

# Predavanje Zajem podatkov iz sistema za upravljanje z energijo in ostalih sistemov za nadzor procesov

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energetsko učinkovitost



# TIMEPAC

## Academy

### Predavanje

## Zajem podatkov iz sistema za upravljanje z energijo in ostalih sistemov za nadzor procesov

**Predavatelj:** Boris Sučić (IJS-CEU)

**21. maj 2024**



Institut "Jožef Stefan" Ljubljana, Slovenija  
Center za energetsko učinkovitost



REPUBLIKA SLOVENIJA  
MINISTRSTVO ZA OKOLJE, PODNEBJE IN ENERGIJO



**EDILCLIMA®**  
ENGINEERING & SOFTWARE



# Naš skupni izziv

- Stavbe so odgovorne za 40% končne rabe energije in 36% vseh emisij CO<sub>2</sub> v Evropi
- Hiša je stroj za bivanje! (Charles-Édouard Jeanneret, bolj znan kot Le Corbusier)
- To ni dehumanizacija - preprosto pomeni, da je **vzpostavitev standardov za merjenje učinkovitosti delovanja različnih sistemov** nujen element sodobnega življenja.
- ... Ko lahko merite tisto o čem govorite in to izrazite v številkah, potem nekaj veste o tem .... (Lord Kelvin)
- **Ali obstajajo univerzalno uporabne rešitve?**
- **Kontekst rabe energije!** Ni mogoče pričakovati uspešne izvedbe začetno definiranih programov energetske učinkovitosti brez ustreznega razumevanja okolja za izvajanje

**Kaj želimo doseči?**

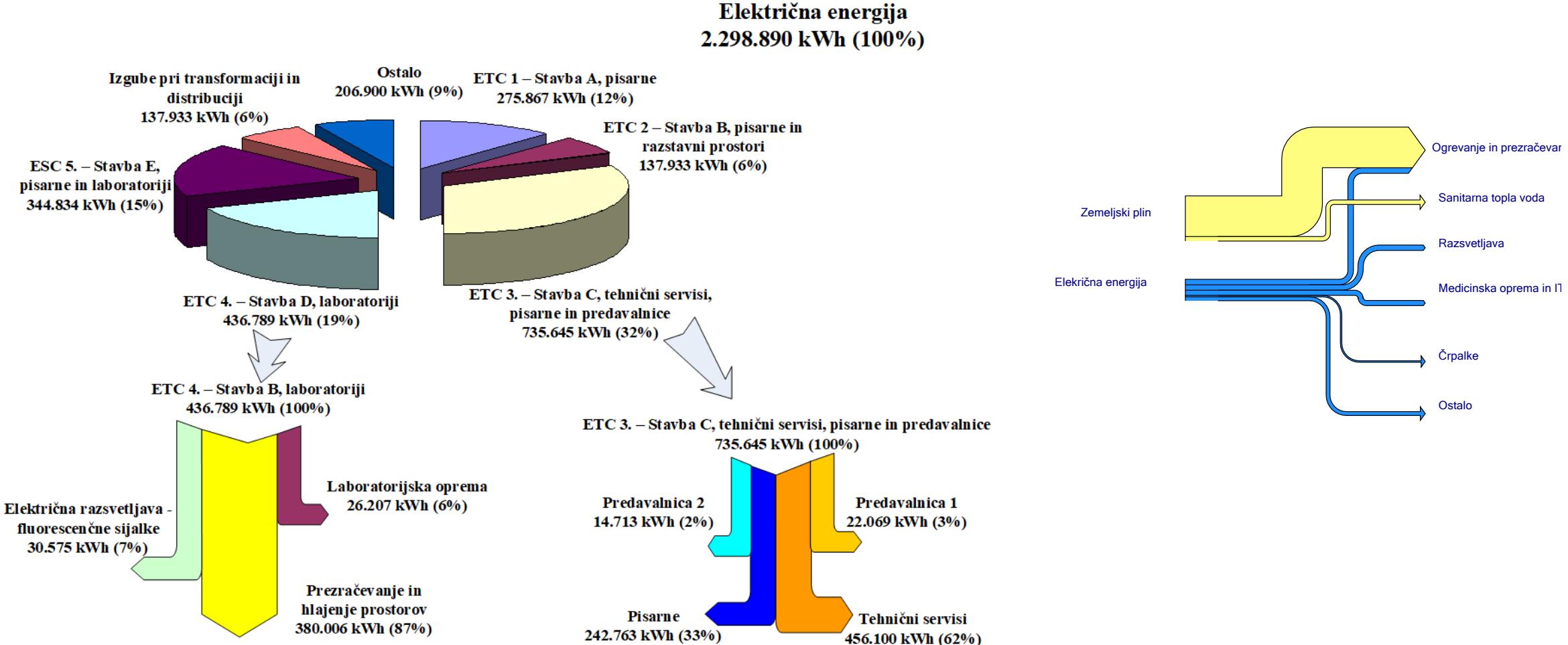


**Izvedba  
projektov!**

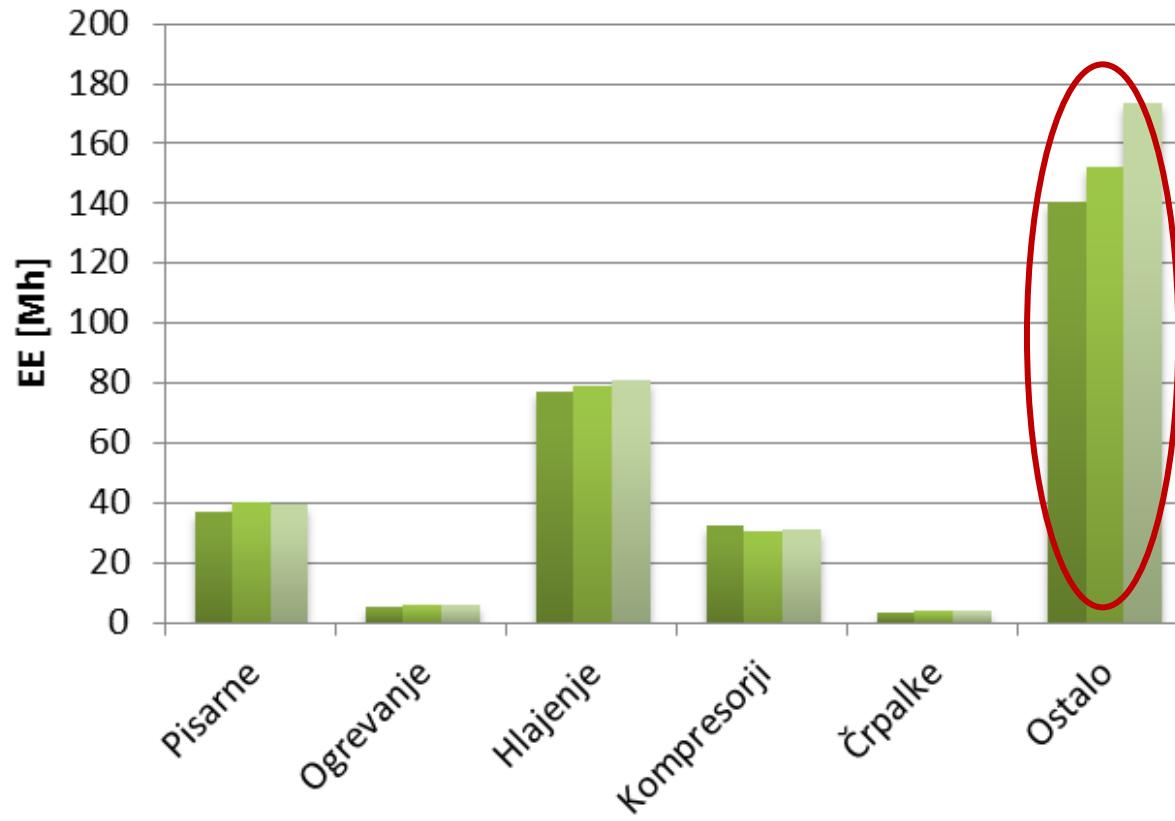
# Energetski pregled

- Prvi korak v smeri **ugotavljanja energetske učinkovitosti stavbe** na podlagi podatkov in drugih informacij (meritve), ki vodijo k identifikaciji priložnosti za izboljšanje učinkovitosti
- Dinamična kategorija - **energetski pregled je potrebno obnavljati** v določenih časovnih presledkih ter tudi ob večjih spremembah na objektih, opremi, sistemih ali procesih
- **Ustrezno podatkovno obdobje pomeni**, da organizacija upošteva zakonske zahteve oziroma spremenljivke, ki vplivajo na rabo in porabo energije
- Spremenljivke lahko vključujejo **vreme, letne čase, cikle poslovanja in druge okoliščine**
- **Energetski pregled se običajno konča s priporočili - ne vključuje podpore za dejansko izvedbo**

# Bilanca rabe energetov po porabnikih – primer električna energija

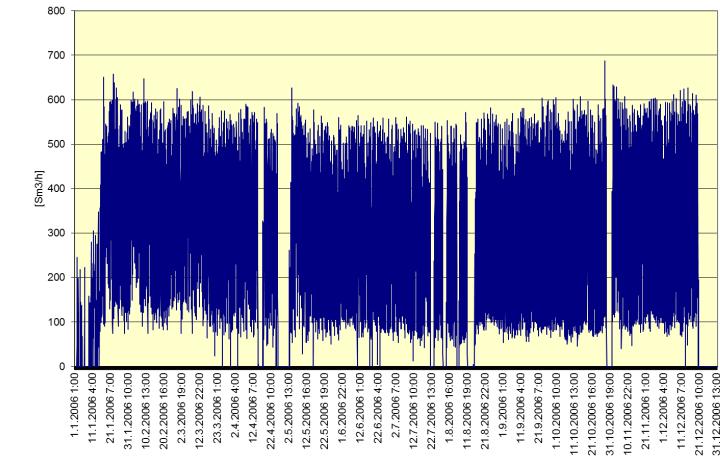
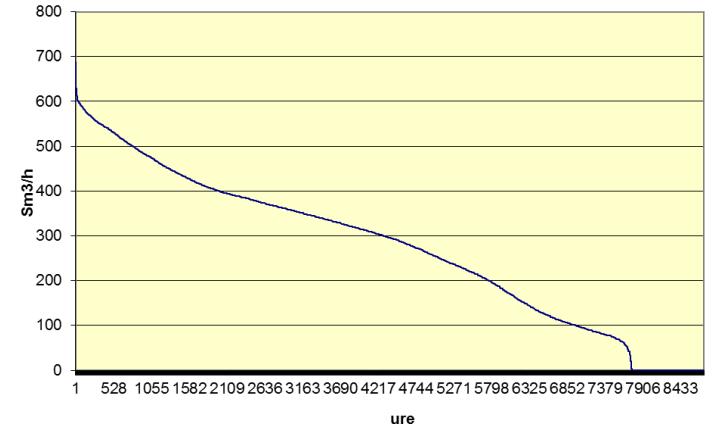
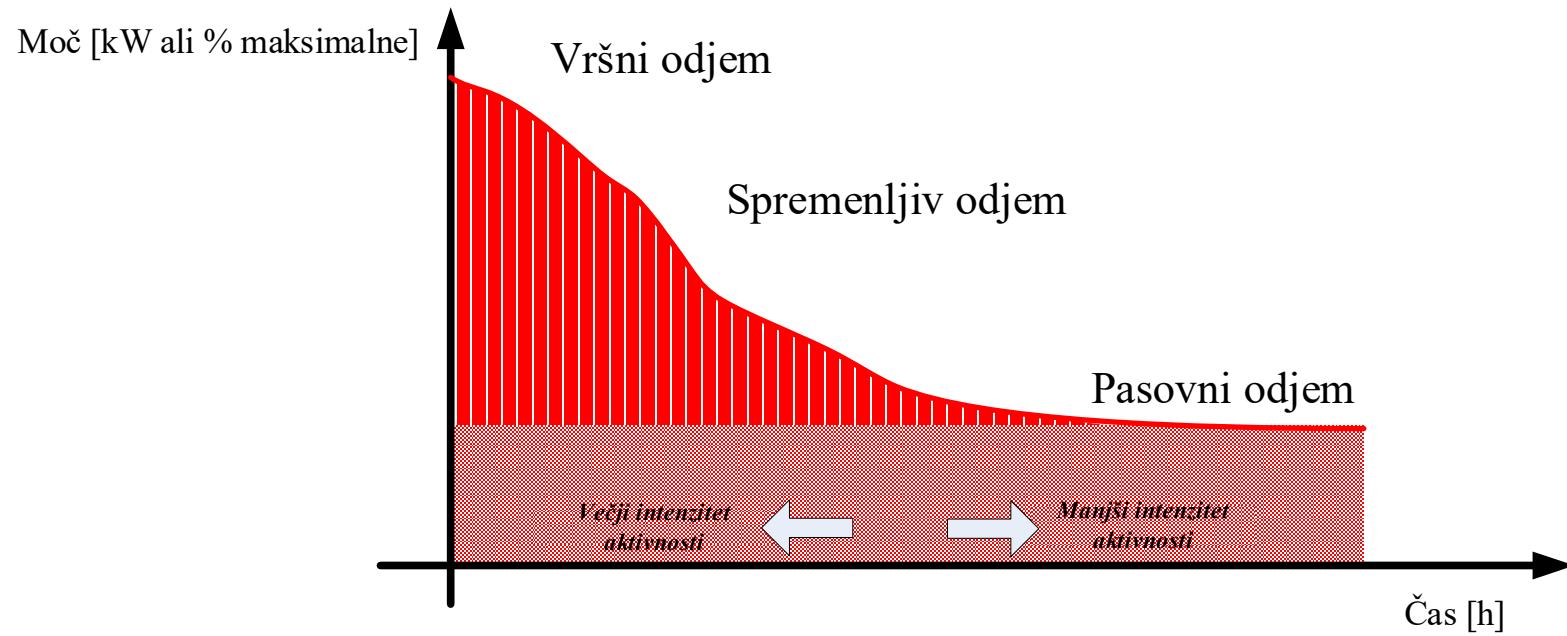


# Bilanca rabe energentov po porabnikih – primer električna energija

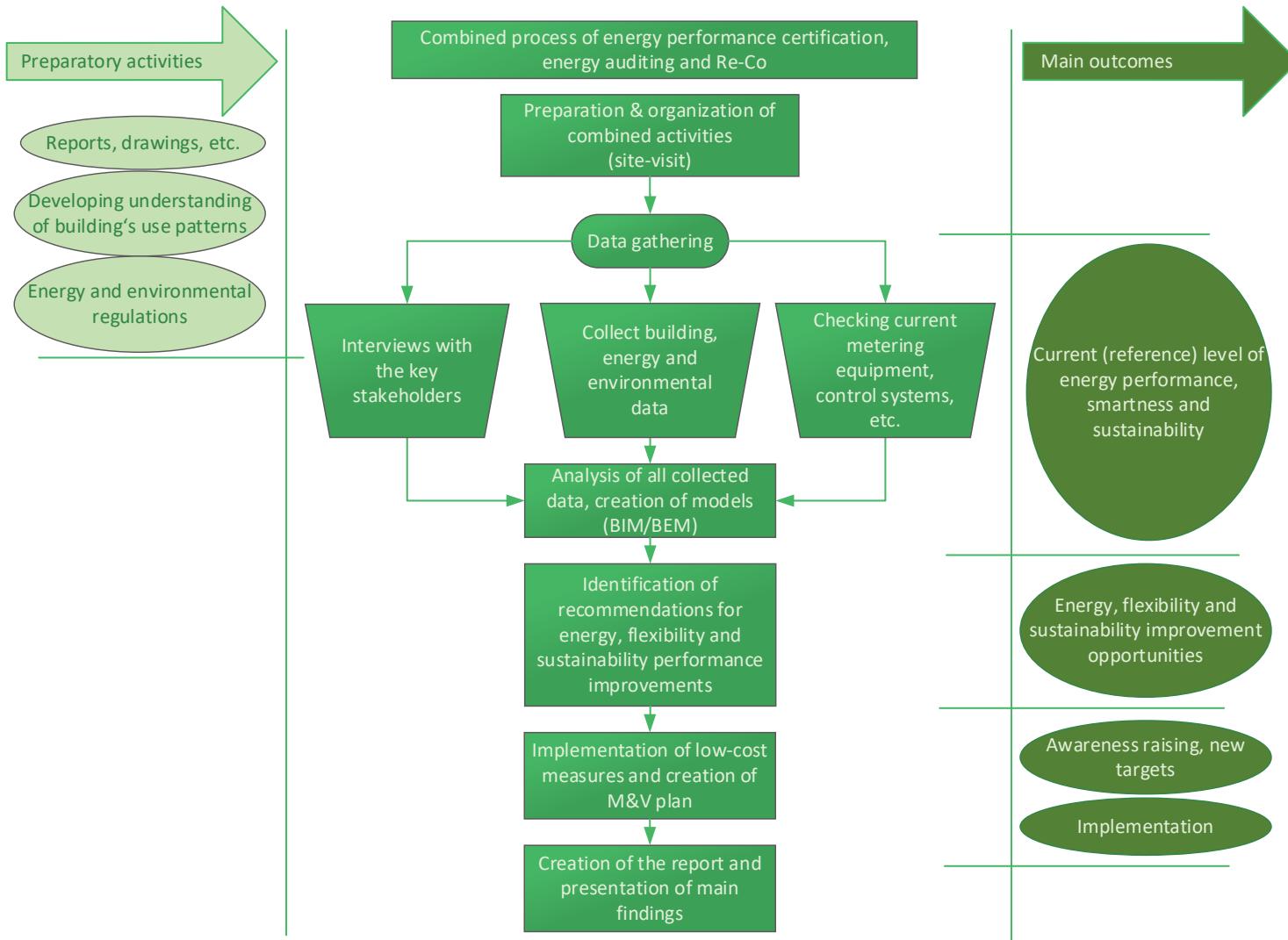


# Bilance in prikaz rabe za vsak energet

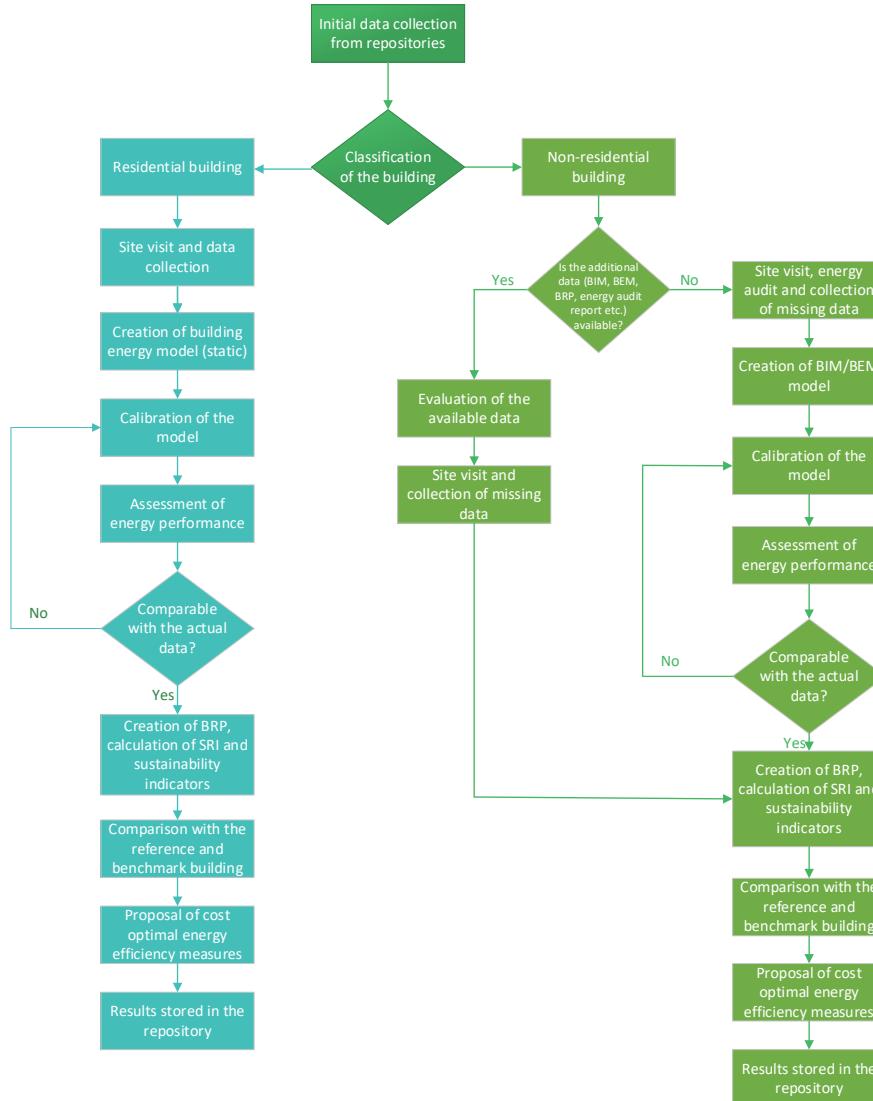
Urejen diagram odjema



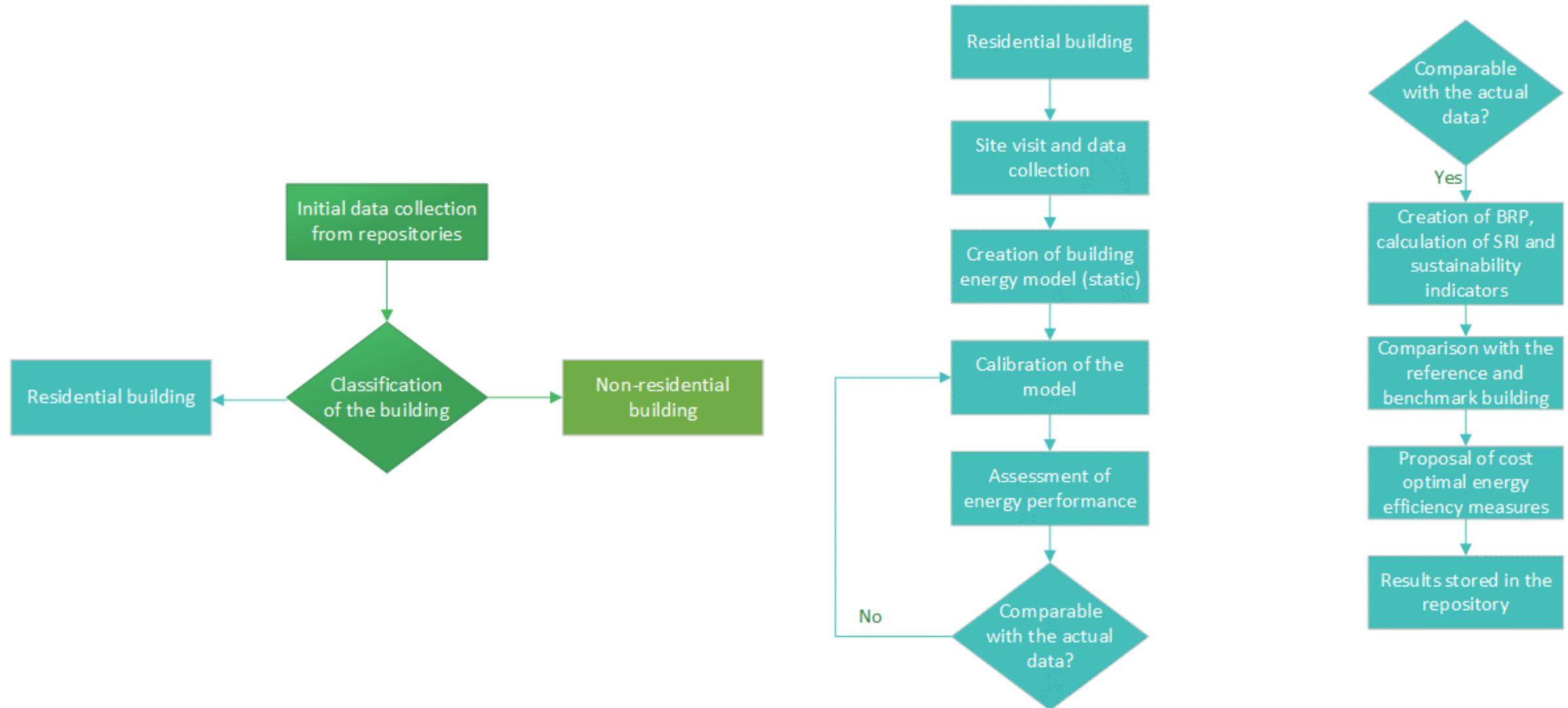
# Povezovanje aktivnosti



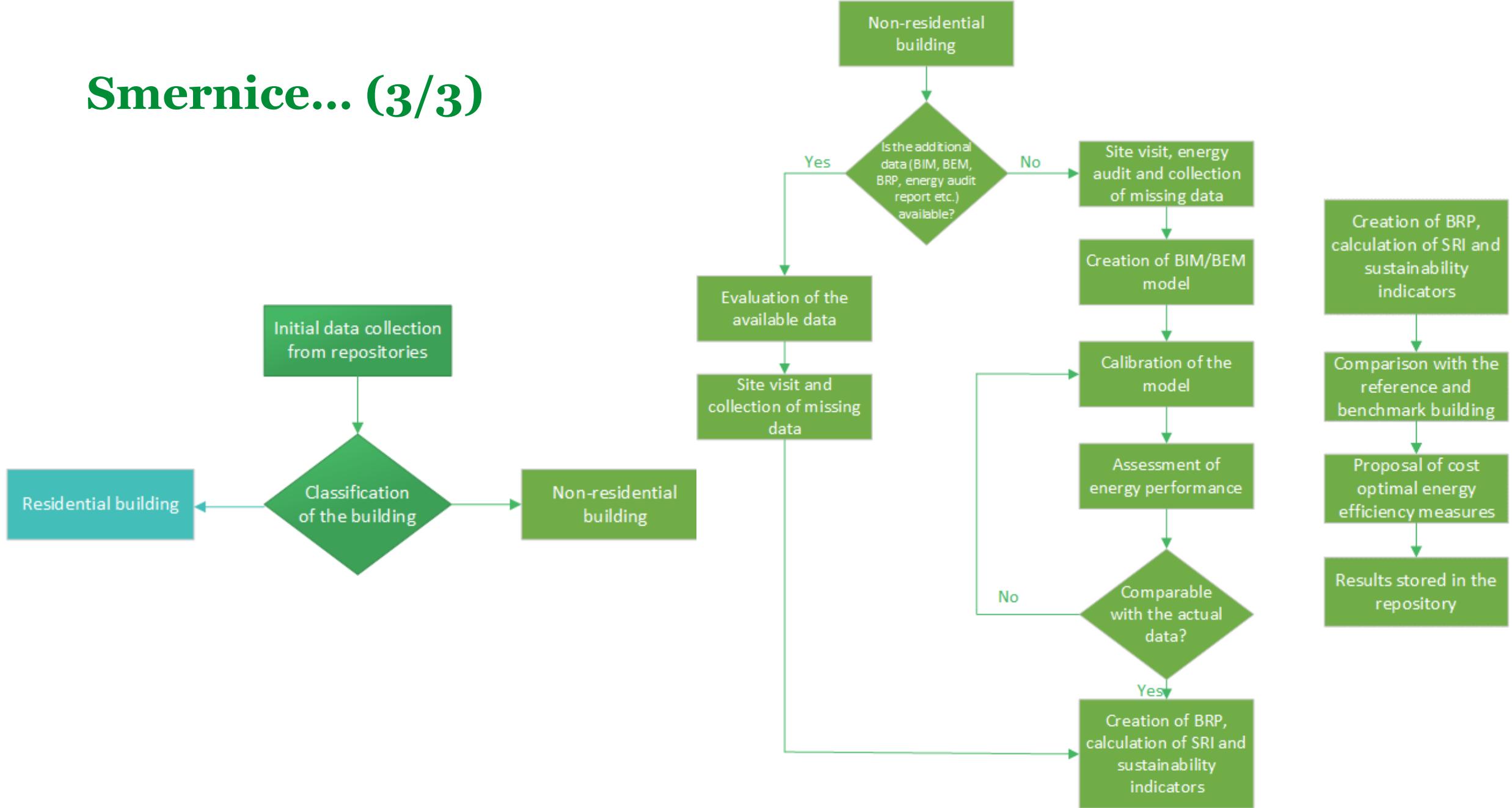
# Smernice za povezovanje aktivnosti (1/3)



# Smernice za povezovanje aktivnosti (2/3)

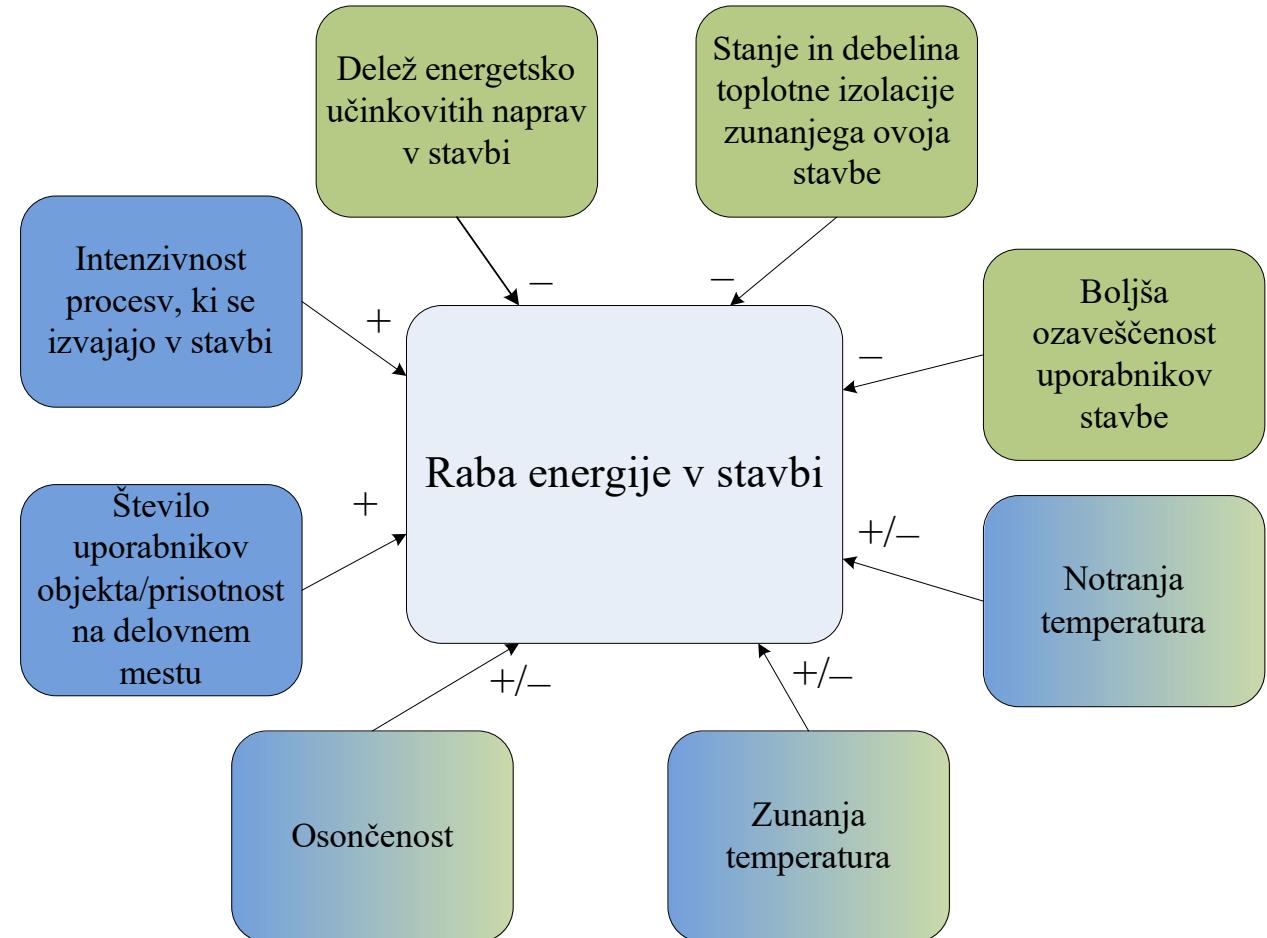


# Smernice... (3/3)



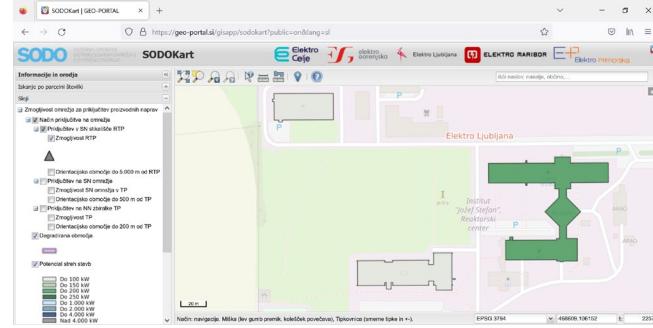
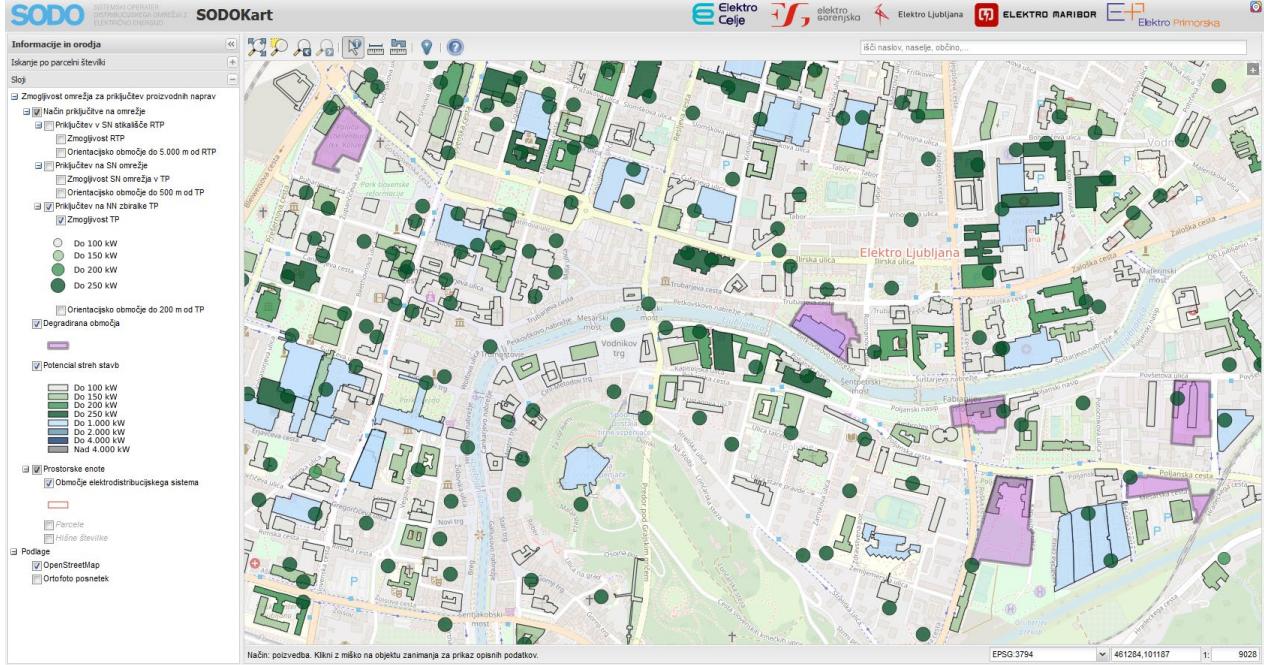
# Podatki, ki potrebni za optimalno delovanje modernih stavb

- Energetski podatki
  - Poraba energije in vode
- Kontekstualni podatki
  - Vsi ostali neenergetski podatki

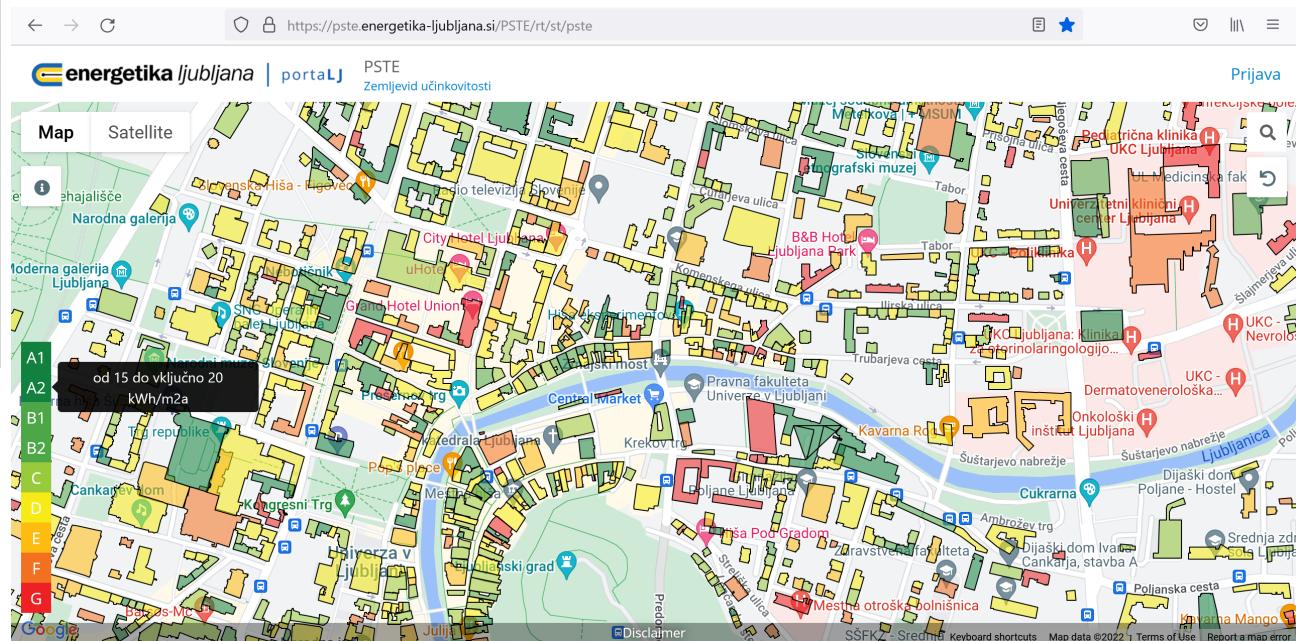


# Ali so podatki problem? (1/5)

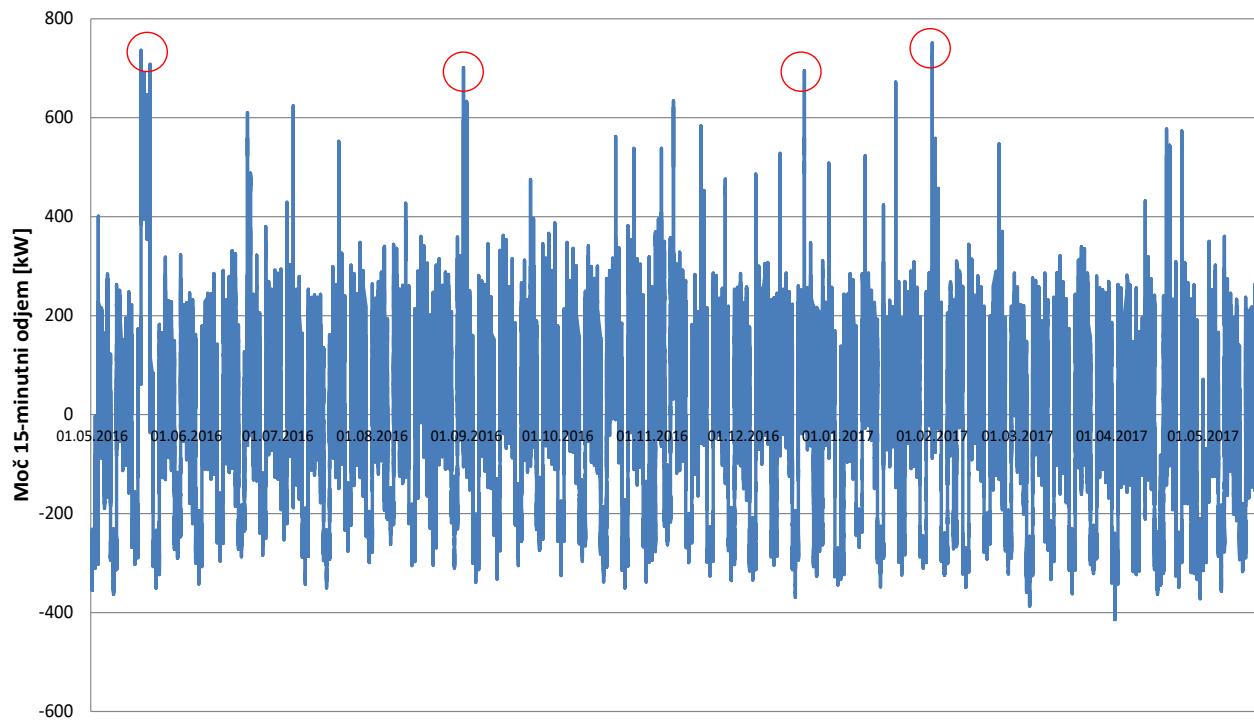
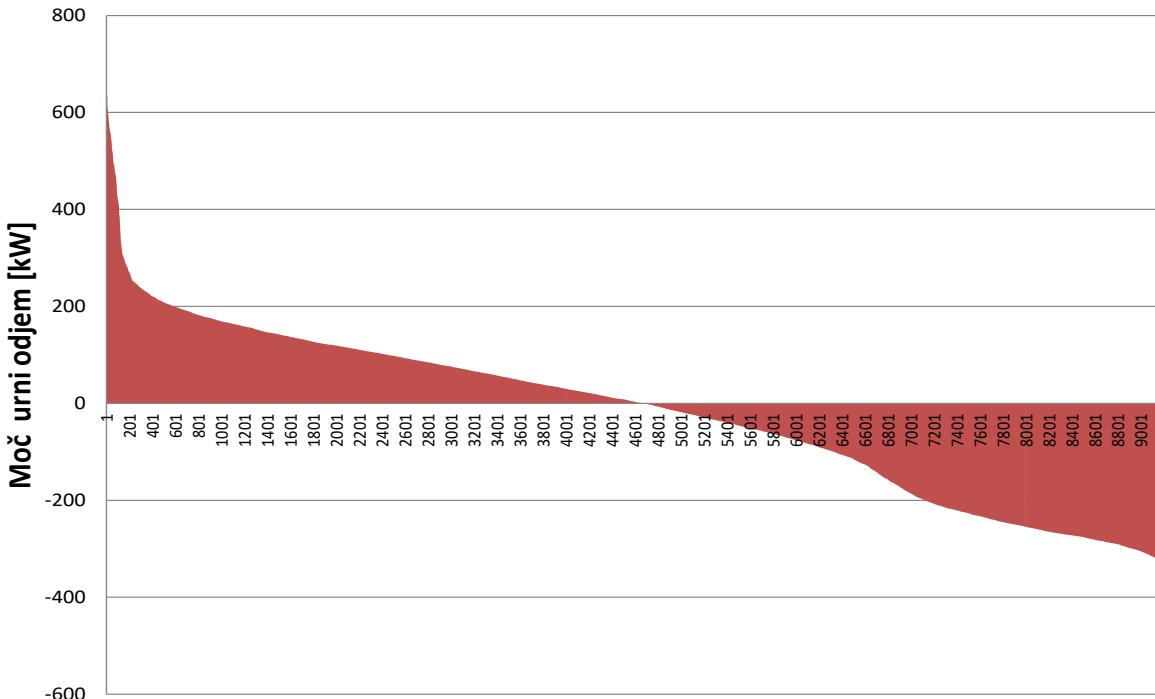
- SODO karta – dostopno na: <https://geo-portal.si/gisapp/sodokart?public=on&lang=sl>



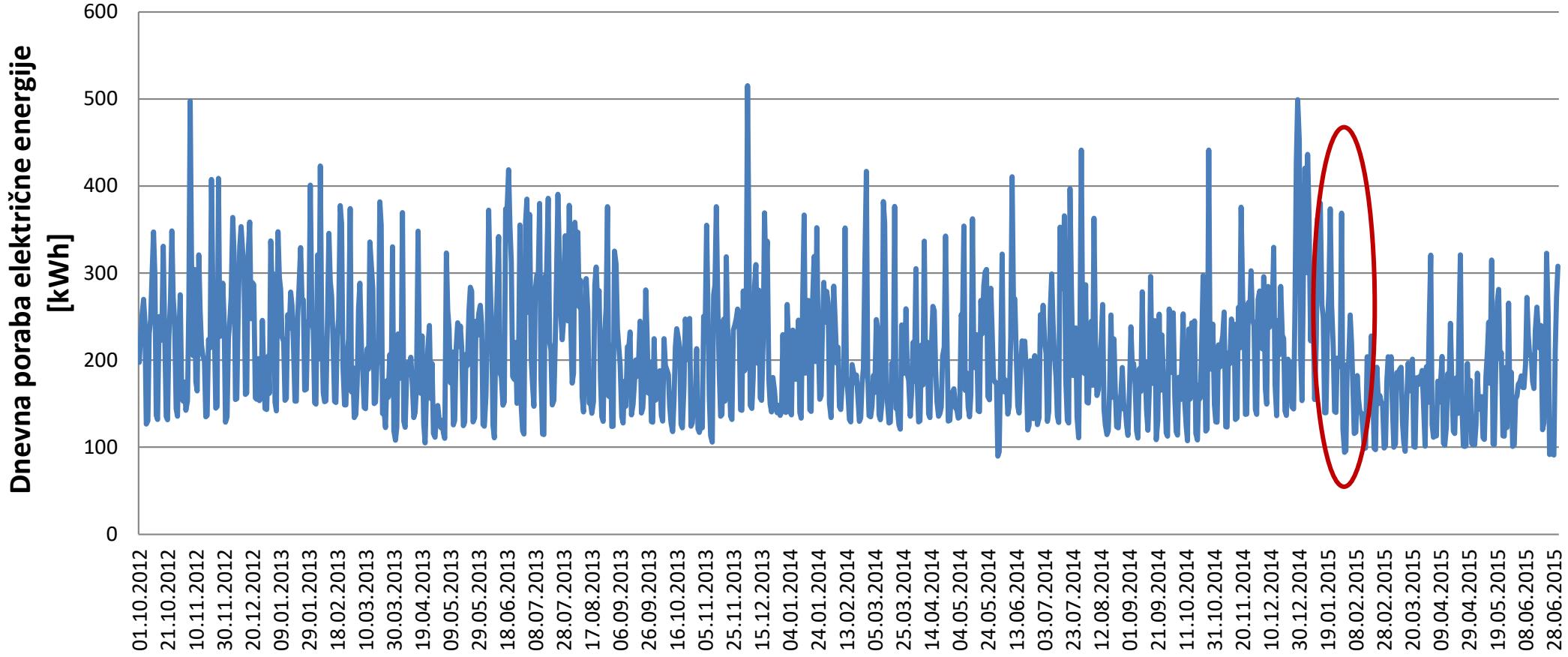
- Napredna orodja za oceno potencialov:  
<https://solarplanner.eu/>



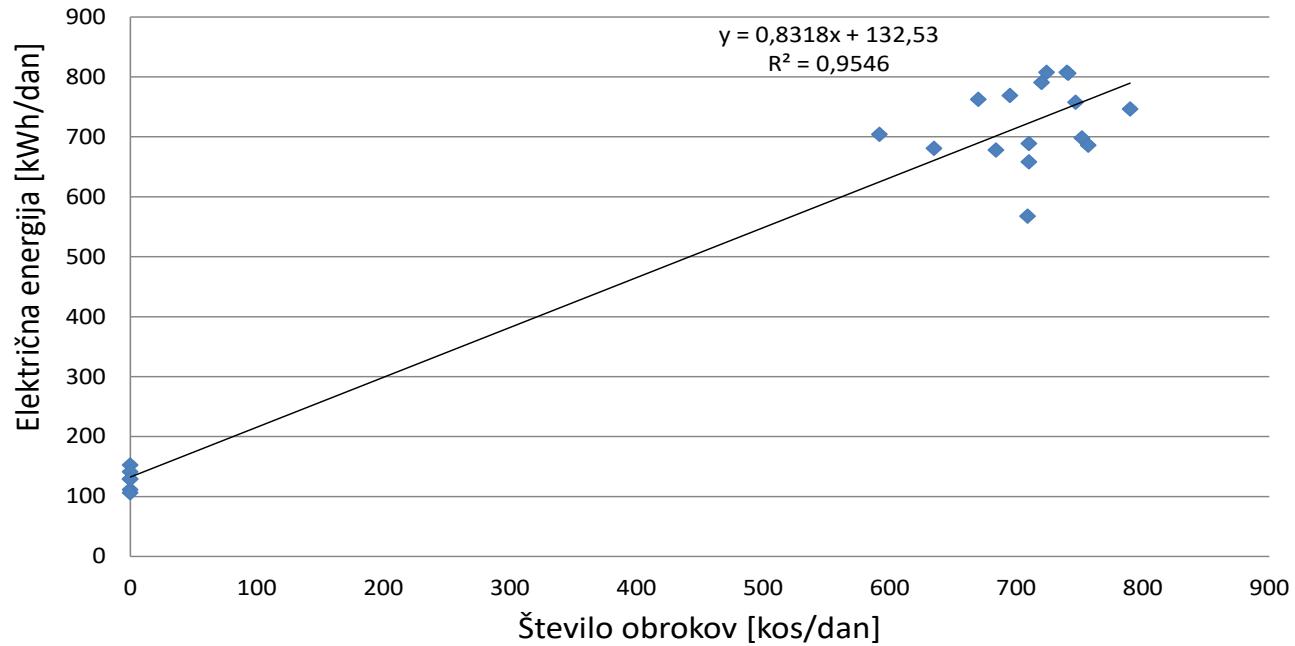
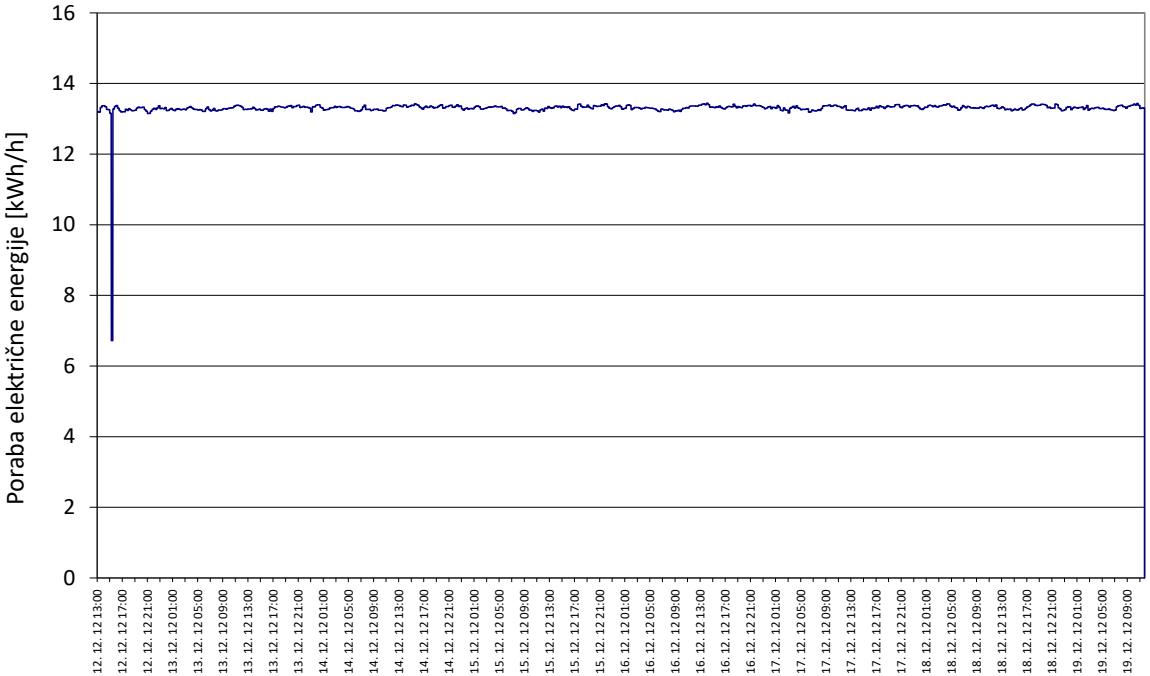
## Ali so podatki problem? (2/5)



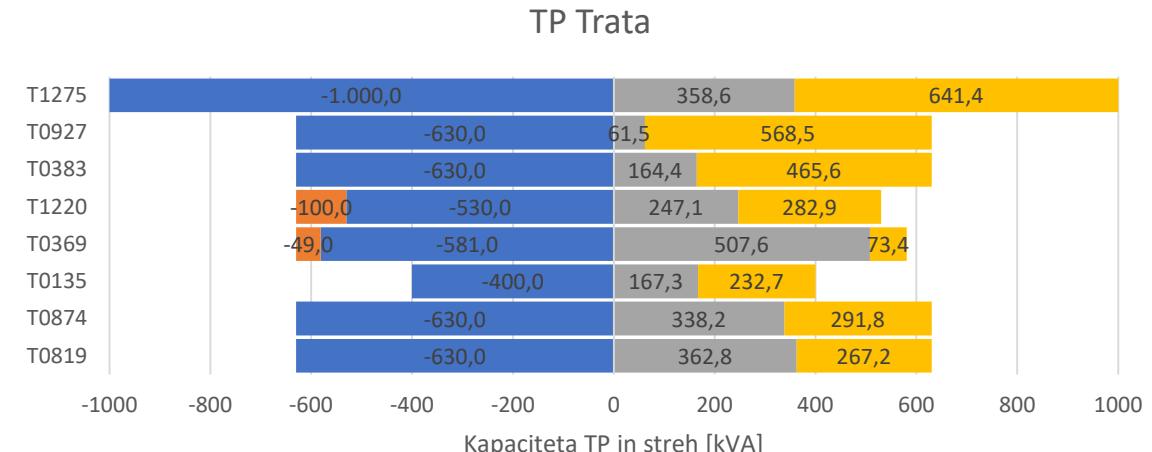
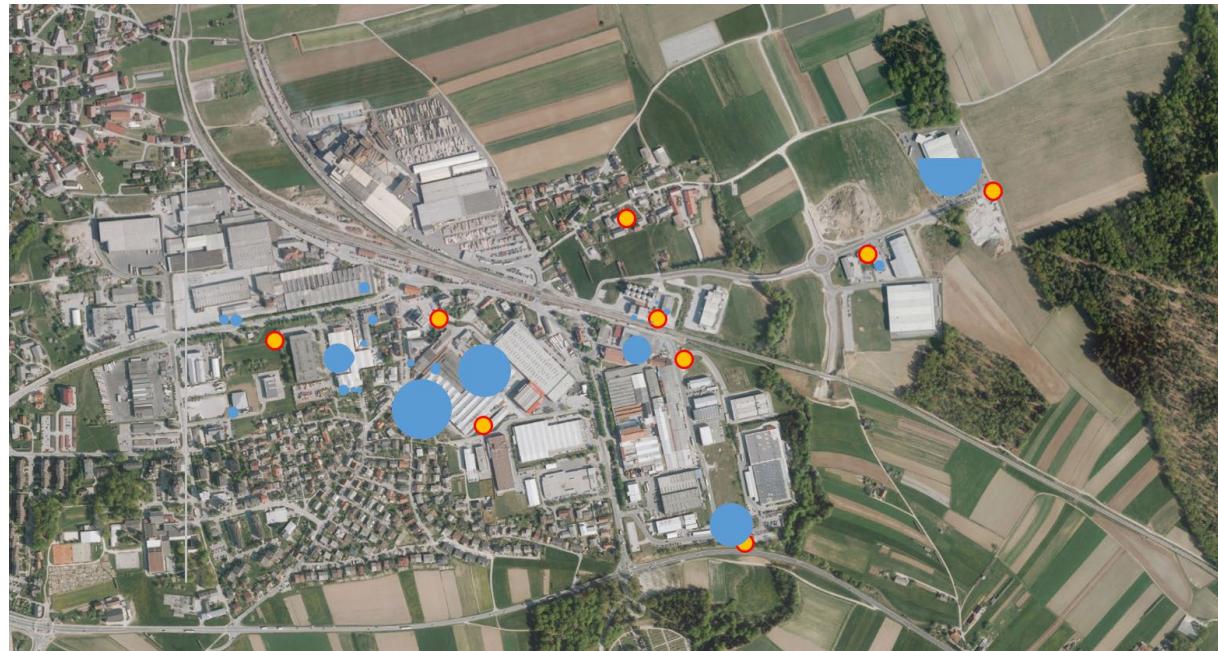
# Ali so podatki problem? (3/5)



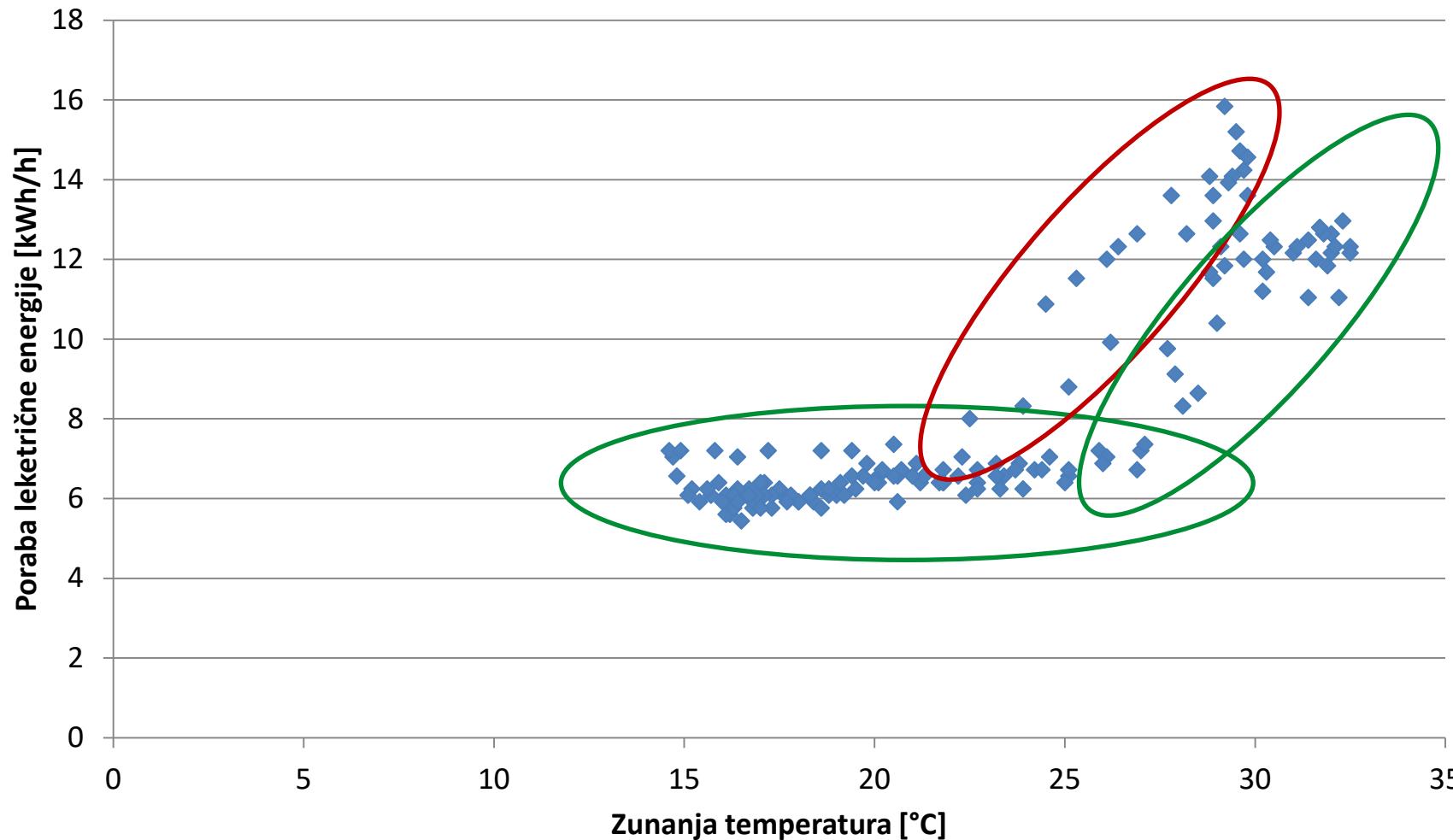
# Ali so podatki problem? (4/5)



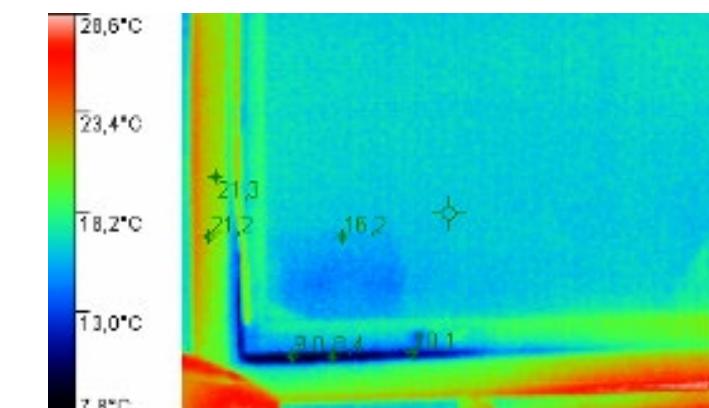
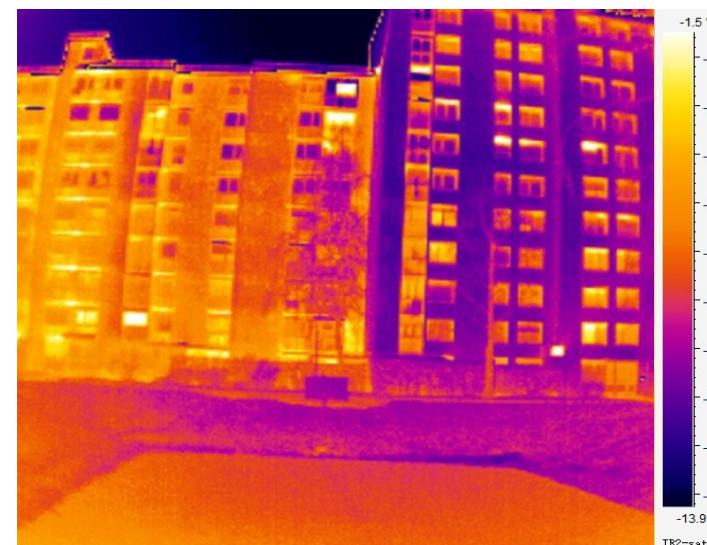
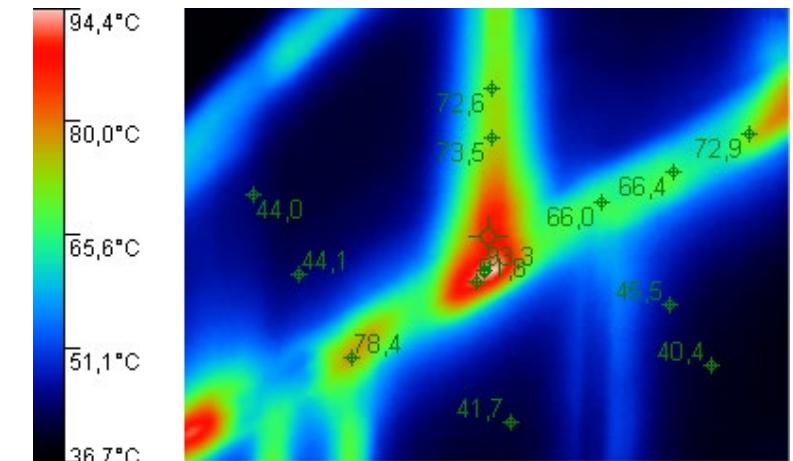
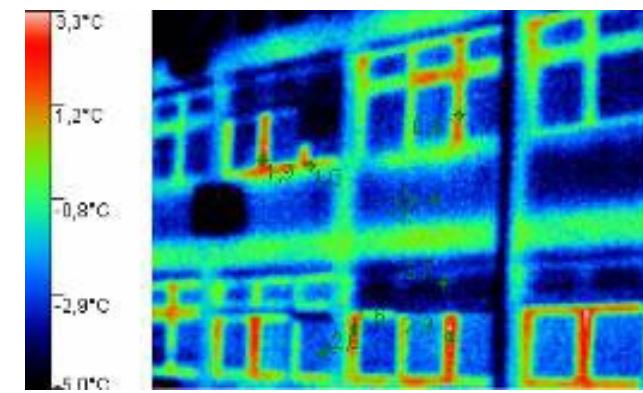
# Ali so podatki problem? (5/5)



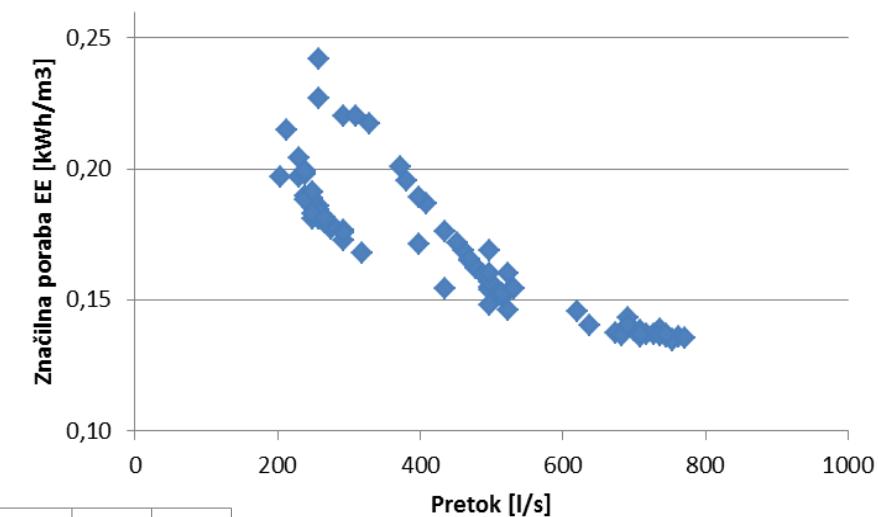
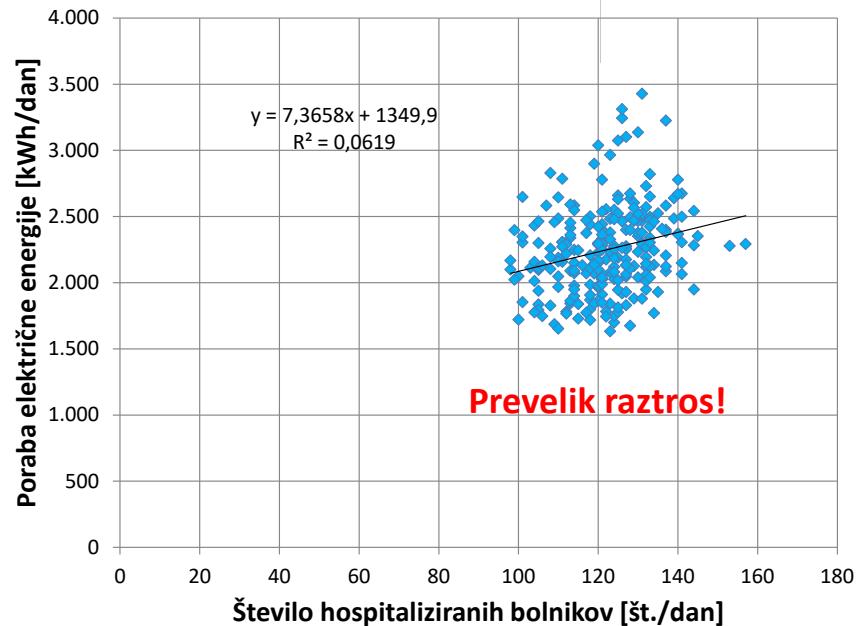
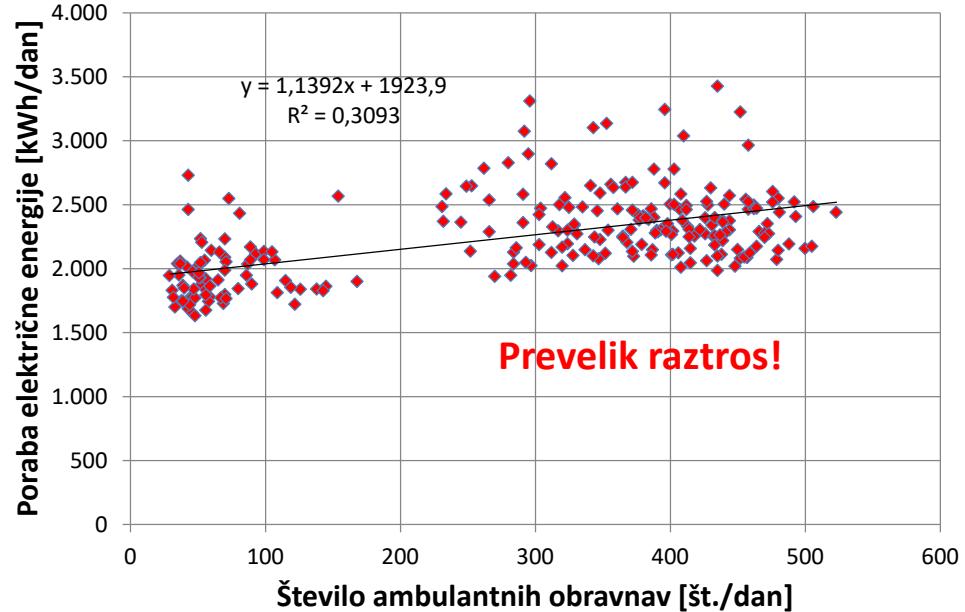
# Ali pravilno razumemo zbrane podatke? (1/6)



## Ali pravilno razumemo zbrane podatke? (2/6)



# Ali pravilno razumemo zbrane podatke? (3/6)



# Ali pravilno razumemo zbrane podatke? (4/6)

Datum	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	00:00	Skupaj
1.5.2015.	4,72	4,74	4,78	4,66	4,70	4,72	4,76	4,76	4,80	4,76	4,74	4,78	4,78	4,82	4,70	4,76	4,76	4,64	4,68	4,70	4,64	4,72	4,66	113,54	
2.5.2015.	4,66	4,72	4,70	4,72	4,62	4,74	4,68	4,64	4,70	4,76	4,72	4,76	4,76	4,82	4,86	4,74	4,98	4,76	4,72	4,80	4,66	4,76	4,70	4,70	113,68
3.5.2015.	4,70	4,70	4,68	4,74	4,70	4,68	4,72	4,66	4,74	4,64	4,68	4,70	4,72	4,68	4,78	4,78	4,64	4,70	4,76	4,68	4,58	4,70	4,62	4,62	112,60
4.5.2015.	4,66	4,58	4,64	4,56	4,68	4,60	4,68	5,50	6,82	7,94	8,26	8,08	10,66	12,82	12,20	11,72	11,16	8,80	6,06	5,94	5,86	5,76	5,84	5,72	171,54
5.5.2015.	5,66	5,52	5,46	5,46	5,40	5,42	5,58	8,28	11,48	12,46	12,04	11,78	11,74	11,58	11,84	8,54	6,32	6,06	5,94	5,90	5,78	5,64	5,68	5,68	185,24
6.5.2015.	5,58	5,62	5,70	5,60	5,58	5,64	5,66	10,36	11,56	13,02	13,12	13,04	12,44	12,02	12,56	7,88	5,70	5,18	5,08	5,10	5,02	4,96	4,92	4,96	186,30
7.5.2015.	4,92	4,86	4,84	4,94	4,88	4,84	4,84	6,20	11,38	12,90	13,62	13,42	13,28	13,74	13,30	13,02	10,04	6,32	5,94	5,94	5,88	5,74	5,82	5,64	196,30
8.5.2015.	5,66	5,52	5,56	5,66	5,52	5,78	7,38	12,00	13,44	14,02	13,98	14,14	14,00	14,00	7,98	6,06	5,54	5,50	5,40	5,20	5,20	5,14	5,10	193,30	
9.5.2015.	5,00	5,10	4,98	4,98	5,04	5,02	4,98	5,02	5,10	5,04	5,06	5,02	5,18	5,10	5,10	5,18	5,08	5,14	5,06	5,14	5,04	5,04	5,12	5,02	121,54
10.5.2015.	5,10	5,06	5,04	5,06	5,08	5,04	4,98	5,02	5,06	5,06	5,04	5,16	5,06	5,10	5,22	5,08	5,10	5,18	5,16	5,06	5,06	4,98	4,96	4,92	121,58
11.5.2015.	4,94	5,06	4,90	4,98	4,92	4,94	4,94	5,80	7,26	12,70	12,58	13,84	13,54	13,20	13,96	13,14	12,54	12,40	6,90	6,72	6,08	5,64	5,60	5,52	202,10
12.5.2015.	5,42	5,54	5,54	5,44	5,46	5,36	5,48	8,54	11,34	12,56	12,84	12,32	12,50	12,50	12,94	9,38	6,72	6,54	5,82	5,74	5,64	5,66	5,60	5,46	190,34
13.5.2015.	5,56	5,48	5,48	5,46	5,46	5,50	5,40	5,50	6,28	6,78	6,74	7,24	7,30	13,94	18,68	19,00	14,28	10,58	8,62	9,06	6,54	7,62	8,22	8,22	202,94
14.5.2015.	8,18	8,16	5,40	8,28	8,16	8,00	5,32	9,48	14,46	15,02	12,90	15,16	15,02	14,32	7,62	9,98	9,12	8,90	6,76	6,00	7,58	7,00	5,04	7,36	223,22
15.5.2015.	7,10	4,94	6,70	7,30	5,44	6,26	7,06	8,00	9,42	7,34	10,30	10,58	10,42	8,88	8,82	10,22	9,70	8,28	6,74	8,98	8,16	5,30	8,14	8,18	192,26
16.5.2015.	6,02	7,20	8,02	7,64	5,60	8,02	8,00	5,16	8,00	8,02	6,06	6,92	7,88	7,94	5,52	7,64	7,90	8,00	5,28	7,96	8,04	5,06	7,98	7,68	171,54
17.5.2015.	7,68	5,18	7,84	7,96	6,86	6,04	7,90	7,70	6,36	6,72	7,86	7,86	5,18	7,84	7,94	6,58	6,50	7,94	7,86	5,12	7,92	7,84	7,94	5,06	169,68
18.5.2015.	7,76	7,80	7,82	6,02	6,88	7,84	7,86	9,24	13,62	14,08	14,56	13,54	13,68	15,00	15,08	12,96	6,80	9,28	9,06	8,18	6,14	8,42	8,58	6,78	236,98
19.5.2015.	7,26	8,34	8,42	6,66	6,88	8,12	8,34	10,18	13,40	14,30	12,32	13,42	12,98	12,10	13,78	11,66	13,08	9,52	7,40	6,56	6,28	7,12	5,32	7,18	230,62
20.5.2015.	5,32	7,00	5,26	6,98	5,34	6,94	5,36	7,54	6,36	9,24	11,80	13,02	11,44	13,14	12,20	12,22	12,98	8,76	6,20	6,16	6,12	6,10	6,14	5,92	197,54
21.5.2015.	5,90	5,92	5,82	5,90	5,80	5,76	5,88	6,24	6,88	7,62	7,34	7,40	7,06	7,26	12,12	22,42	12,20	6,64	6,06	5,98	5,86	5,72	5,78	5,78	179,34
22.5.2015.	5,80	5,38	5,40	5,38	5,32	5,40	5,34	6,86	9,10	12,60	12,18	12,80	13,48	13,92	14,18	11,76	11,02	10,46	6,68	5,52	5,56	5,34	5,40	5,48	200,36
23.5.2015.	5,40	5,42	5,46	5,40	5,30	5,36	5,36	5,30	5,38	5,50	5,48	5,42	5,28	5,42	5,38	5,38	5,40	5,34	5,42	5,30	5,38	5,28	5,36	5,32	129,04
24.5.2015.	5,28	5,40	5,30	5,28	5,32	5,36	5,26	5,38	5,46	5,28	5,32	5,34	5,34	5,34	5,42	5,36	5,30	5,44	5,32	5,40	5,44	5,34	5,46	128,50	
25.5.2015.	5,40	5,34	5,30	5,34	5,40	5,56	5,86	6,48	9,96	10,52	7,80	8,18	8,42	9,00	8,26	7,22	6,52	5,96	5,54	5,46	5,42	5,48	5,38	5,48	159,28
26.5.2015.	5,36	5,32	5,36	5,36	5,36	5,32	5,48	6,00	7,08	7,72	7,98	8,02	7,70	7,82	8,06	7,86	7,36	6,28	5,94	5,82	5,74	5,66	5,52	5,54	153,66
27.5.2015.	5,54	5,50	5,50	5,48	5,32	5,46	5,62	6,46	7,22	7,34	7,92	7,92	8,02	7,20	7,30	7,12	6,40	5,90	5,72	5,36	5,34	5,32	5,12	5,16	149,24
28.5.2015.	5,12	5,20	5,10	5,04	5,14	5,00	5,04	5,72	6,30	6,90	7,80	7,52	7,62	7,90	8,04	7,86	6,56	6,34	6,12	6,00	6,10	5,88	5,88	5,88	150,06
29.5.2015.	5,90	5,92	5,40	5,40	5,38	4,96	5,04	5,58	6,34	7,30	7,88	7,84	7,54	7,78	6,98	7,22	6,14	5,74	5,72	5,70	5,64	5,56	5,64	5,56	148,16
30.5.2015.	5,52	5,52	5,56	5,54	5,50	5,62	5,48	5,32	5,54	5,40	5,50	5,44	5,54	5,50	5,42	5,56	5,46	5,48	5,56	5,42	5,50	5,46	5,54	5,46	131,84
31.5.2015.	5,48	5,56	5,48	5,40	5,50	5,58	5,48	5,48	5,52	5,50	5,50	5,54	5,50	5,48	5,48	5,60	5,46	5,44	5,52	5,52	5,54	5,52	5,54	5,54	132,10

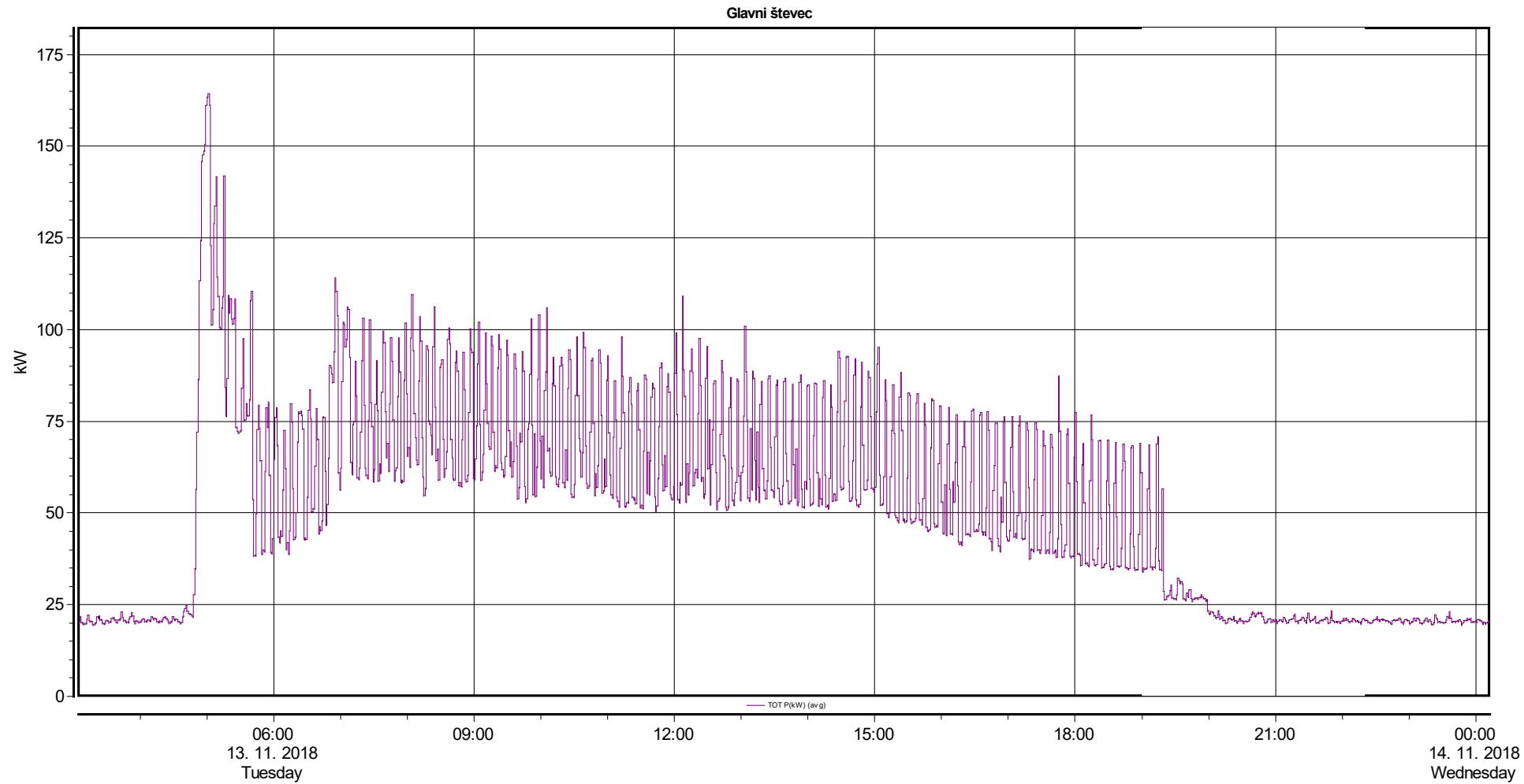
# Ali pravilno razumemo zbrane podatke? (5/6)

Datum	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	00:00	
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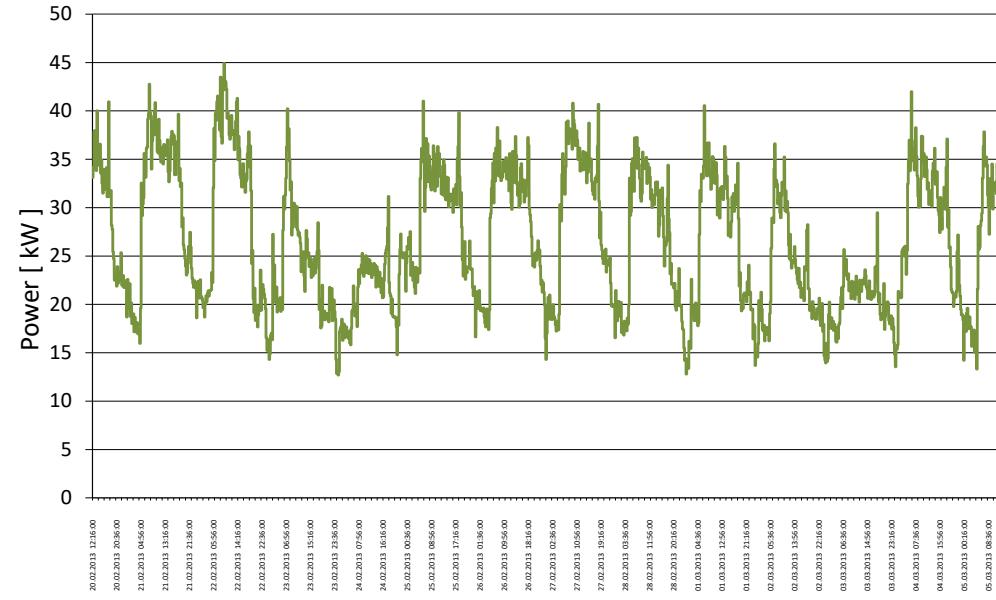
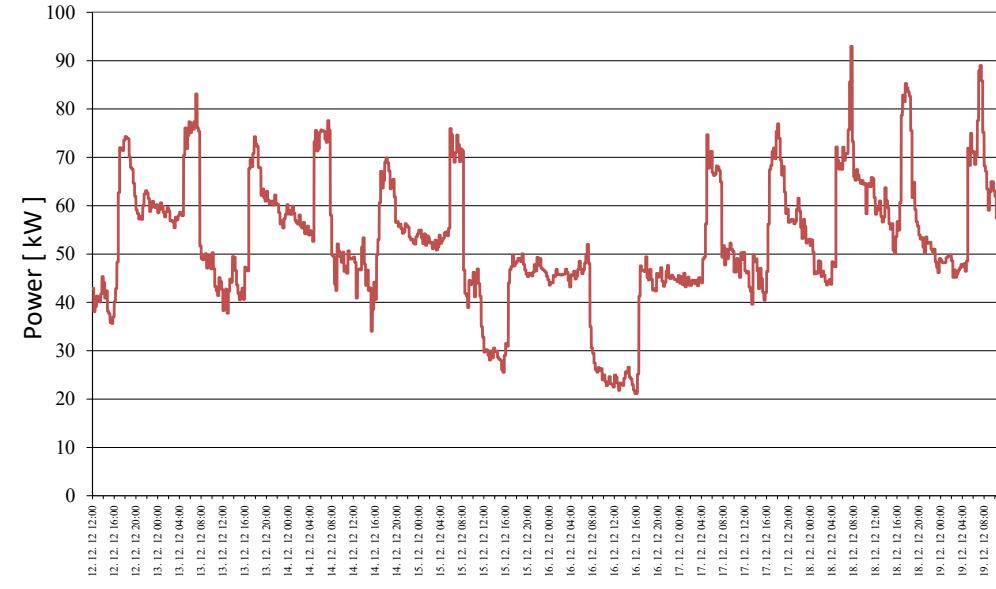
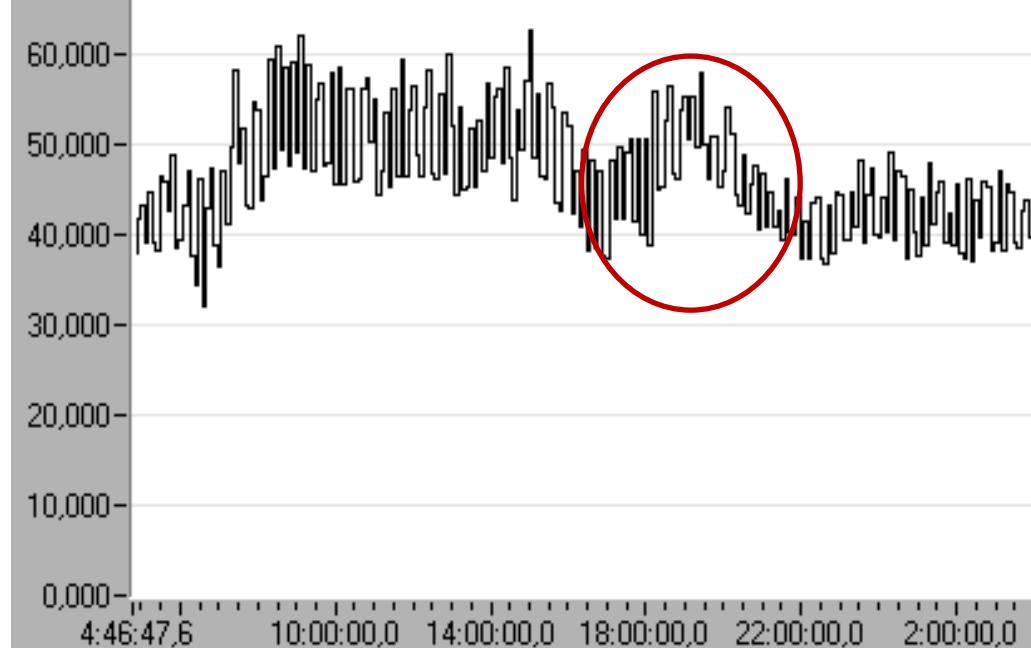
# Ali pravilno razumemo zbrane podatke? (6/6)

Datum	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	00:00		
1.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
2.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
3.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
4.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	112%	105%	107%	100%	100%	100%	100%	100%	100%		
5.5.2015.	100%	100%	100%	100%	100%	100%	100%	114%	100%	118%	113%	108%	107%	102%	102%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
6.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	119%	114%	105%	108%	100%	100%	100%	100%	100%	100%	100%	100%		
7.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	111%	122%	100%	123%	105%	110%	115%	100%	111%	100%	100%	100%	100%	100%	100%	100%		
8.5.2015.	100%	100%	100%	100%	100%	100%	101%	102%	100%	127%	111%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
9.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
10.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
11.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	105%	105%	124%	100%	110%	120%	100%	110%	108%	107%	101%	100%	100%	100%	
12.5.2015.	100%	100%	100%	100%	100%	100%	100%	118%	100%	119%	100%	112%	114%	100%	112%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
13.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	105%	100%	100%	100%	110%	110%	100%	109%	128%	138%	136%	100%		
14.5.2015.	140%	139%	100%	144%	145%	137%	100%	130%	154%	142%	105%	138%	137%	126%	100%	100%	101%	116%	106%	100%	126%	118%	100%	122%	100%	
15.5.2015.	121%	100%	118%	127%	100%	108%	123%	110%	100%	100%	100%	100%	100%	100%	100%	100%	107%	108%	105%	143%	136%	100%	137%	136%	100%	
16.5.2015.	111%	135%	143%	137%	106%	147%	143%	100%	145%	145%	111%	125%	146%	141%	101%	139%	143%	142%	100%	149%	143%	100%	142%	145%	100%	
17.5.2015.	142%	100%	139%	143%	130%	110%	141%	145%	115%	122%	144%	142%	100%	139%	146%	119%	118%	141%	145%	100%	149%	143%	100%	147%	141%	100%
18.5.2015.	133%	133%	138%	104%	123%	135%	137%	127%	145%	133%	136%	124%	125%	132%	130%	118%	100%	121%	142%	130%	102%	141%	144%	112%	100%	
19.5.2015.	124%	143%	148%	116%	123%	139%	146%	140%	142%	135%	115%	123%	119%	106%	119%	106%	145%	124%	116%	105%	105%	120%	100%	119%	100%	
20.5.2015.	100%	120%	100%	121%	100%	119%	100%	104%	100%	100%	110%	119%	104%	115%	105%	112%	144%	114%	100%	100%	102%	102%	103%	100%	100%	
21.5.2015.	101%	101%	102%	102%	103%	100%	103%	100%	100%	100%	100%	100%	100%	100%	105%	205%	135%	100%	100%	100%	100%	100%	100%	100%	100%	
22.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	102%	101%	100%	100%	100%	107%	100%	100%	105%	100%	100%	100%	100%	100%	
23.5.2015.	100%	102%	100%	100%	100%	100%	100%	100%	100%	100%	100%	101%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
24.5.2015.	100%	101%	100%	100%	101%	100%	100%	101%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	101%	100%	100%	102%	100%	103%	
25.5.2015.	100%	100%	100%	100%	100%	100%	102%	100%	106%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
26.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
27.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
28.5.2015.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
29.5.2015.	101%	101%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
30.5.2015.	102%	104%	100%	100%	104%	103%	100%	100%	101%	100%	101%	100%	103%	100%	100%	101%	100%	103%	101%	100%	102%	100%	103%	100%	104%	
31.5.2015.	101%	104%	100%	100%	104%	102%	100%	103%	100%	100%	101%	100%	102%	100%	101%	102%	100%	104%	102%	100%	104%	103%	100%	104%	104%	

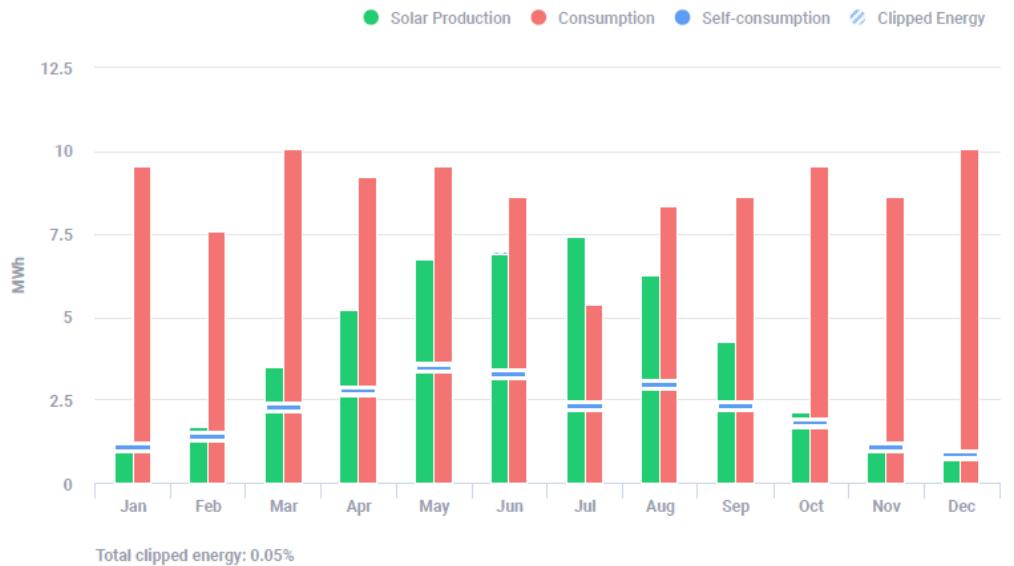
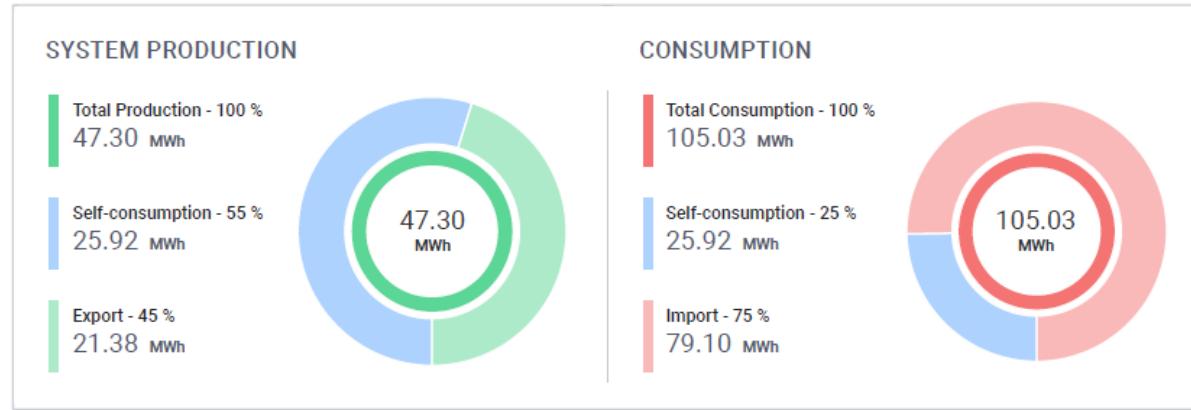
# Presenečenja iz prakse (1/2)



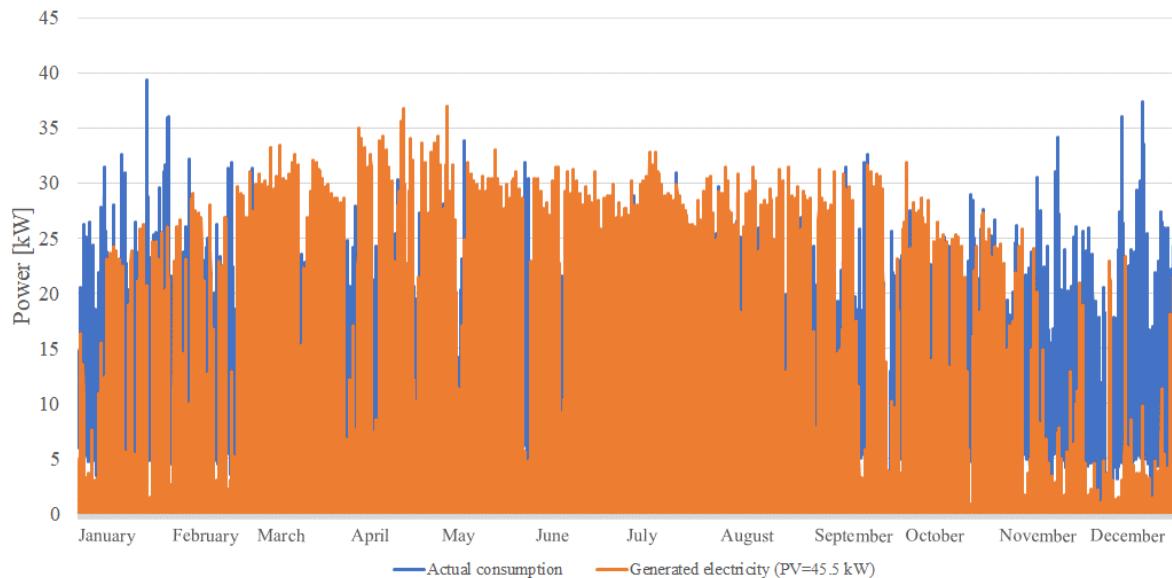
# Presenečenja iz prakse (2/2)



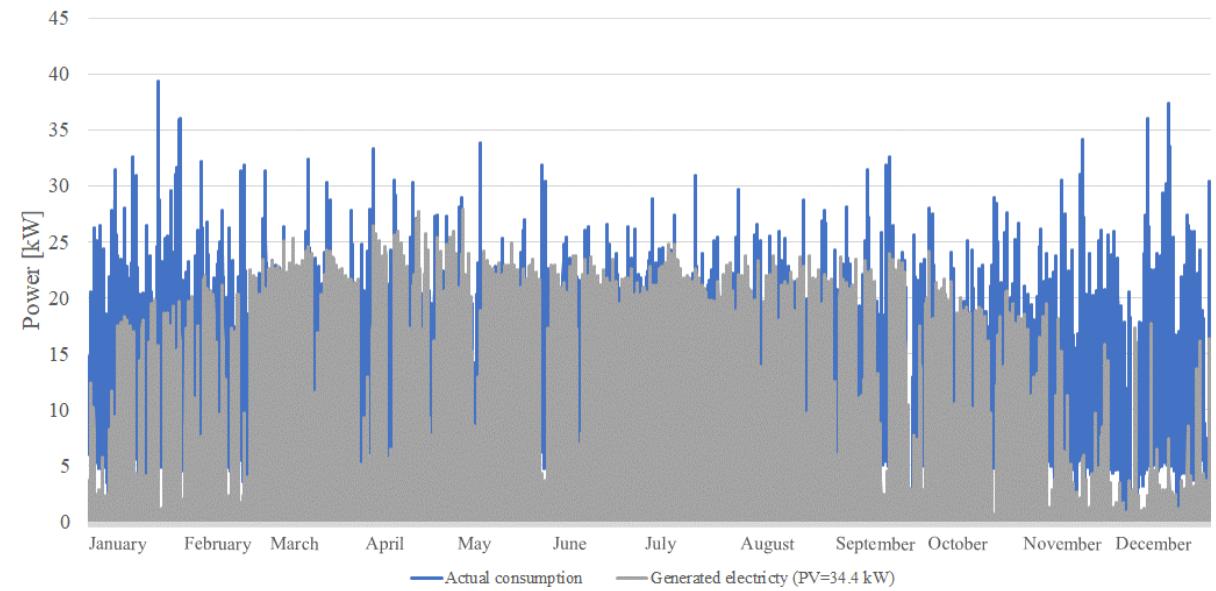
# Izračun ekonomičnosti sončne elektrarne (1/3)



# Izračun ekonomičnosti sončne elektrarne (2/3)



$\text{SSR} = 45\%$  in  $\text{SCR} = 72\%$ .



$\text{SSR} = 34\%$  in  $\text{SCR} = 84\%$ .

# Izračun ekonomičnosti sončne elektrarne (3/3)

	Units	
Installed power	kW	45.5
Unified/Single Tariff (including price of energy and grid fee)	EUR/MWh	160
Investment	EUR/kW	1,300
Economic lifetime	years	30
Required return on equity	%	4%
Fixed annual maintenance costs	EUR/kW	9
Fixed annual insurance costs	EUR/kW	9
Design, connection and commissioning	EUR	3,000
Total costs of the PV system (investment)	EUR	62,150
Expected electricity generation	MWh/year	47.55
Value of the generated electricity (SCR = 100%)	EUR/year	7,607.60
Operation, maintenance and insurance costs	EUR/year	819.00
Total savings (SCR = 100%)	EUR/year	6,788.60
Value of the generated electricity (SCR = 72%)	EUR/year	5,465.97
Operation, maintenance and insurance costs	EUR/year	819.00
Total savings (SCR = 72%)	EUR/year	4,646.97
Simple payback period (SCR = 100%)	years	9.2
Net present value (SCR = 100%)	EUR	55,238.70
Simple payback period (SCR = 72%)	years	13.4
Net present value (SCR = 72%)	EUR	18,205.57

	Units	
Installed power	kW	34.4
Unified/Single Tariff (including price of energy and grid fee)	EUR/MWh	160
Investment	EUR/kW	1,300
Economic lifetime	years	30
Required return on equity	%	4%
Fixed annual maintenance costs	EUR/kW	9
Fixed annual insurance costs	EUR/kW	9
Design, connection and commissioning	EUR	3,000
Total costs of the PV system (investment)	EUR	47,720
Expected electricity generation	MWh/year	35.95
Value of the generated electricity (SCR = 100%)	EUR/year	5,751.68
Operation, maintenance and insurance costs	EUR/year	619.20
Total savings (SCR = 100%)	EUR/year	5,132.48
Value of the generated electricity (SCR = 84%)	EUR/year	4,832.07
Operation, maintenance and insurance costs	EUR/year	619.20
Total savings (SCR = 84%)	EUR/year	4,212.87
Simple payback period (SCR = 100%)	years	9.3
Net present value (SCR = 100%)	EUR	27,075.84
Simple payback period (SCR = 84%)	years	11.3
Net present value (SCR = 84%)	EUR	11,684.46

# Sistematičen proces uvajanja sprememb

## UČINKOVITA OPIMIZACIJA

- Podpora odločanju
- Sistem merjenja
- Nadzor in prilagajanje porabe energije dejanskim potrebam
- Dinamično vrednotenje
- Verifikacija doseženih prihrankov

## ZNANJE

- Pravilno razumevanje porabe energije in vode
- Povezovanje porabe in konteksta
- Vrednotenje (eng. *benchmarking*)
- Ocena (napoved) bodoče porabe energije in vode

## INFORMACIJE

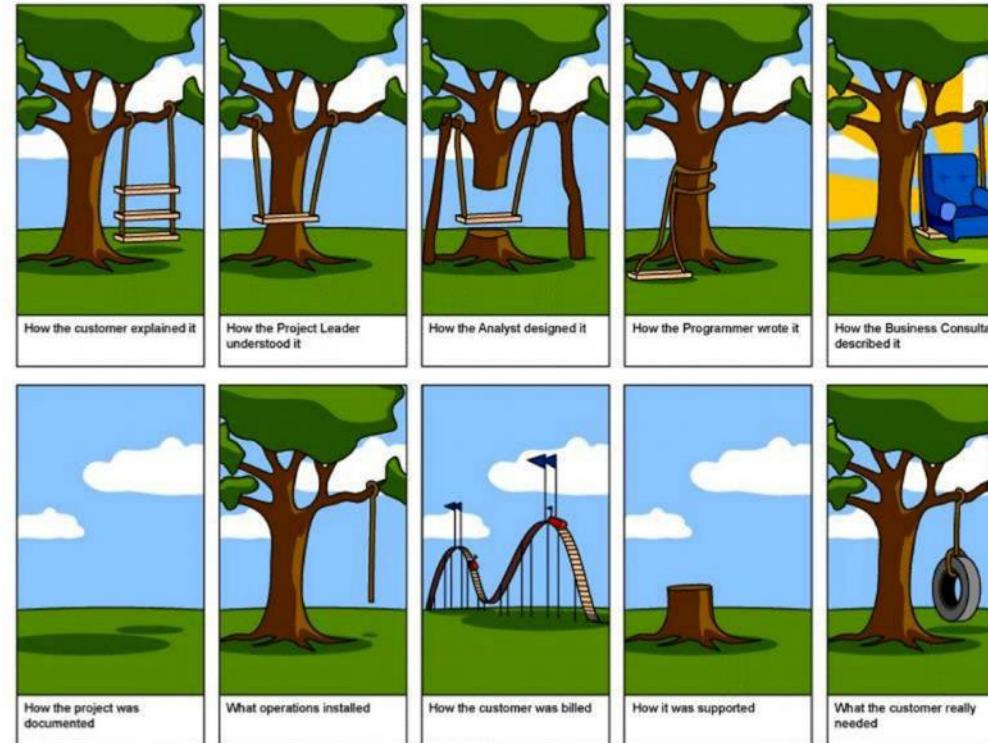
- Kazalniki
- Stroški za energijo in vodo
- Obdelani kontekstualni parametri
- Razni alarmi

## PODATKI

- Poraba energije in vode
- Zunanja temperatura
- Osončenost
- Notranja temperatura
- Prisotnost na delovnem mestu
- Cena energije

# Namesto zaključka – ohranite enostavnost pristopa

- Združujte aktivnosti, vendar nikoli ne pozabite na svoje začetne cilje in pričakovanja naročnika!



Source: Watts, A. (2014). *Project Management*. Victoria, B.C.: BCcampus. Retrieved from <https://opentextbc.ca/projectmanagement/> and Watt, A., Barron, M., and Barron, A. (2014). *Project Initiation in Project Management*. Victoria, B.C.: BCcampus [online] Available at: <https://opentextbc.ca/projectmanagement/chapter/chapter-7-project-initiation-project-management/> [Accessed 19 March 2024]

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Hvala za vašo pozornost!

