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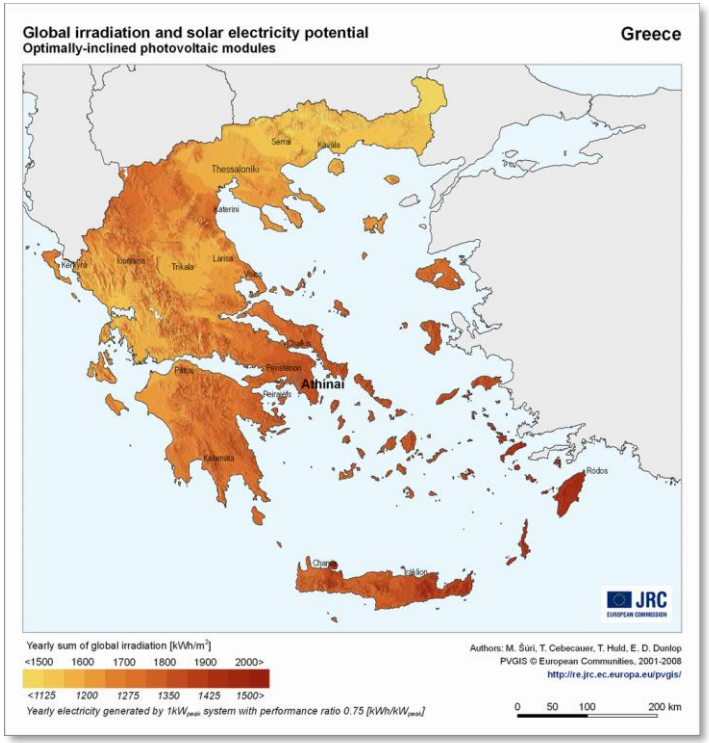
CISOLAR 2019 8th INTERNATIONAL CONFERENCE AND TRADE SHOW SOLAR ENERGY OF CENTRAL AND EASTERN EUROPE

8th International Conference and Trade Show
Solar Energy Industry in Central and Eastern Europe

CISOLAR 2019

Kiev – Ukraine



April 2019

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The Greek Electrical Systems

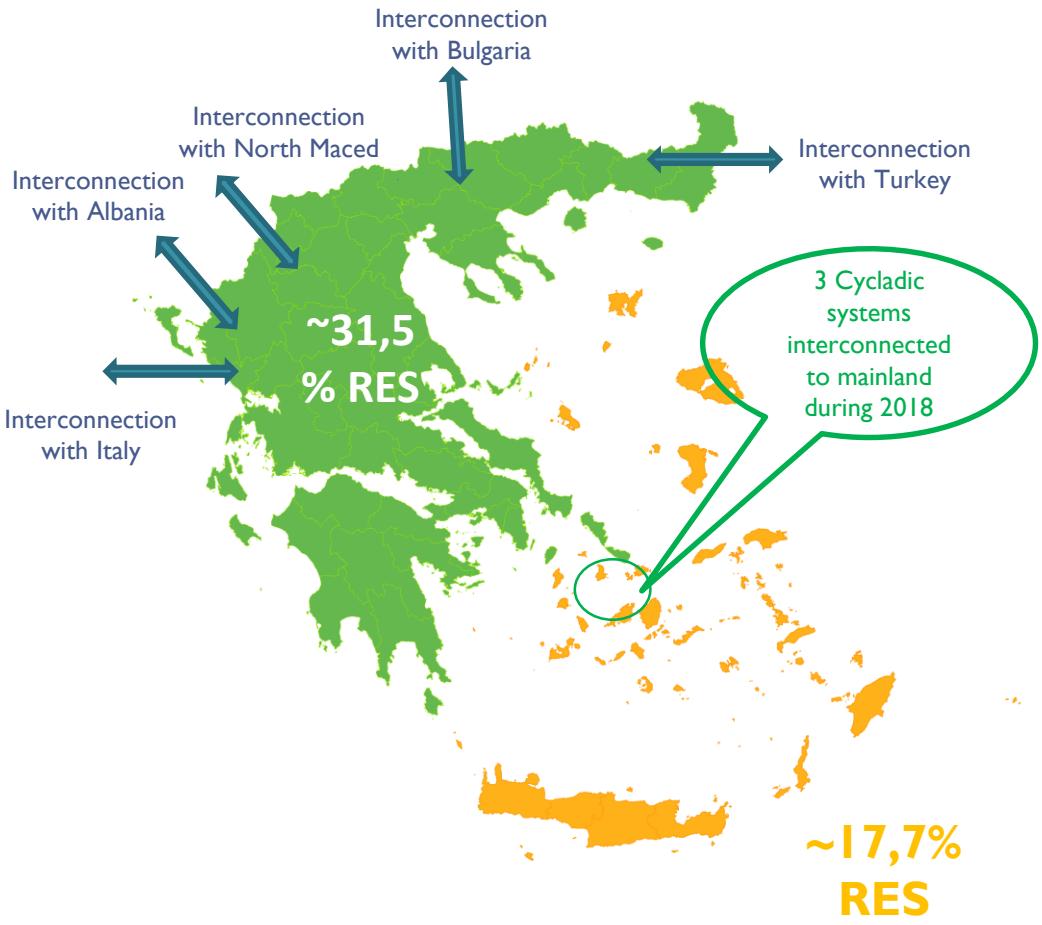
~51,6 TWh electricity demand

1 mainland system including Ionian Islands, interconnected with other European (Italy, Albania, North Macedonia, Bulgaria) and neighbor (Turkey) Countries

+

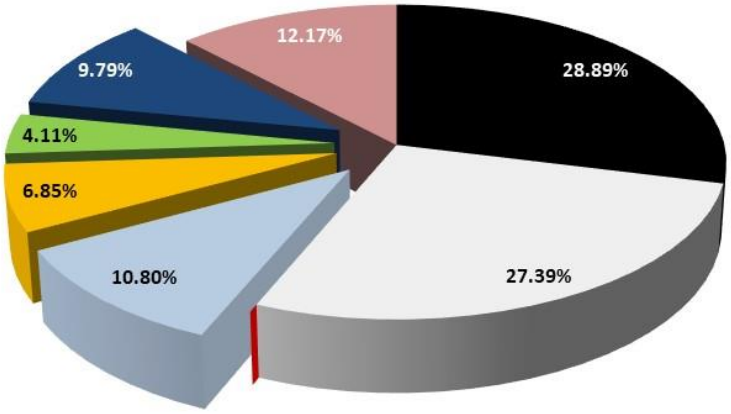
29 non interconnected to mainland electrical systems that cover Aegean islands plus Crete

~5.6 TWh electricity demand



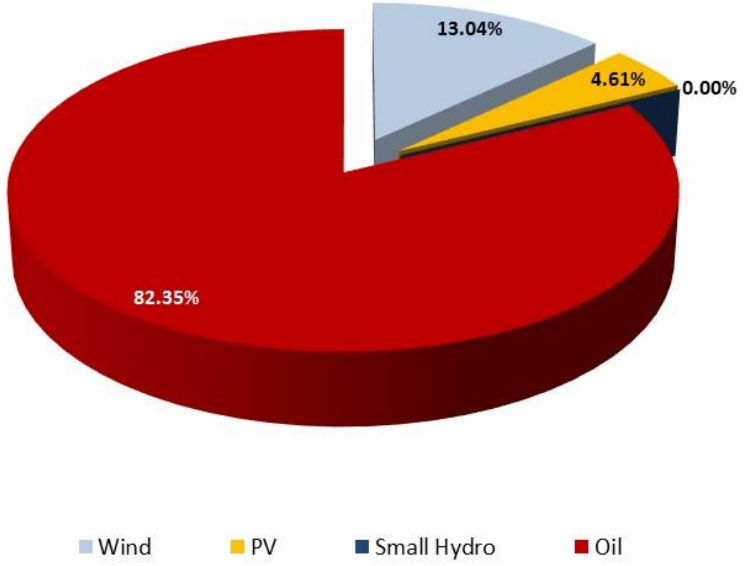
RES penetration % shares in electricity demand in Greece - 2018 (GWh)

Mainland 31,6%



	Share	GWh
Lignite	28.89%	14,907
Natural Gas	27.39%	14,136
Oil	0.00%	0
Wind	10.80%	5,574
PV	6.85%	3,536
Other RES & COGEN	4.11%	2,120
Large Hydro	9.79%	5,051
Interconnections	12.17%	6,279
	100%	51,603

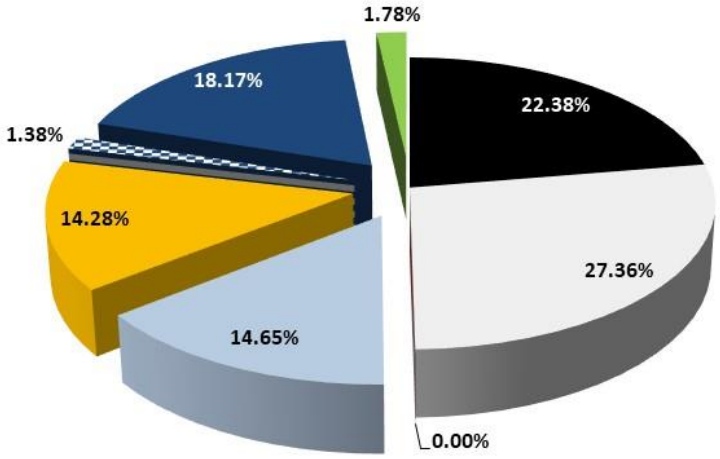
Non Inter/ted Islands ~17,7%



	Share	GWh
Wind	13.04%	726.11
PV	4.61%	256.77
Small Hydro	0.00%	0.26
Oil	82.35%	4586.12
	100.00%	5569.26

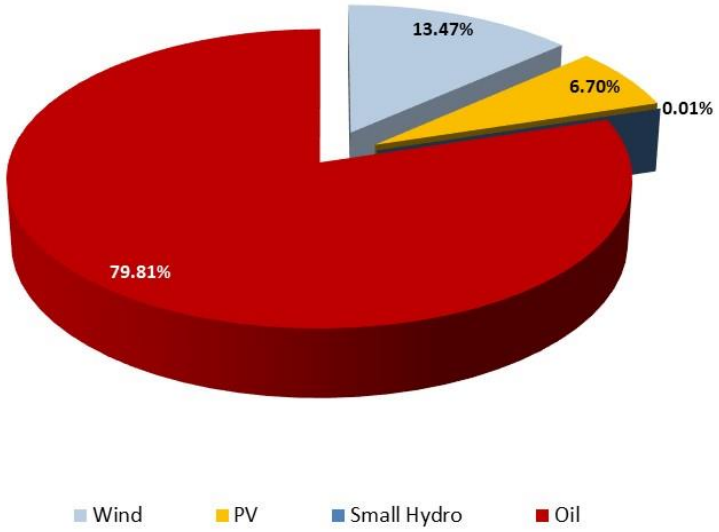
Thermal and RES Installed Operational Capacity MW in Greece - 2018

Mainland



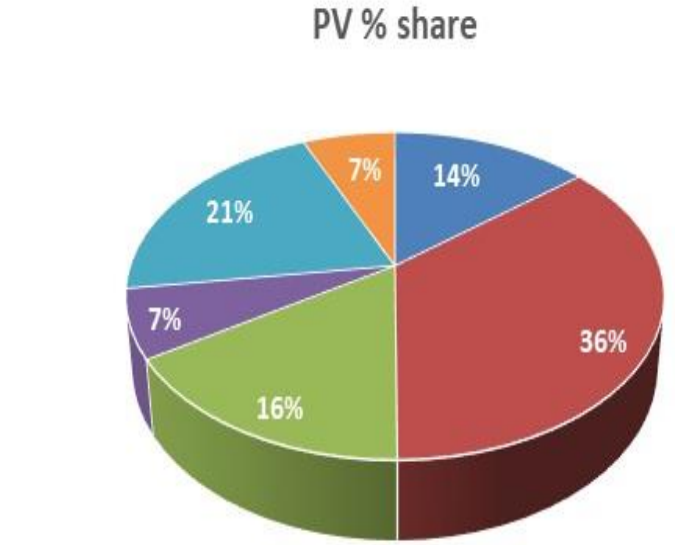
	Share	MW
Lignite	22.38%	3,904
Natural Gas	27.36%	4,772
Oil	0.00%	0
Wind	14.65%	2,555
PV	14.28%	2,491
Small Hydro	1.38%	240
Large Hydro	18.17%	3,170
Other RES & COGEN	1.78%	311
	100.00%	17,443

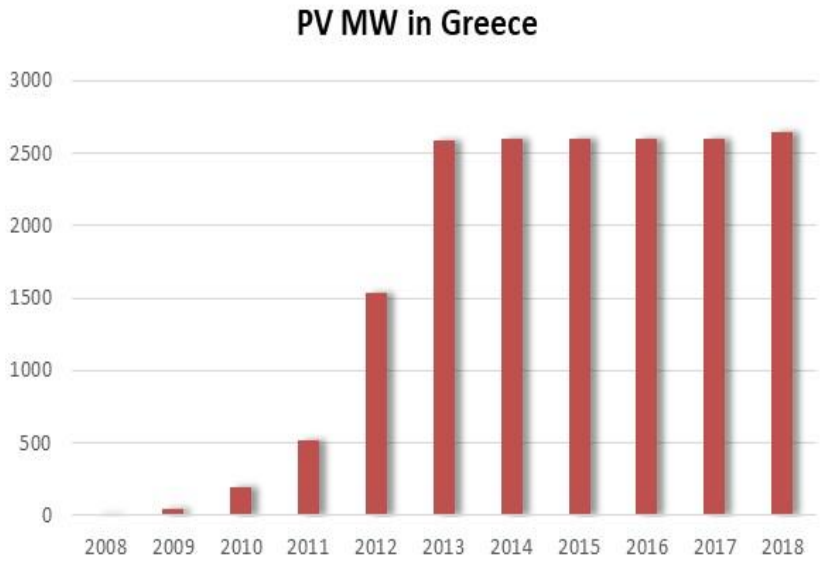
Non Inter/ted Islands



	Share	MW
Wind	13.47%	305.23
PV	6.70%	151.81
Small Hydro	0.01%	0.30
Oil	79.81%	1,808.33
	100.00%	2,265.67

Evolution & Profile of PV installations in Greece



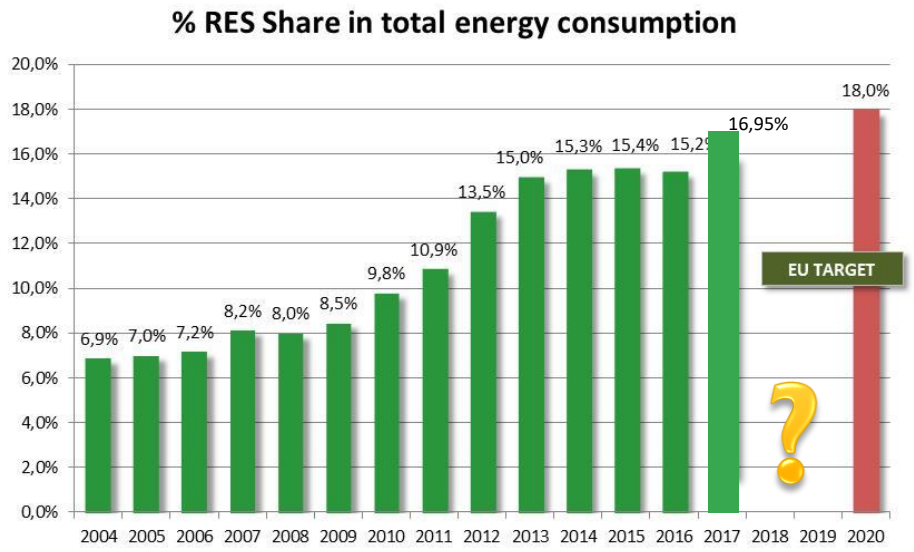


End 2018

PV	<10 kW	10-100kW	100-500 kW	0.5-1 MW	1-5 MW	>5 MW	Ttl Greece
MWp	375	945	427	178	546	175	2,646
% share	14%	36%	16%	7%	21%	7%	100%

2030 New RES Targets for Greece

RES National Targets in MW for electricity production	Old targets		Present	New National Plan		
	2014	2020	Capacity	2020	2025	2030
Wind	4,000	7,500	2,860	3,400	4,200	6,400
PV	1,500	2,200	2,646	3,300	5,500	6,900
Hydro	3,700	4,650	3,410	3,400	3,700	3,900
Bio	200	350	83	100	100	300
Solar thermal for electricity	120	120	0	0	100	100
Geothermal	0	0	0	0	0	100
Total RES MW	9,520	14,820	8,999	10,200	13,600	17,700

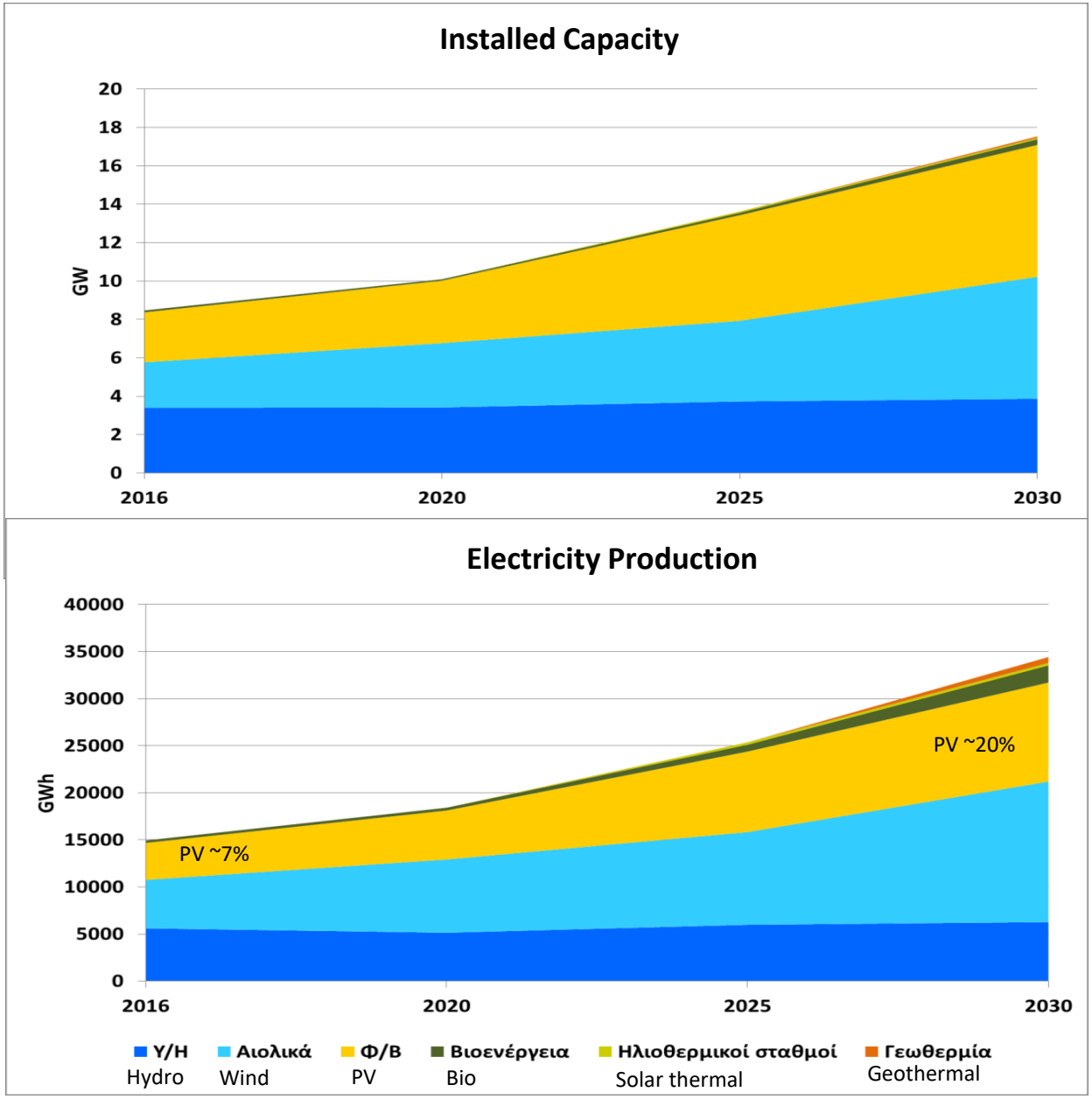


2030 New RES Targets

RES contribution at 32% in Final Gross Energy Consumption

RES contribution at 56% in Final Gross Electricity Consumption

RES projected evolution according to National Plan



Feed In Premium (FIP) under existing market model, under Target Model and future direct market participation for RES

New Context	Challenges on new RES projects
Sliding FIP under existing electricity market model.	Leads to little differentiation in final remuneration compared to agreed Reference Price (RP) per project (<2%).
Sliding FIP under full implementation of Target Model with operational Intraday and Balancing markets.	Could lead to higher differentiation of net remuneration vs Reference Price per project. Clearing of imbalances for new RES projects through aggregators could cost ~10% of their turnover especially at initial stages.
Potential further removal of RES priority for new RES projects and direct participation to the market through Target Model.	Not full absorption of RES production. Consequently new RES project's Levelized Cost of Energy (LCOE) will tend to rise, unless technology maturity could absorb it or economically competitive and efficient storage solutions are applied.

FIP and FIT for new PVs

RAE's last PV technology specific auction in Dec '18 gave FIP average Reference Price was at 66.67 euros/MWh in Category I (projects <1 MW). Category II (projects 1-20 MW) was canceled.

Category I and II now merged, so competition is expected to rise. Likely the prices are expected to decline further in future auctions. Overfill competition rule in auctions is now reduced from 75% to 40%. The net quantity for 2019 that can be selected in PV specific auctions is 432 MW for new PVs.

For commercial PV projects < 500 kW off-auction prices (FIT) are offered. Effective of 1/1/20 these FIT prices will be at a premium of +5% on the weighted average auction Reference Price of previous 3 auctions apart from the last one.

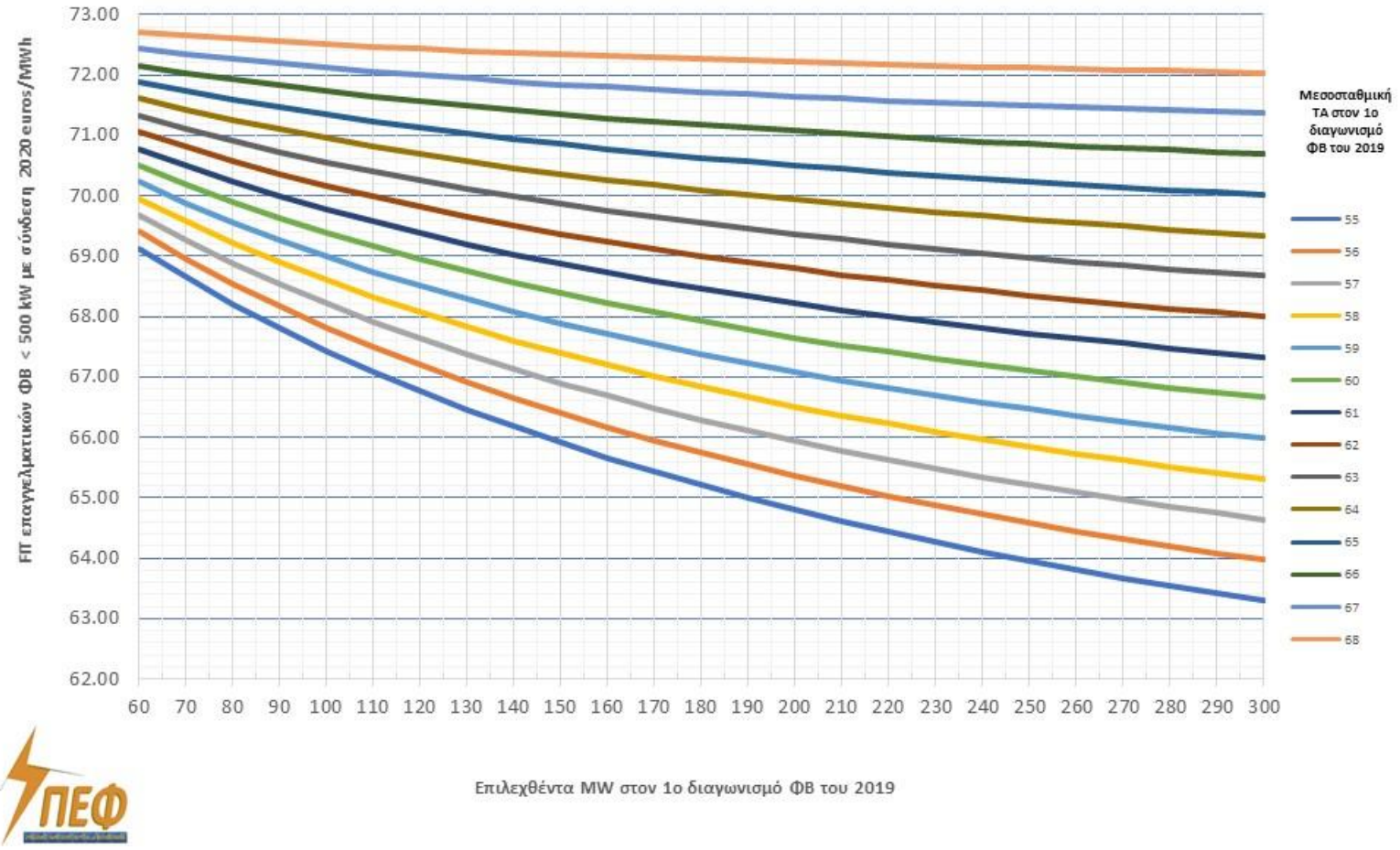
Presumed that there are going to be 2 PV auctions in 2019 (the first one will be in June) and in the first one 120MW of PV projects are selected at a weighted average Reference Price of i.e. 60euros/MWh, this leads to an off-auction FIT price of 68,94euros/MWh for PV projects <500kW connected to the grid beginning of 2020.

During 2019 (connection date to the grid) off-auction FIT prices offered for PV projects < 500 kW are:

- at 1.2 x average SMP of 2018 (72.47 euros/MWh) for projects < 100 kW
- at 1.1 x average SMP of 2018 (66.43 euros/MWh) for projects 100 kW<P<500 kW.

where SMP is System's Marginal Price namely electricity wholesale price.

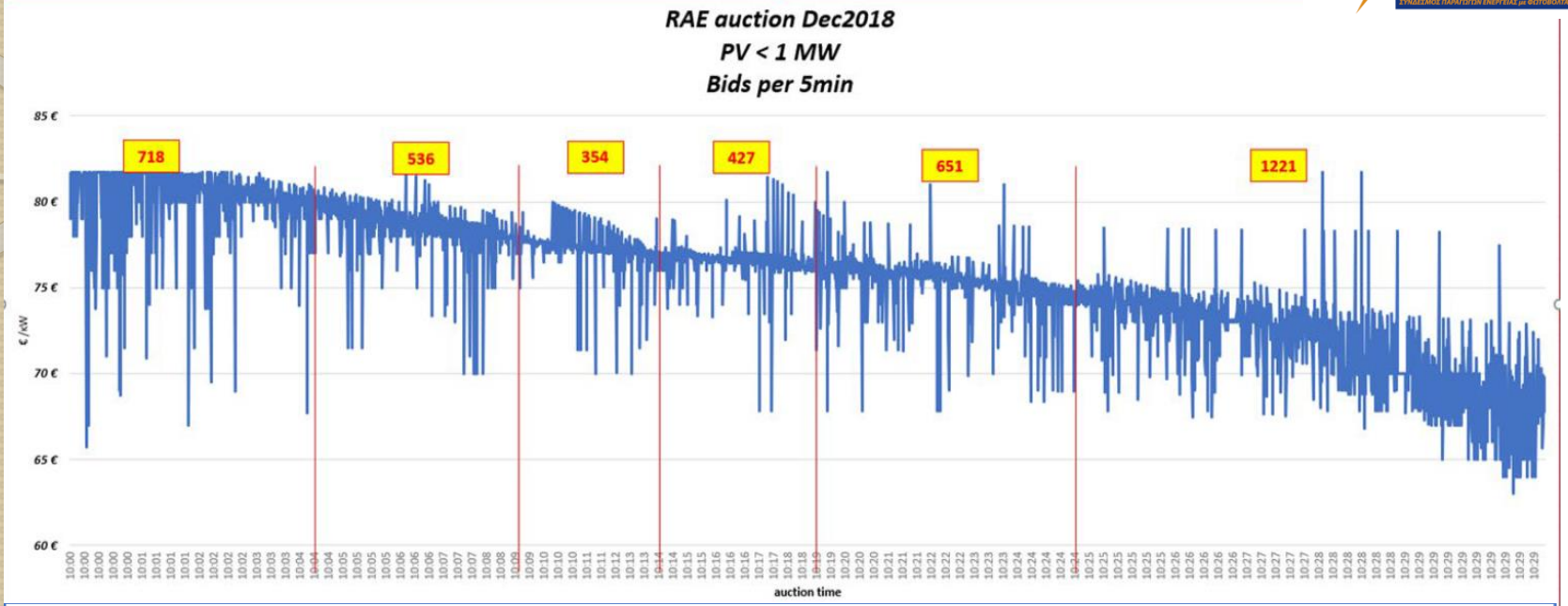
FIT for new commercial PVs< 500 kW
(a few scenarios for off-auction prices)

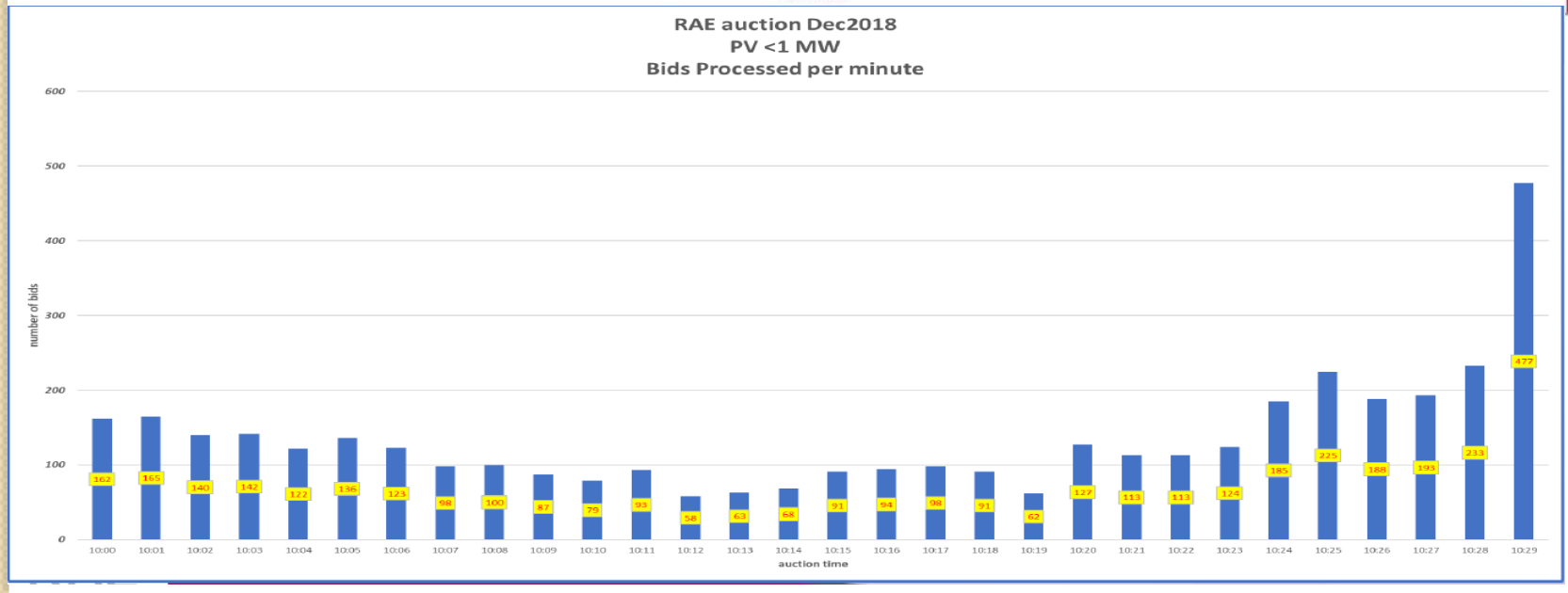


Assumptions:

- Two specific auctions for PV's during 2019.
- Connection to the grid takes place after 1/1/20 but prior the 1st auction of 2020.

Category I for PV, Dec 2018 RAE auction





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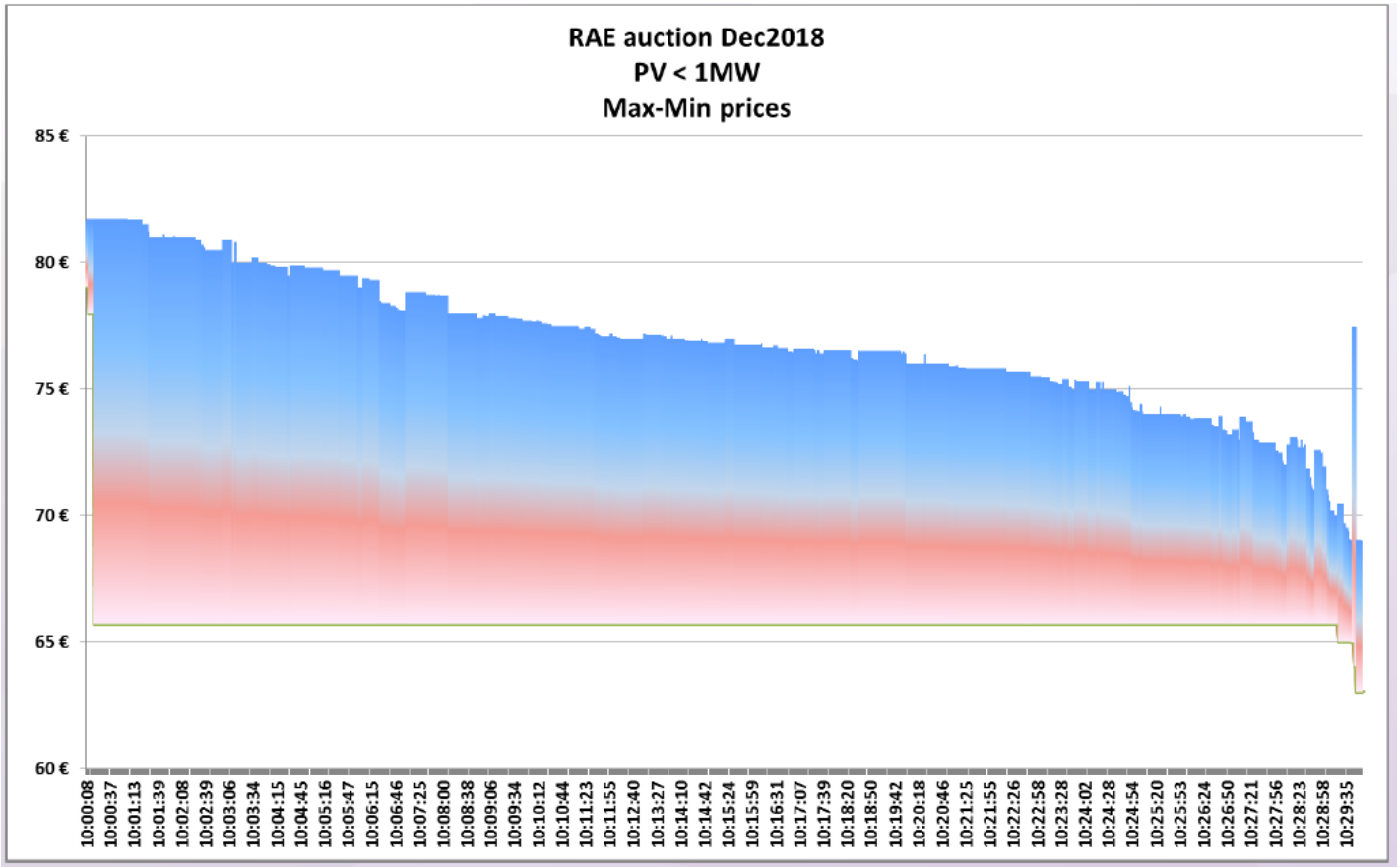


RES imbalances cost

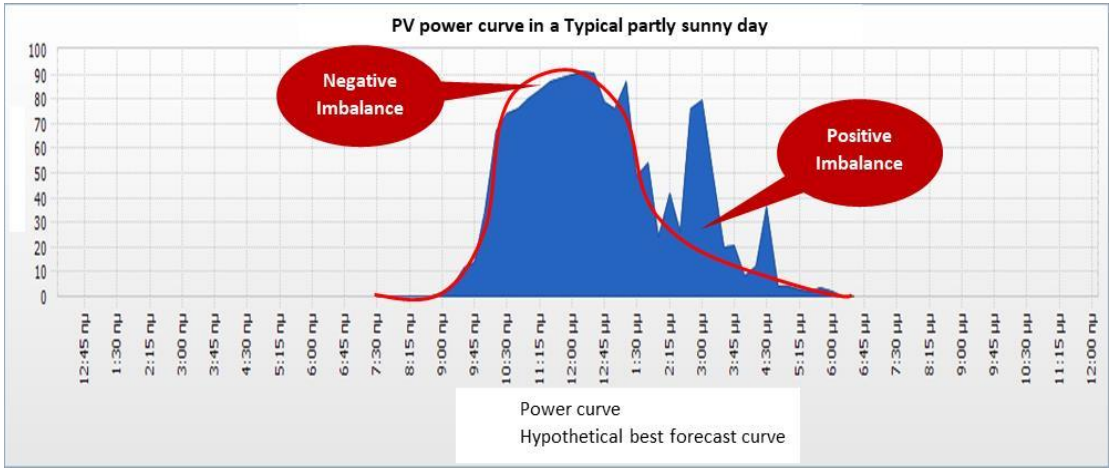
The cost for RES imbalances (IPt) per MWh will be single for positive or negative deviations, calculated according to the following:

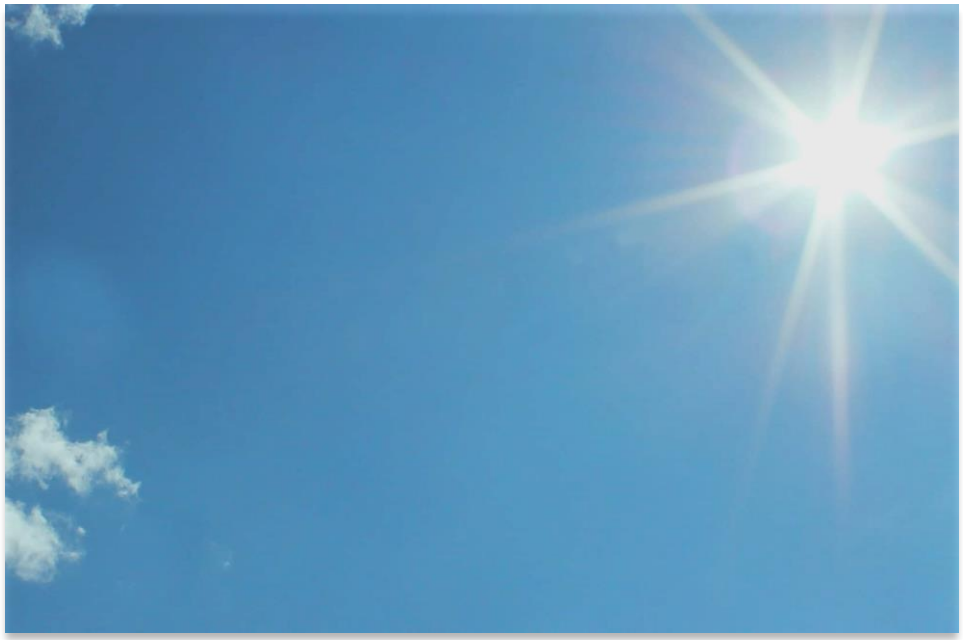
$$IP_t = \left| \frac{\sum_e ABEC_{e,t}^{mFRR,up} + \sum_e ABEC_{e,t}^{aFRR,up} + \sum_e ABEC_{e,t}^{mFRR,dn} + \sum_e ABEC_{e,t}^{aFRR,dn}}{\sum_e ABE_{e,t}^{mFRR,up} + \sum_e ABE_{e,t}^{aFRR,up} + \sum_e ABE_{e,t}^{mFRR,dn} + \sum_e ABE_{e,t}^{aFRR,dn}} \right|$$

Namely, it is the absolute value of total cost for upward and downward balancing paid to BSP divided by total balancing energy needed.

The cost of an upward balancing service will reflect the remuneration that a Balancing Services Provider (BSP) would ask, in order to increase his production and fill the gap.

The cost of a downward balancing service will reflect the remuneration that a BSP would ask to keep, in order to reduce his production compared to his prepaid position in Day Ahead Market and hence counteract the spike.





THANK YOU !

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