

SOLAR THERMAL POTENTIAL IN THE DISTRICT HEATING SYSTEM OF BELGRADE CITY

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DISTRICT ENERGY IN CITIES

A GLOBAL INITIATIVE TO UNLOCK THE POTENTIAL OF ENERGY EFFICIENCY AND RENEWABLE ENERGY





STRUCTURE (%) OF RENEWABLE ENERGY POTENTIAL IN SERBIA

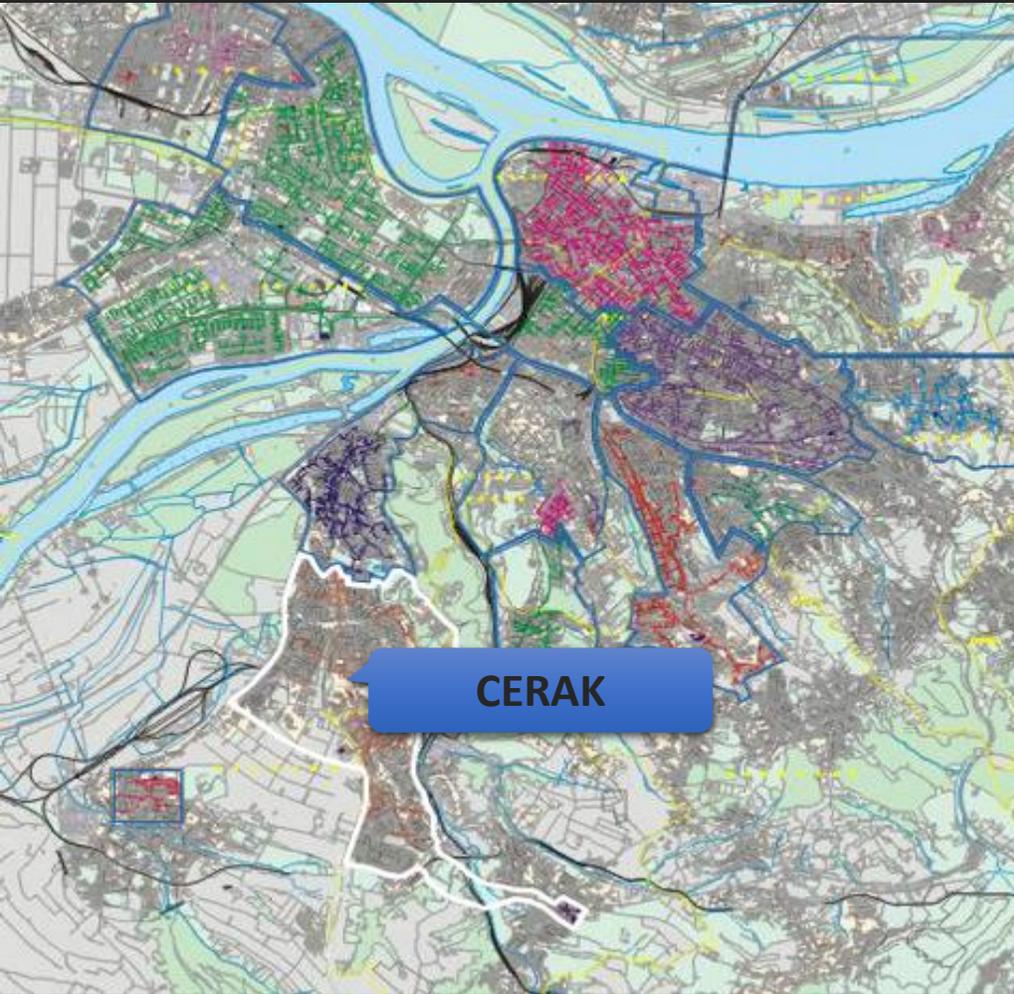
Type of RES	Potential
Biomass	63%
Solar	14%
Wind	4.5%
Geothermal	4.5%
Hydro	14%





ASSESSMENT OF SOLAR THERMAL IN CERAK, BELGRADE

- **Cerak** is located in Belgrade's municipality of Čukarica;
- The population of more than **40,000 residents**;





CLIMATE DATA FOR BELGRADE

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C	4.6	7.0	12.4	18.0	23.5	26.2	28.6	28.7	23.9	18.4	11.2	5.8	17.4
Daily mean °C	1.4	3.1	7.6	12.9	18.1	21.0	23.0	22.7	18.0	12.9	7.1	2.7	12.5
Average low °C	-1.1	-0.1	3.7	8.3	13.0	15.8	17.5	17.6	13.5	9.0	4.2	0.2	8.5
Average snowy days	10	7	4	1	0	0	0	0	0	0	3	8	33
Mean monthly sunshine hours	72.2	101.7	153.2	188.1	242.2	260.9	290.8	274.0	204.3	163.1	97.0	64.5	2,111.9





CERAK POWER PLANT

- **Cerak** power plant has been in operation **since 1985**;
- The **capacity** of **245 MW** (2x58 MW + 116 MW gas water boilers, 2x6.5 MW oil steam boilers);
- Due to a new connections there is a potential to **increase a future capacity**;
- Heat is supplied to **~27,000 apartments** (1,500,000 m²);
- Cerak heat plant has a **site** of about **76,000 m²**;





CERAK POWER PLANT

- **110 km** District Heating **Network** pipeline (Dn700/Dn600);
- Cerak heat plant has a **site** of about **75,900 m²**;





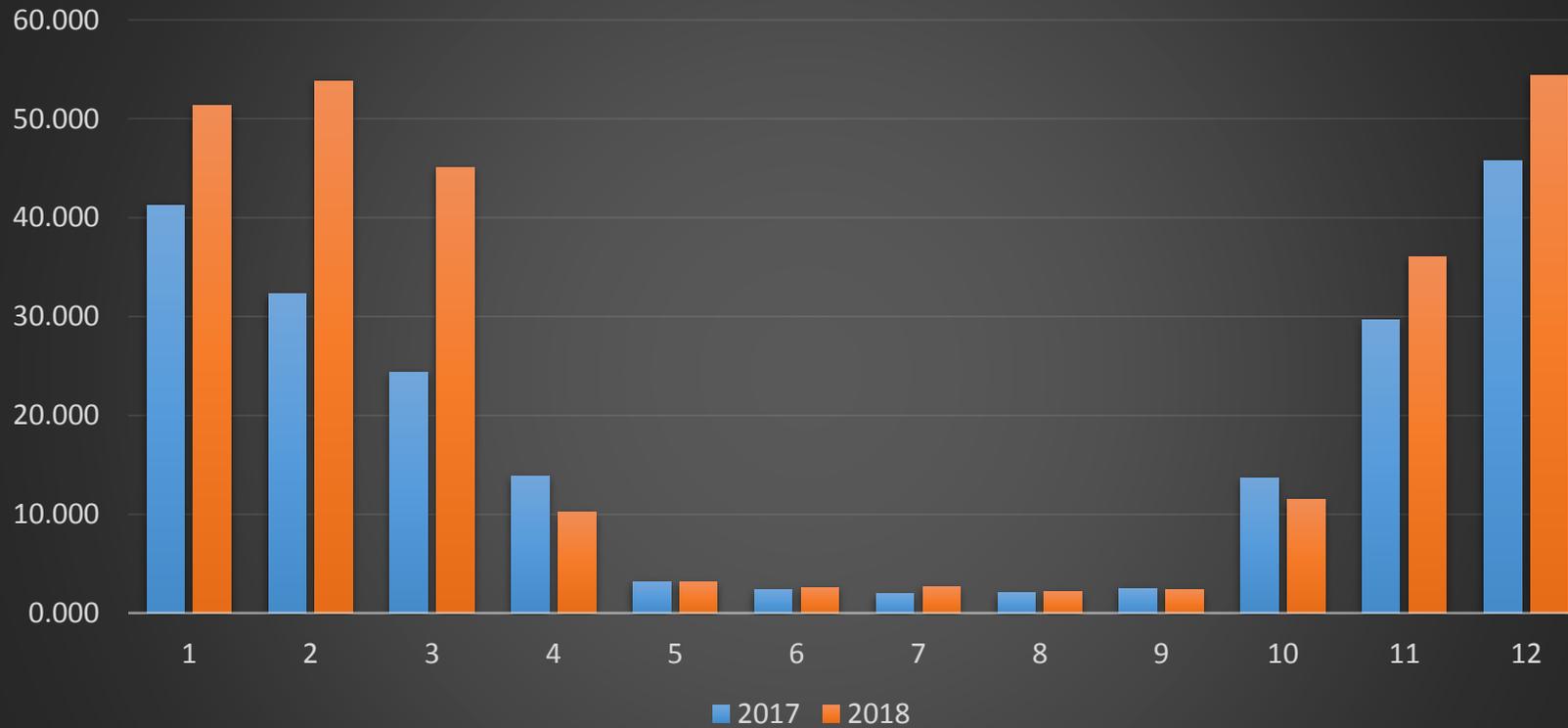
HEAT ENERGY DEMAND IN CERAК

Date	Heat demand, MWh 2017	Heat demand, MWh 2018	Average heat demand, MWh 2017-2018	Share from total heat demand in 2017-2018, %
Jan	41,265	51,327	46,296	19.0
Feb	32,281	53,845	43,063	17.6
Mar	24,380	45,078	34,729	14.2
Apr	13,865	10,213	12,039	4.9
May	3,188	3,116	3,152	1.3
Jun	2,369	2,630	2,499	1.0
Jul	1,992	2,659	2,325	1.0
Aug	2,042	2,147	2,094	0.9
Sep	2,488	2,337	2,412	1.0
Oct	13,663	11,470	12,566	5.1
Nov	29,620	36,018	32,819	13.4
Dec	45,724	54,437	50,080	20.5
Total	212,877	275,283	244,080	100.0





HEAT ENERGY DEMAND IN CERAK

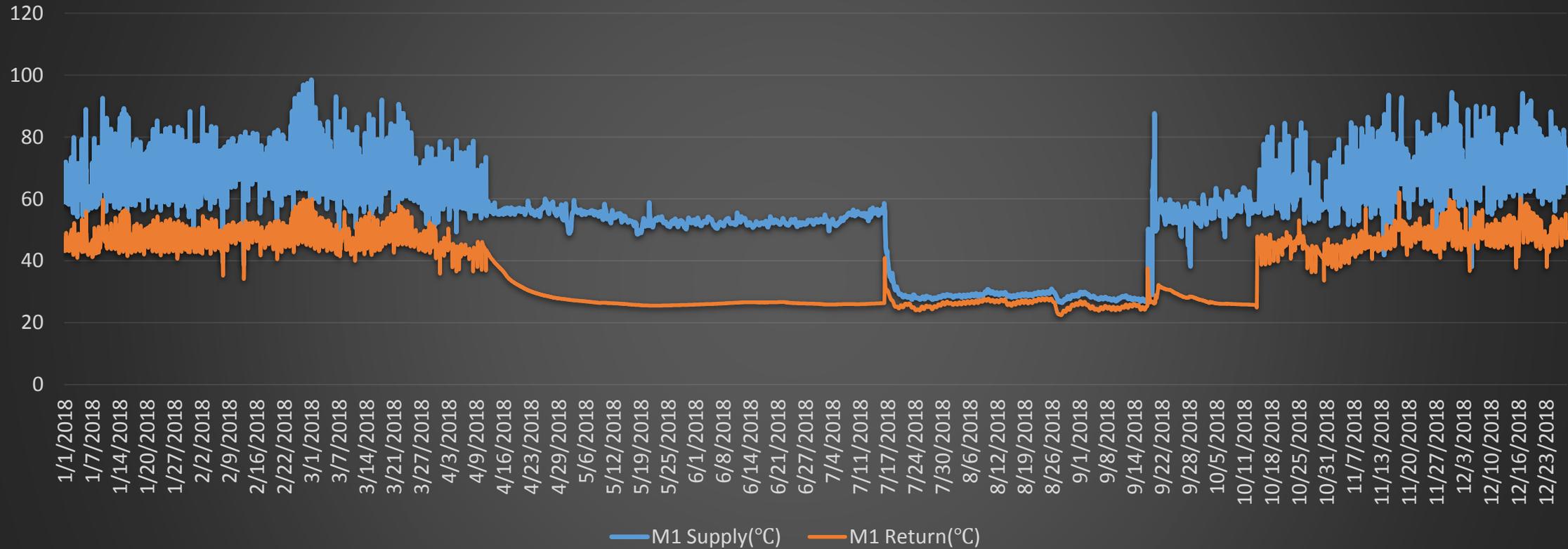




SOLAR THERMAL POTENTIAL IN BELGRADE DISTRICT HEATING SYSTEMS



DISTRICT HEATING NETWORK SUPPLY AND RETURN TEMPERATURES IN CERAK





HEAT DEMAND AND SOLAR HEAT PRODUCTION PER SOLAR THERMAL COLLECTOR AREA

Date	Heat demand 2018, MWh	Heat product, KWh/m2	Heat product, MWh			
			10,000 m2	31,800 m2	35,000 m2	39,700 m2
Jan	51'327	16	163	518	570	647
Feb	53'846	31	312	992	1'092	1'239
Mar	45'079	45	447	1'420	1'563	1'773
Apr	10'214	51	506	1'609	1'771	2'008
May	3'117	72	719	2'286	2'516	2'853
Jun	2'631	79	786	2'500	2'752	3'121
Jul	2'659	81	805	2'559	2'816	3'194
Aug	2'148	78	780	2'481	2'731	3'098
Sep	2'338	57	574	1'825	2'009	2'279
Oct	11'470	41	411	1'308	1'439	1'633
Nov	36'019	23	229	728	802	909
Dec	54'438	16	155	492	542	614
Total	275'283	589	5'886	18'718	20'602	23'368

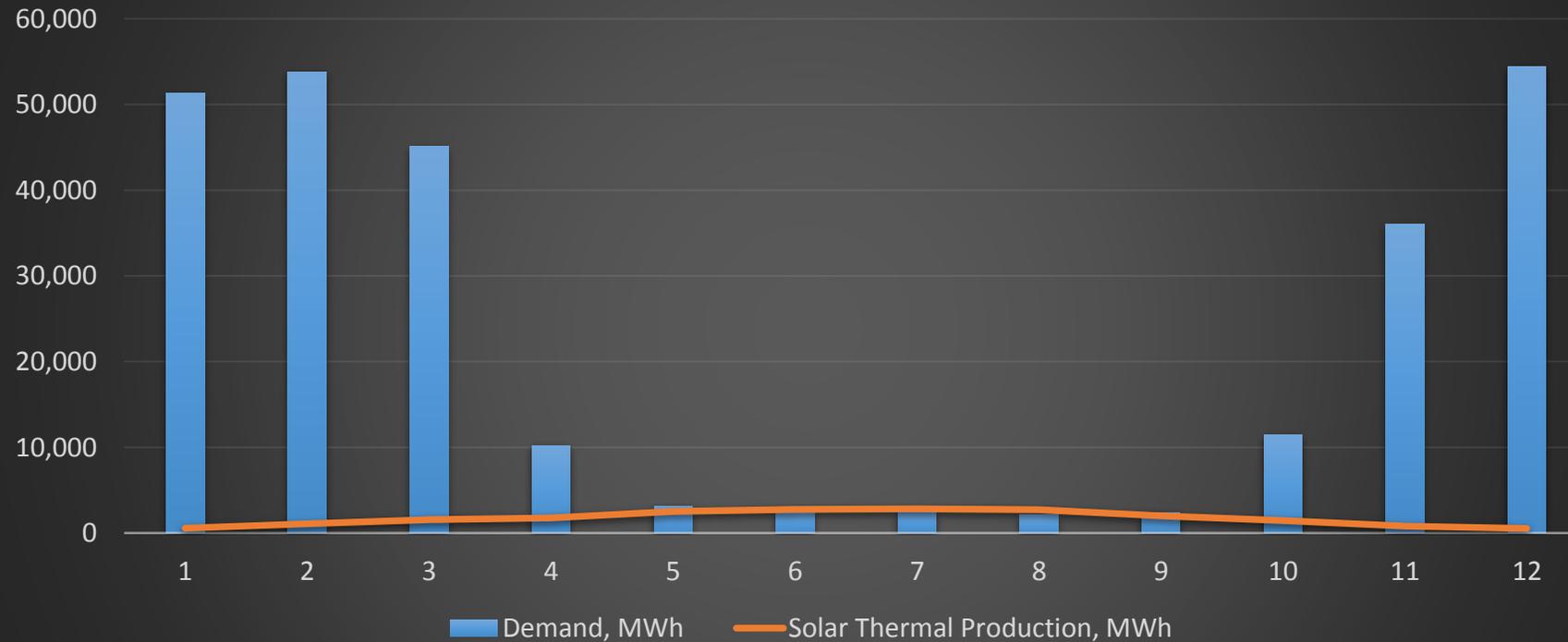




SOLAR THERMAL POTENTIAL IN BELGRADE DISTRICT HEATING SYSTEMS



HEAT DEMAND AND SOLAR HEAT PRODUCTION PER SOLAR THERMAL 35.000 m² COLLECTOR AREA





SOLAR THERMAL PANELS INSTALLATION

- The required **site area** for installation of **10,000 m²** of solar thermal collector panels is about **18,000 m²**,
- The solar thermal collector area of **35,000 m²** requires about **62,000 m²** of site area.

Total solar collector area	10,000 m ²	35,000 m ²
Solar collector length	5.97 m	5.97 m
Row distance	4 m	4 m
Ground area	23.88 m ²	23.88 m ²
Required land area	18,000 m ²	62,000 m ²





LAND AVAILABILITY IN CERAK POWER PLANT

- The **site area** of the **Cerak** heat plant is about **82,000 m²**;
- The area of the **main facilities** including boilers, oil tanks and management/control building is about **44,000 m²**;
- The remaining site area can be estimated to be about **38,000 m²**.
- This area is enough for **10,000 m²** of solar thermal collector panels installation (land of **18,000 m²**), but for **35,000 m²** solar collectors area (land of **62,000 m²**) requires additional area outside power plant.





FINANCIAL ANALYSIS OF SOLAR THERMAL INSTALLATION IN CERAK POWER PLANT

- For the installation of the **10,000 m²** solar thermal collectors is necessary **2,5 mln. Eur CAPEX**. (without thermal storage, land and transmission line).
- **OPEX** makes **14,500 Eur** per year;
- **IRR** makes **8,5 %**;
- **Payback 10 years** (3% interest).





Thank You

Dr. Romanas Savickas

