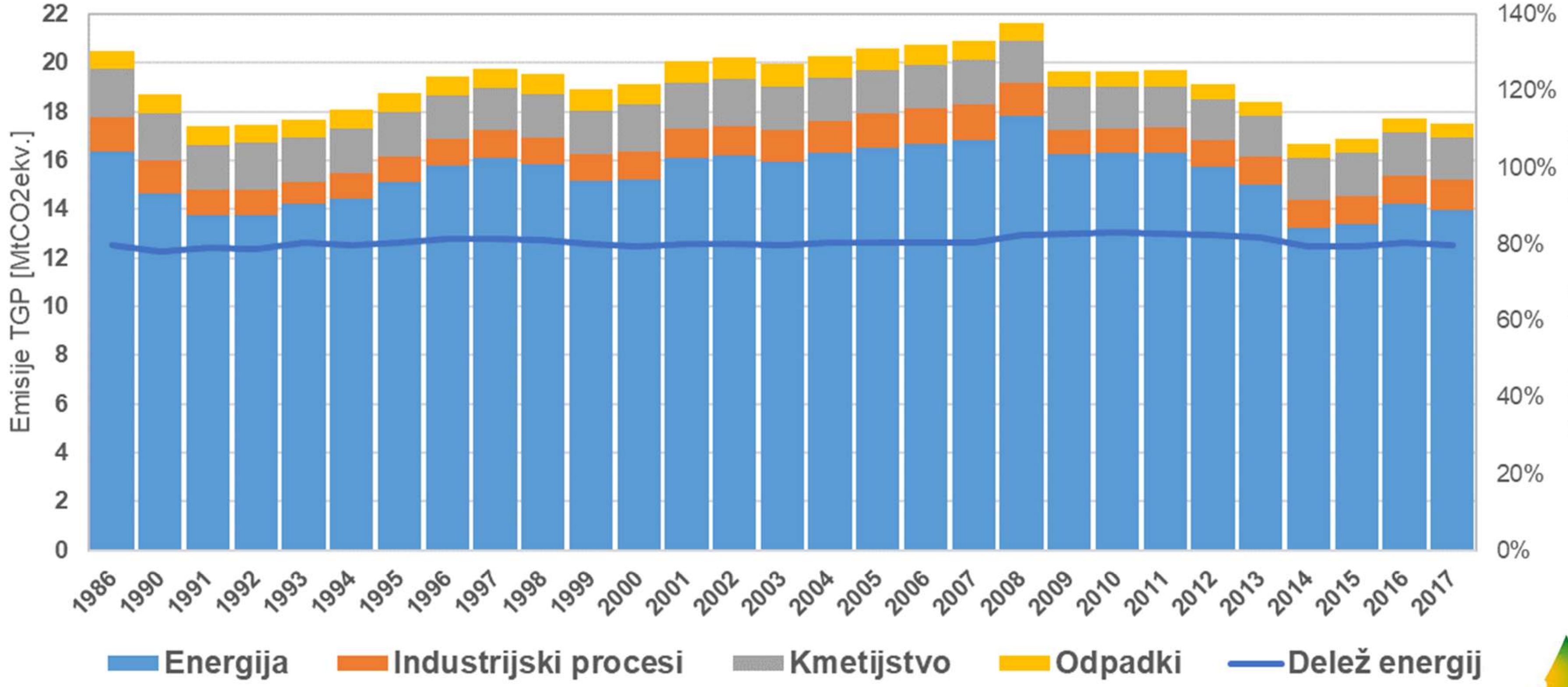
LIFE CLIMATE PATH 2050

RABA PLITVE GEOTERMALNE ENERGIJE V NOVIH SISTEMIH DALJINSKEGA OGREVANJA V SLOVENIJI

SZE 2019
Trajnostna in čista oskrba z energijo za ogrevanje in hlajenje

Portorož, Slovenija
1.4.2019

Emisije TGP 1986 - 2017



Vir: IJS-CEU

1986: 20,5 $MtCO_{2ekv.}$ (bazno leto Kjoto) **Cilj EU 2030: -40 $\%_{1990}$**

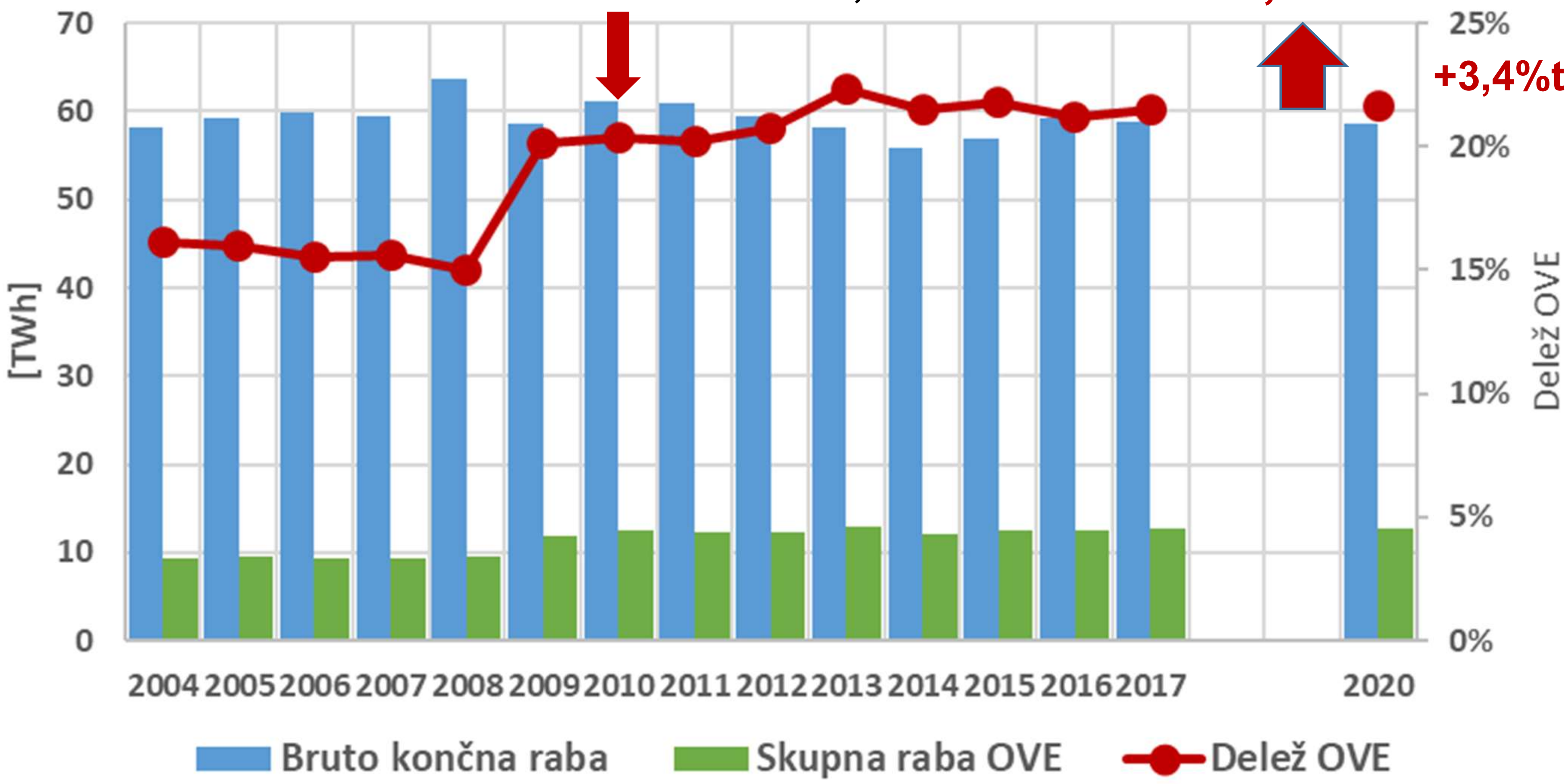
2005: 20,6 $MtCO_{2ekv.}$

2017: 17,5 $MtCO_{2ekv.}$ $-15\%_{2005}$ (do 2030: neETS: $-15\%_{2005}$, ETS $-43\%_{2005}$)

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

Bruto končna raba in delež OVE

Delež OVE 2010: 20,4% - do 2017 le +1,2%t



Vir: IJS-CEU

Projekcija 2020:

Bruto končna raba: 58,6 TWh

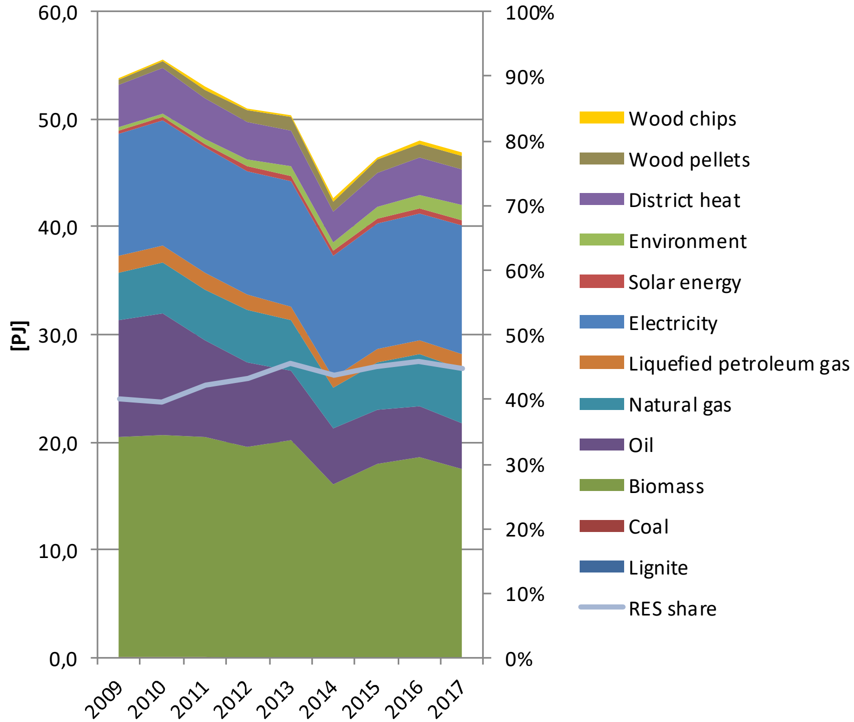
OVE: 12,7 TWh 21,6% - Cilj 25% = 14,7TWh

1% ~ 600 GWh_{OVE}

+ 2TWh +3,4%t

Energetska bilanca gospodinjstev

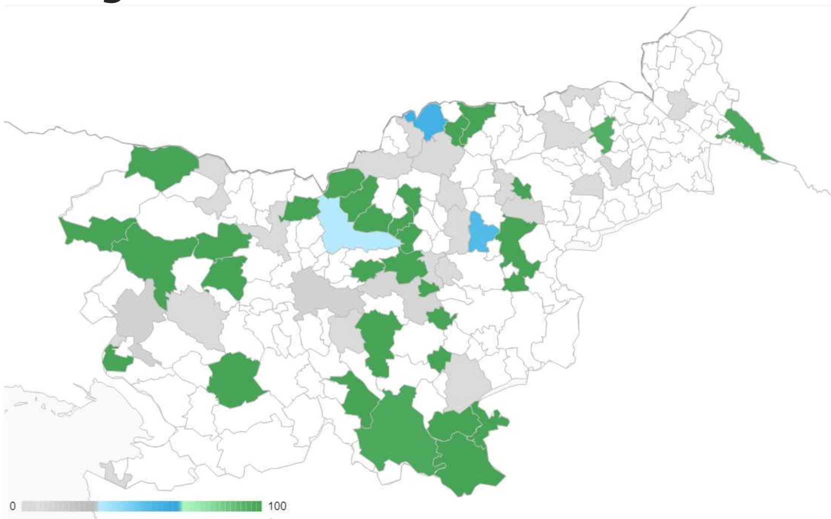
- Stanovanjski sektor predstavlja 23% celotne končne rabe energije.
- Zmanjšanje rabe za 20,9% v primerjavi z letom 2009.
- 45% delež OVE v letu 2017.
- Med energenti prevladuje lesna biomasa.
- V zadnjem desetletju opazna rast solarne energije in toplotnih črpalk.



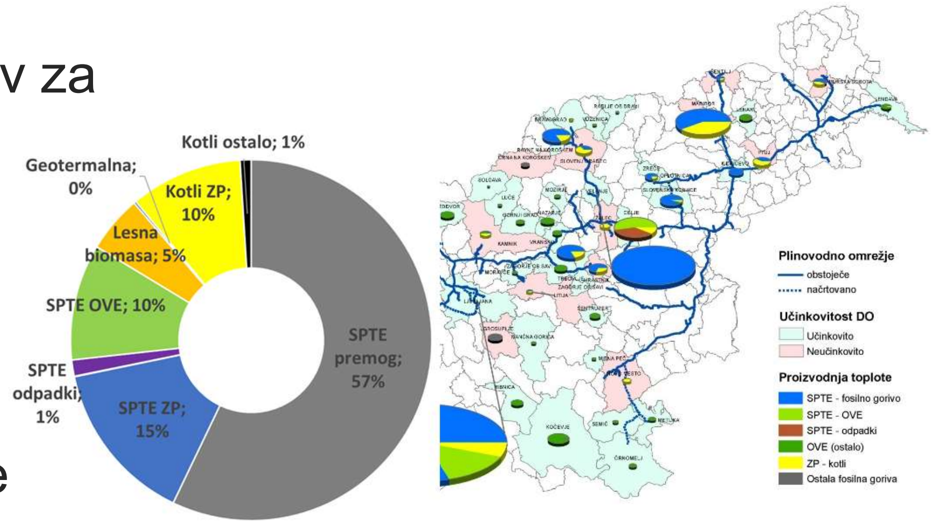
Vir: IJS-CEU

Daljinski sistemi v Sloveniji

- V Sloveniji imamo (vsaj) **96 sistemov DO**, od tega 27 na lesno biomaso.
- Razvoj sistemov zaznamujeta dva vidika: (1) izboljšuje se učinkovitost sistemov in (2) povečuje se raznolikost virov za proizvodnjo toplote.
- Z uvajanjem 4 generacije sistemov se bo dodatno zagotavila stroškovna učinkovitost dekarbonizacije



Delež OVE v sistemih DO (vir: *semafor.podnebnapot2050.si*)



Struktura proizvodnje toplote (vir: IJS-CEU)

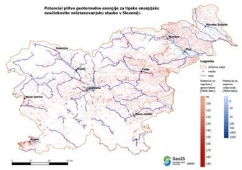
Razvoj modela izrabe plitve geotermalne energije v Sloveniji

LIFE CLIMATE PATH 2050

GeoZS Geološki zavod Slovenije

Analize potenciala plitve geotermalne energije v Sloveniji do leta 2050, za projekt LIFE ClimatePath2050 (LIFE 16 GIC/SI/000043)

Končno poročilo



Ljubljana, julij 2018

(2017-2018)

4DH Smart Energy Systems and 4th Generation District Heating

Pathway for shallow geothermal energy potential in district heating systems development in Slovenia

G. Stegnar[1,*], M. Česen[1], J. Čižman[1], A. Urbančič[1], S. Merše[1], S. Pestotnik[2], J. Prestor[2], D. Staničić[1]

[1] Jožef Stefan Institute – Energy Efficiency Centre, Jamova cesta 39, 1000 Ljubljana, Slovenia

[2] Geological Survey of Slovenia, Dimičeva 14, 1000 Ljubljana, Slovenia

*Corresponding and presenting author.
E-mail address: gasper.stegnar@ijs.si, phone number: 00386 1 588 53 00 (Gašper Stegnar)

Key words: district heating, heat pump, geothermal energy, spatial constraints, GIS

Abstract

Slovenia is setting energy and climate policy paving the way to low carbon society based on renewable energy by 2050. That transition should include, beside extensive heat savings and traditional use of biomass for heating, the large-scale implementation of district heating in urban areas and electrification of the heating sector, primarily using heat pumps in rural areas and introducing the smart energy systems approach based on a cross-sectoral use of all grids. In this analysis, the potential for district heating and use of geothermal energy for heating in Slovenia is identified, based on geographical information system (GIS) mapping of the heat demand and shallow geothermal energy potential.

Highly efficient district heating systems have a significant potential for primary energy savings and reduction of greenhouse gas emissions through the utilization of waste heat and renewable energy sources, including intermittent ones. These potentials are still highly underutilized in Slovenia. In order to ensure the optimal level of district heating penetration in the heating sector, a comprehensive analysis was performed to determine the actual and future heat demand, considering implemented and foreseen energy savings measures. Based on heat demand, the technical and economically feasible district heating potential was determined using the GIS heat map. A geothermal energy potential assessment methodology was developed and results incorporated in the heat map, providing necessary data for future analysis and planning, either centralised or decentralised smart heating systems.

Head demand mapping is based on a bottom-up model of the building stock in order to ensure sufficiently accurate and comprehensive analysis of energy balance of the residential and non-residential building stock. Since the heat demand models are physics-based, the number of inputs required to estimate the energy consumption of each building is large. The model integrates four publicly available databases, by which it is possible to determine the current state of the thermal envelope and technical systems. The approach used builds on the GIS-based data of energy demand for heating and domestic hot water.

Large scale assessment of shallow geothermal economic potential (SGP) for heating in Slovenia was performed. It takes into account water-water systems in alluvial aquifers and borehole heat exchangers (BHE) in other geological layers. The main criteria for BHE potential analysis were: ground temperature, thermal conductivity, heat flux and heat capacity. The criteria of one half of the BHE depth as a minimum distance between different neighbouring BHE installations was introduced in order to eliminate thermal influence on each other. Furthermore, depending on the presence of special geological conditions or protected areas, areas of narrowest and narrower water protection areas and protected artesian aquifer were excluded from the analysis. Spatial distribution of SGP along with economic viability for six different building types and usage profiles was identified for Slovenia on 100x100 m grid using GIS.

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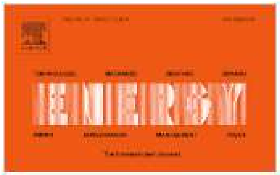

A framework for estimation of technical and economic potential of shallow geothermal energy in individual and district heating systems: A case study of Slovenia

Gašper Stegnar[1,*], D. Staničić[1], M. Česen[1], J. Čižman[1], S. Pestotnik[2], J. Prestor[2], A. Urbančič[1], S. Merše[1]

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[2] Geological Survey of Slovenia, Dimičeva 14, 1000 Ljubljana, Slovenia

*Corresponding author. E-mail address: gasper.stegnar@ijs.si, phone number: 00386 1 588 53 00

Abstract

The deployment of geothermal energy systems can contribute significantly to climate change mitigation and play part in transition to low carbon society based on renewable energy by 2050. This study proposes a framework to identify shallow geothermal energy potential for new individual and district heating (DH) systems in order to satisfy heating demands. A model accounts for thermal interference between neighbouring wells and Borehole Heat Exchangers, where the main criteria for analysis are ground temperature, thermal conductivity, heat flux and heat capacity. The paper presents cost-effective area method for the identification of new DH network areas, while considering the competitiveness of the energy price. Economic potential is determined based on the cost effectiveness of the competitive technologies, separately for urban and rural areas.

A framework for estimation of technical and economic potential of shallow geothermal energy in individual and district heating systems: A case study of Slovenia

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Metodologija

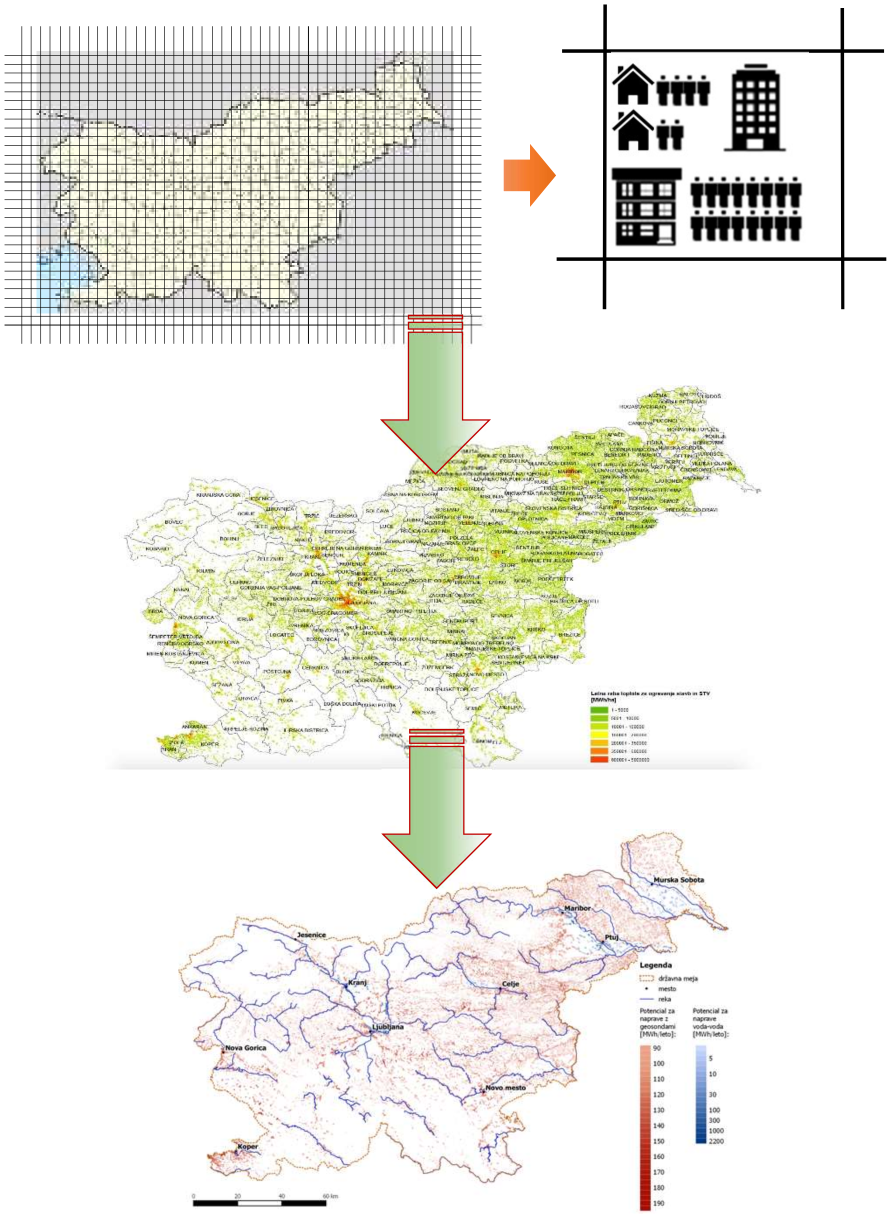
POTREBE PO OSKRBI S TOPLOTO

OBSTOJEČI DO SISTEMI

MODELIRANJE PLITVE GEOTERMALNE ENERGIJE

RAZVOJ MODELA ZA IDENTIFIKACIJO NOVIH DO SISTEMOV

ANALIZA TEHNIČNEGA IN EKONOMSKEGA GE POTENCIALA



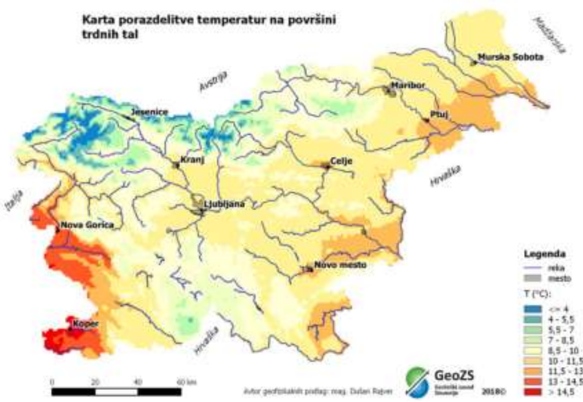
Upoštevani vidiki

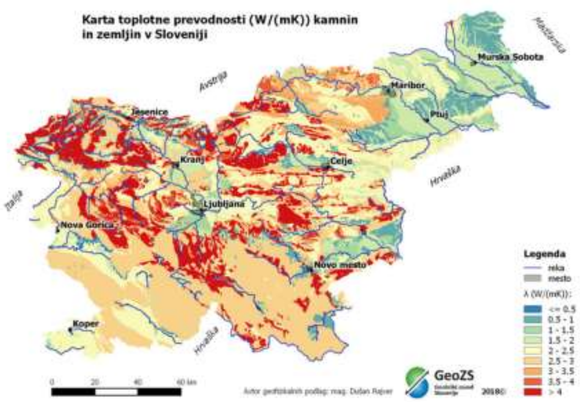
TOPLOTA: Izračun potrebne toplote za ogrevanje in pripravo tole vode na podlagi dejanskega stanja stavb iz javno dostopnih baz podatkov.

TLA: - ovire: območja izključitev in območja opozoril

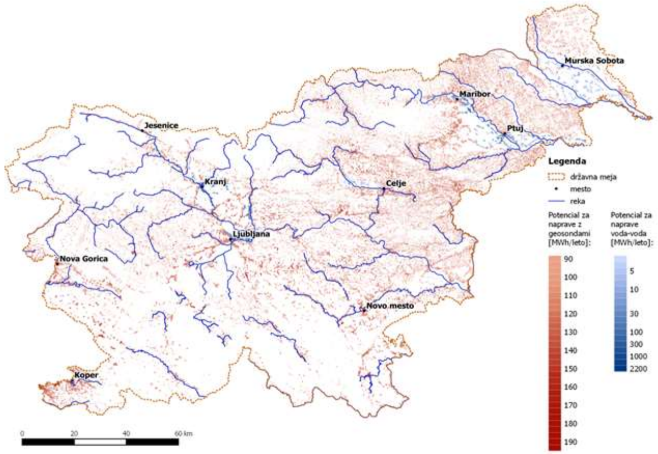
- dejavniki: površinska temperatura tal, temp. prevodnost zemljin in kamnin, gostota geoloških plasti, prostorninska toplotna zmogljivost

EKONOMSKA ANALIZA: analiza vseživljenjskih stroškov (LCC)





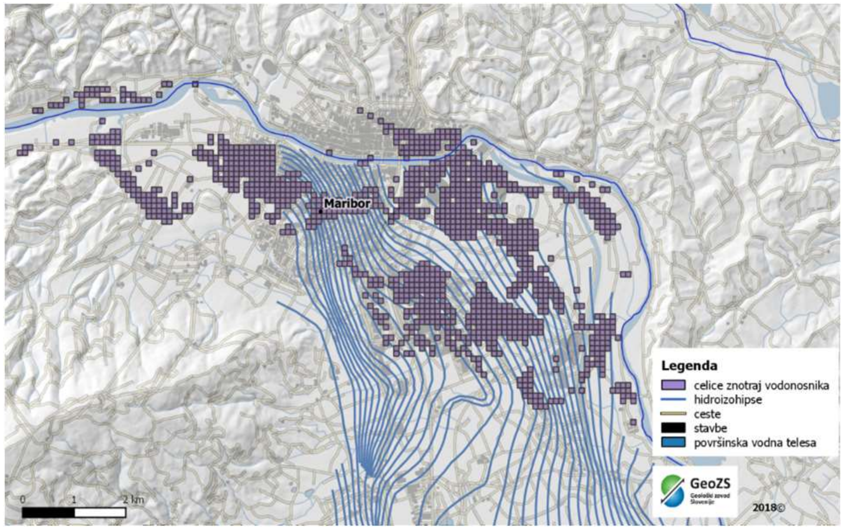
Rezultati na nacionalni in lokalni ravni

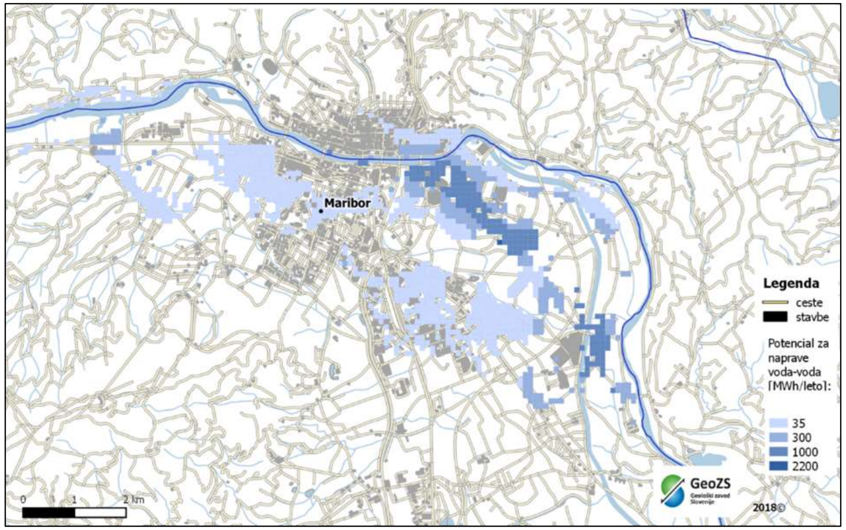


Levo zgoraj: **tehnični potencial GE v Sloveniji**

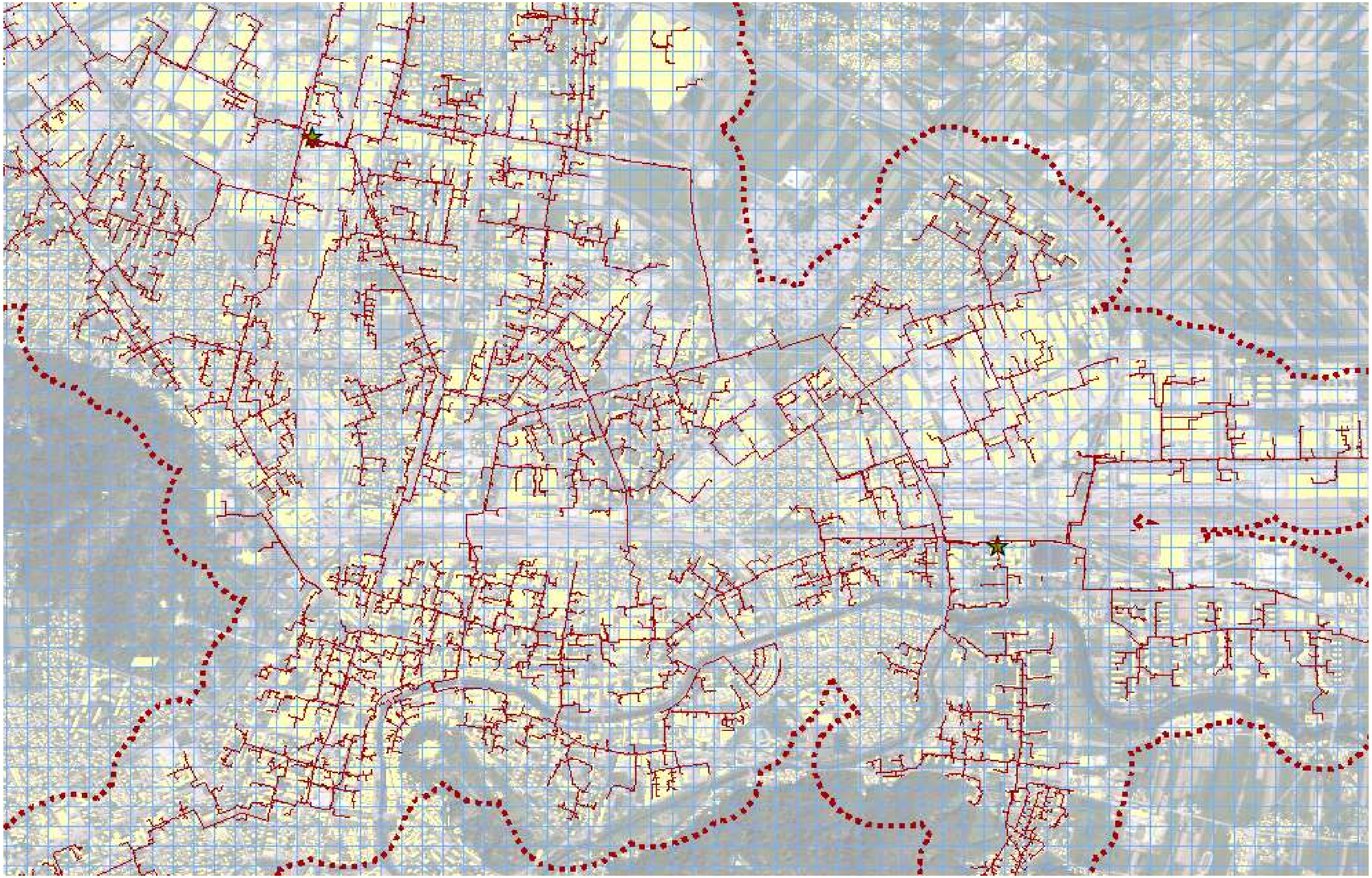
Levo spodaj: **območja vodonosnika v Mestni občini Maribor (MOM)**

Desno spodaj: **tehnični potencial za izrabo vodonosnika v MOM**





Novi centralizirani sistemi (DO) - METODE



Novi centralizirani sistemi - REZULTATI

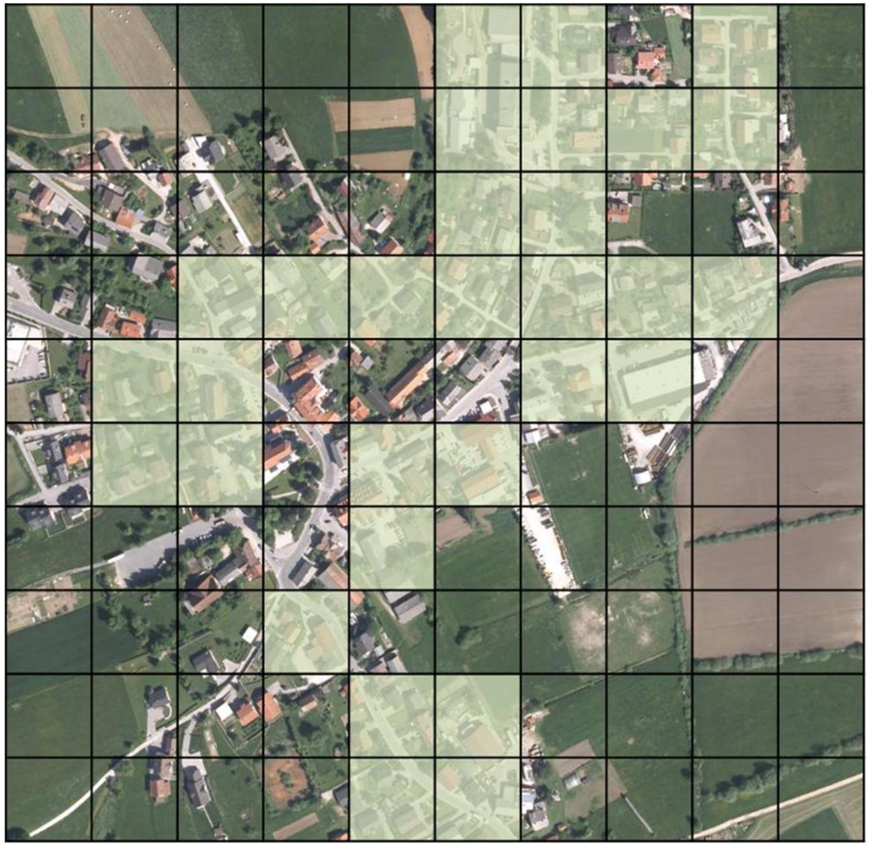
Potencial:

za nova DO:

1,67 TWh/a v 757 sistemih

mikro DH:

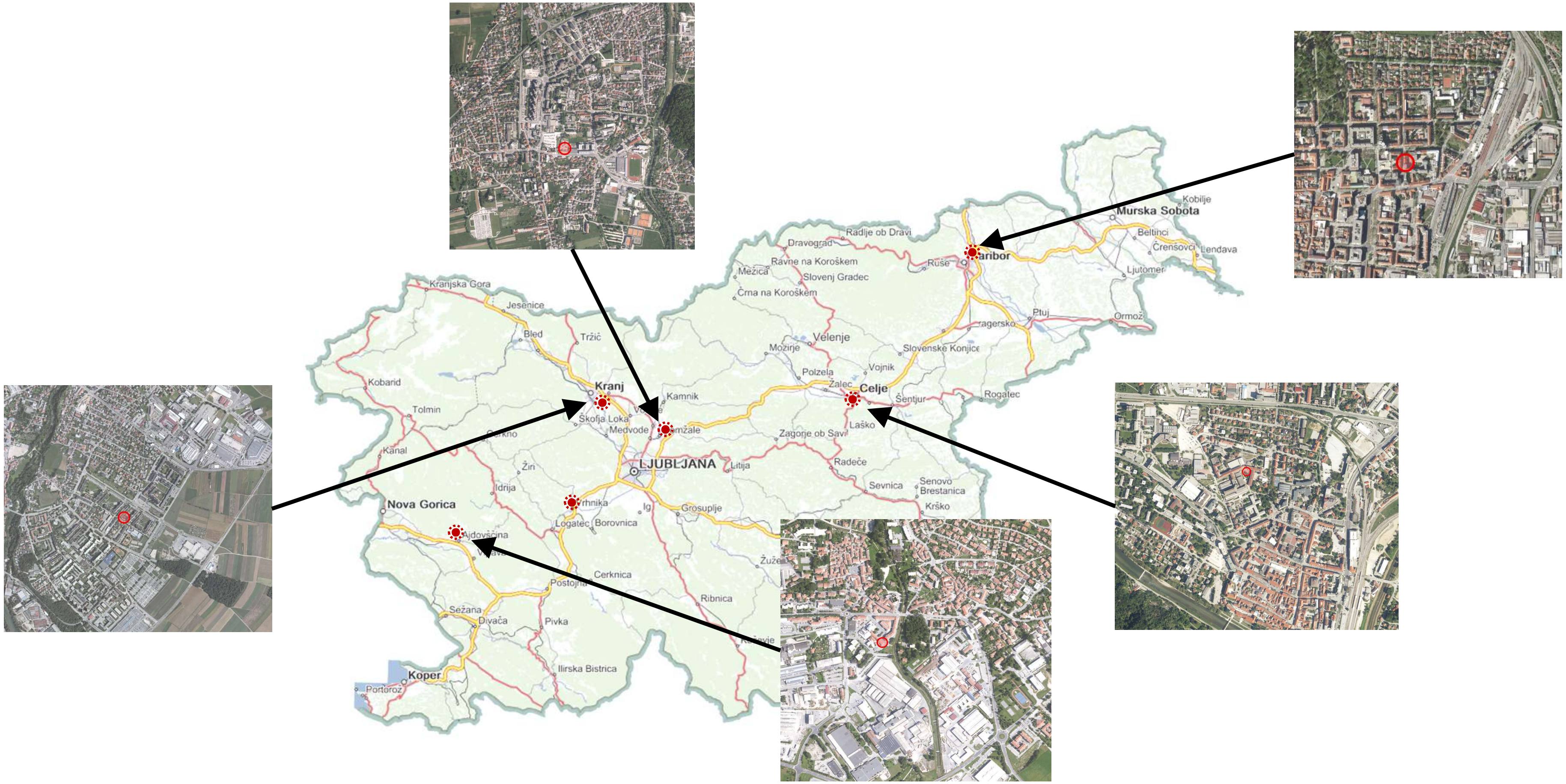
0,94 TWh/a v 1640 sistemih



Primerjava

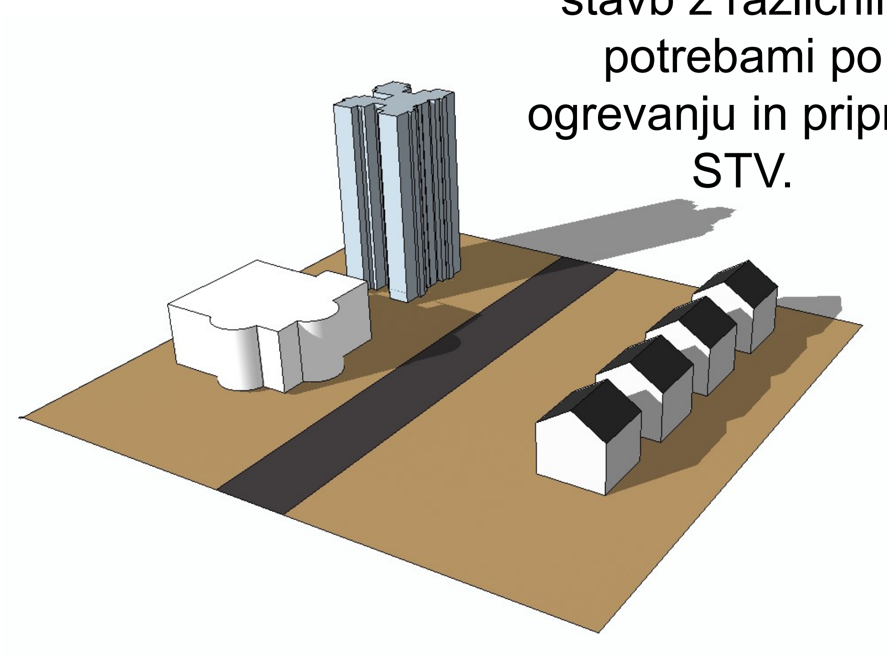
Poraba geotermalne energije v gospodinjstvih je v letu 2017 znašala 0,092 TWh/a

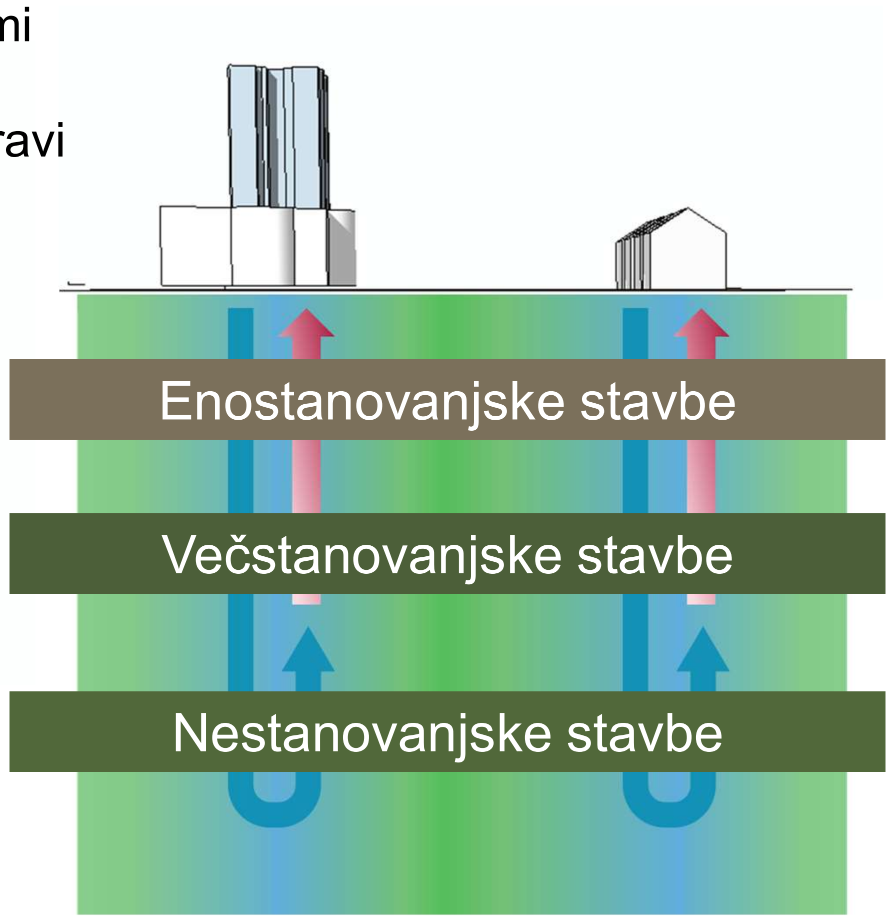
Potencial za nove sisteme daljinskega ogrevanja (primeri)



Novi decentralizirani sistemi - METODE

Območje z več tipi stavb z različnimi potrebami po ogrevanju in pripravi STV.





Identifikacija potenciala:

1. Izbor stavbe z največjo porabo energijo
2. 100% oskrba s plitvo geotermalno energijo
3. Ponovitev koraka 1 dokler ne zmanjka potenciala

Novi decentralizirani sistemi - REZULTATI

Tehnični potencial plitve geotermalne energije za namen ogrevanja in priprave STV:

6,93 TWh/a

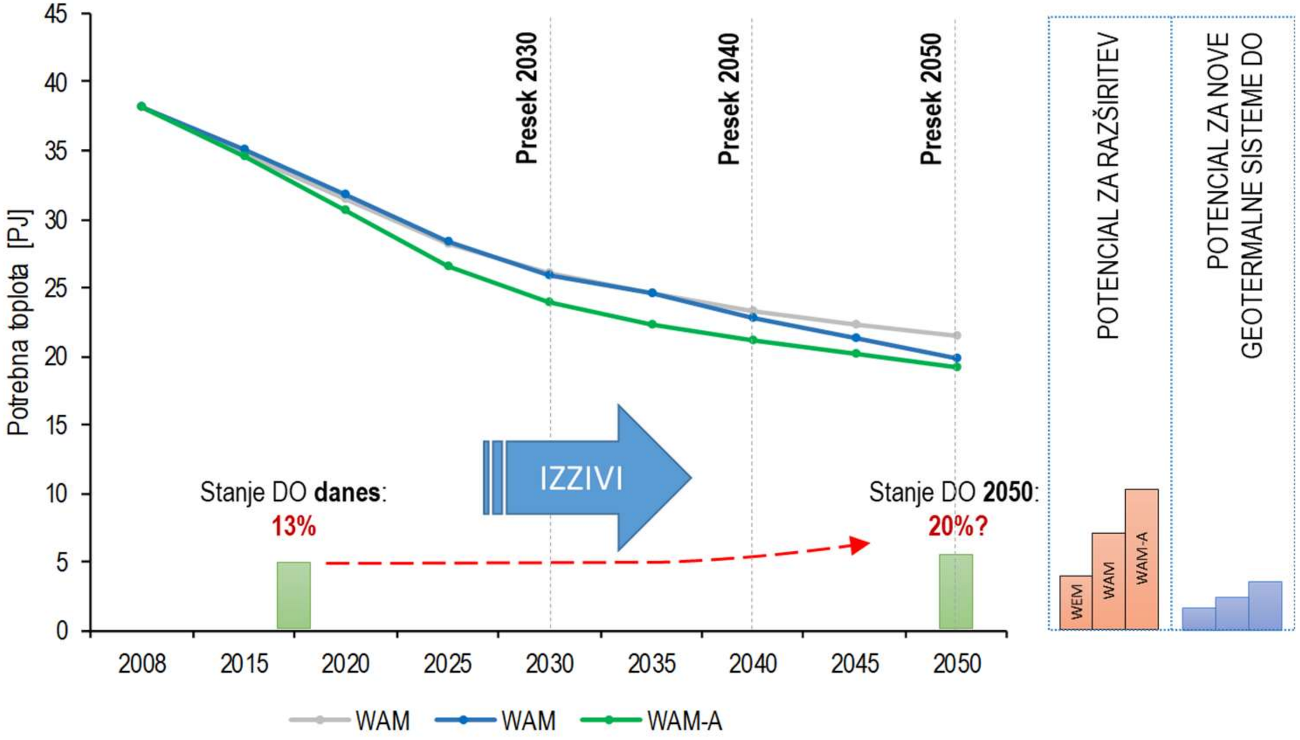
Primerjava

Poraba ELKO v gospodinjstvih je v letu 2017 znašala: 0,93 TWh/a

Vloga plitve geotermije v celotni energetski bilanci

	Poselitev Redka	Poselitev Gosta
Hiše	35%	21%
Bloki	1%	18%
Javni sektor	1%	9%
Zasebni sektor	3%	12%

- Struktura tehnologij je odvisna od **novih sistemov dalinskega ogrevanja**, kjer je še vsaj **50% potenciala**.
- **Potencial OVE v novih DO je znaten**.
- Zaradi **razpršene poselitve** verjetno ne bo mogoče oskrbovati stavb iz DO v 50% deležu (povprečje EU) v celotnem deležu rabe energije.



Potencial (novi sistemi)	Enota	WEM	WAM	WAM-A
Minimalen nivo odjema	MWh/ha	**350**	**200**	**100**
Daljinska toplota	PJ	3,72	7,5	10,7
Geo. en. vodonosnika	PJ	1,3	2,17	3,17

Zaključki

- Izraba plitve geotermalne energije v Sloveniji je v porastu.
- Ekonomski in tehnični potencial za nove centralizirane sisteme je znaten, ampak ga ni povsod mogoče koristiti v celoti kot edini vir za proizvodnjo energije.
- Plitva geotermalna energije z geosondami se kaže kot priložnost za individualne, decentralizirane sisteme, še posebej pri novih stavbah. Pri energetskih prenovah je potrebna LCC analiza.

Zaključki

- Potencial geotermalnih sistemov, ki izkoriščajo energijo vodonosnikov je znaten in predstavlja eno izmed glavnih usmeritev pri izrabi okolju prijaznim virov energije in dekarbonizaciji stavb.
- Toplotne karte se izkazujejo kot močno orodje pri nacionalnem in lokalnem načrtovanju, zato bodo postale sestavni del podnebno-energetskih načrtov in strateških dokumentov.

Ključni izzivi – zanesljivost in konkurenčnost oskrbe

Zmanjšanje potreb po energiji v vseh sektorjih (URE + OVE)

Delež samozadostnosti el. en.
proizvodnja, rezervne kapacitete,…

Razvoj OVE-E: umeščanje v prostor, Natura 2000, podporni mehanizmi, uvoz?

Institut "Jožef Stefan"
Center za energetsko učinkovitost

Jamova 39
1000 Ljubljana, Slovenija
Tel: +386 1 5885 210
www.ijs.si

Kontakt:
gasper.stegnar@ijs.si

Hvala za pozornost.