HRVATSKI OGRANAK MEĐUNARODNOG VIJEĆA
ZA VELIKE ELEKTROENERGETSKE SUSTAVE – CIGRE
COMITE NATIONAL CROATE
CROATIAN NATIONAL COMMITTEE

tel: +385 1 487 25 07

Berislavićeva 6, HR-10000 ZAGREB, CROATIA

National strategies for decarbonization of Energy sector and impacts to Electric Power System

SOUTH-EAST EUROPEAN REGIONAL COUNCIL OF CIGRE (SEERC)

SECOND CIGRE SEERC Colloquium

Ljubljana, Slovenia
29. February 2024

Targets - RED III Directive

The share of RES in gross final energy demand in 2030 of 42.5%

The share of RES in heating and cooling in 2030 – an increase of 1.1 percentage points per year (1.5 percentage points if waste heat is used)

The share of RES in centralized heating and cooling systems - an increase of 2.1 percentage points per year

49% RES in buildings by 2030 - indicative goal increase of REN of 1.1 percentage points per year in industry - indicative target

Targets - RED III Directive

Reduction of greenhouse gas emissions at least 13% by 2030.

Reduction of net emissions by -55% at EU level in 2030 compared to 2005.

Reduction of emissions for the ETS sector -62% – for 2030 compared to 2005.

Reduction of emissions for the non-ETS sector at EU level -40% – for 2030 compared to 2005.

Reduction of emissions for the non-ETS sector for Croatia -16.7% - for 2030 compared to 2005.

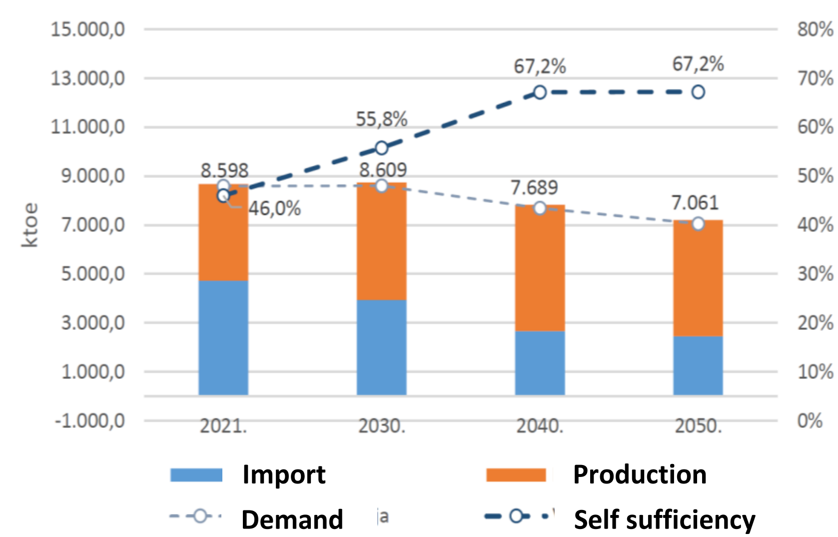
Share of Renewables

Share, %	Existing targets 2021.	Targets 2030. Existing NECP	Updated NECP	RED III
In the gross final consumption of energy	**31,7**	36,6	42,5	42,5
In the final consumption of electricity	**53,5**	63,8	73,6	
In the final consumption of energy for heating and cooling	**38,0**	36,6	47,1	1,1 p.p./god.
In the final consumption of energy in transport	**7,1**	14,0	21,6	(26,0)*

* - according to RED III, the traffic goal is defined as a reduction of greenhouse gas emissions (13% in 2030 compared to 2020), which corresponds to about 26% of the share of RES in 2030.

100 measures planned for implementation! (up to 2026./2030.)

https://mingor.gov.hr/azurirani-integrirani-nacionalni-energetski-i-klimatski-plan-republike-hrvatske-za-razdoblje-od-2021-2030-necp/9220



Total energy consumption and self sufficiency

ETS i non-ETS sectors

	EU target for 2030. compared to 2005.	CRO target in 2030. compared to 2005. (WAM)
ETS sector	-62 % (target for all EU)	-50,2 %
Non-ETS sector	-40 % (target for all EU) -16,7 % (target for Croatia)	-16,7 %

Energy efficiency

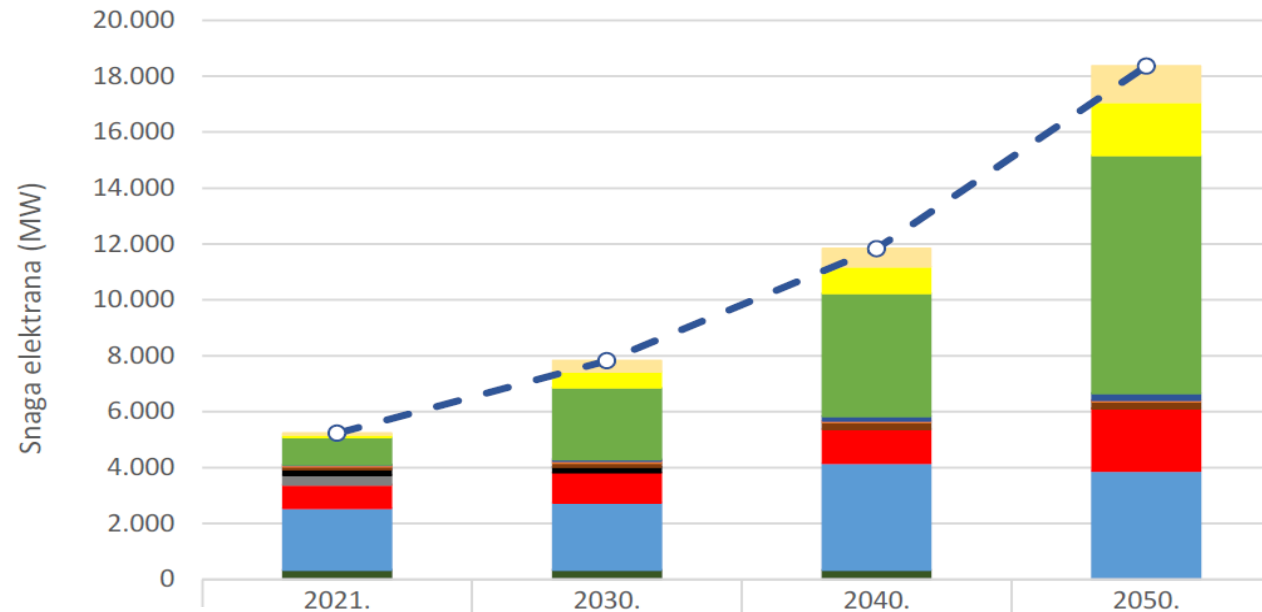
	Cilj za 2030.	
	Existing NECP	Updated NECP
Primary energy consumption	344,4 PJ	340,9 PJ
Final energy consumption	286,9 PJ	274,2 PJ
Cumulativne savings 2021.-2030.	125,3 PJ	180,6

WAM-with aditional measures

Croatia's key objectives, targets and contributions

	2030 value submitted in the draft updated NECP	2030 target under EU legislation	Assessment of 2030 ambition level
GHG emissions in ESR sectors (compared to 2005)	-17.1%	-16.7%*	Croatia reaches its target based on projections.
GHG removals in LULUCF (Mt CO2 eq. net greenhouse gas removals)	-4.24	-0.593 (additional removal target) -5.527 (total net removals)**	Not reaching its target based on projections.
Energy Efficiency (Final energy consumption)	6.6 Mtoe	5.9 Mtoe***	Croatia's final energy consumption is above the indicated target resulting from EU legislation.
Renewable Energy (Share of renewable energy in gross final consumption)	42.5%	44%****	Croatia's contribution to the EU target is slightly below the one resulting from EU legislation.

Expected capacity WAM



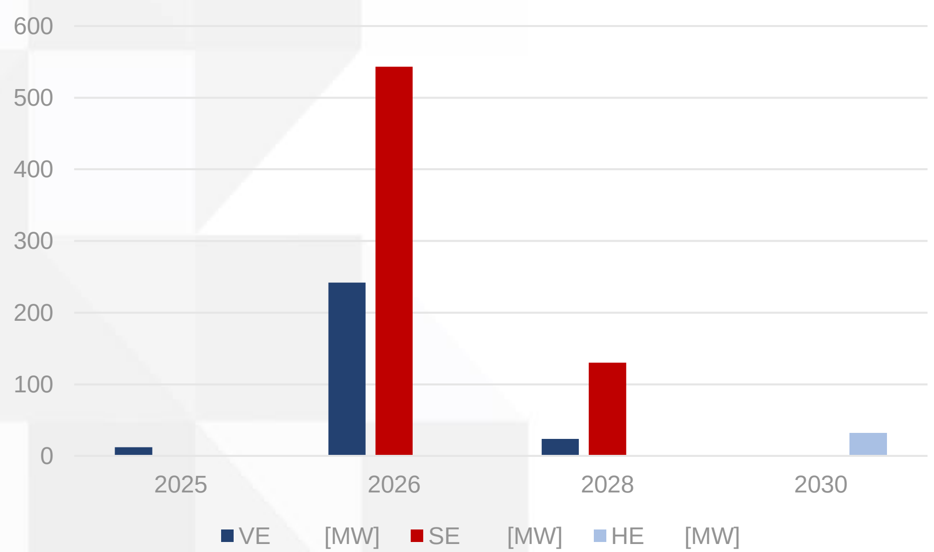
	2021.	2030.	2040.	2050.
Integrated PV	55	384	640	1.275
Non Integrated PV	83	576	960	1.913
Wind	987	2.562	4.384	8.519
Geothermal	10	68	168	238
Bioplin	59	59	59	59
Biomass	95	145	245	245
Coal	210	210	0	0
Liquid fuel	344	0	0	0
Naturag gas	840	1.079	1.212	2.231
Hydro	2.201	2.393	3.814	3.882
Nuclear	348	348	348	0
Total	5.232	7.824	11.830	18.362

Some basic numbers of transmission system in Croatia

Renewables on the transmission system:

Wind power plants	1106 MW
Solar power plants	12,4 MW

The total production of all wind farms in Croatia in 2023 was 2532.5 (2071,41) GWh. The average hourly production of all wind farms plants in the last 12 months was 289.13 (236,49) MWh.



RES plants that have a Connection Agreement until 2030

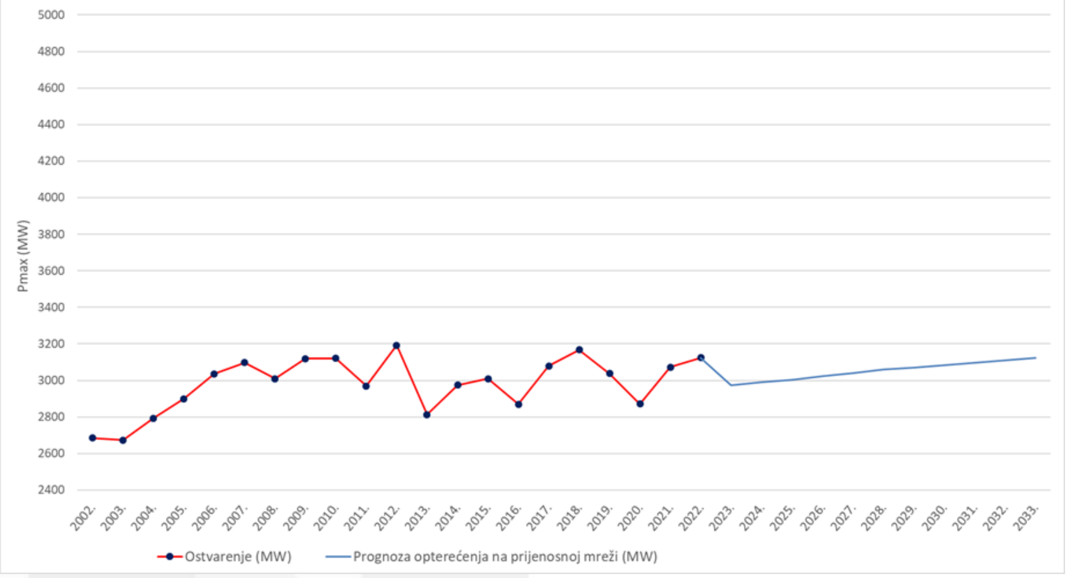
	Wind [MW]	PV [MW]	Hydro [MW]
2025	12		
2026	242	543,3	
2028	24	130	
2030			32
Total	278	673,3	32

Some basic numbers of transmission system in Croatia

If all projects are realized on the transmission network, a total of 983.3 MW + 6364 MW of production would be connected with only 80 MW of electricity storage facilities

A total of 5031 MW (HE, VE, TE, SE) is connected to the transmission network.

TYNDP has no new Interconnection capacity to the TSO Croatia in the foreseeable future



Peak Load in Power System, history and future

Near future - 6364 MW

Number of RENs connected to distribution system

As of 31. January 2024

	Number of power plants		Installed capacity (kW)		Total	
	Low voltage	Meddle voltage	Low voltage	Meddle voltage	Number of power plants	Installed capacity (kW)
Solar	15.812	321	298.614	184.036	16.133	482.650
Wind	0	10	0	95.850	10	95.850
Biomass	9	34	4.264	95.768	43	100.032
Hydro	18	29	3.281	73.022	47	76.303
Geotermalna	0	1	0	10.000	1	10.000
Other	15	60	3.859	93.943	75	97.802
Total	15.854	455	310.018	552.619	16.309	862.637

In the last 12 months **app 240 MW of new solar power plants** has been installed (20 MW/monthly)

Requirements for connection of RENs

The number of requests for RENs connection has more than doubled. In 2023, 8,756 RENs were connected, and for comparison, by 2022, a total of 7,005 RENs were connected to the distribution network.

Very near future in DSO

Requirements for connection of RENs

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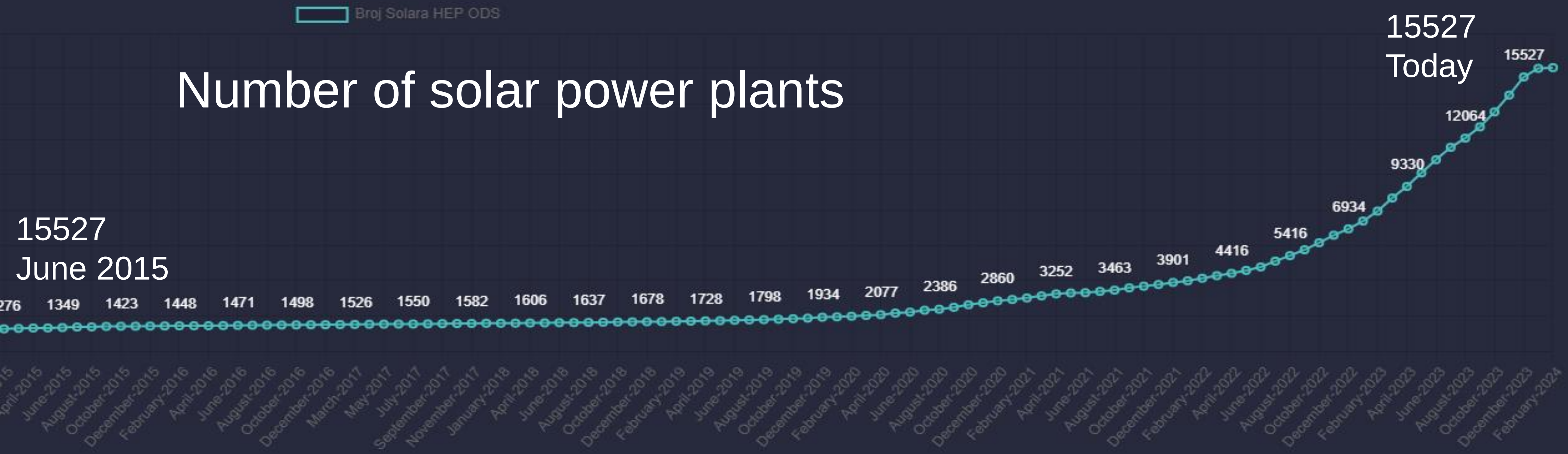
Expected connection of RENs

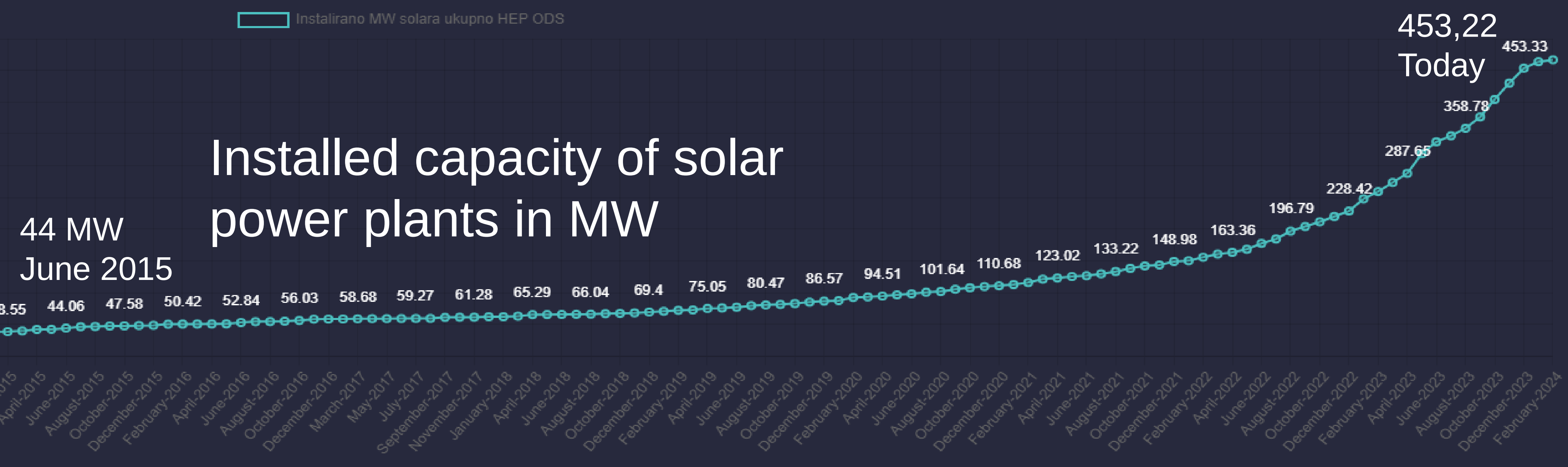
At the moment, there are 5290 power plants, mostly solar; in the process of getting permission or similar activity in order to install PV and build connection to the Grid.

It equals as 1320 MW of new power on the distribution grid.

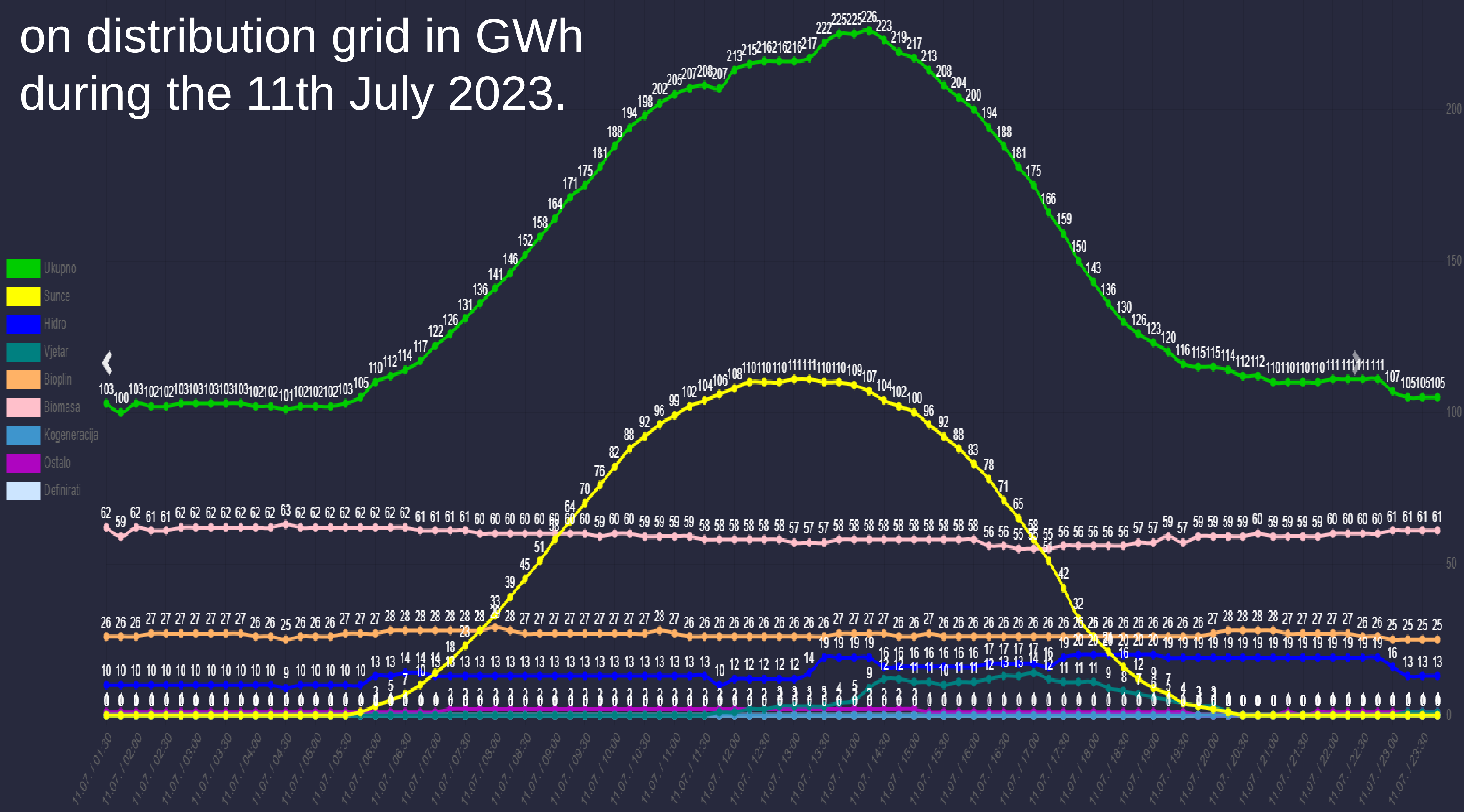
Additional we have indication of new 9795 power plants to start process of getting connection permit which equals to 444 MW.

All-in-all by the end of the year it wouldb be cca 2626 MW RENs on DS

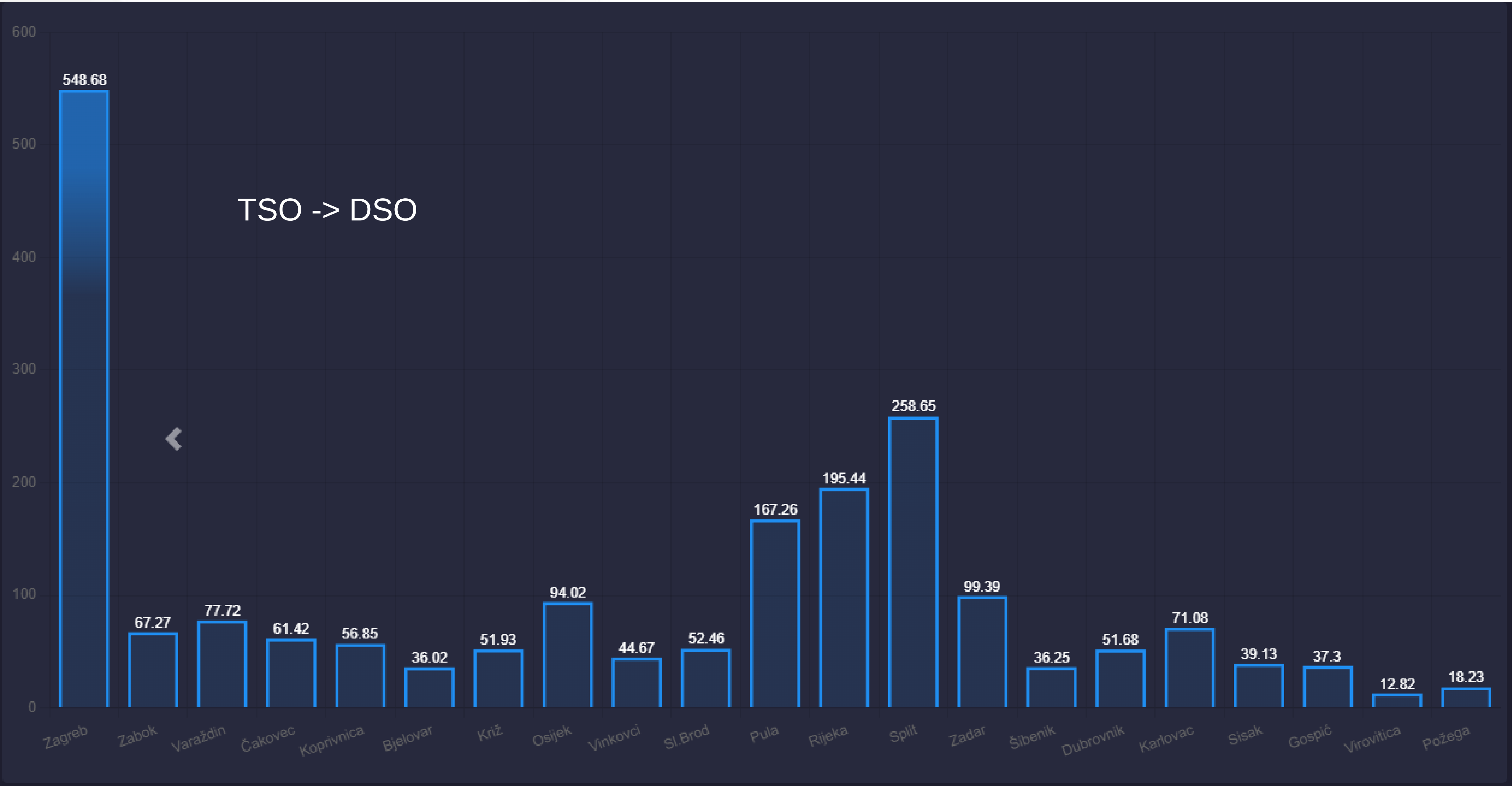

Broj Solara HEP ODS
Number of solar power plants
15527
Today
15527
June 2015
276
1349
1423
1448
1471
1498
1526
1550
1582
1606
1637
1678
1728
1798
1934
2077
2386
2860
3252
3463
3901
4416
5416
6934
9330
12064
15527


Instalirano MW solara ukupno HEP ODS
Installed capacity of solar power plants in MW
453,22
Today
44 MW
June 2015
44.06
47.58
50.42
52.84
56.03
58.68
59.27
61.28
65.29
66.04
69.4
75.05
80.47
86.57
94.51
101.64
110.68
123.02
133.22
148.98
163.36
196.79
228.42
287.65
358.78
453.33

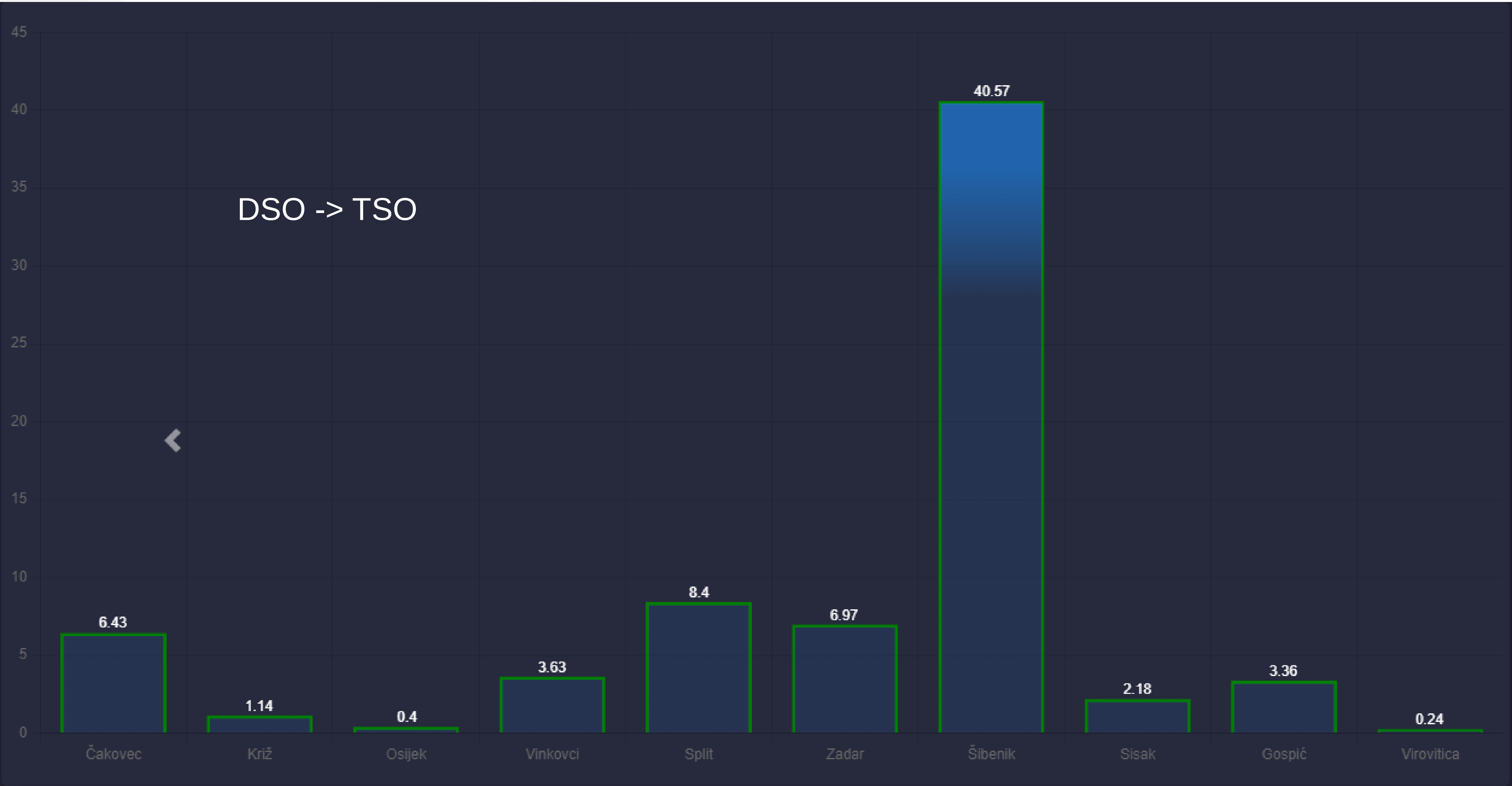
Production in renewables on distribution grid in GWh during the 11th July 2023.



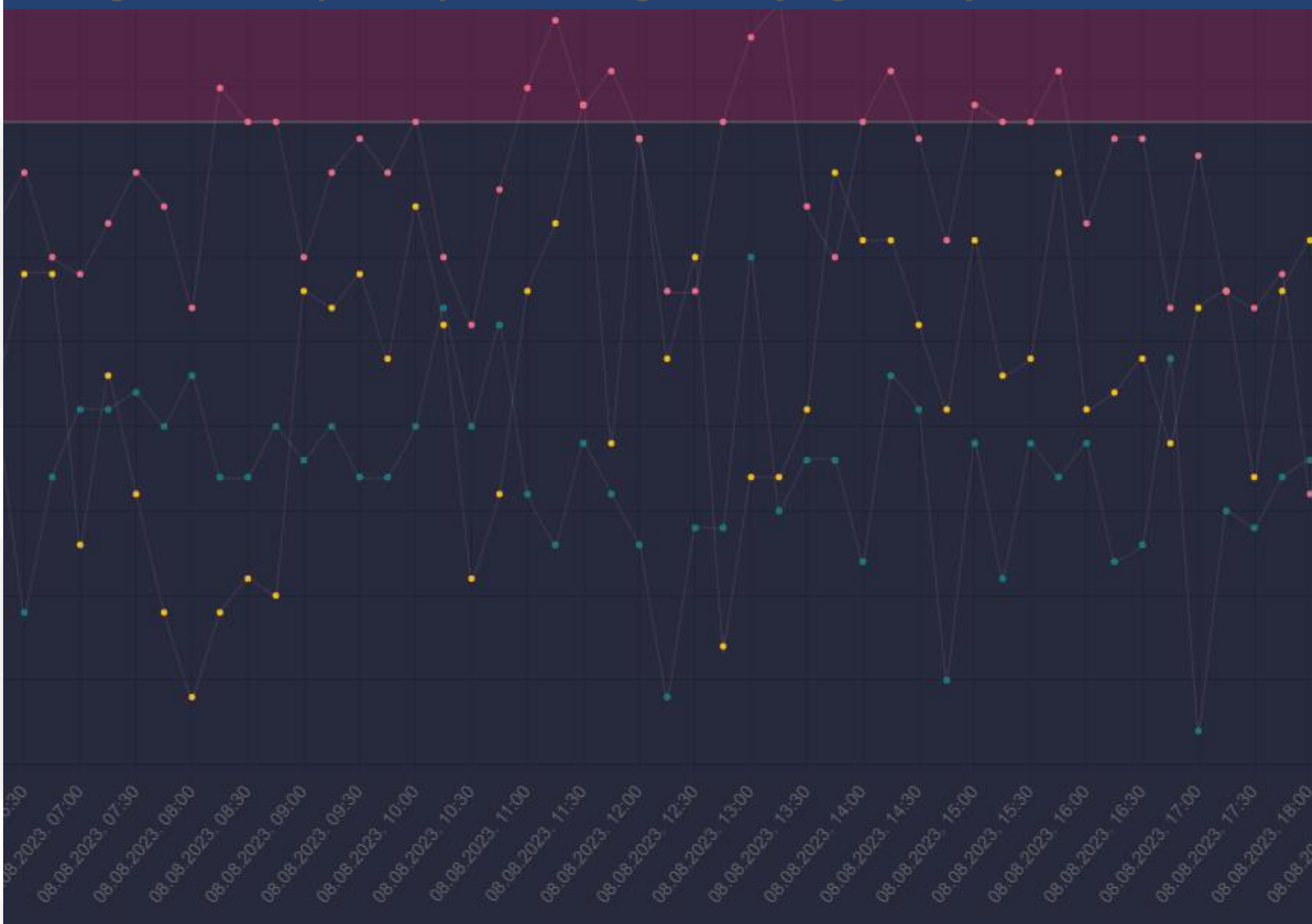
Peak power (in MW) from transmission system to distribution system in distribution area



Peak power (in MW) from distribution system in different distribution area to transmission system



Voltage on solar power plant during the day light in Bjelovar



RENs in distribution system

The problem with RENs is not only intermittency by itself, but also the fact that distribution network is not "strong" enough for this intermittency

A large number of RES, especially PV, are connected to DS at low voltage levels, and as such (according to the requirements placed on them) are unmanageable and inflexible. This becomes especially pronounced if we take into account the cumulative of a large number of "small" sources, with a high concurrency factor.

A lot of "small" resources on the network, which are intermittent, inflexible, unmanageable actually lead to becoming a source of instability for the system for which we have to find an alternative in flexibility (investing in the network, batteries, using flexibility in the network and using customer flexibility services,...)

Some specifics of the distribution system

In the "traditional DS", conditionally speaking, only the users-customers were the source of the need for system flexibility, which was solved by the flexibility in the network (network capacity, regulation possibilities of elements in the network, change of switching states, etc.)

RES connected to the distribution network lead to new extreme conditions for which the network is not dimensioned

Connecting a large number of RES requires greater/additional elasticity (flexibility) of the system (network + users)

The flexibility of the distribution network has not increased significantly over time, but the requirements and need for flexibility have increased dramatically

Possible solutions in the distribution network

Adaptation of infrastructure - smart networks, innovative solutions, energy storage and flexible consumption systems

Network users become an active participant in the functioning of the system as a whole so why not every stakeholder takes his responsibility

Encourage changes in the way the distribution network is used (mandatory support/flexibility of the network, tariffs, auxiliary services, ...)

Requirements for RES flexibility should be linked to their relative influence in the network and not to the installed/connected power