ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY

Dept. of International & European Studies MSc Energy

Elective Course /
Special Issues in Energy Finance and Risk Management

Renewable Energy Sources in Greece

Lessons learned in RES auctions:

The Greek case

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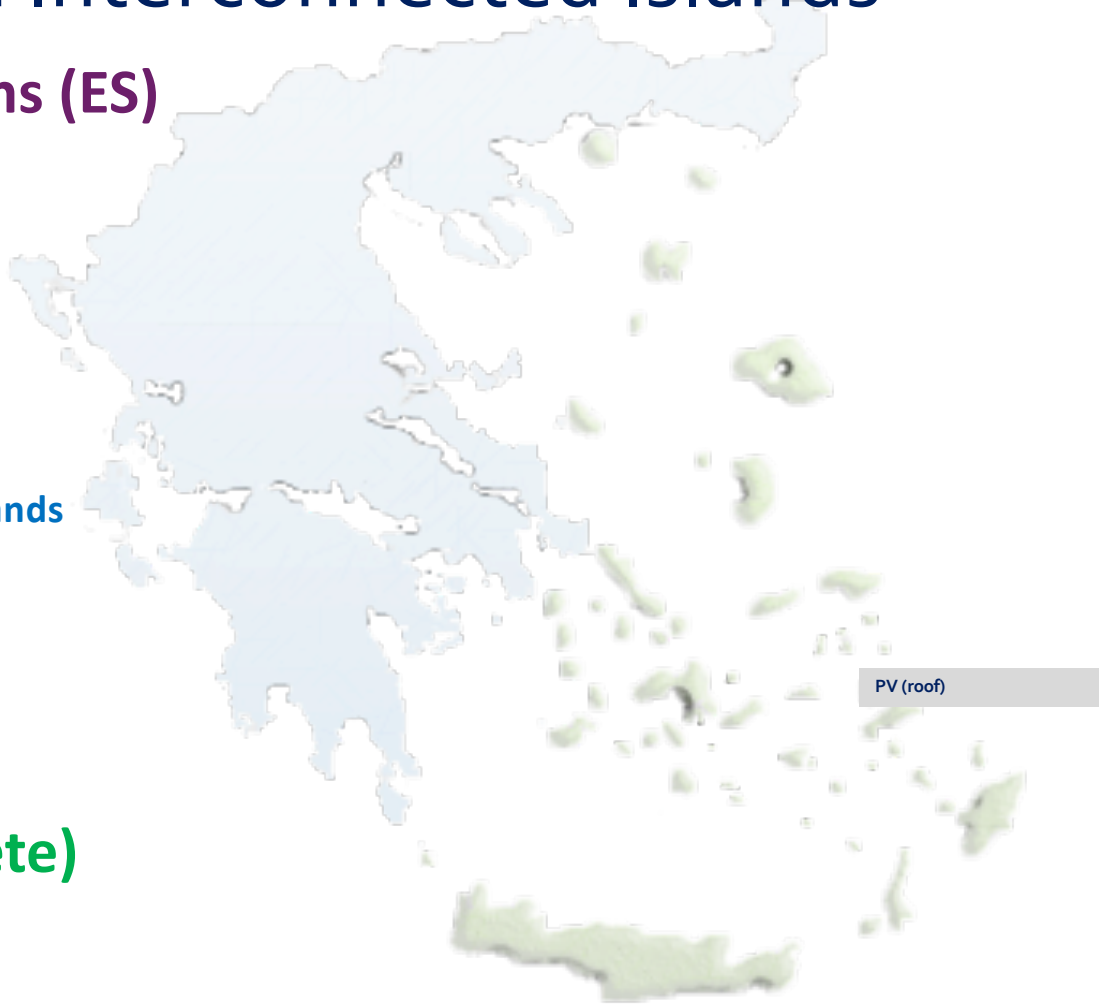
Introduction
The Greek energy System

Current Situation of the Greek energy System

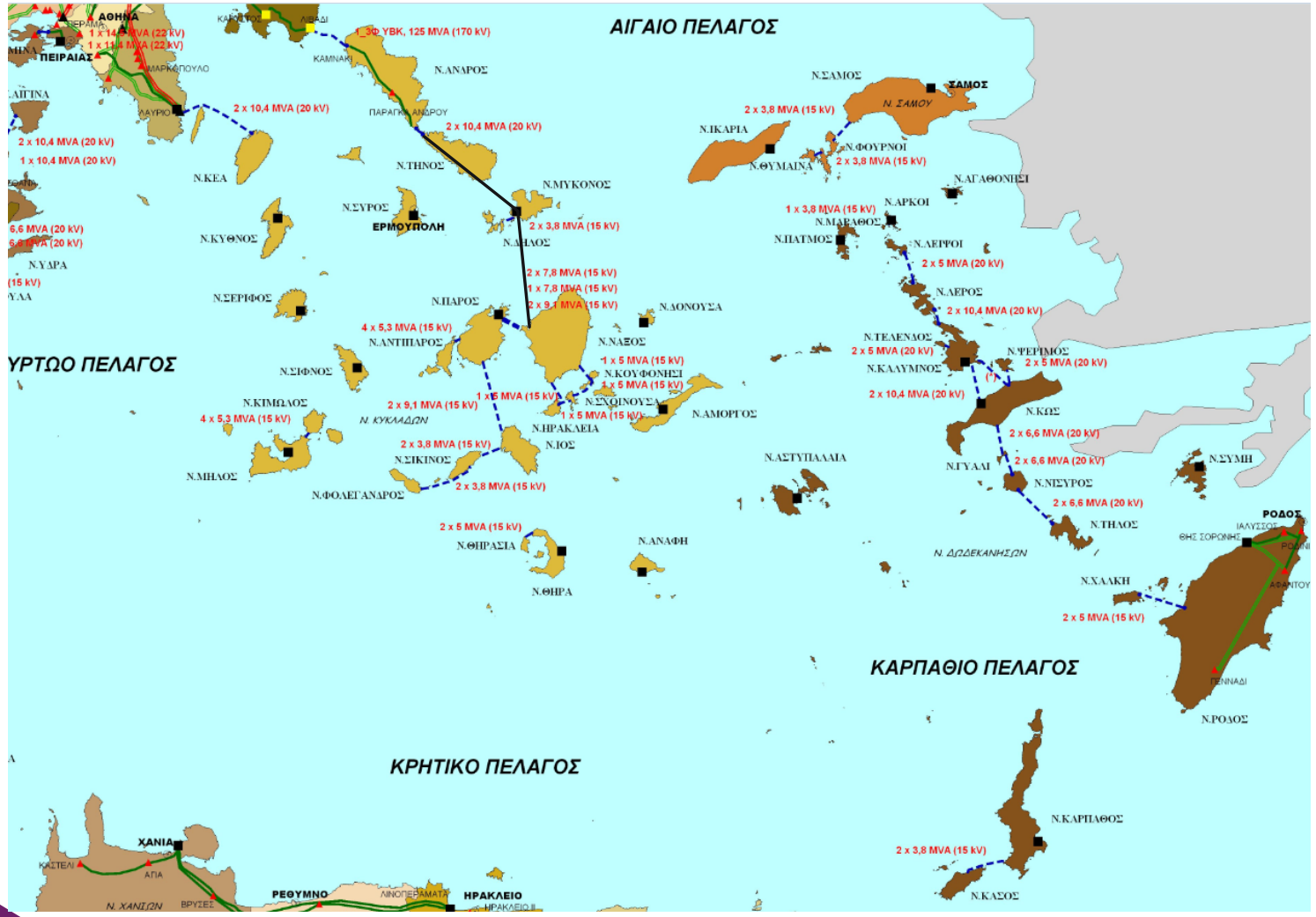
- **Greece has one Mainland electrical system and 29 autonomous electrical systems in Non Interconnected Islands.**
- Most islands today in Greece (mainly in the Aegean Sea) are electrified autonomously by both local thermal power plants, which operate with fuel oil, heavy (mazut) or light (diesel), and RES plants (especially wind farms and PV).
- The electricity market of non-interconnected islands consists of twenty nine (29) autonomous systems. Some of them consist of several islands (islands' clusters), where in charge of the operation and management of the relevant Markets and networks is the HEDNO S.A.
  - Nineteen (**19**) "small" autonomous systems have **peak demand up to 10 MW.**
  - Eight (**8**) "average size" autonomous systems have **peak demand from 10 MW to 100 MW.**
  - Two (**2**) "large" autonomous systems have **peak demand exceeding 100 MW**, i.e. Crete (with peak demand over 600 MW) and Rhodes (demand peak ~ 200 MW).

The structure of the Greek Mainland & Non Interconnected Islands

- **1 Mainland Electrical Systems (ES)**
- **47 Islands**
- **29 Electrical Systems (ES)**
  - 9 ES consisting of 27 interconnected islands
  - 20 ES consisting of autonomous islands
- **28 Isolated Microgrids**
- **1 Small Isolated System (Crete)**

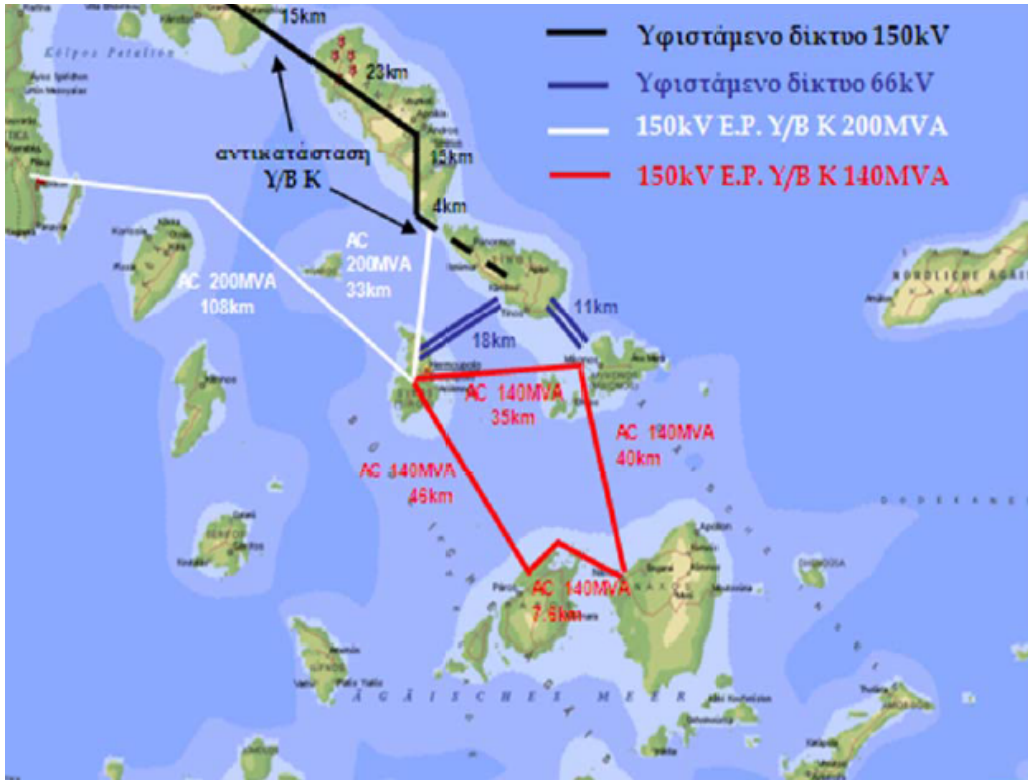


Current Situation of Interconnections
Andros - Tinos, Cyclades, Dodecanese



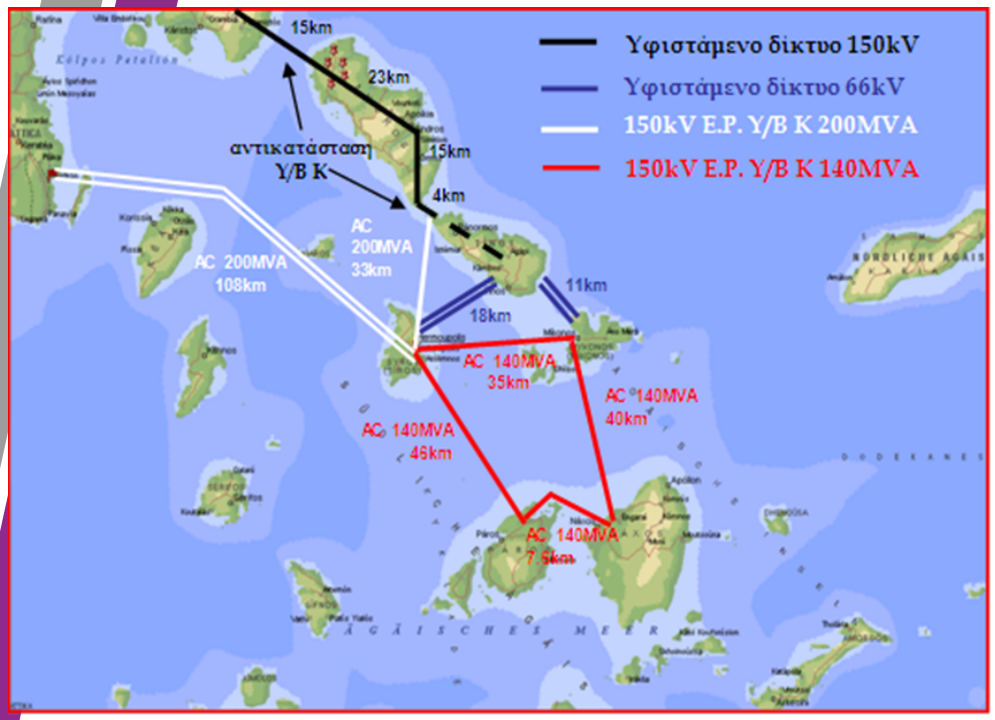
Interconnections of Cyclades (Phase A,B)

Phase A (done)
(Attiki- Syros, Syros-Tinos & Syros-Mukonos & Syros-Paros)

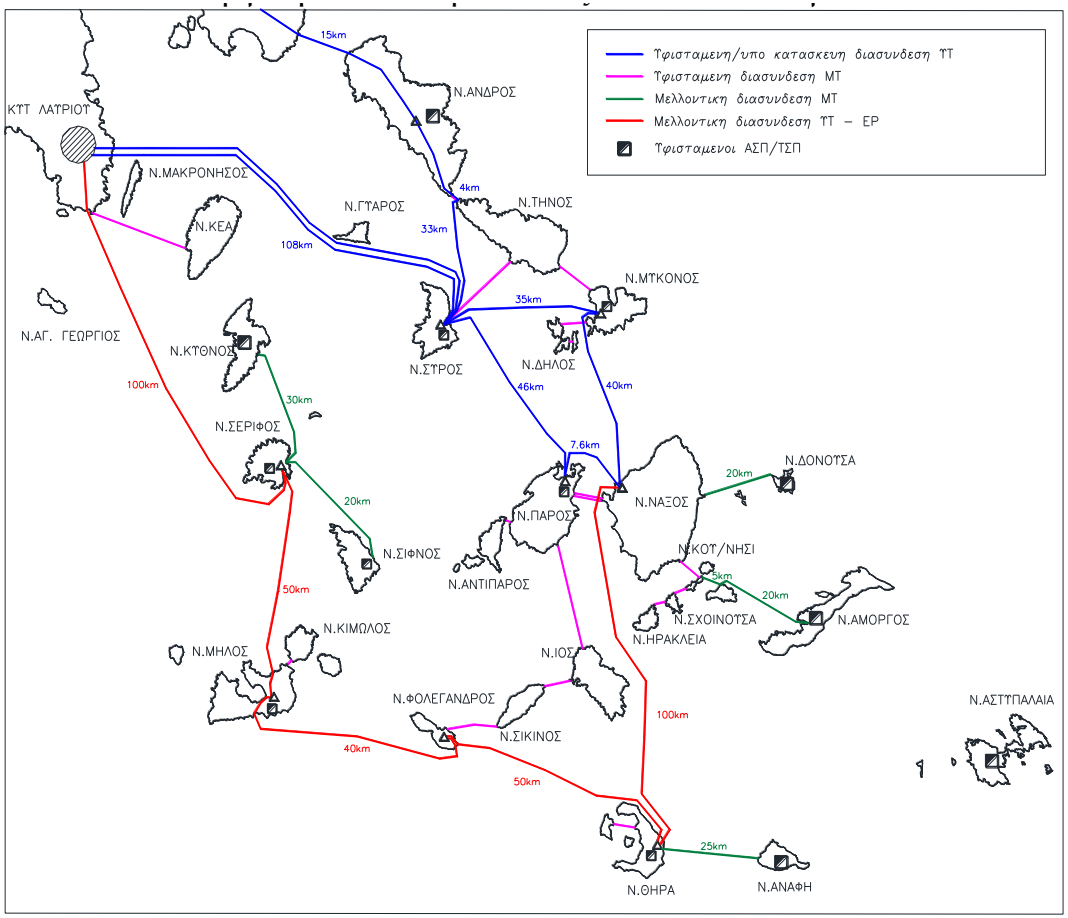


Phase B (done)
(Connection Naxos-Paros & Naxos- Mukonos, upgrade the connection of Andros with Evia and Tinos)

Interconnections of Cyclades (Phase C, D (on process))



Phase C (done)
(2nd cable Attiki-Syros and Mukonos-Naxos)

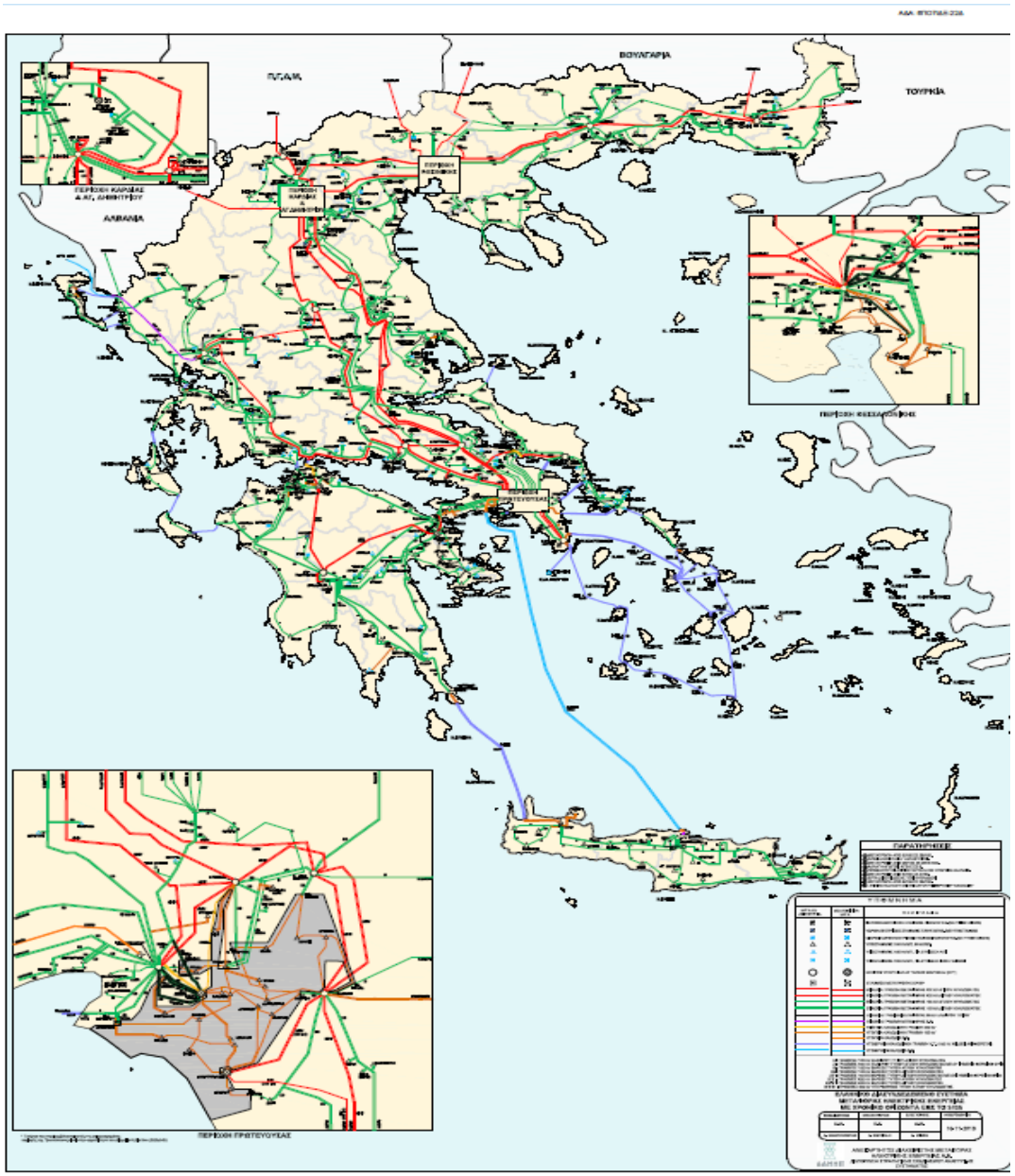


Phase D (on process)
Connection Paros (or Naxos) - Thira

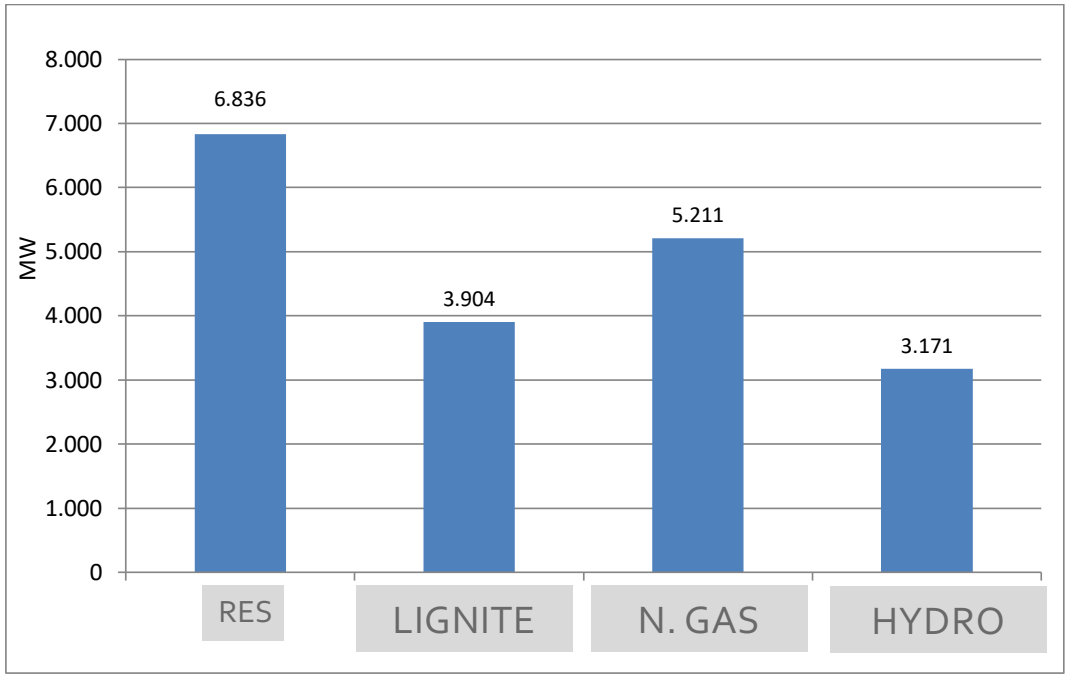
Current Situation of Interconnections Samothraki, Thasos, Sporades, Psara

Current Situation of Interconnections
Ionian islands, Sporades, Kea, Saronic

Approved by RAE - 1O TYNDP year Planning by Greek TSO (2019-2028)
(Decision of the Board of RAE 1097/2019, FEK B’ 1048/2020).

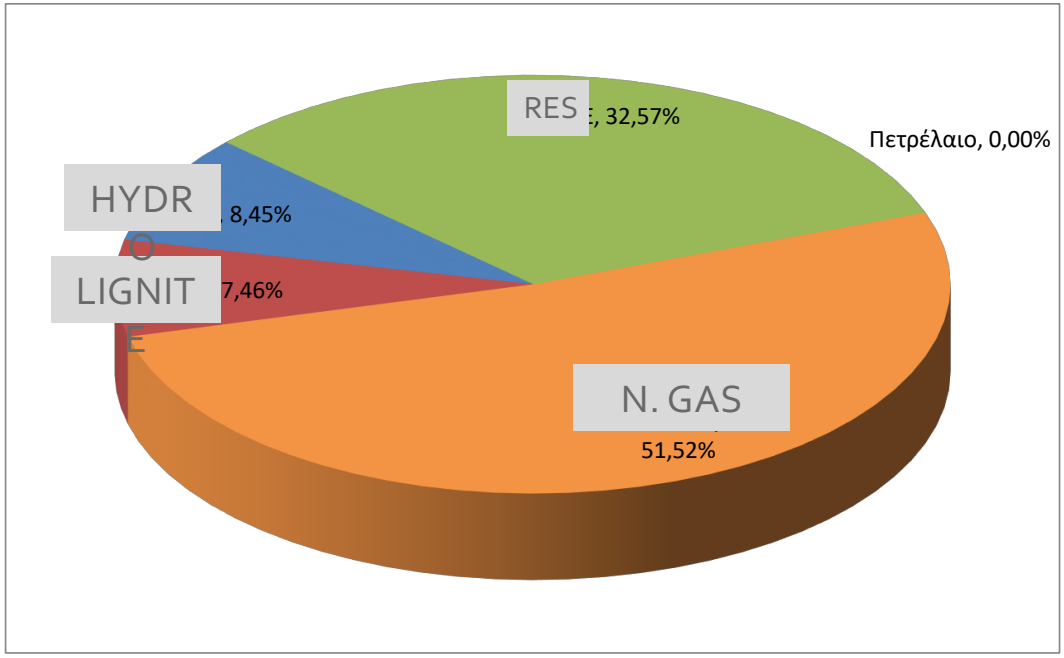


Installed Capacity per technology (snapshot - July 2020)
Mainland electrical system

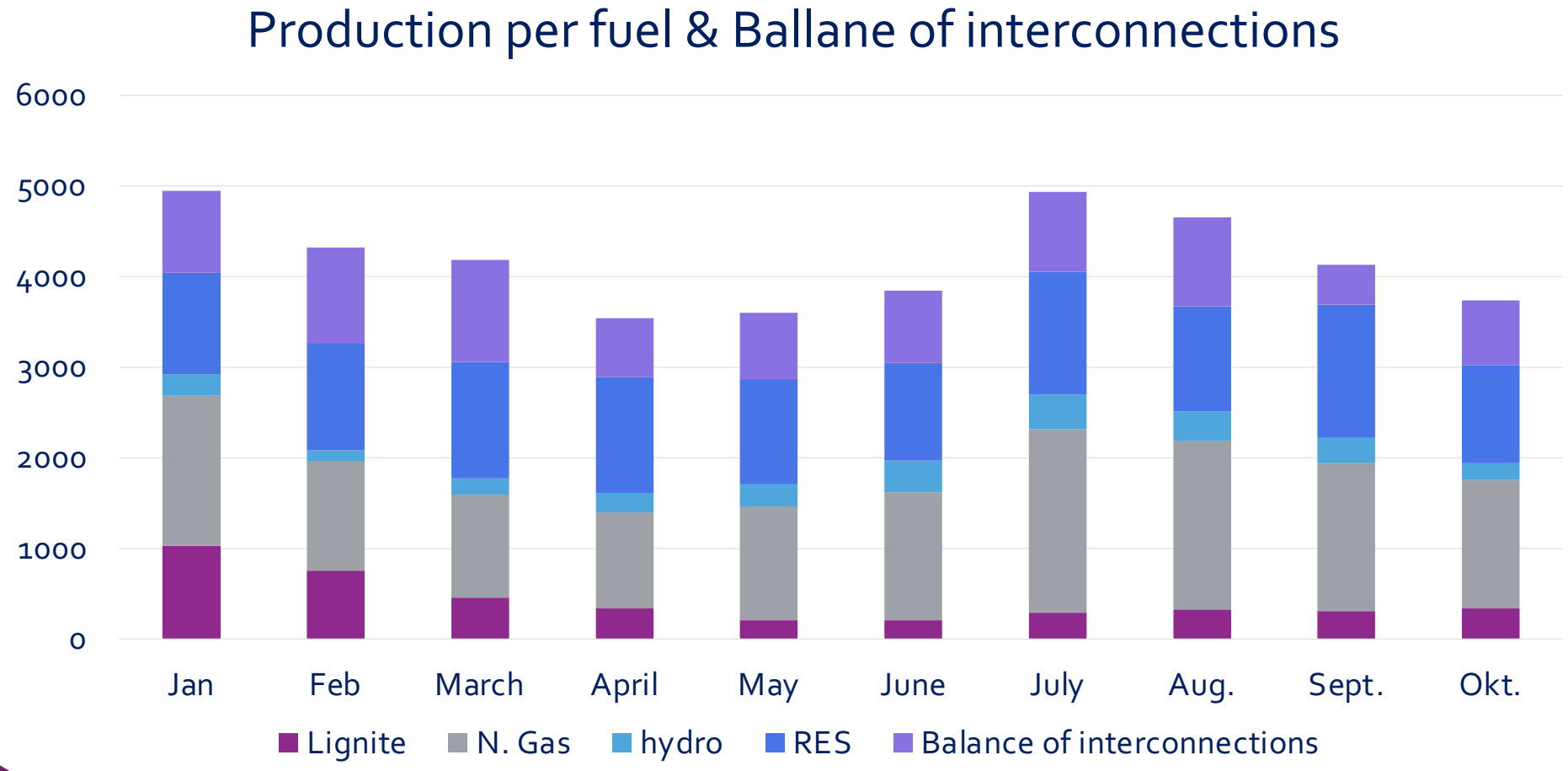


35% 20,42% 27,25% 16,58%

Production per fuel (July 2020)

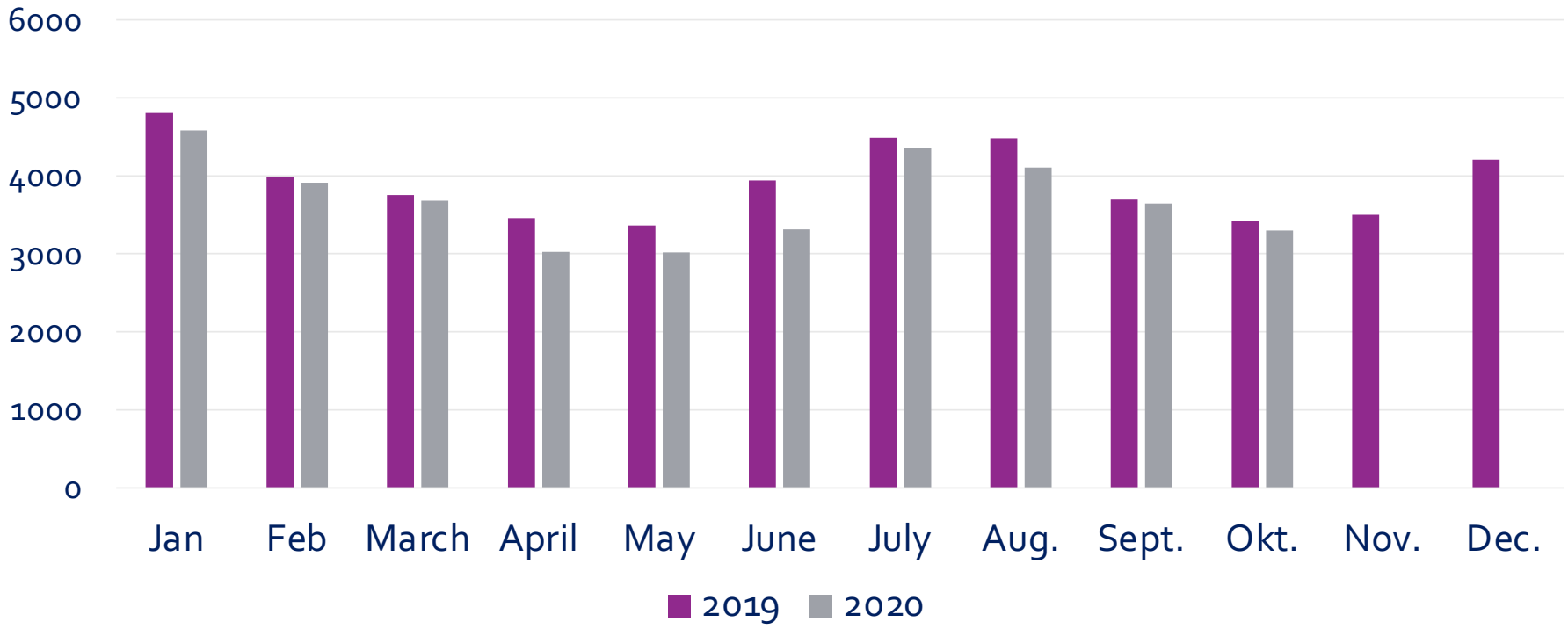


Production per fuel including imports/exports (Okt. 2020)



Source: Hellenic Transmission System Operator (ADMIE SA)

Demand (GWh)

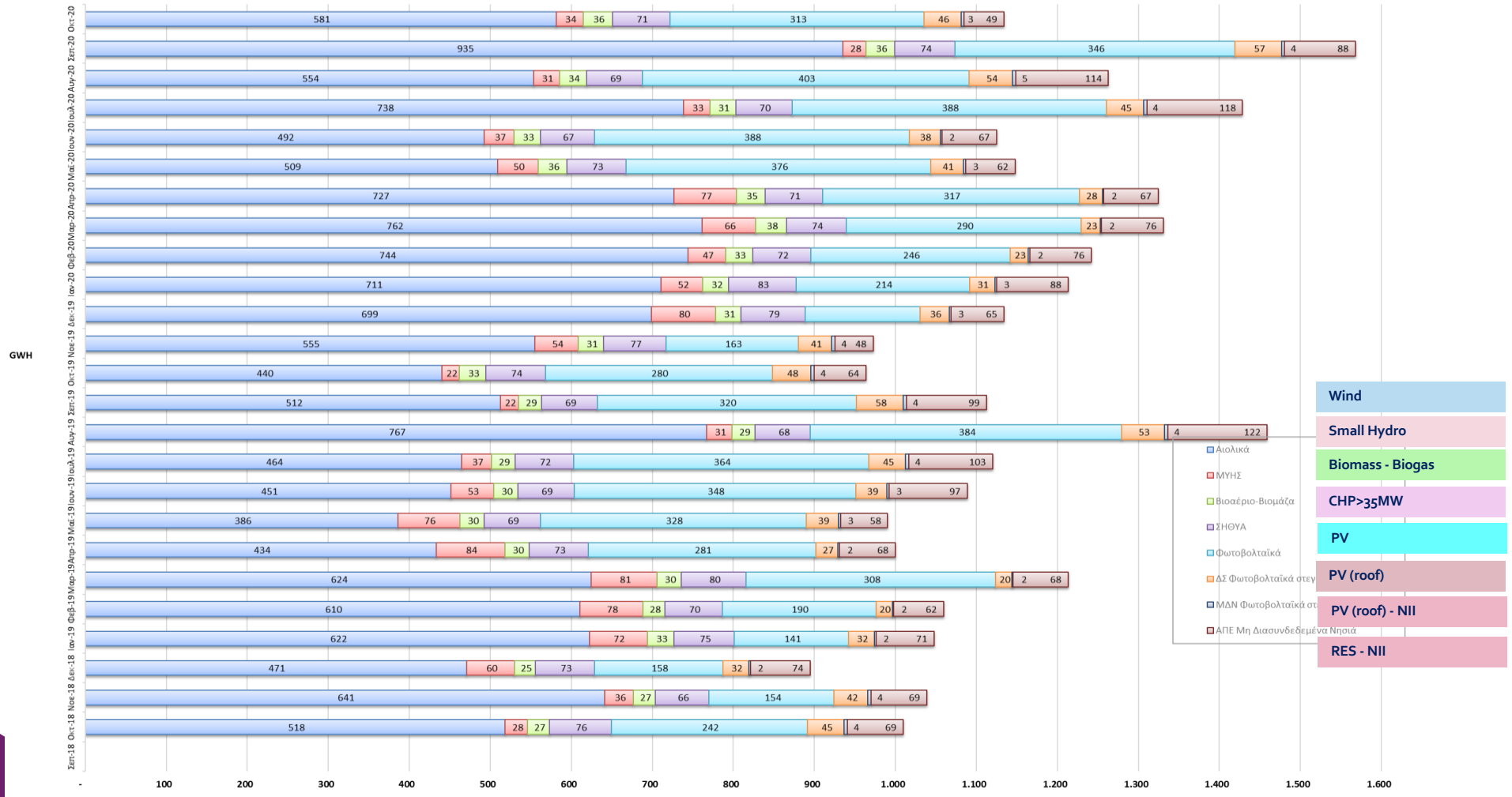


Source: Hellenic Transmission System Operator (ADMIE SA)

RES Installed capacity in Greece (Okt. 2020) – **7.052 MW**

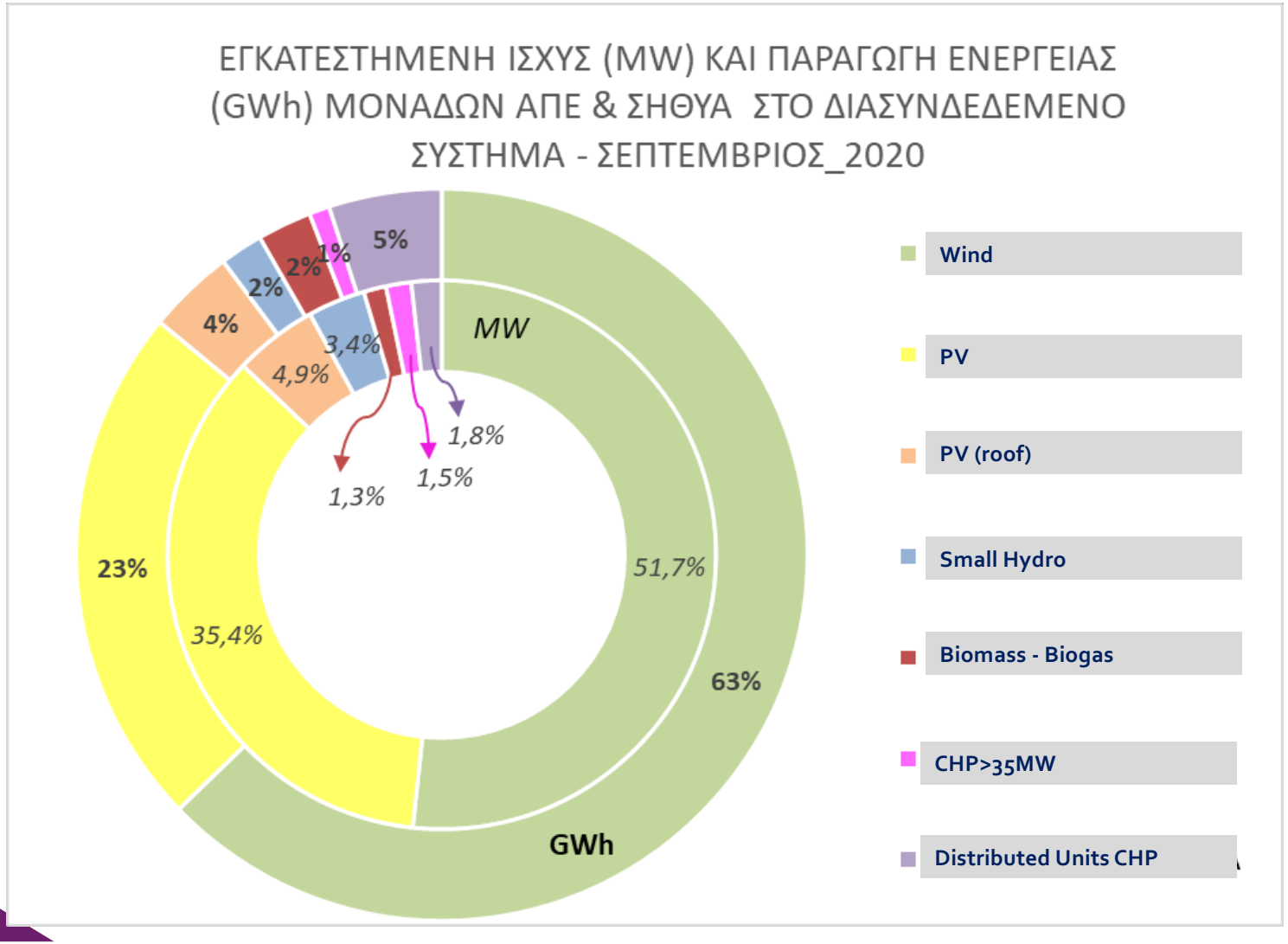
Source: Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

Energy production per RES technology (GWh) – Okt. 2020

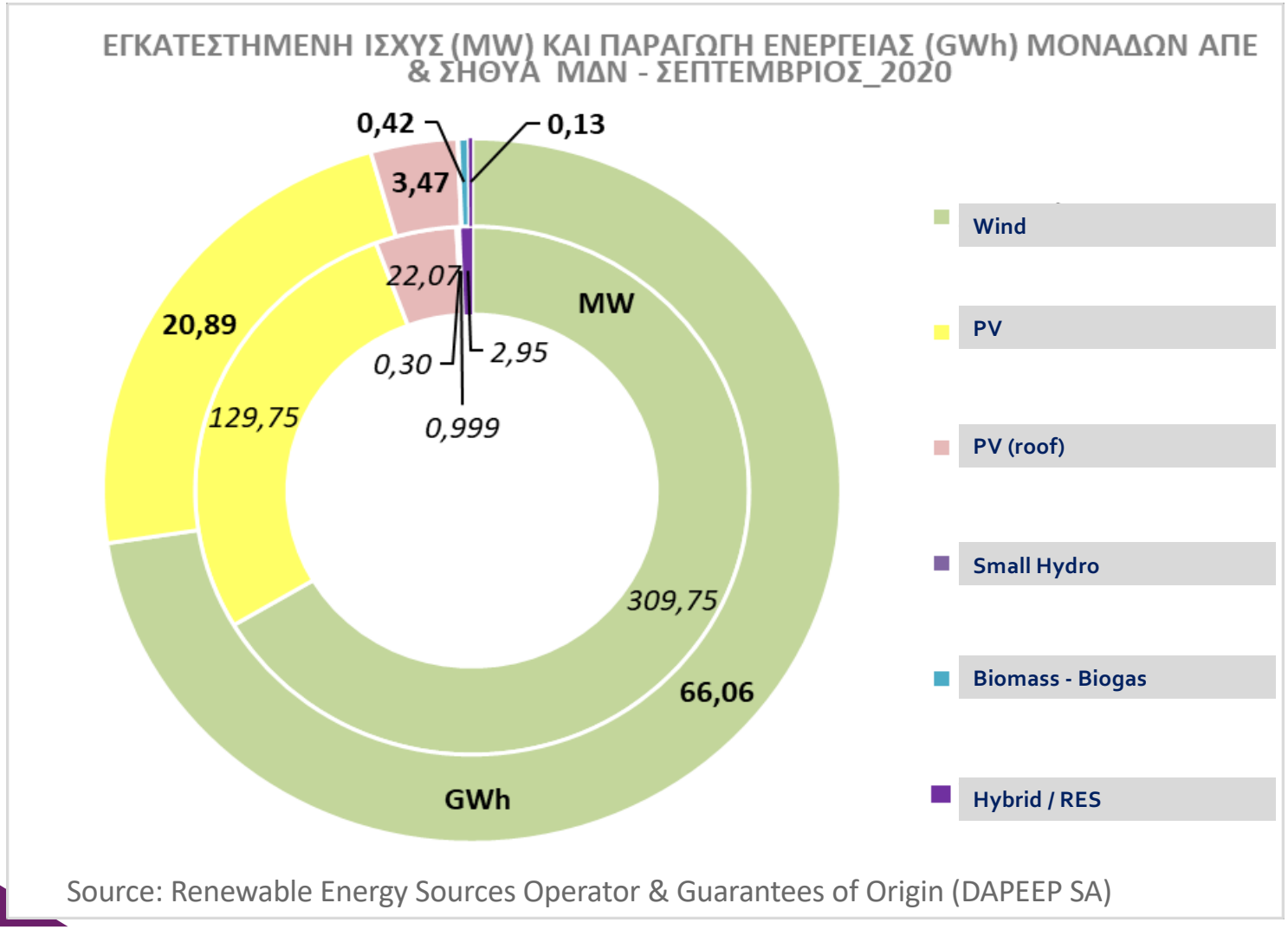


Source: Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

Installed Capacity (MW) & Production (GWh) – Sept. 2020

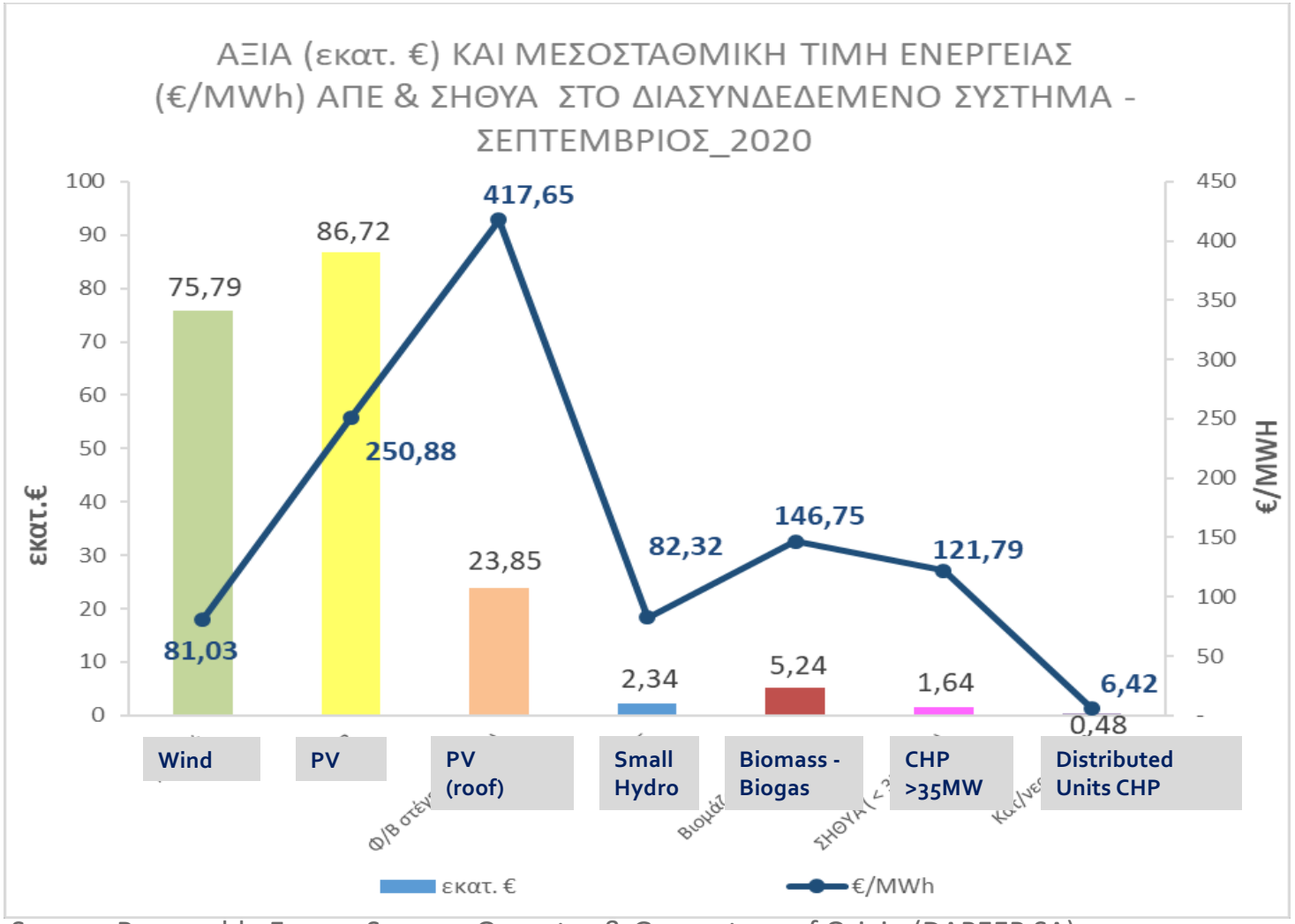


Installed Capacity (MW) & Production (GWh) – Sept. 2020
Non Interconnected Islands



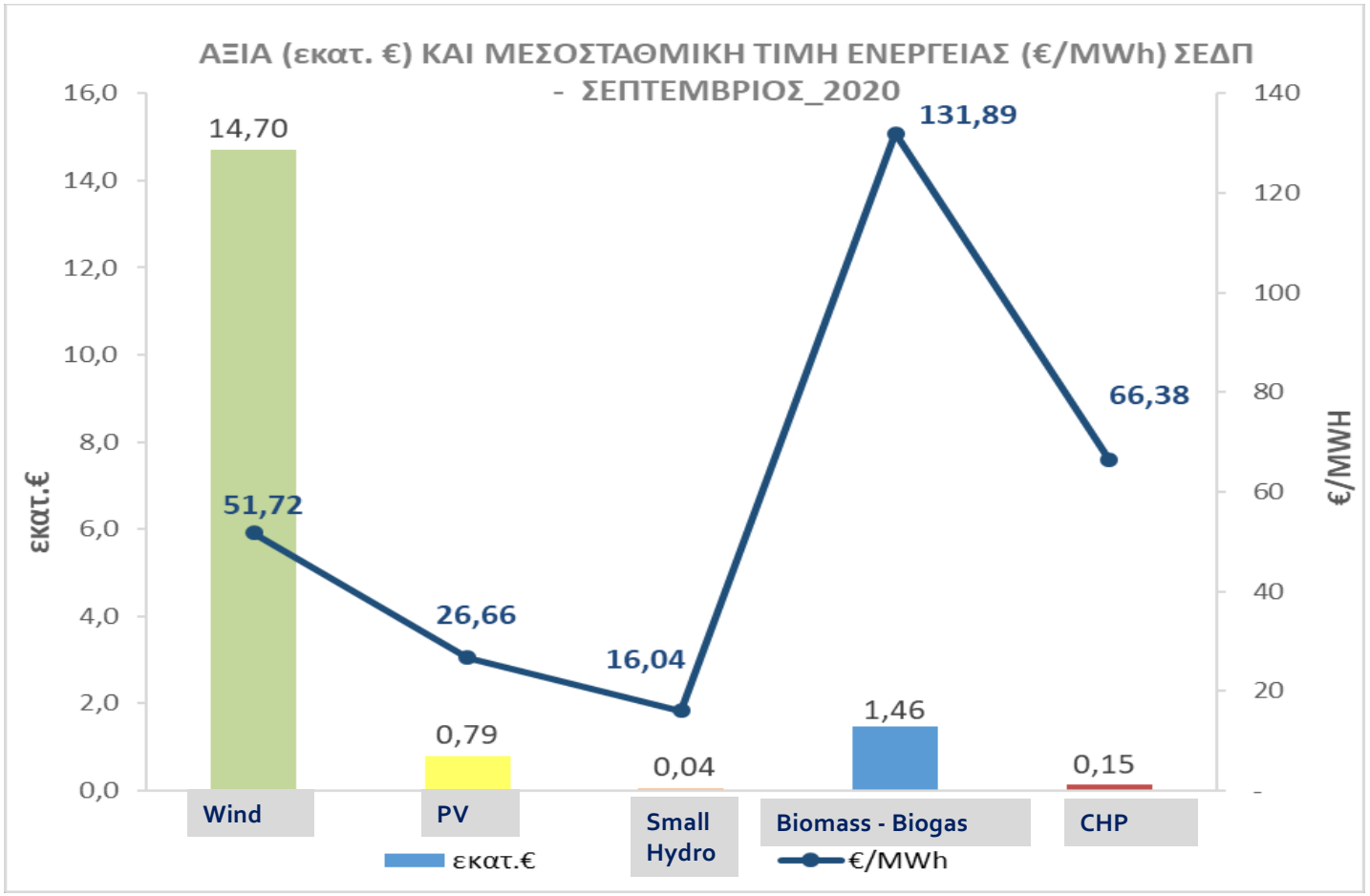
Source: Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

Weighted average price (€/MWh) & Value (m€) - Sept. 2020



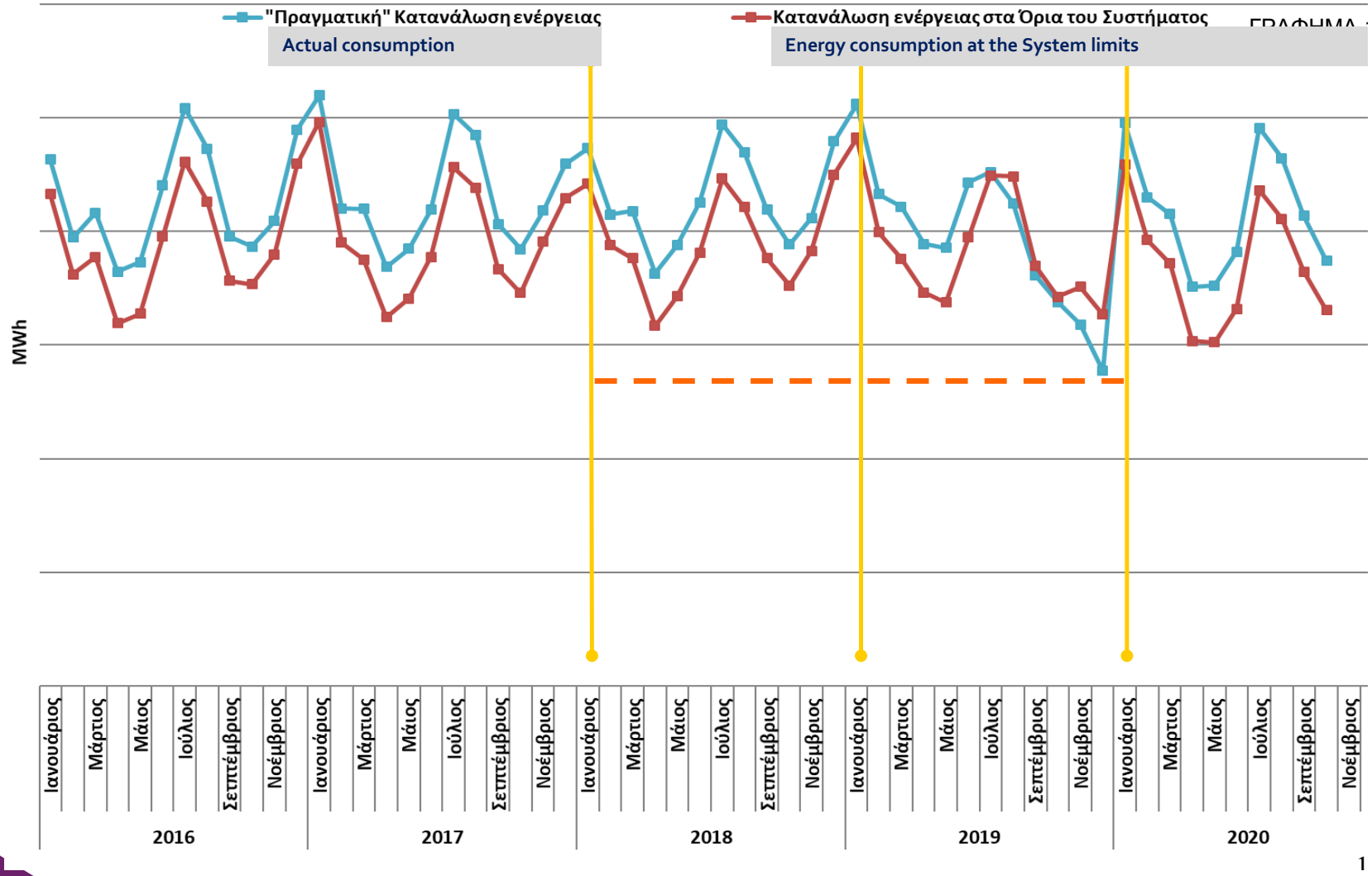
Source: Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

Weighted average price (€/MWh) & Value (m€) - Sept. 2020
Non Interconnected Islands

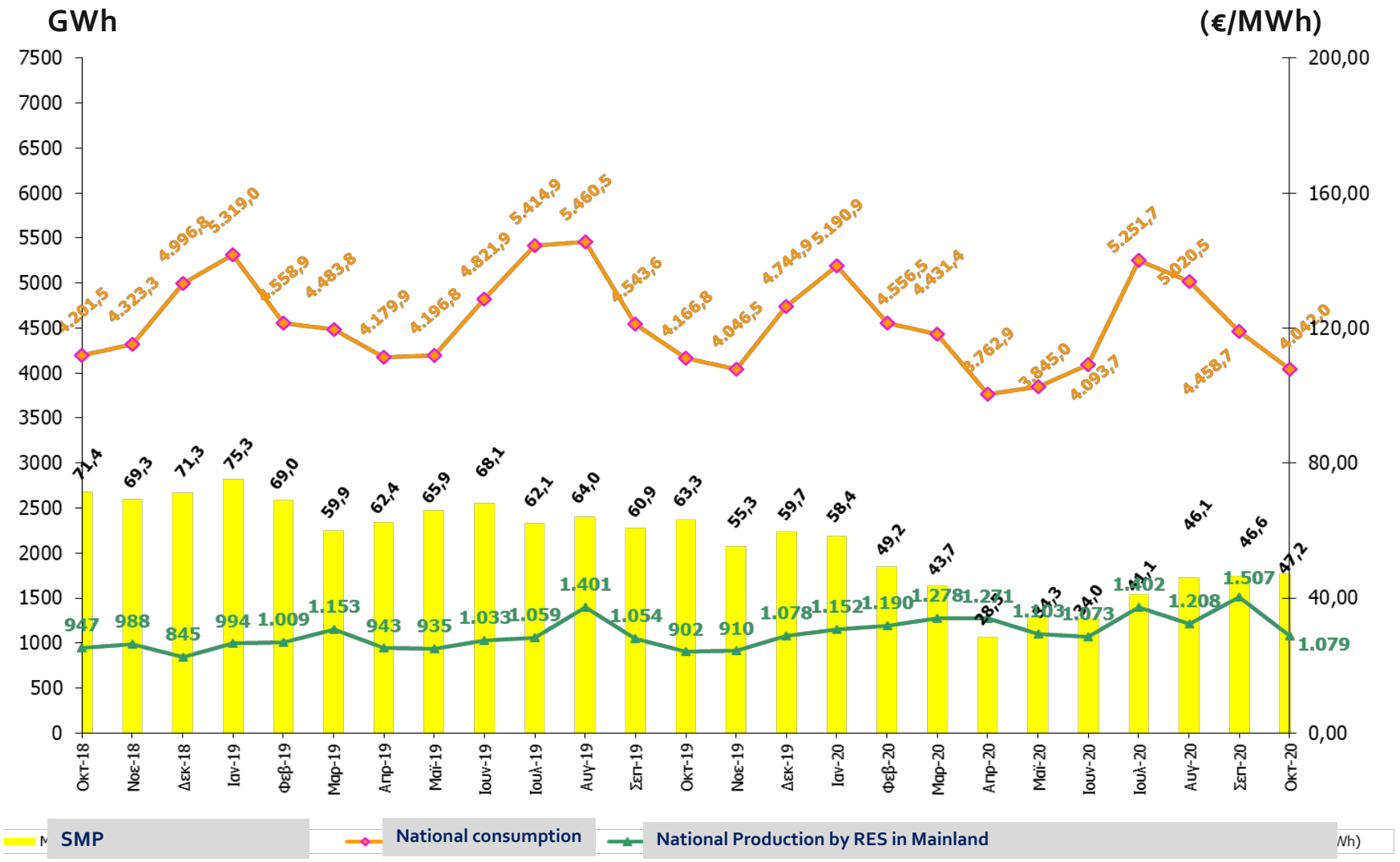


Source: Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

"Actual" consumption & energy consumption at the System limits

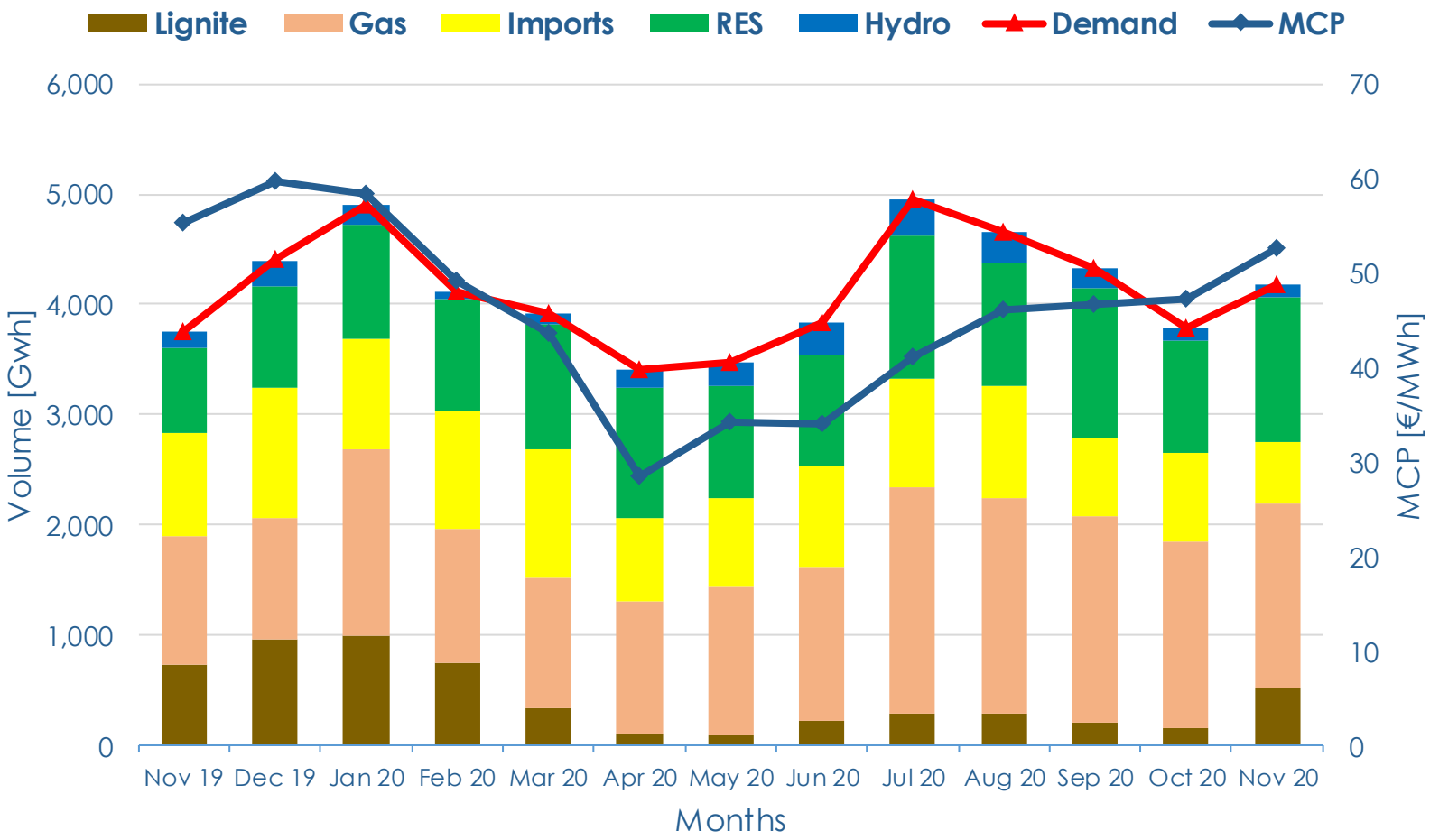


Source: Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)



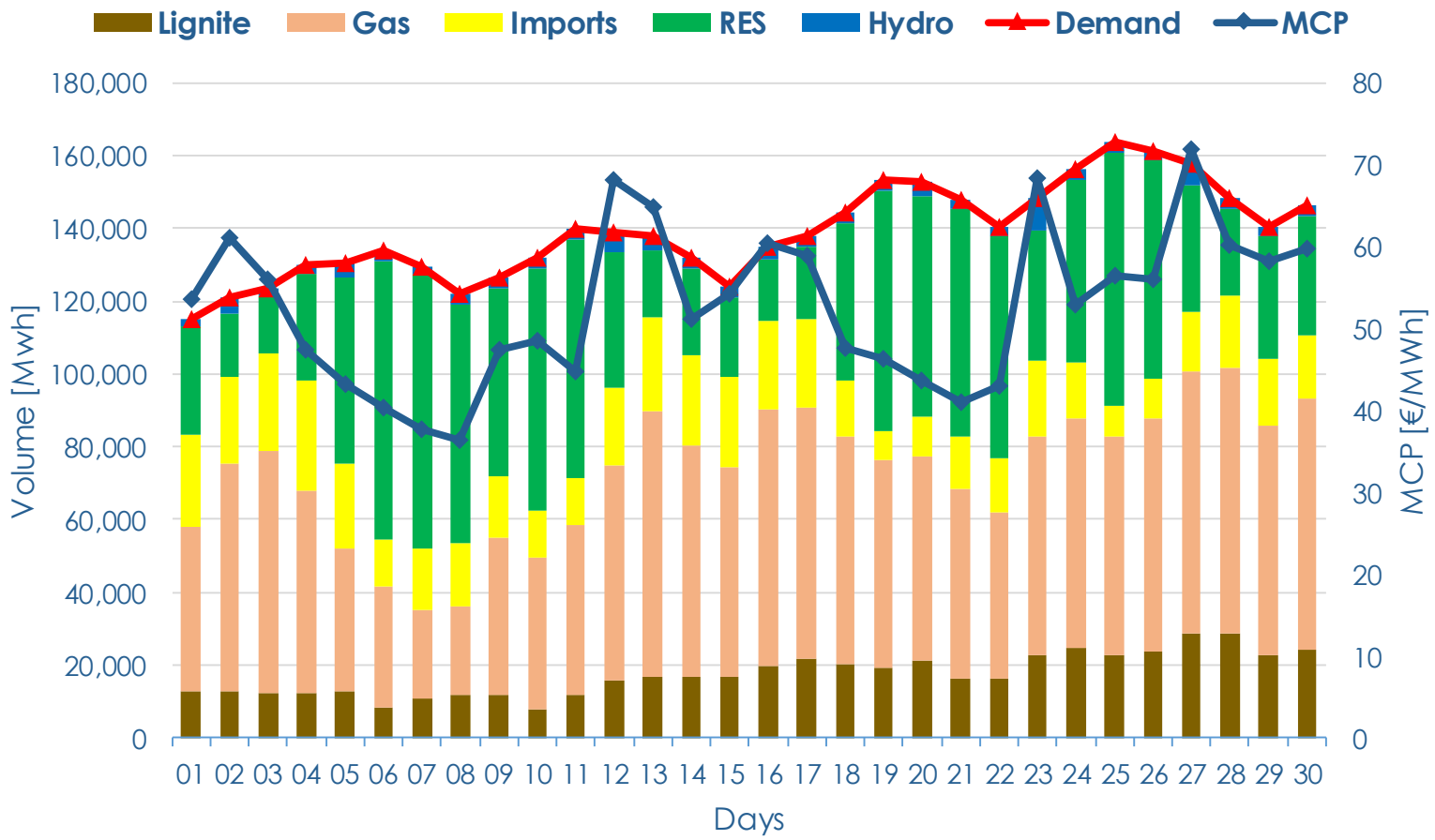
Source: Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

Volume mix of sell side per month (Nov. 2020)



Source: ENEXGROUP

Volume mix of sell side per day (enexgroup - Nov. 2020)

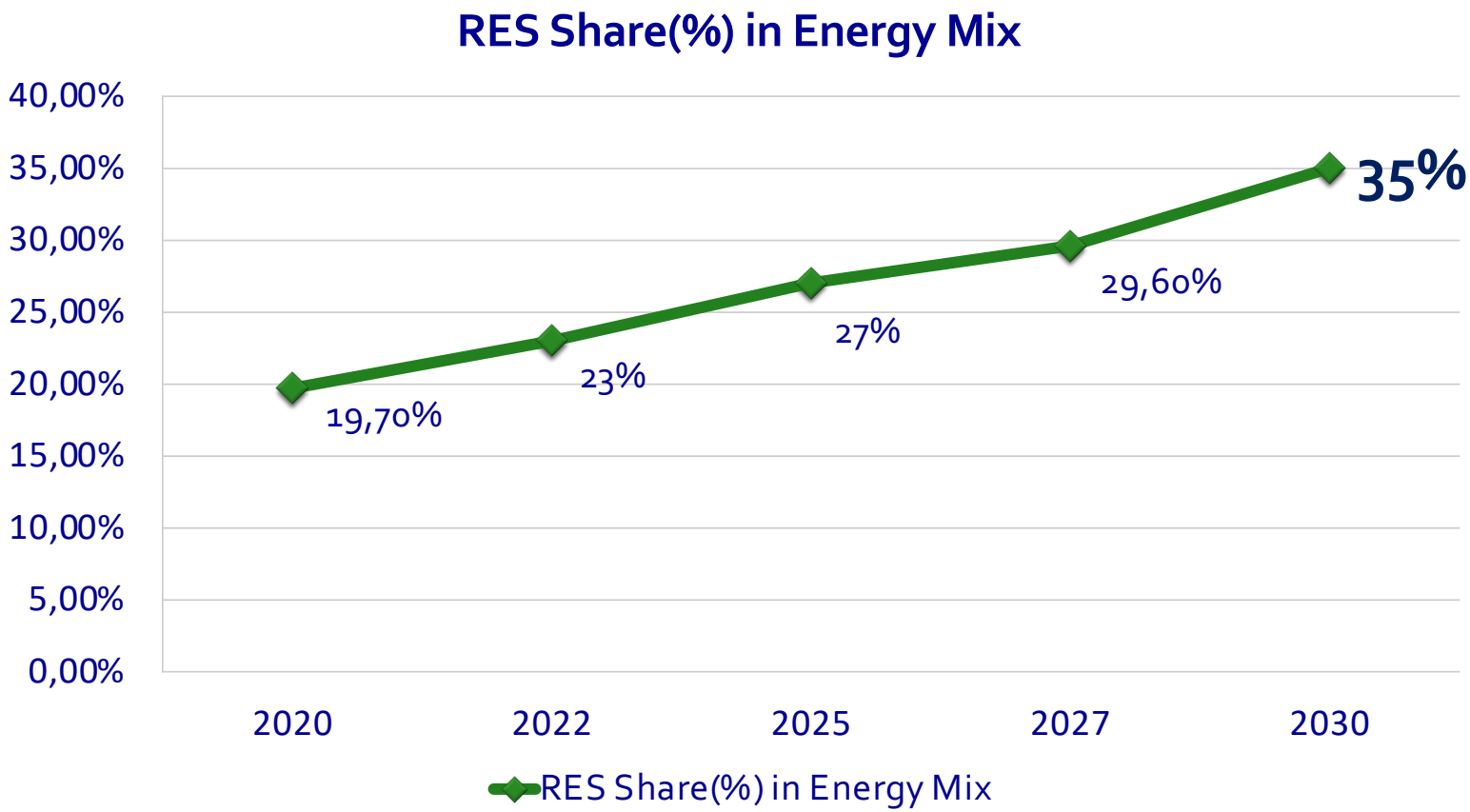


Source: ENEXGROUP

National Energy & Climate Plan

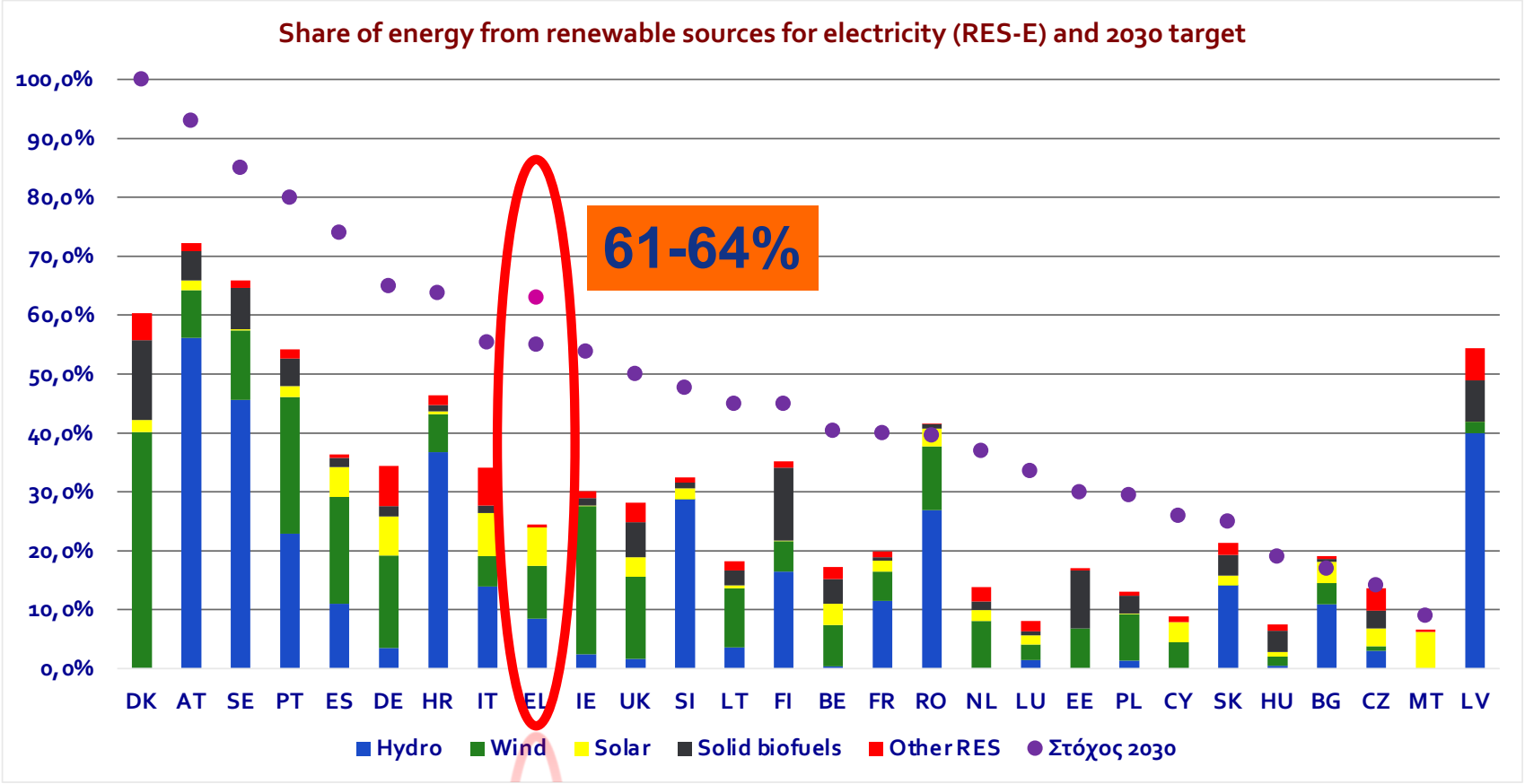
New National Plan

Target for RES Share (%) in Energy Mix (2030)

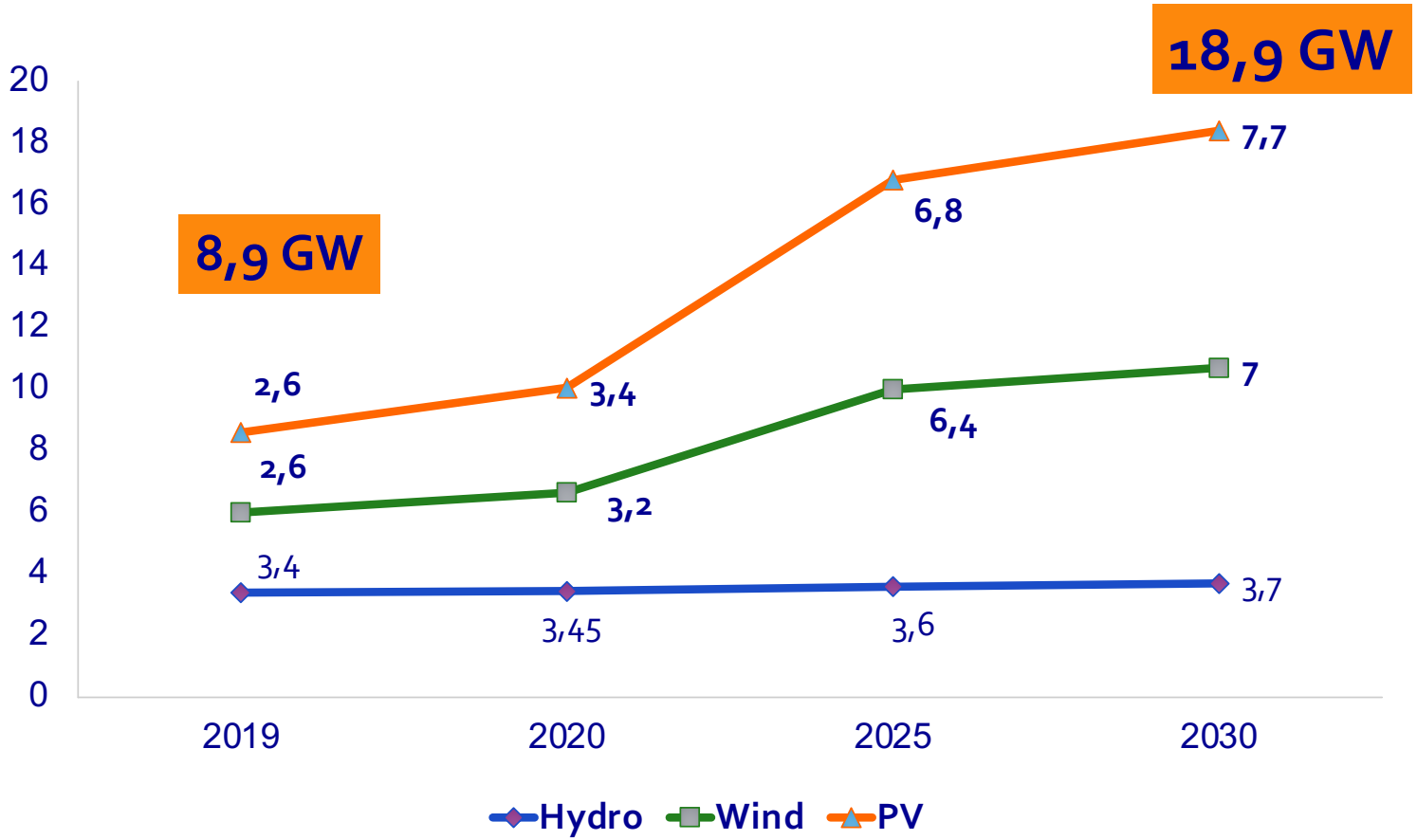


New National Plan

Share of energy from renewable sources for electricity (RES-E) and 2030 target



New National Energy and Climate Plan (NECP) 2021-2030



New National Plan

~ 43 bn €

~1GW per year PV & Wind

RES support mechanisms

RES Auctions

Europe & Greece

Support Schemes for the Promotion of RES Development

- **Feed-In Tariff (FIT)**
- **Feed-In Premium (FIP)**
- **Tradeable Green Certificates (TGC)**
- **Competitive Auction Schemes**
- **Investment Grants**
- **Tax Exemptions/ Other Incentives**

Note : When RES technologies (REST) become competitive – no support is required – REST can participate in the market if there is any

A new sustainable era for the new RES investments

New operating aid scheme for the production of electricity from RES and HECHP approved by EC

1

- ✓ Sell electricity directly in the market
- ✓ Are subject to balancing responsibilities, unless no liquid intra-day market exist
- ✓ Operating aid is granted as a premium (Feed-in premium, FiP)
- ✓ Greece has designed a sliding FiP (sFiP) support mechanism
- ✓ The support mechanism has been approved by European Commission **SA.44666**, C(2016) 7272 final / 16.11.2016
- ✓ *http://ec.europa.eu/competition/elojade/isef/case_details.cfm?proc_code=3_SA_44666*

A new sustainable era for the new RES investments

- ✓ Participation in the market means more opportunities for additional income (e.g. through market optimization techniques, provision of balancing services etc.)….

  …… but also more risks and costs

- ✓ The RES producers can outsource the new obligations to aggregators
- ✓ In Greece, a new design of the whole electricity marker is currently under implementation. The Energy Exchange was established on June 2018 and will operate on 1st of November 2020:
  - ➢ forward market (EXE SA)
  - ➢ day-ahead market (EXE SA)
  - ➢ intra-day market (EXE SA)
  - ➢ balancing market with imbalance clearance (ADMIE SA)

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RES support mechanisms : the sliding Feed-in Premium

The remuneration of the energy generated by a PV (or wind farm) is based on the ***Reference Value (RV).*** For simplified practical reasons, the following can be written :

Reference Value = Reference Market Price + Premium

1. **Reference market price** is calculated as the hourly system marginal price (i.e. the Day-ahead price) increased by the value corresponding to other wholesale market mechanisms if existed.

2. The **Premium** is calculated on a monthly base, taking into account the electricity produced by all producers for the same technology, per technology, in a way incentivizing the ones producing more valuable electricity i.e. at hours with higher market prices.

Based on simulation studies the RV will fluctuated less than ±1,5%

Categories of Competitive procedures

- **PRICE-BASED TENDERS,** WHERE THE BIDS WITH THE LOWEST OFFERED SUPPORT LEVELS WILL BE AWARDED

- **MULTI-CRITERIA TENDERS**, WHERE THE AWARDING OF A BID IS SUBJECT TO AN EVALUATION OF VARIOUS CRITERIA.

RES-E Auctions Schemes
(**Overview of Support Schemes**)

	Feed-in tariff (FIT)	Feed-in premium (FIP)	Tradeable Green Certificates (TGC)	Competitive auction schemes	Investment grants	Open window	tax exemptions/ incentives	Other
Albania	■	■		■				
Algeria				■				
Croatia	■							
Cyprus	■			■	■		■	■
Egypt	■			■				■
France	■	■		■		■	■	
Greece	■	■		■	■		■	■
Italy	■	■		■			■	
Israel	■			■			■	
Jordan				■	■		■	■
Lebanon				■				■
Palestine	■					■	■	■
Portugal	■			■				
Slovenia	■	■		■				
Turkey	■			■			■	

RES-E Auctions Schemes (**Role of the Regulator**)

	Competent Authority	Comment
Albania	Ministry	The NRA does not have any role in the procedure
Algeria	Ministry or NRA	For small capacities up to 20GWh per year the Regulator is the competent authority. For the capacities beyond 20GWh per year, the Ministry of Energy is in charge. In second case, the Regulator gives an opinion on the price of the lowest tender, to define if it is acceptable or not.
Croatia	n/a	
Cyprus	Ministry	The NRA informally provide its guidance
Egypt	Ministry & NRA	
France	Ministry & NRA	The indicative planning of auctions (which includes the frequency of auctions and their design in terms of technology and capacity) as well as the auctions' ToR are determined by the Gov. The NRA is consulted on both the planning and the ToR. The competent authority for carrying out the auction is the NRA.
Greece	Ministry & NRA	
Italy	Ministry	The NRA does not have any role in the procedure
Israel	NRA	
Jordan	Ministry & NRA	In Jordan there is a Direct Proposal Scheme whereby the RES developer proposes to MERM a project with a fixed tariff. The level of the tariff should be within an acceptable range according to the reference price list that is prepared by the NRA
Lebanon	Council of Ministers	
Palestine	n/a	
Portugal	Ministry	
Slovenia	NRA	
Turkey	Ministry & TSO & NRA	For Licensed Projects: EMRA (NRA) is responsible for receiving the pre-license applications and making the pre-evaluation of these applications. The projects passing the pre-evaluation phase (both in terms of technical and financial eligibility) are sent to TEIAS (TSO) for conducting auctions. For YEKA (Gov.) projects: EMRA has no responsibility in application and tendering sessions; it only carries out the licensing operations after tender was completed.

	RES Technologies (year and capacity in which tendering process has been carried out)					
	PV	Wind on shore	Wind offshore	Biomass	Technology Neutral	Other
Albania	**2018** (50MW)					
Algeria	In 2016 the Ministry announced an auctioning process for the installation of 4,050MW PV					
Croatia						
Cyprus	**2013** (40MW)					
Egypt		**2013** (250MW)				
France	**2017** (1575MW) **2018** (1902MW)	**2018** (626MW)		**2018** (53MW)	**2018** (wind & PV)	Hydro **2016** (27MW)& **2018** (29,6MW)
Greece	**2016** (40MW) &**2018** (169MW)	**2018** (337MW) &			**2019** (PV& wind on shore) (437,87MW)	
	2019 & 2020 plans	**2019 & 2020 plans**				
Israel	**2017** (355MW)& **2019** (700MW)					
Italy		**2013** (400MW) **2014**(356MW) **2016** (800MW)	**2016** (30MW)	**2013** (34MW) **2014** (18MW) **2016** (20MW)		Geothermal **2016** (20MW)
Jordan	**2015** (200MW) & **2018** (250MW)	**2015** (117MW), **2016** (80MW), **2018** (170MW)				
Lebanon		**2018** (206,7MW)				
Palestine						
Portugal	**2019** (1400MW)					
Slovenia	**2016** (3,78MW) **2017** (3,129MW) **2018** (16,33MW)	**2016** (25,34MW) **2017** (80,92MW) **2018** (108,71MW)		**2016** (2,2MW) **2017** (0,4MW) **2018**(1,41MW)		
Turkey	**2015**(600MW)& **2017** (1000MW)	**2017** (1000MW)				geothermal

Implemented
No plans so far
Potential plans

Note: data from 2013 and onwards.

RES-E Auctions Schemes – weighted average price (€/MWh)

	Weighted average price per MWh and per technology resulted from the latest auctions in each country					
	PV	**Wind on shore**	**Wind offshore**	**Biomass**	**Technology Neutral**	**Other**
Albania	**2018** (59,9 €/MWh)					
Algeria	n.a.	n.a				
Cyprus	**2013** (93€/MWh)					
Egypt						
France	**2017** (62-77 €/MWh for ground-based installations 85-93€/MWh for roof top installations 93-99€/MWh for installations on parking shelters)	**2018** (65,4€/MWh)		**2018** (122,5€/MWh)		Hydro **2018** (89,9€/MWh)
Greece	**2018** (66,66€/MWh) for Ppv≤1MW **2018** (63,81€/MWh) 1MW<Ppv≤20MW	**2018** (58,58€/MWh)			**2019** (PV& wind on shore) (57,03€/MWh)	
Israel	**2019** (47,5€/MWh)					
Italy		**2016** (66€/MWh)	**2016** (161,7€/MWh)	**2016** (112.87€/MWh)		Geothermal **2016** (82,32€/MWh)
Jordan	**2015, 2018** n.a.	**2015, 2016, 2018** n.a.				
Lebanon		**2018** (87,2€/MWh)				
Portugal	**2019** (20,33€/MWh) average FiT					
Slovenia	**2018** (67,4€/MWh)	**2018** (63,7€/MWh)		**2018** (147,17€/MWh)		
Turkey	**2017** (63,5€/MWh)	n.a.				

Implemented

No auction

RES-E Auctions Schemes

	Type of auction used	Special IT tool	Safety net value
Albania	n.a.	n.a.	n.a.
Algeria	Sealed bid auction (alignment to the lowest price)	NO	YES
Cyprus	Descending bid auction	Electronic Platform	YES
Egypt	n.a.	Electronic Platform	NO
France	Pay-as-bid	Electronic Platform	YES
Greece	Descending bid auction	Electronic platform	NO
Israel	1st & 2nd price sealed bid auction	Electronic platform	YES
Italy	Descending bid auction	NO	NO
Jordan	n.a.	n.a.	n.a.
Lebanon	Descending bid auction	NO	NO
Portugal	ascending clock model, with several rounds, and pay-as-bid price	Electronic platform	YES
Slovenia	Lowest offered price of electricity up to the use of offered funds	NO	YES
Turkey	Several types (e.g. Reduction from a predetermined ceiling price as sealed-bi type followed by an open session for further reduction of the auction price by the participation of 5 min. offers)	NO	NO

RES-E Auctions Schemes (Requirements or Constraints for the bidders)

	Legal Requirements	Proof of financial adequacy	Past experience	Technological & professional requirements	Location constraints	Guarantee from a bank or credit institution	Grid access permit	other	Same terms apply for all eligible technologies?
Albania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Algeria									NO
Cyprus									NO
Egypt									n.a.
France									NO
Greece									YES
Israel									NO
Italy									YES
Jordan									YES
Lebanon									YES
Portugal					Predefined location				nap
Slovenia									YES
Turkey									NO

RES-E Auctions Schemes - (**SWOT Analysis of Auctions**)

Strengths

1. Cost Efficiency due to price competition
2. Useful to establish competitive pricing
3. Investor security linked to long term PPAs
4. Policy objectives can be achieved through auctions
5. Auctions are useful for volume and budget control
6. Flexibility on design

Weaknesses

1. Long, costly and cumbersome administrative procedures
2. Discontinuous market development
3. Possibility of strategic behaviour
4. Participating in auctions requires resources that small scale or new project developers may not have
5. Competitve bidding may lead to underbidding

Opportunities

1. Development of different RES Technologies
2. Large-scale established developers are more likely to win a bid
3. Winning prices resulting from healthy competitive bidding can be used to establish cost-based FIT levels for certain RET
4. Potential of real price discovery

Threats

1. Deficient competition
2. Risk of winners' curse and underbidding
3. Fail to deliver on time projects due to unrealistically low bids
4. Countries that have legally binding targets for RES-E, can easily fall back on their plan and targets
5. Failure to achieve the minimum mass of participants

RES-E Auctions Schemes (Recommendations)

- ✓ **Auction design needs to be adapted to country conditions**

(economic situation, structure of the energy sector, maturity of the power market, level of RES deployment)

- ✓ **Clear and Transparent Auction Procedures and framework**
- ✓ **Use of safety cautions**

(such as critical mass of participants, defining the right size of projects in order to ensure competition and effective project implementation, safety net value, financial guarantees, penalties etc.)

- ❖ **Market Stability– RES Auction Roadmap**

Conclusions

No single perfect auction design exists.

Auction design needs to consider policy goals and the current market situation of each country. Auction design should be monitored to implement adjustments for updated policy goals and market environments.

The extent to which each of the strengths and weaknesses affects the outcome of auctions highly depends on the auction design.

Legislation Framework (2)

New scheme for auctions approved by EU

2

- **New scheme for auctions procedures approved by EU** (State Aid 48143)

(Link: http://europa.eu/rapid/press-release_IP-18-5461_en.htm)

- The necessary national legislation framework is in issue.

Auctions are a vehicle for development of RES and new technologies

Legislation Framework (2)

RES Special Account

3

- Significant delays on RES payments since 2016
- New legislation framework solve a systematic problem of RES Specific Account → drive to a positive
- Currently (January 2021), the payments of RES Projects are secure.

RES Auctions

Technology Specific & Neutral

RES Auction plan (period 2018-19-20)

	Technology	Auctioned Capacity (max) - (MW)
2018	PV	**300 MW (July & December)**
	Wind	**300 MW (July & December)**
2019	PV	**300MW (July & December)**
	Wind	**300 MW (July & December)**
	Pilot competitive auctions (neutral)	**400 MW (April)**
2020	PV	**482 MW (July)**
	Wind	**481,45 MW (July)**
	Pilot common competitive auctions (neutral)	**600 MW (April)**
2020-21	(Pilot - neutral – small res)	**350 MW (On process…)**
	Initial target	**2,6 GW – [already 2,71GW]**

On process: Extension for 2022

Public Consultation and workshops with market

- *September 2016 (81st TIF), Thessaloniki*
- 21 October 2016, NTUA
- *September 2017 (82nd TIF), Thessaloniki*
- 24 January 2018, NTUA
- 04 May 2018, Thessaloniki
- 10 May 2018, Athens
- 15 May 2018, Ioannina
- 10 July 2018, Naxos Forum, Naxos
- *September 2018 (83rd TIF), Thessaloniki*
- 8 February 2019 (Helexpo –Infacoma), Athens
- *September 2019 (84Tth TIF), Thessaloniki*
- 4 October 2019, Rhodes Forum, Rhodes

Thessaloniki 8th of May 2018

Thessaloniki Music Hall

Athens 10th of May 2018

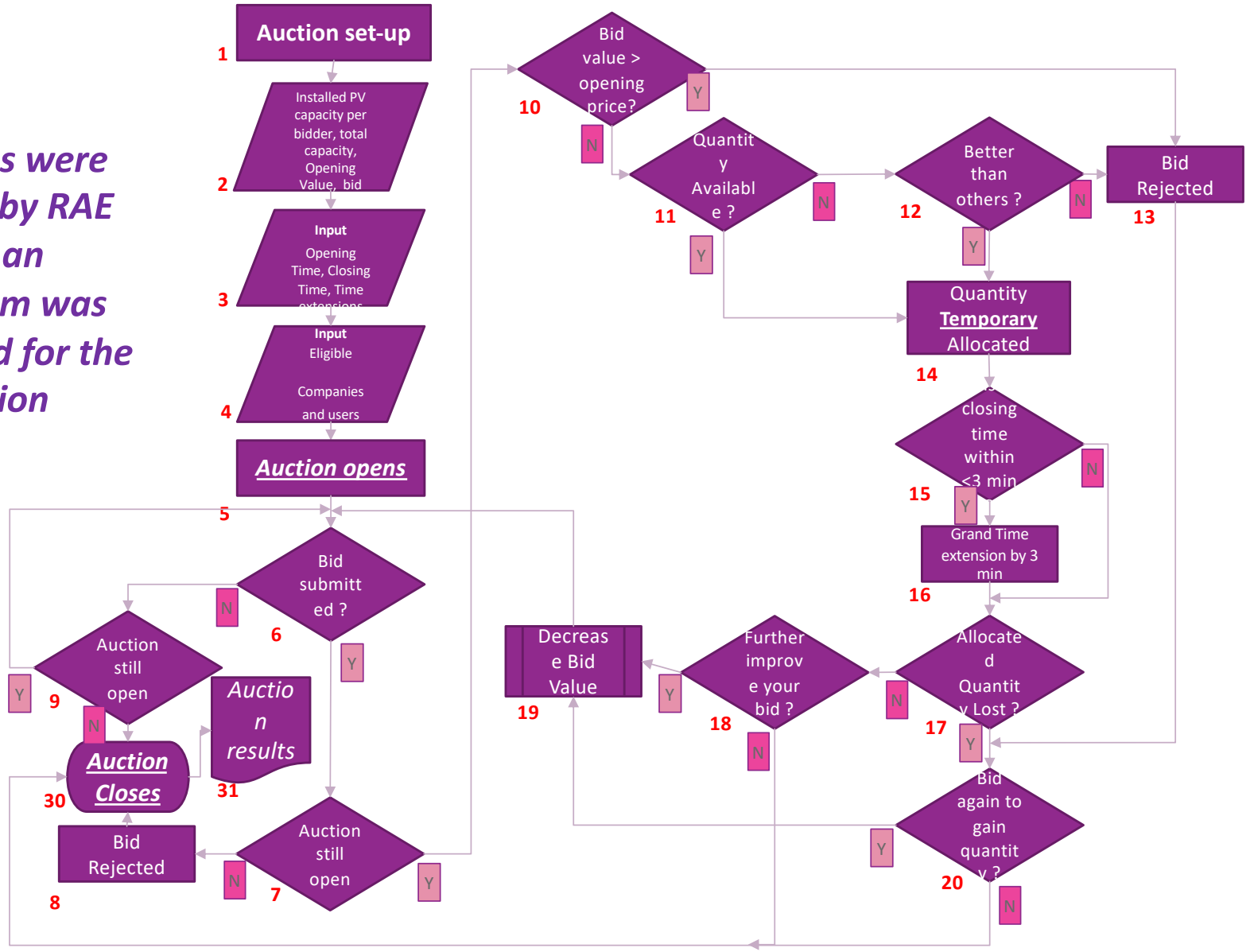
Hellenic Wind Energy Association

Athens 10th of May 2018

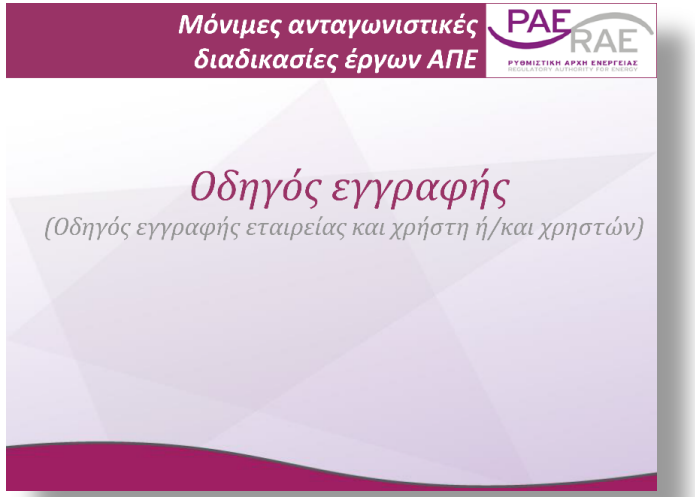
150 experts took part in the specific training (electronic auction platform). The whole procedure: Registration, Submission of application and electronic auctions was presented to the participants.

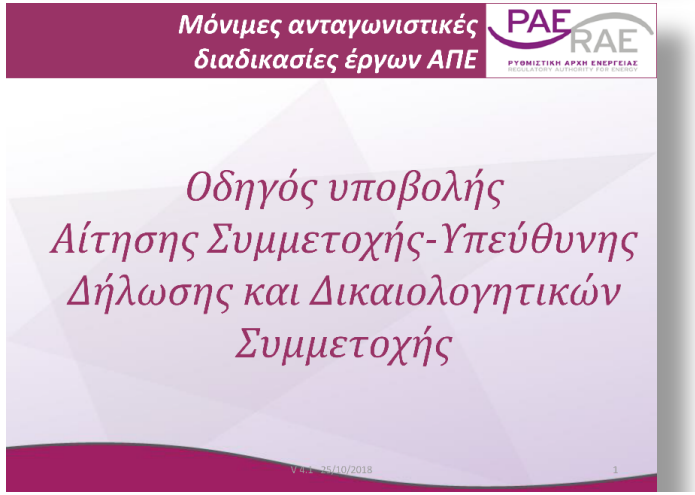
Ioannina 15th of May 2018

The rules were decided by RAE and an algorithm was developed for the auction

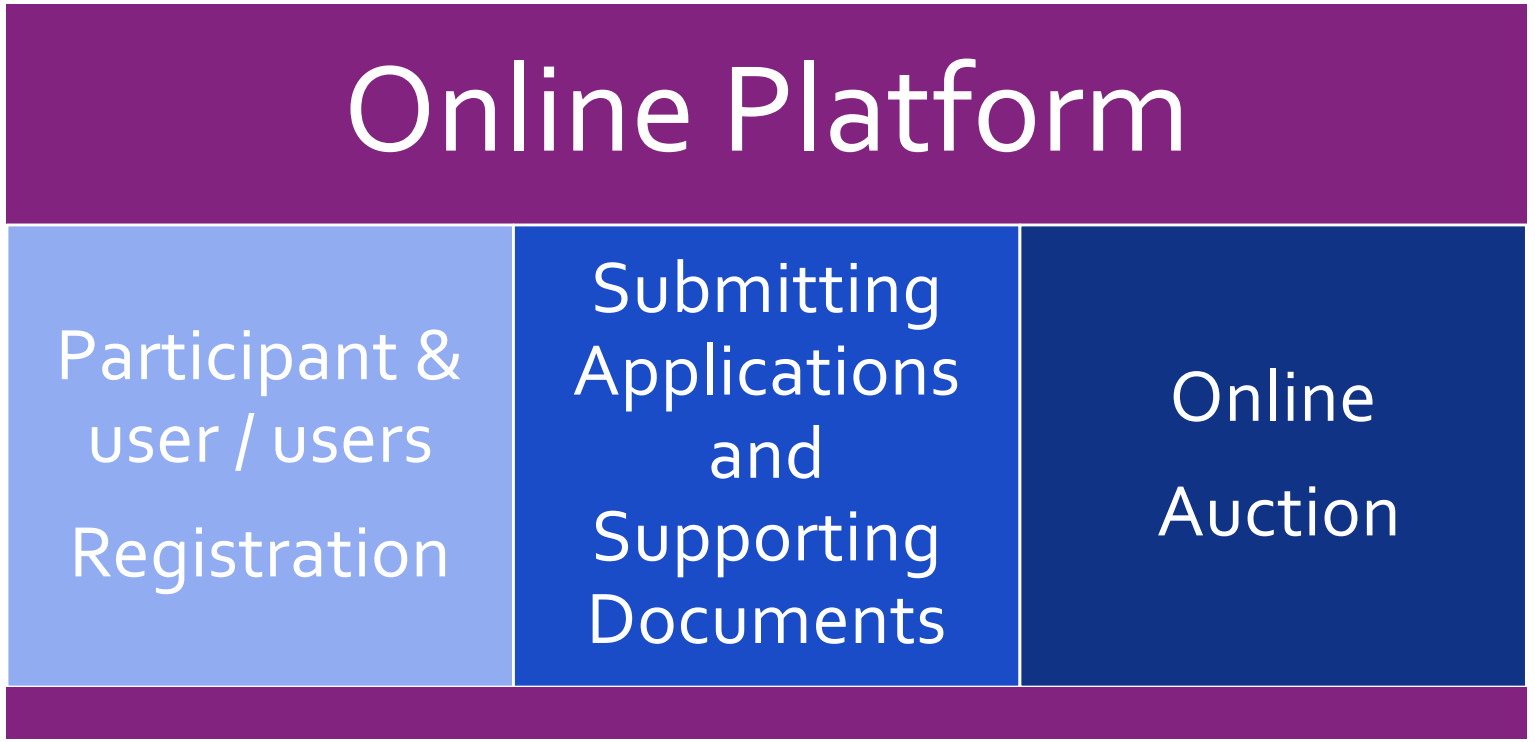


Guidelines from RAE



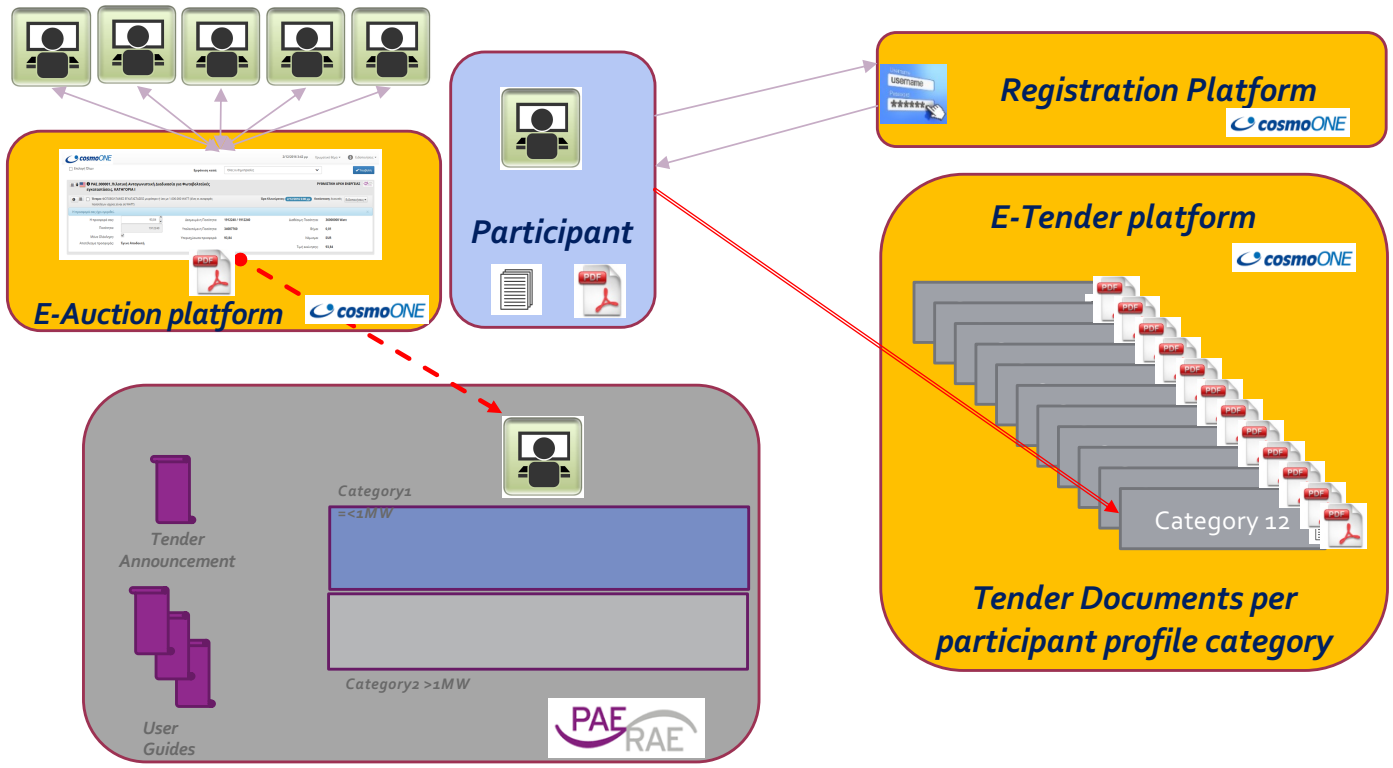


Description of the Process (2)

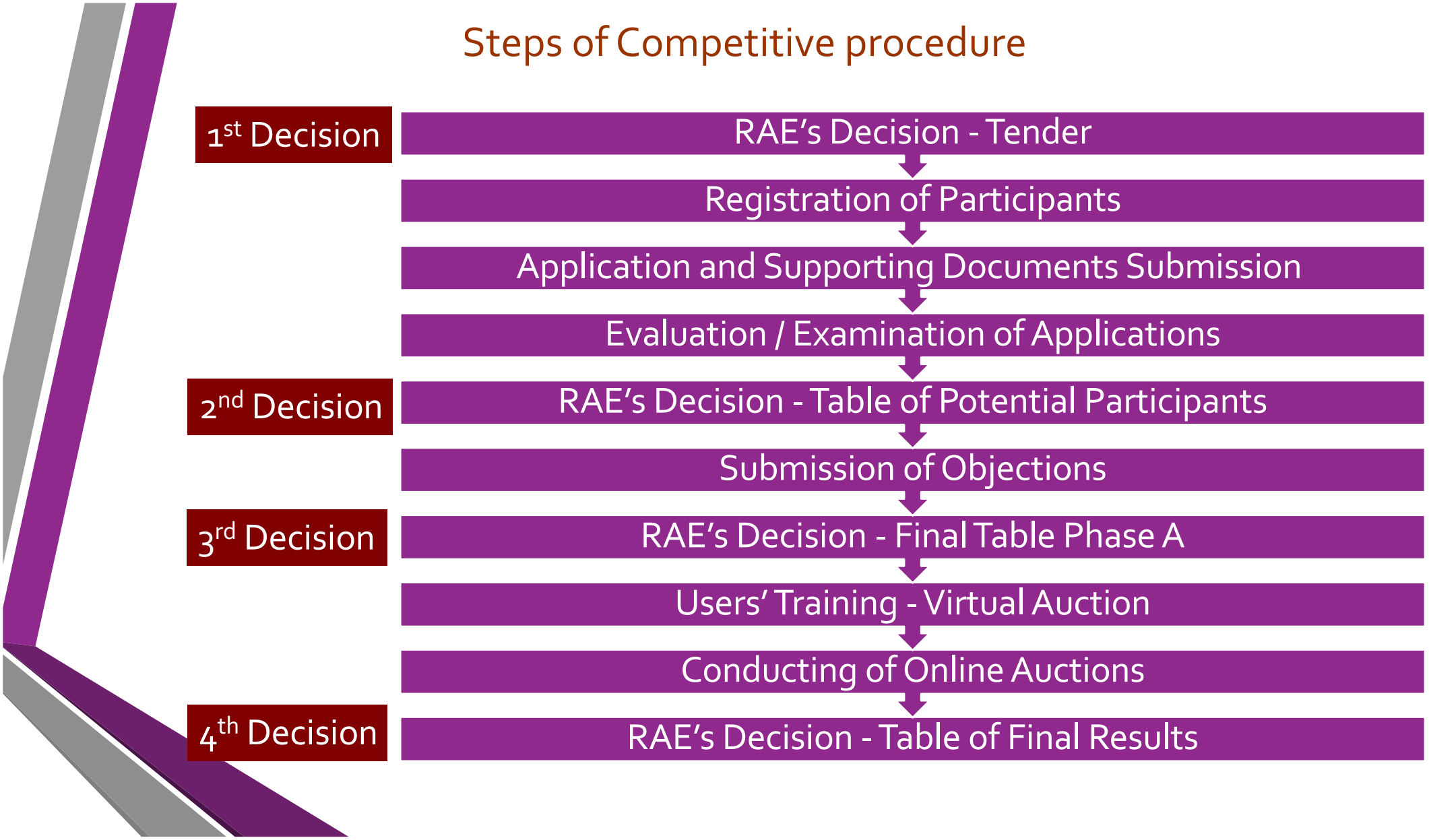


Video: https://youtu.be/RXIOEof8v9c

Description of the Process



Steps of Competitive procedure



The Basic components of the three auctions for each Category

	$P_{PV} \leq 1$ MW	1 MW < $P_{PV} \leq$ 20 MW	3 MW < $P_{Wind} \leq$ 50 MW
Maximum Auctioned Capacity (MW)	70	230	300
Accurate Auction Capacity (MW)	53,52	53,40	176,39
Fee for participation (€)	500	1000	1000
Ceiling Price (€/MWh)	85	80	90
Level of competition	75%	75%	75%
Letter of Guarantee for participation in the auction procedure (typical installation: PV=10€/kW, Wind=12,5€/Kw)	1%	1%	1%
Letter of Guarantee for proper performance	4%	4%	4%
Timetable for Connection (months)	12	**15m** //1 MW < $P_{PV} \leq$ 5 MW **24m** // 3 MW < $P_{WIND} \leq$ 10 MW **18m** // P_{PV} > 5MW **36m** // PWIND > 10 MW **6m** of the above limits if a Substation is needed	

2nd of July 2018 / Results of the Electronic auction

1st Pilot Auction, PV - Technology Specific, December 2016 - Results

Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
PV stations $P_{PV} \leq 1MW$	5	**4,8**	14	6,89	13	6,80	9	4,80	35	**104**	104	94,97	**98,78**
					Συμμετοχή στην Ηλεκτρονική δημοπρασία	6,8							
PV stations $1MW < P_{PV} \leq 20$ MW	35	**35,2**	13	53,17	12	50,21	7	35,12	446	**94**	88	79,97	**83,3**
					Συμμετοχή στην Ηλεκτρονική δημοπρασία	93,44							

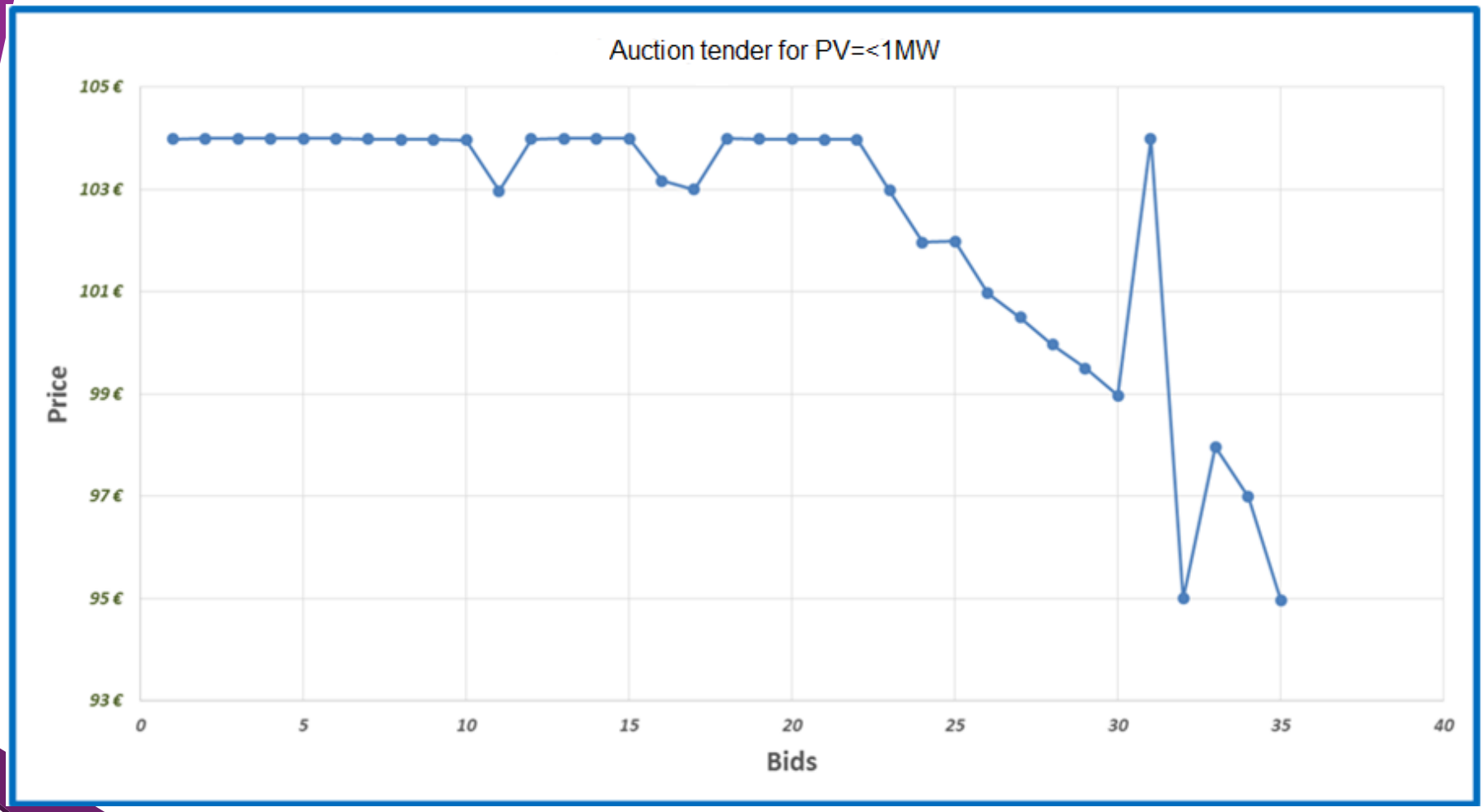
5,2 €/MWh (-5,1%)

11,7 €/MWh (-11,4%)

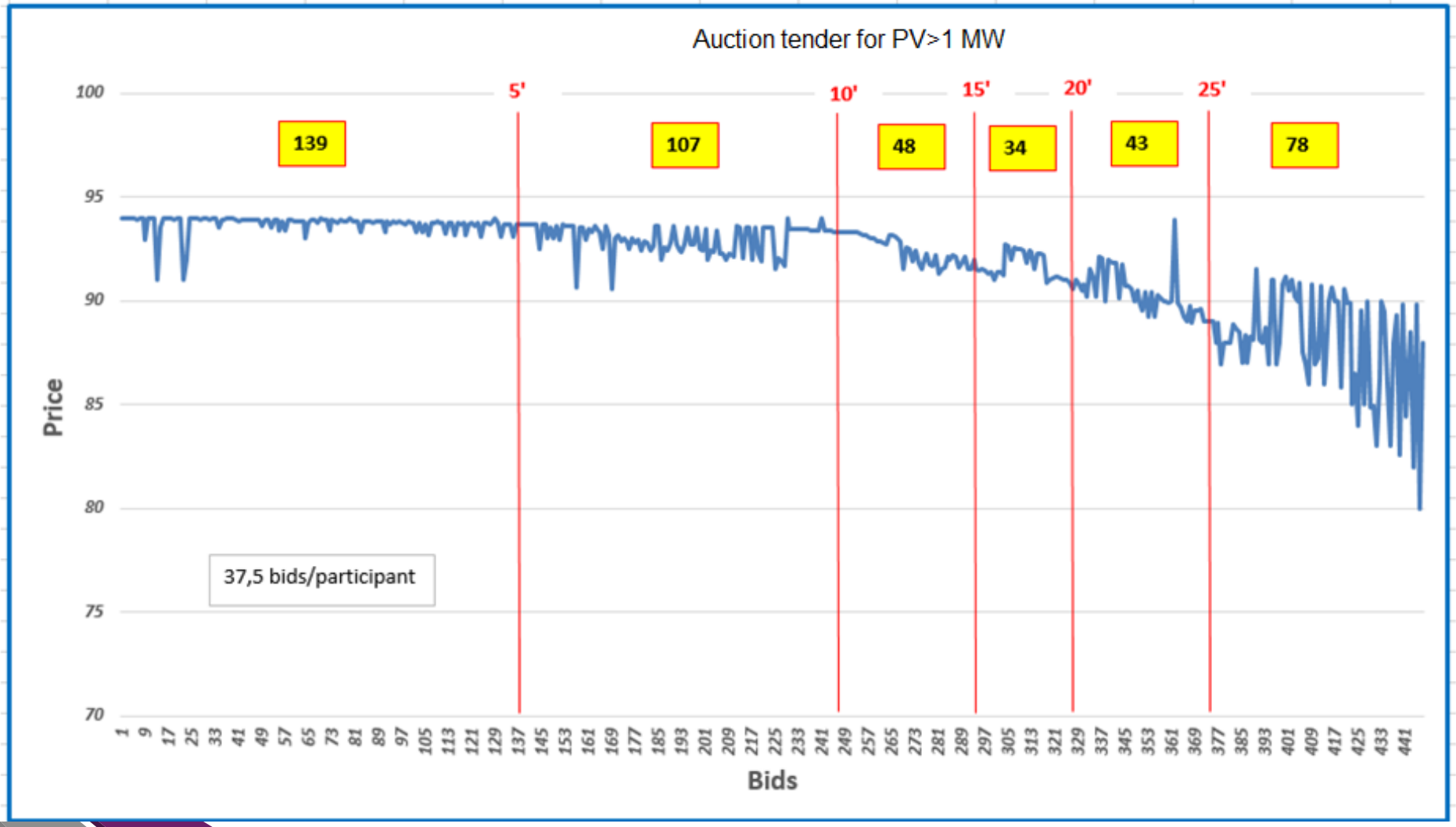
Absolut success

All the PV installations connected to the grid

Auction tender for PV ≤1MW



Auction tender for PV >1MW



1st Cycle Auction, July 2018 - Results

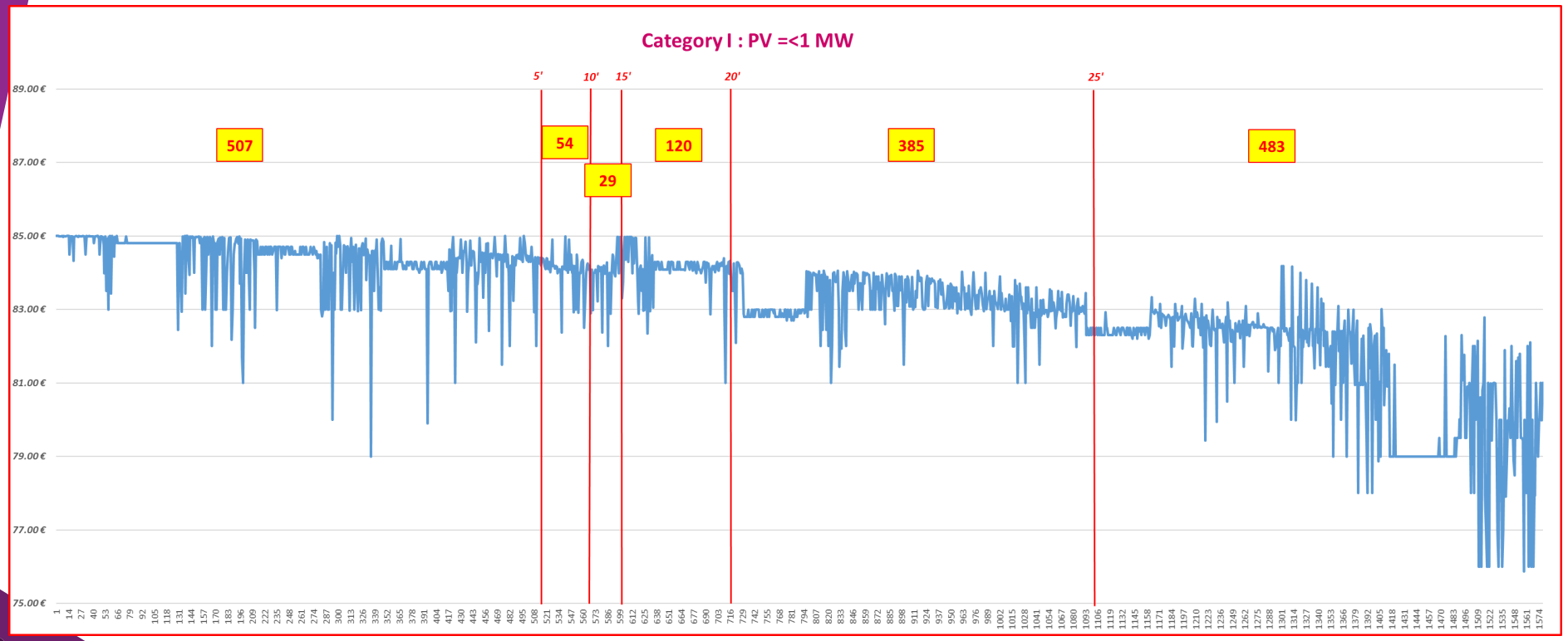
Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
PV stations $P_{PV} \leq 1MW$	70	**53,52**	177	105,54	155	94,07	83	53,48	1527	**85**	80	75,87	**78,42**
										6,5 €/MWh			
PV stations $1MW < P_{PV} \leq 20$ MW	230	**53,40**	34	197,21	13	93,44	8	52,92	280	**80**	71	62,97	**63,81**
										16 €/MWh			
Wind Stations $3MW < P_{Wind} <$ 50 MW	300	**176,39**	14	308,68	14	308,68	7	170,93	336	**90**	71,93	68,18	**69,53**
										21,5 €/MWh			

Absolut success

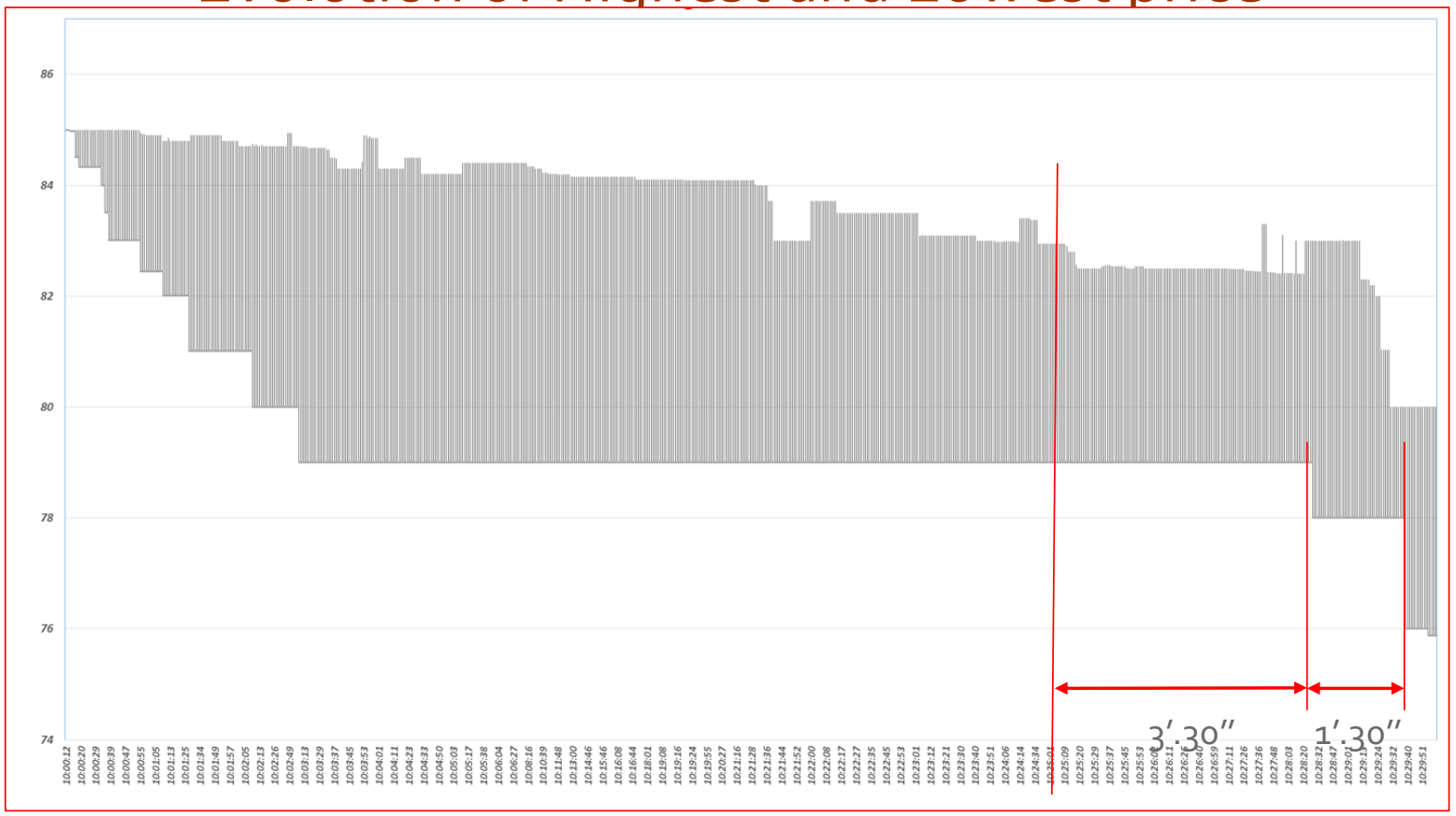
Category I

All the PV installations connected to the grid

July 2018 - Category I (PV installations ≤ 1MW)
#Bids per 5min intervals
155 participants – 1.527 bids



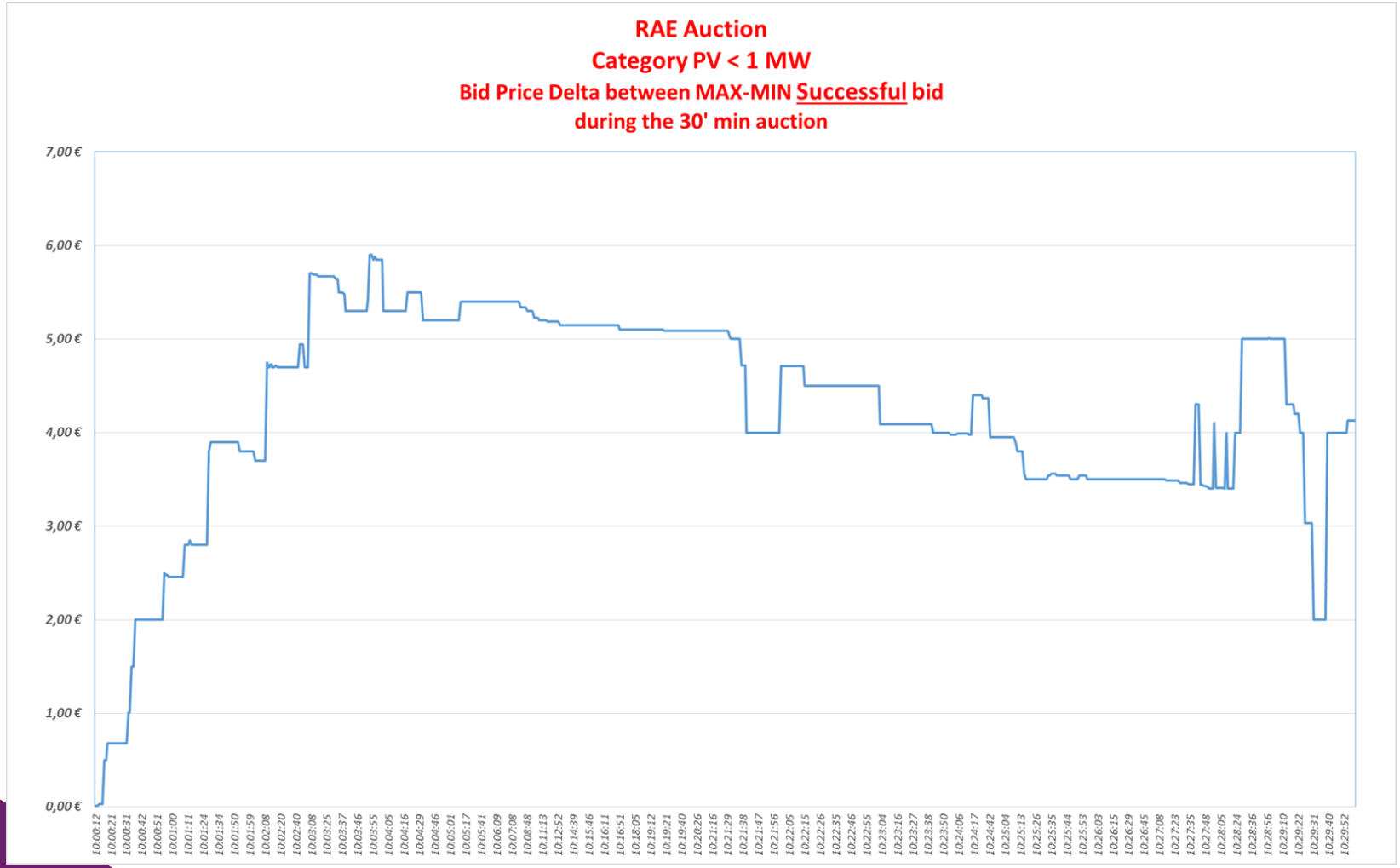
July 2018 - Category I, PV ≤ 1MW
Evolution of Highest and Lowest price



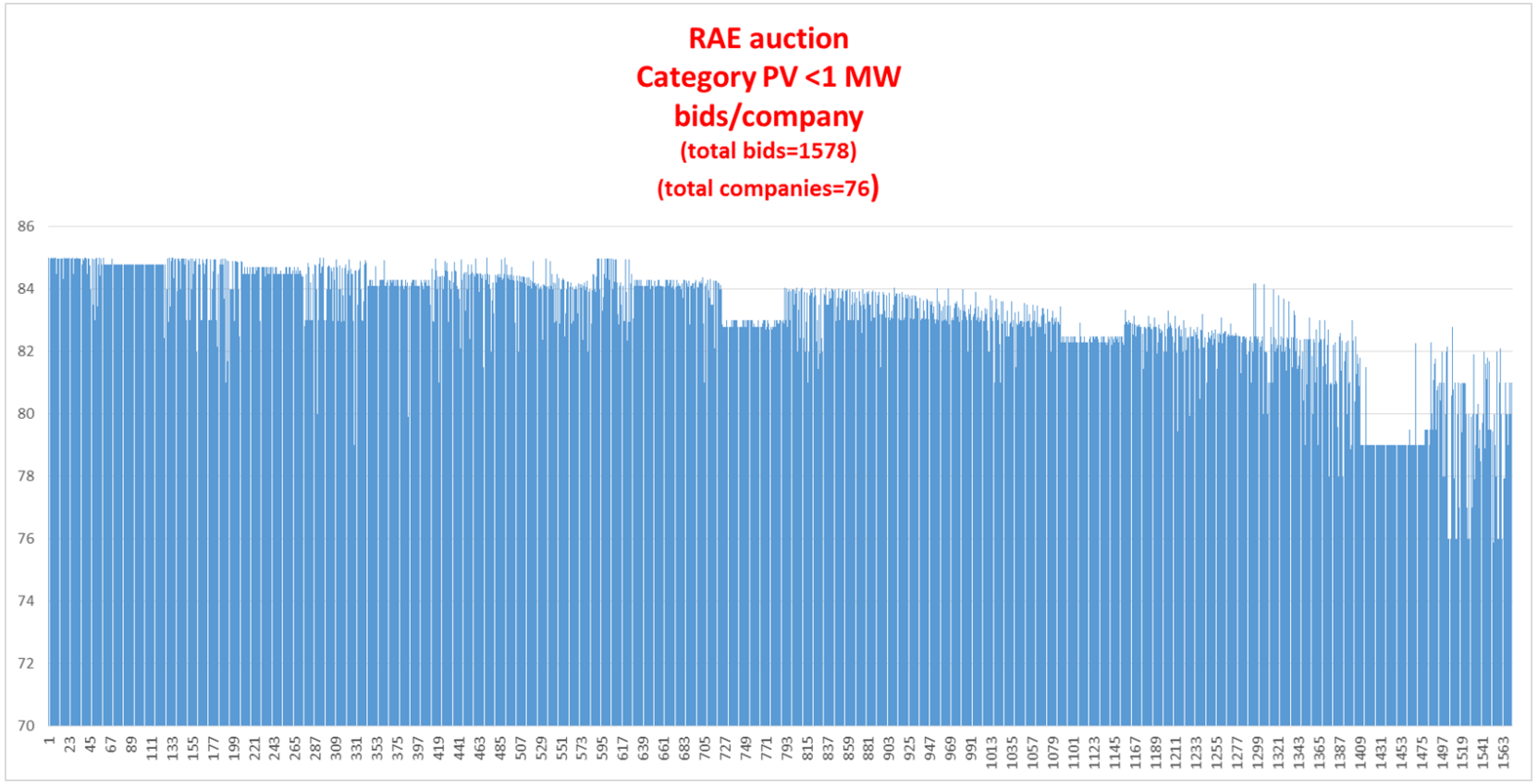
Remark: **It took 1':30" to drop the lowest price from 79 to 76 €/MWh (-3,8%)**

July 2018 - Category I, PV ≤ 1MW

Evolution of Delta between Highest and Lowest price

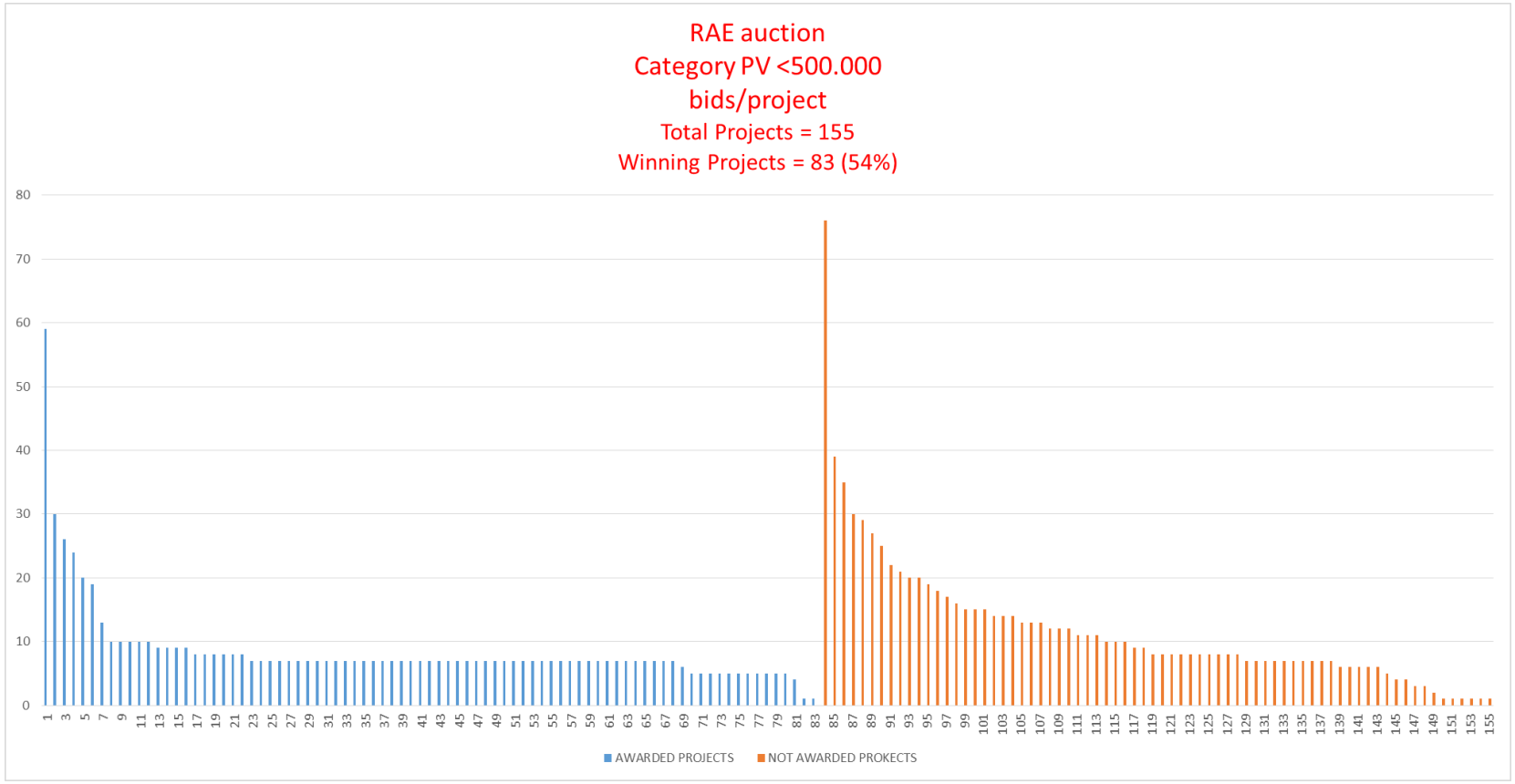


July 2018 - Statistics (1) – Category I



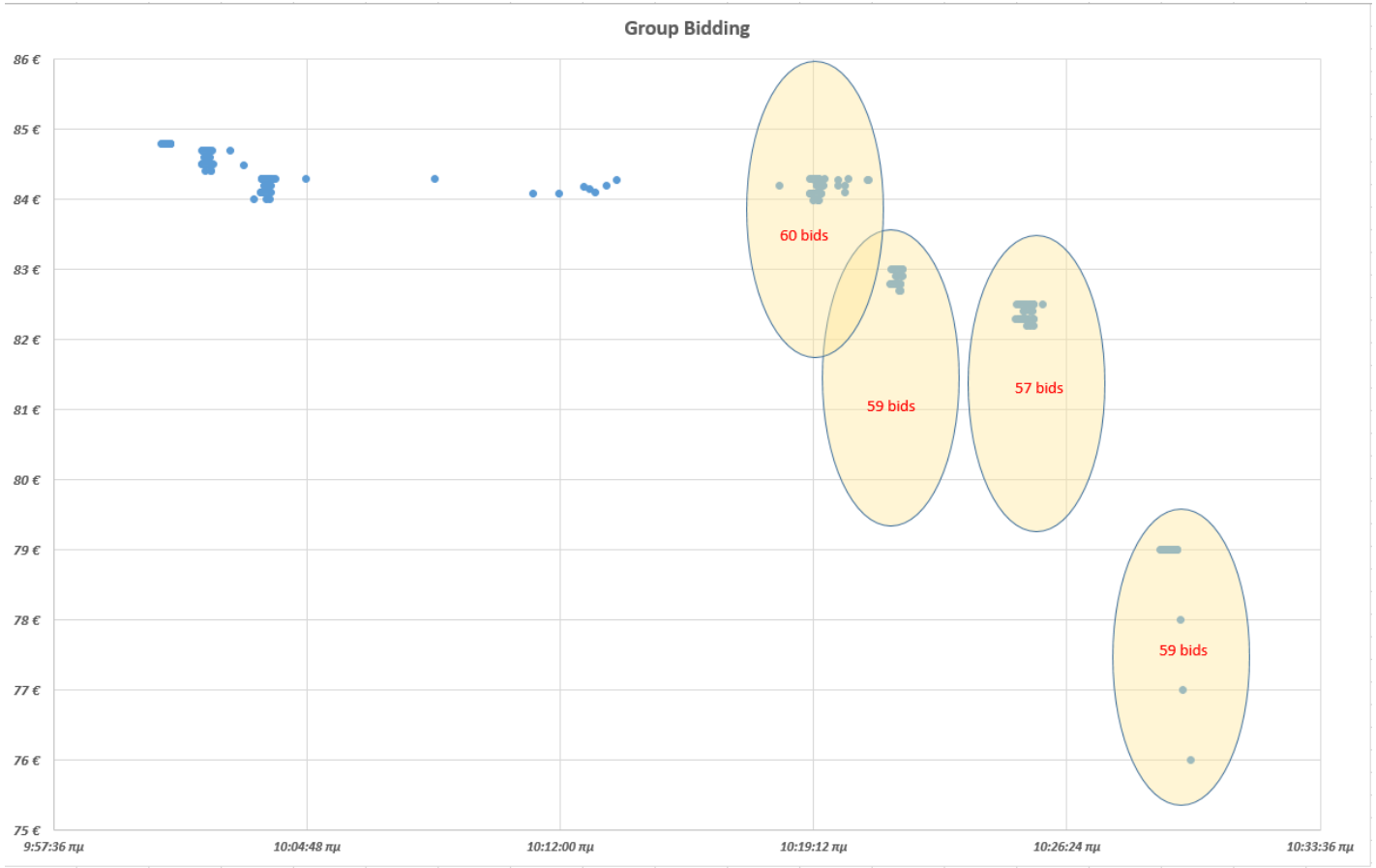
Remark : 1578 bids, within 30 minutes, **correspond to 0,6 bids/sec**

July 2018 - Statistics (5) – Category I

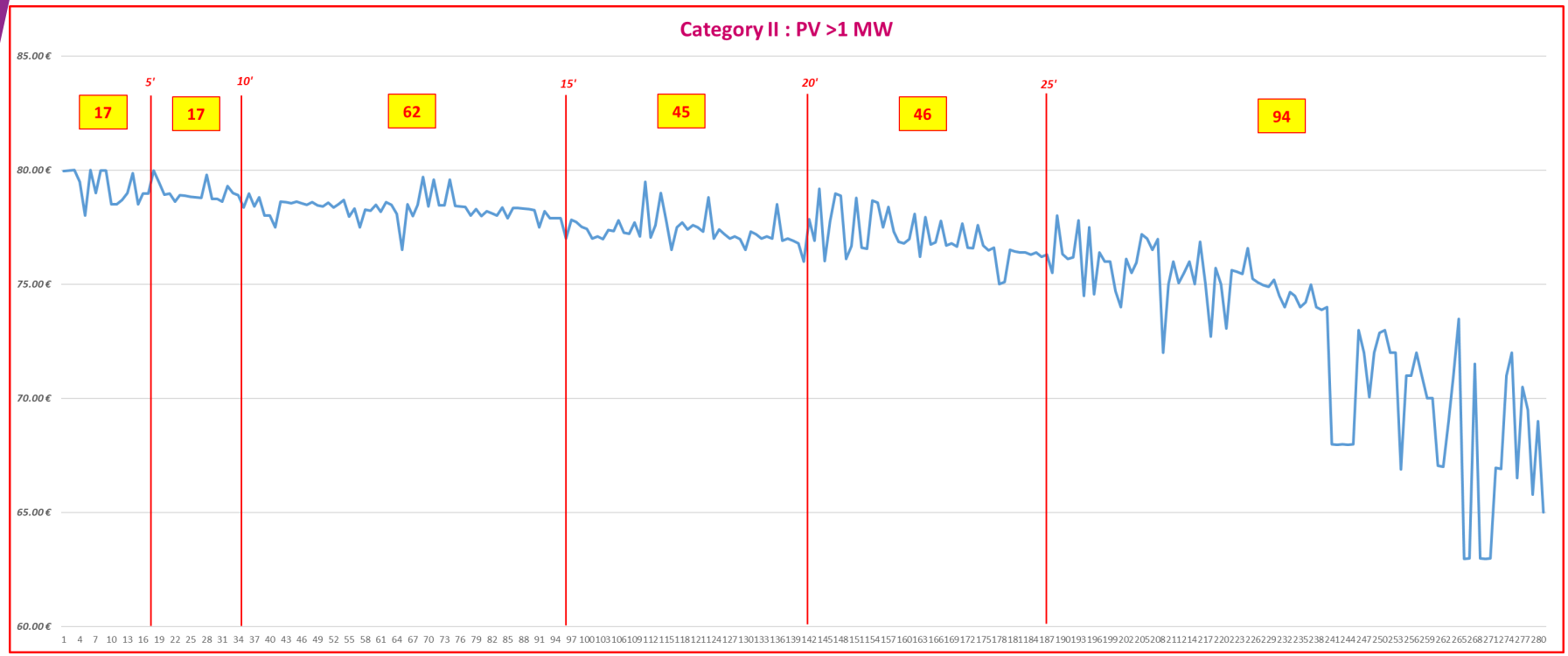


Remark : The **projects that won**, seem to have a **better strategy, by submitting less and more "effective" bids**

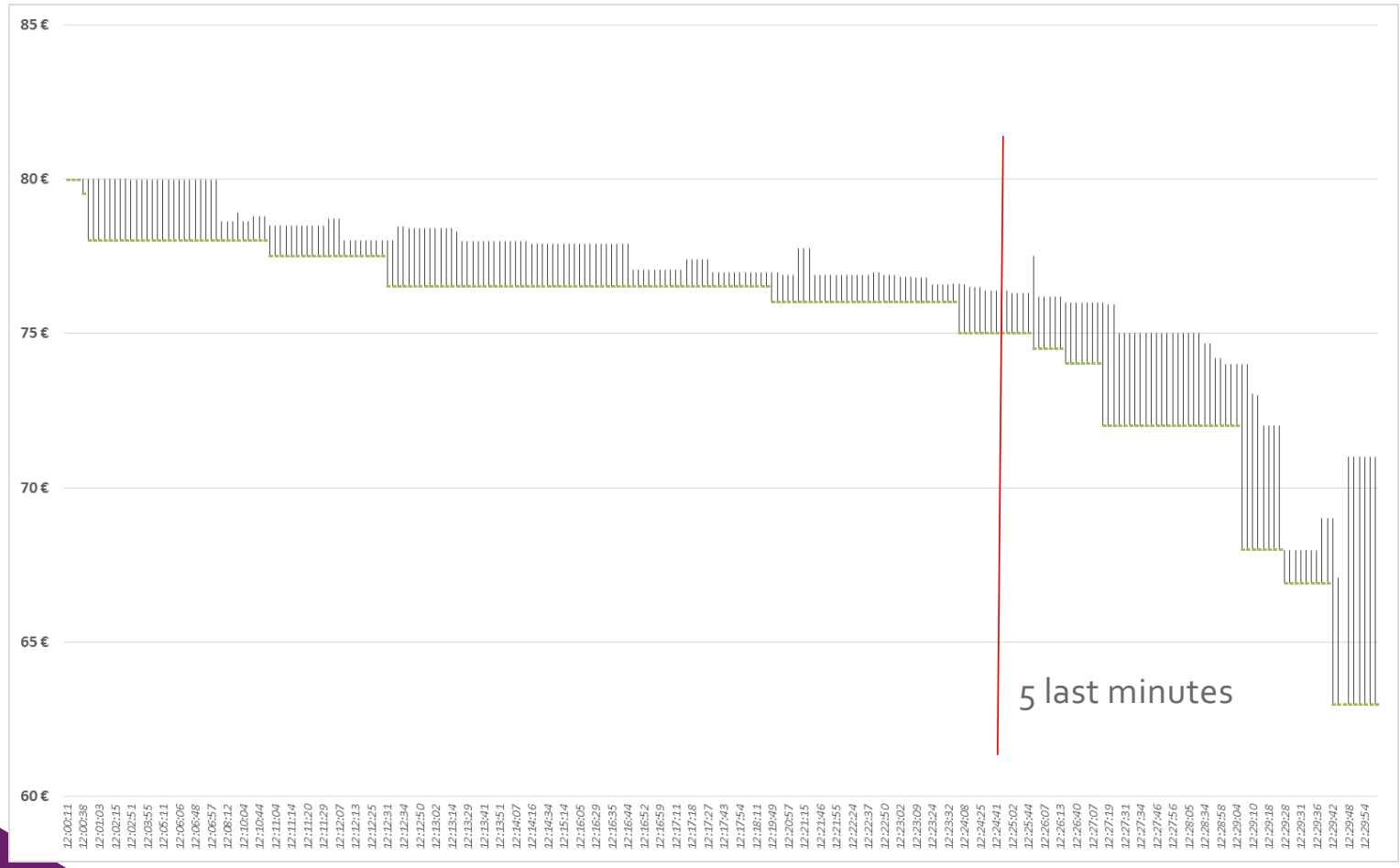
Group Bidding



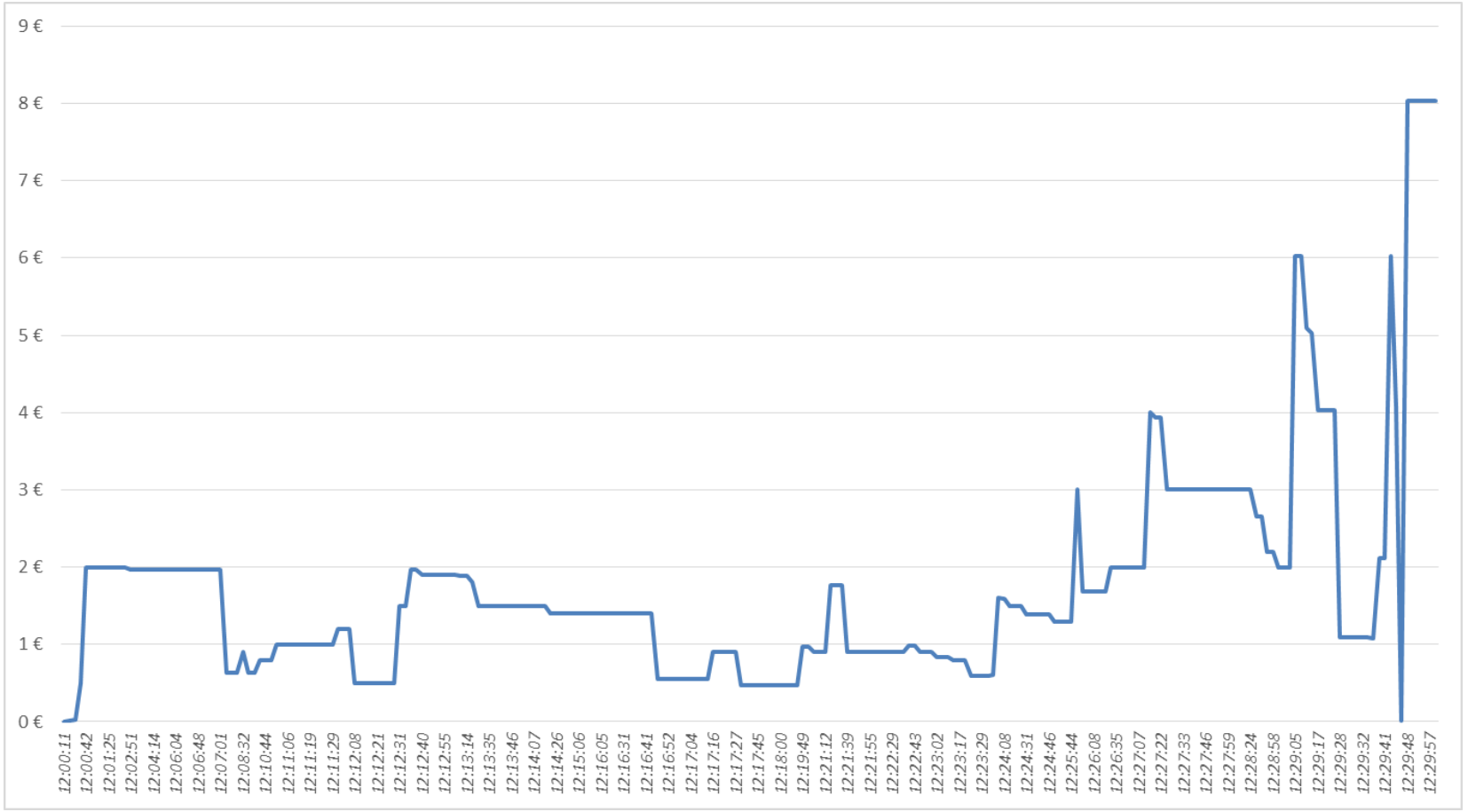
July 2018 - Category II, 1MW<PV<20MW
#Bids per 5min intervals



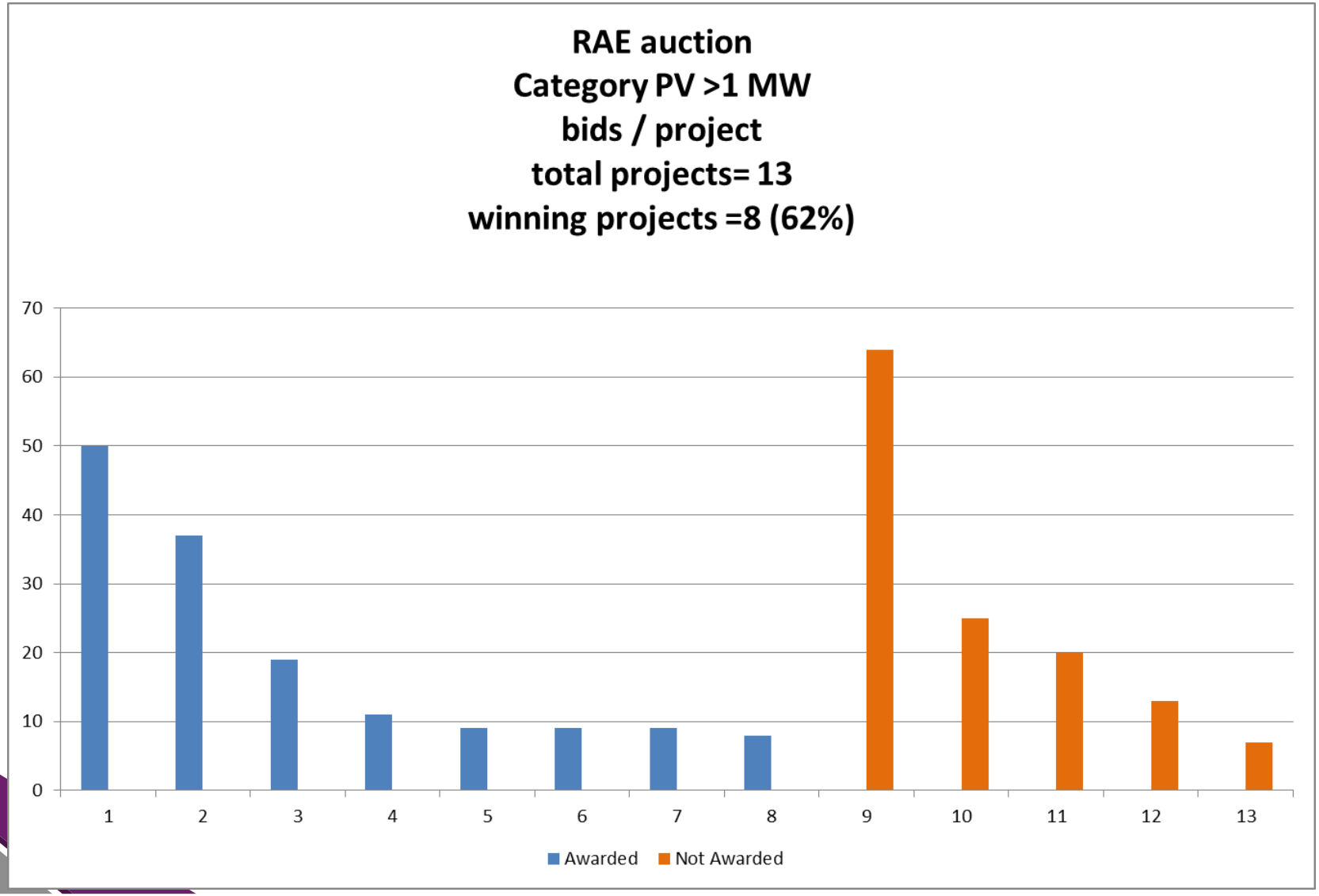
July 2018 - Category II, 1MW < PV <20MW
Evolution of Highest and Lowest price



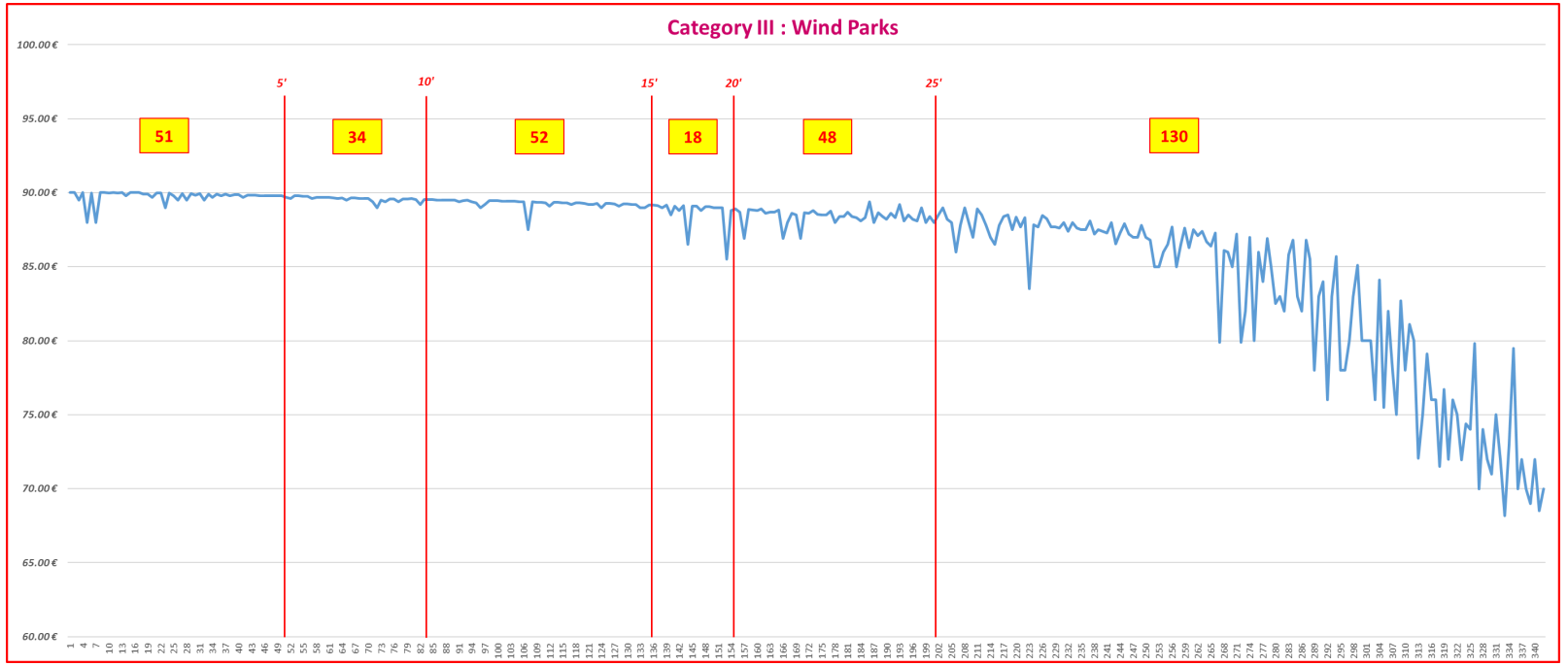
July 2018 - Category II, 1MW < PV <20MW
Evolution of Delta between Highest and Lowest price



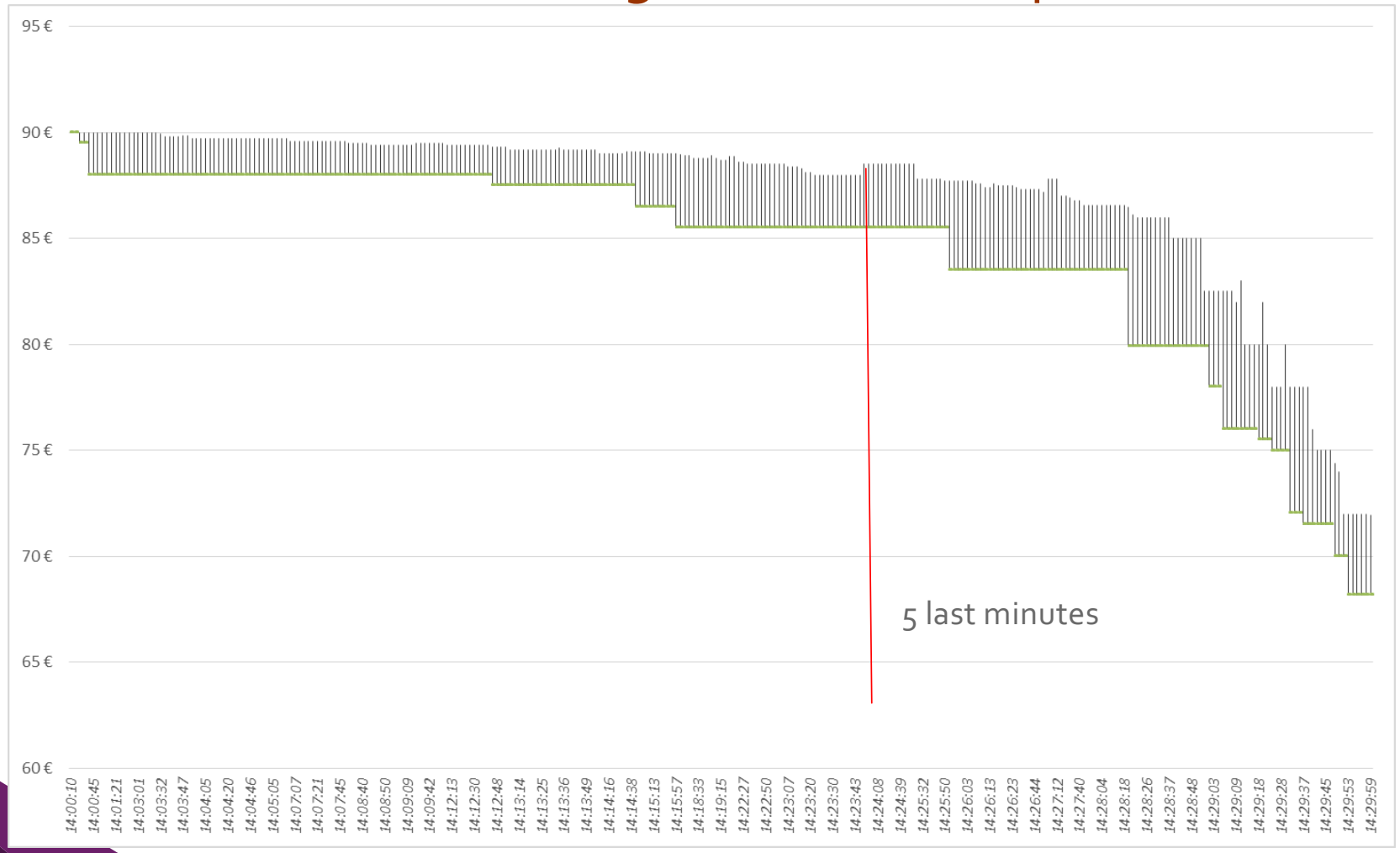
July 2018 - Statistics (4) – Category II



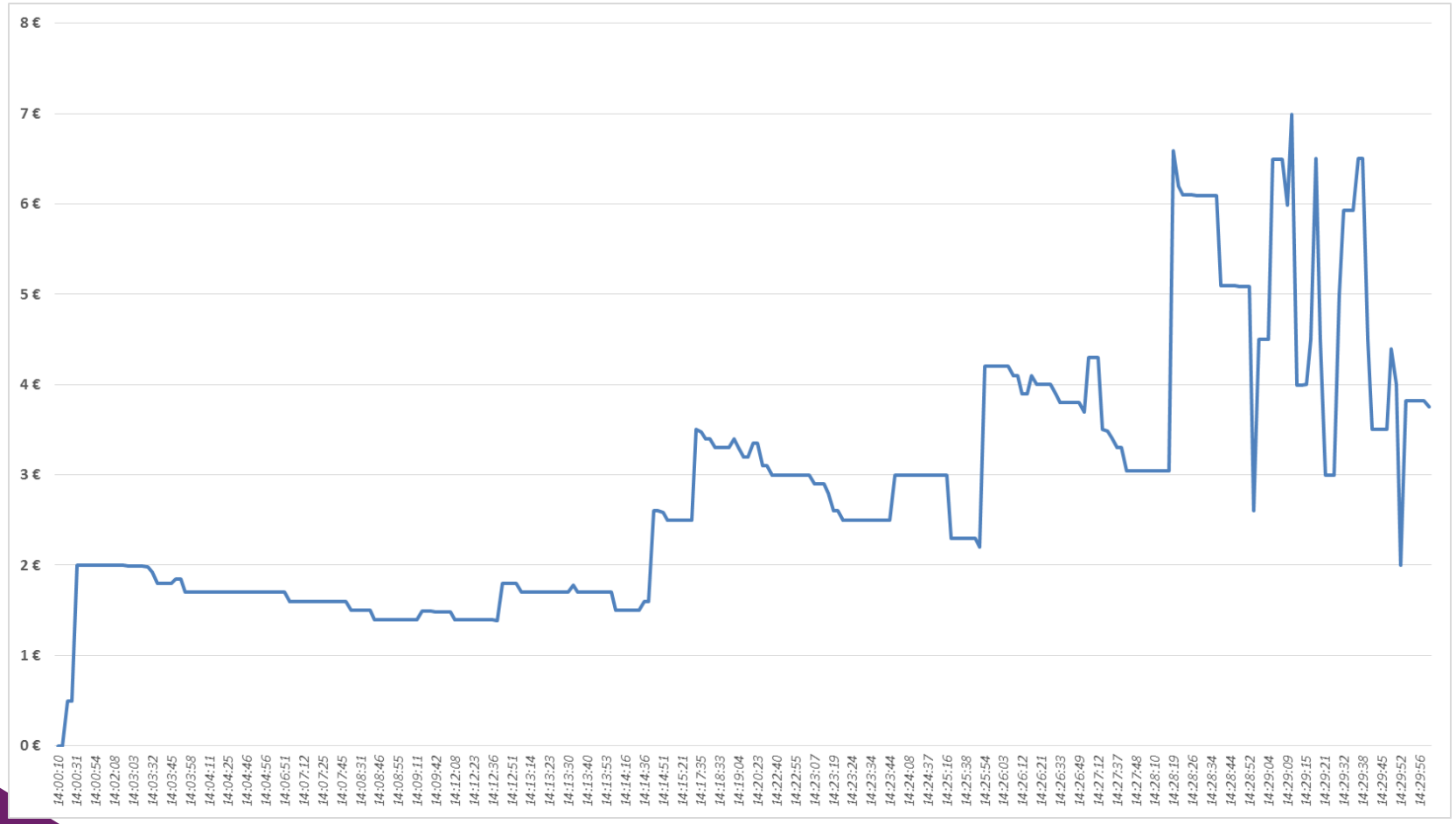
July 2018 - Category III (3MW< P_{Wind} ≤ 50MW)
#Bids per 5min intervals
14 participants – 336 bids



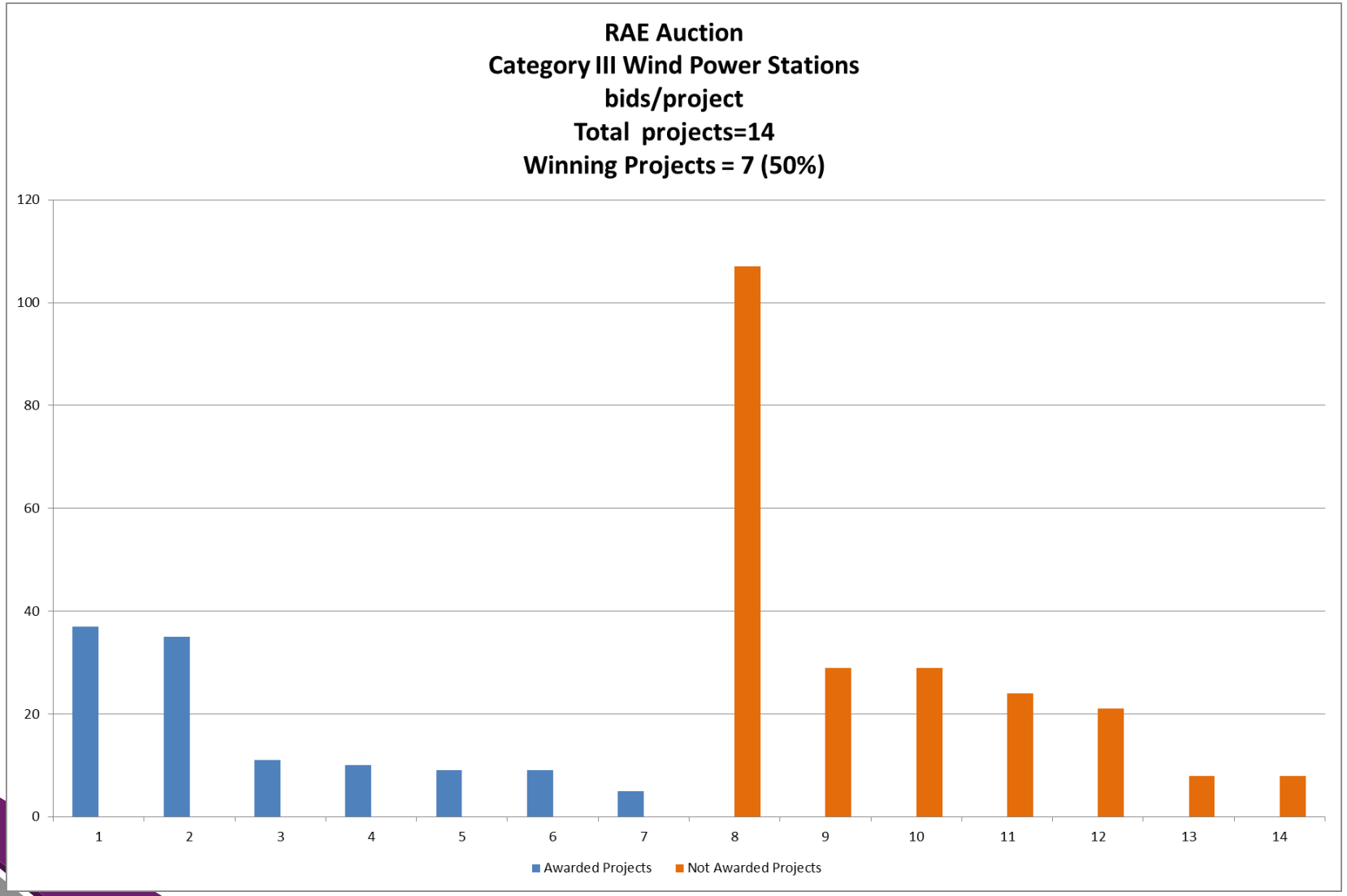
July 2018 - Category III, Wind installations
Evolution of Highest & Lowest price



July 2018 - Category III, Wind installations
Evolution of Delta between Highest and Lowest price



July 2018 - Statistics (3) – Category III

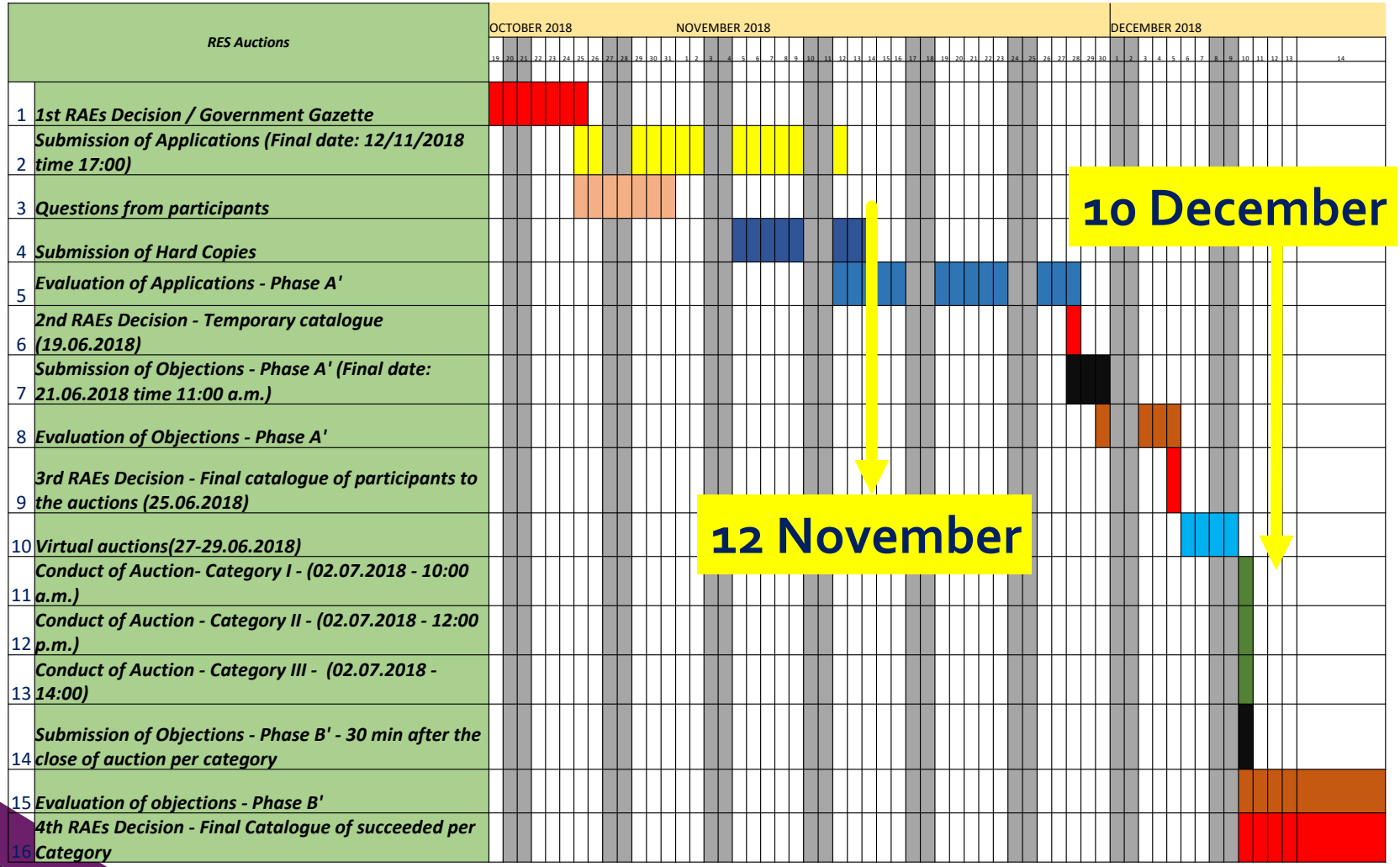


2nd Cycle Auction, December 2018 - Results

Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighted average price (€/MWh)
PV stations $P_{PV} \leq 1MW$	90	61,95	204	114,62	192	108,40	95	61,94	3907	81,71	68,99	63	66,66
										15 €/MWh			
PV stations $1MW < P_{PV} \leq 20$ MW	100	86,47	27	151,32	27	151,32	12	85,99	30	71,91	71,91	63	~~70,39~~
										1,5 €/MWh			
Wind Stations $3MW < P_{Wind} < 50$ MW	229	160,94	14	281,65	14	281,65	8	159,65	362	79,77	65,37	55	58,58
										21,2 €/MWh			

Cancelled

Timetable – 1026/2018 (FEK B' 4784/25.10.2018)

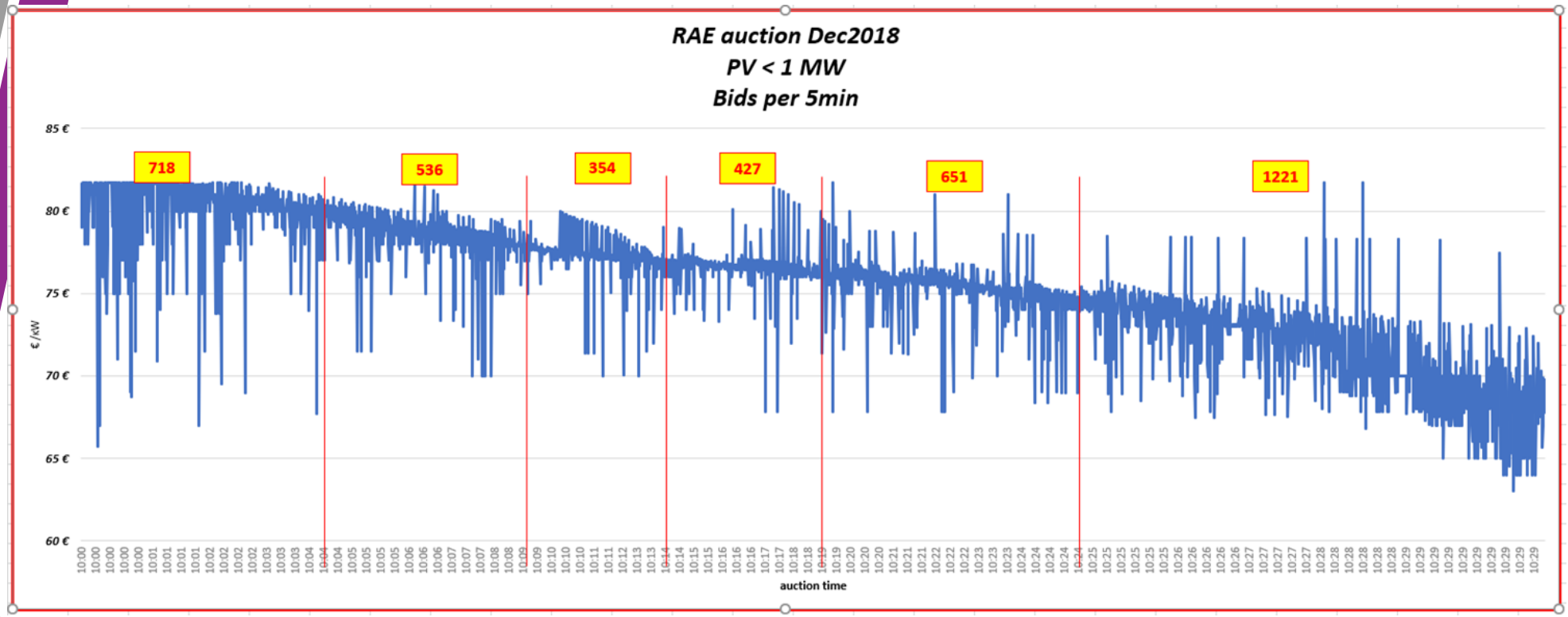


The Basic components of the three auctions for each Category

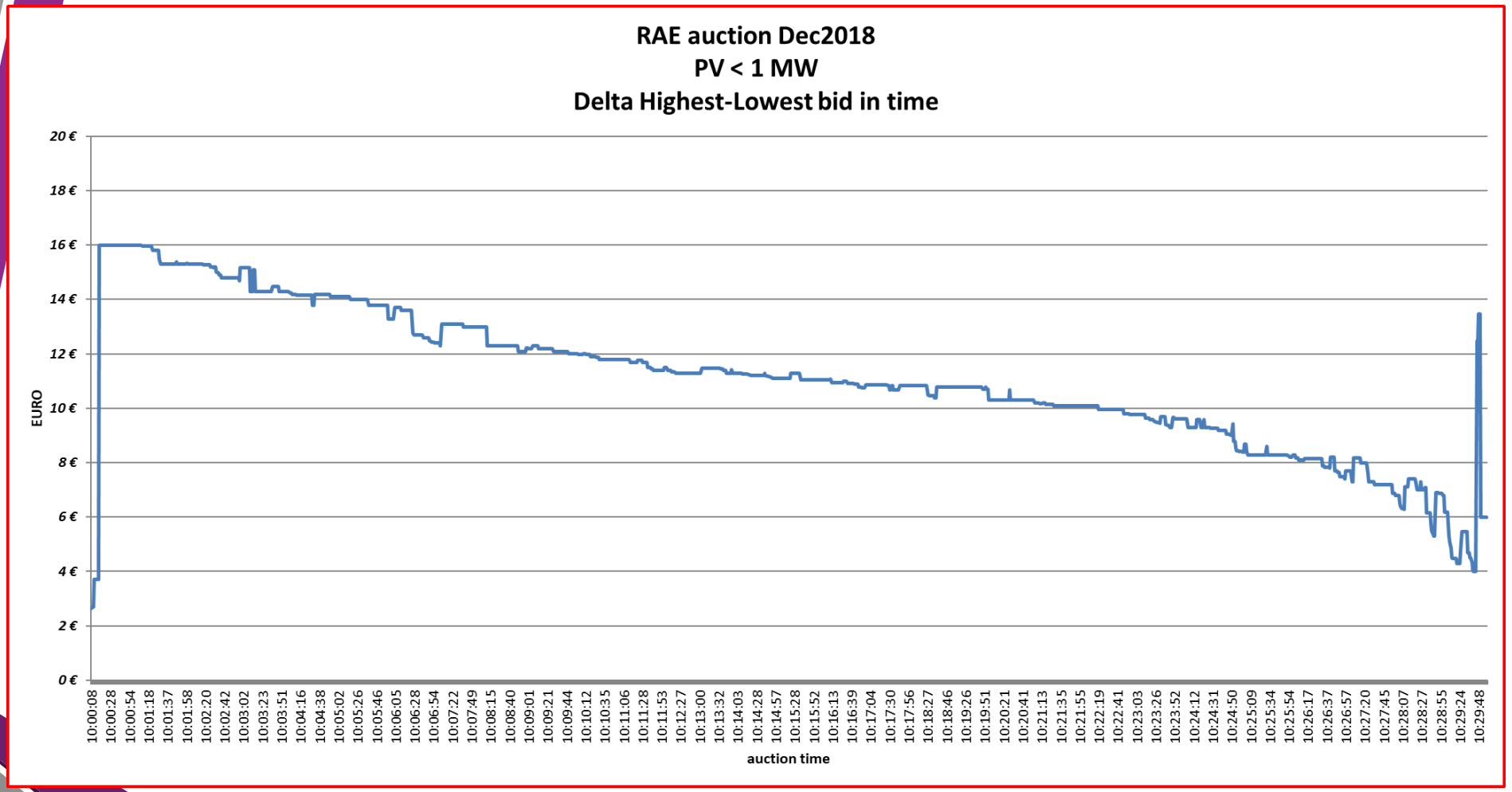
RES Auction, December 2018			
	$P_{PV} \leq 1$ MW	1 MW < $P_{PV} \leq 20$ MW	3 MW < $P_{Wind} \leq 50$ MW
Auctioned Capacity (max) (MW)	90	100	229
[Number of Participants] - MW	[200 apl.] - 114,61	[27 apl.] - 151,32	[14 apl.] - 281,65
Application fee (€)	500	1.000	1.000
Ceiling Price (€/MWh) / RAE's Opinion	81,71	71,91	79,77
Level of competition (minimum)	75%	75%	75%
Auctioned Capacity (MW)	61,94	85,99	159,65
Letter of Guarantee to participate (Typical installation: PV=10€/kW, Wind=12,5€/Kw)	1%	1%	1%
Letter of Guarantee for Good performance	4%	4%	4%
Timetable for Connection to the Grid (m)	12	**15m** //1 MW < $P_{PV} \leq 5$ MW **18m** // P_{PV} > 5MW **6m** of the above limits if a Substation is needed	**24m** // 3 MW < $P_{WIND} \leq 10$ MW **36m** // PWIND > 10 MW

**Starting bid is calculated as the average of the previous auction starting bid and the weighted average of bids. For example, the starting bid for the wind category is the average of 90€/MWh and 69,53€/MWh which are respectively the starting bid and the weighted average of bids of the first auction.*

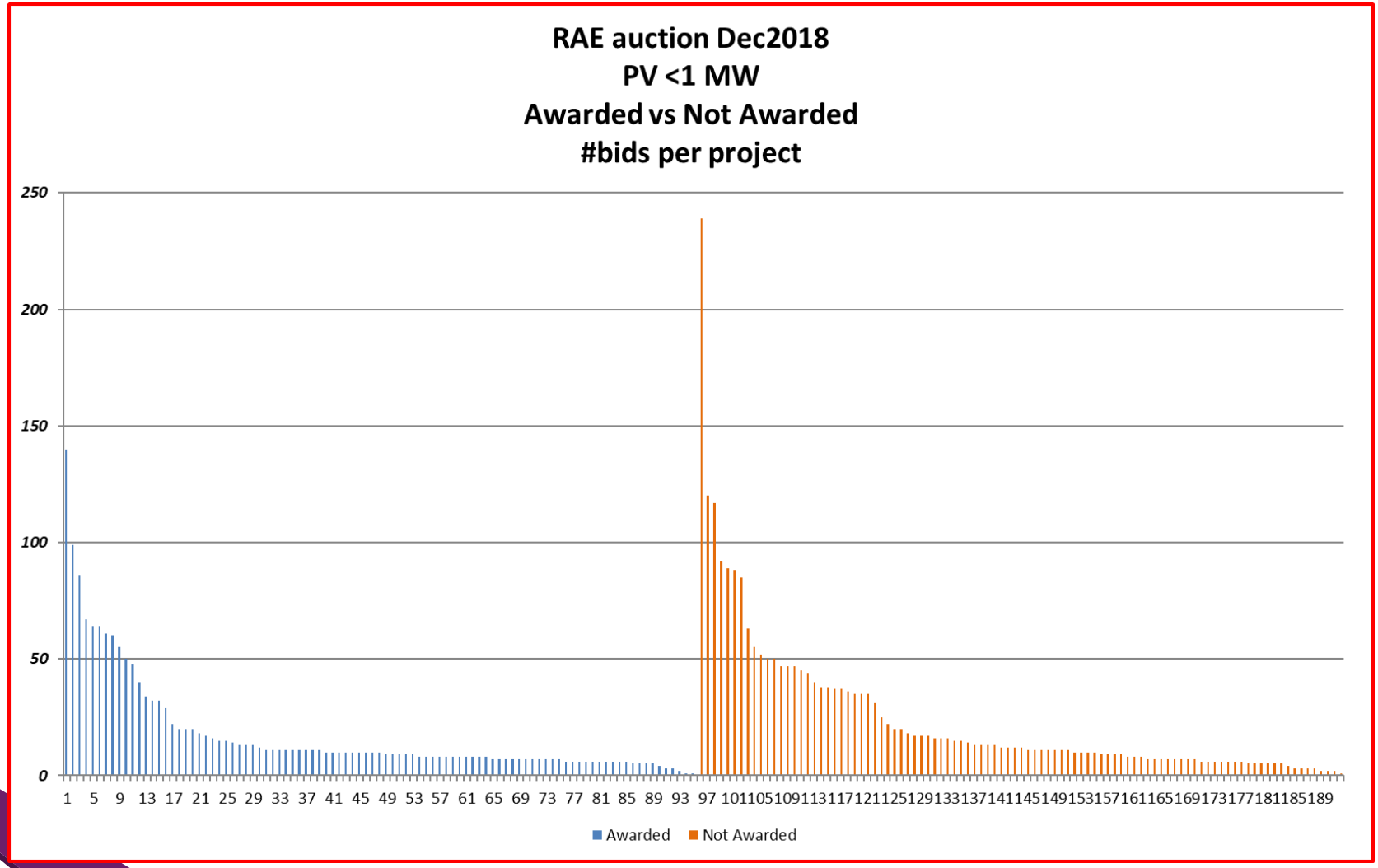
Category I, PV=< 1MW - Dec 2018



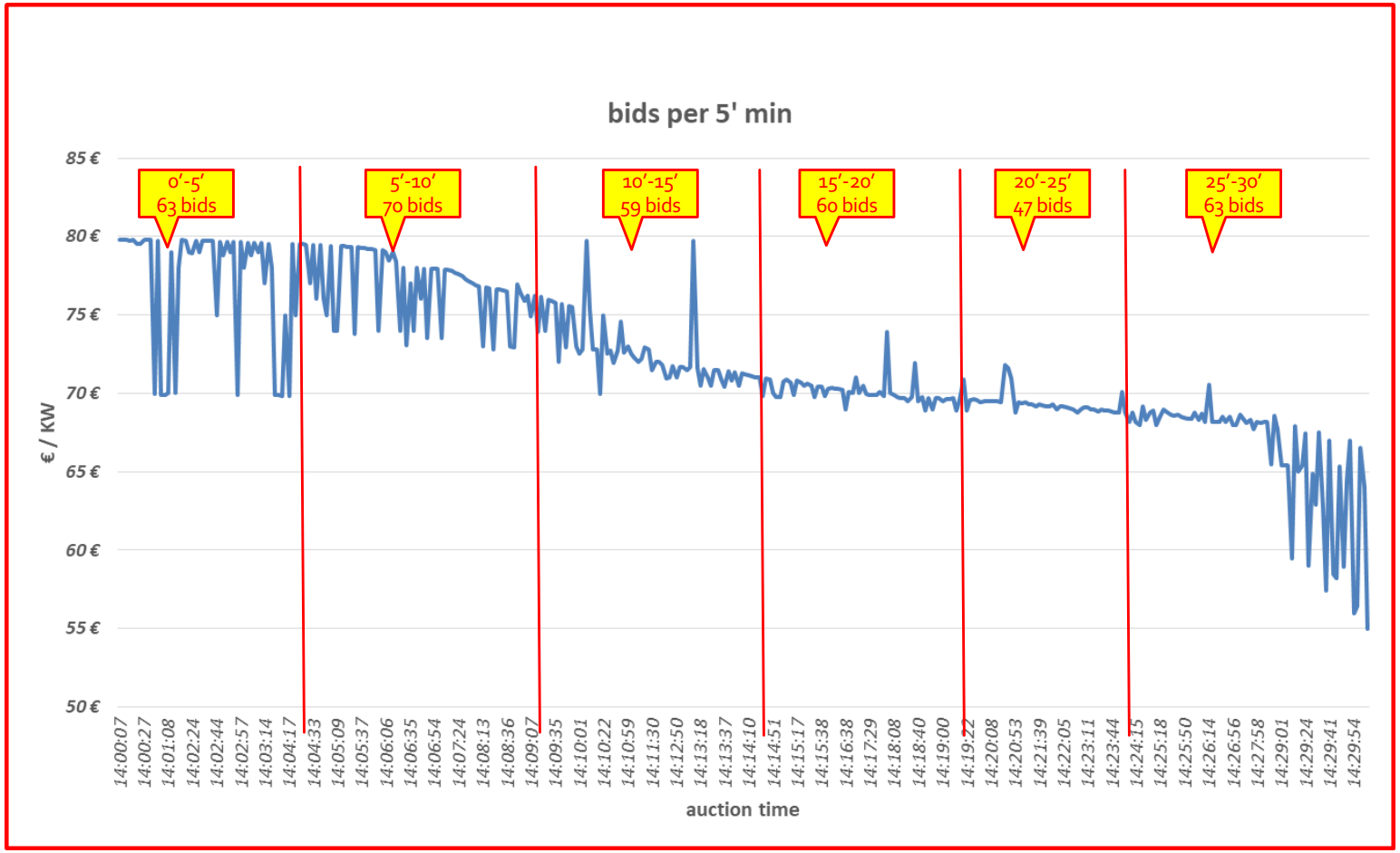
Category I, PV=< 1MW - Dec 2018



Category I, PV=< 1MW - Dec 2018

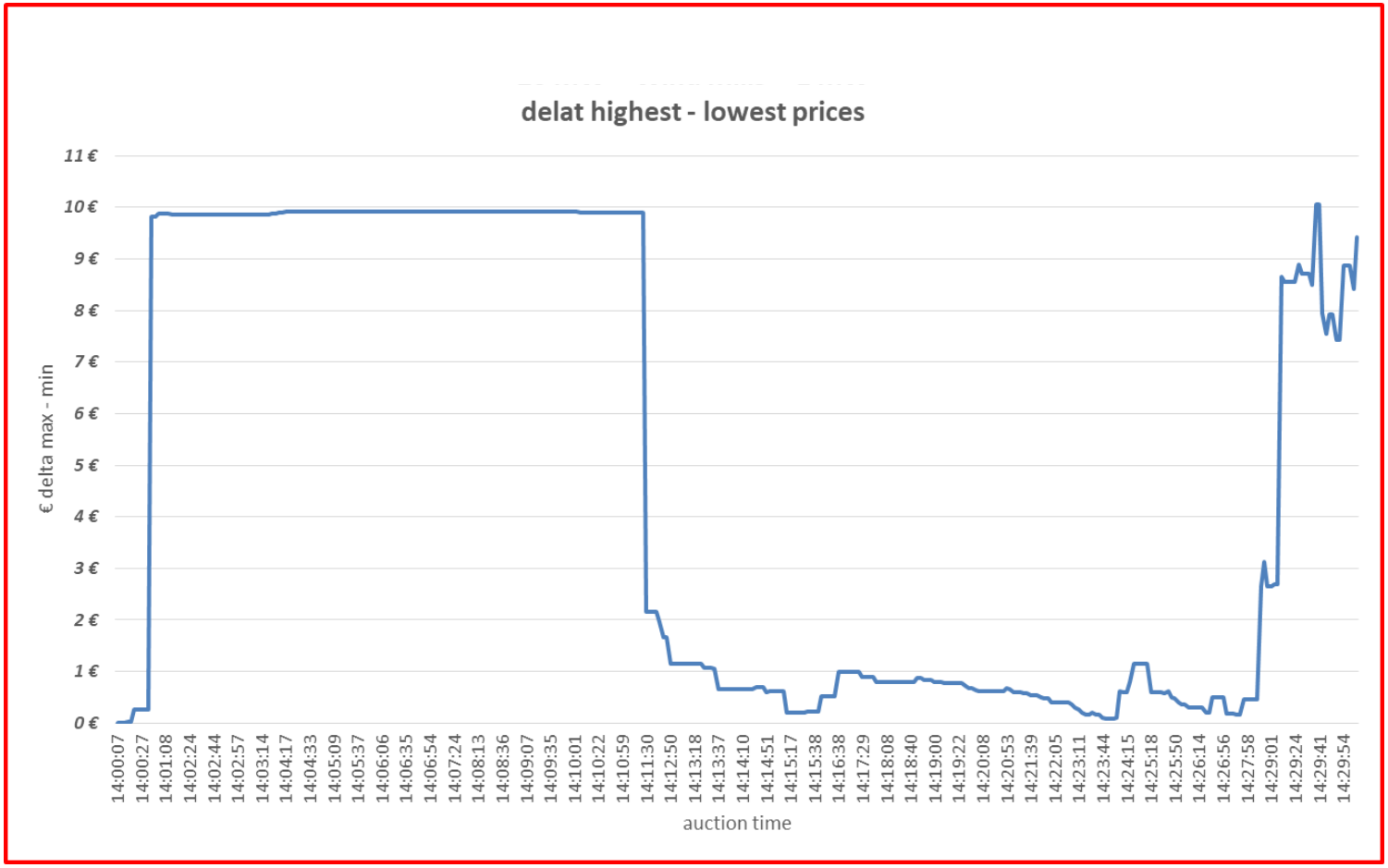


Category III, 3MW < Wind ≤ 50MW, Dec. 2018

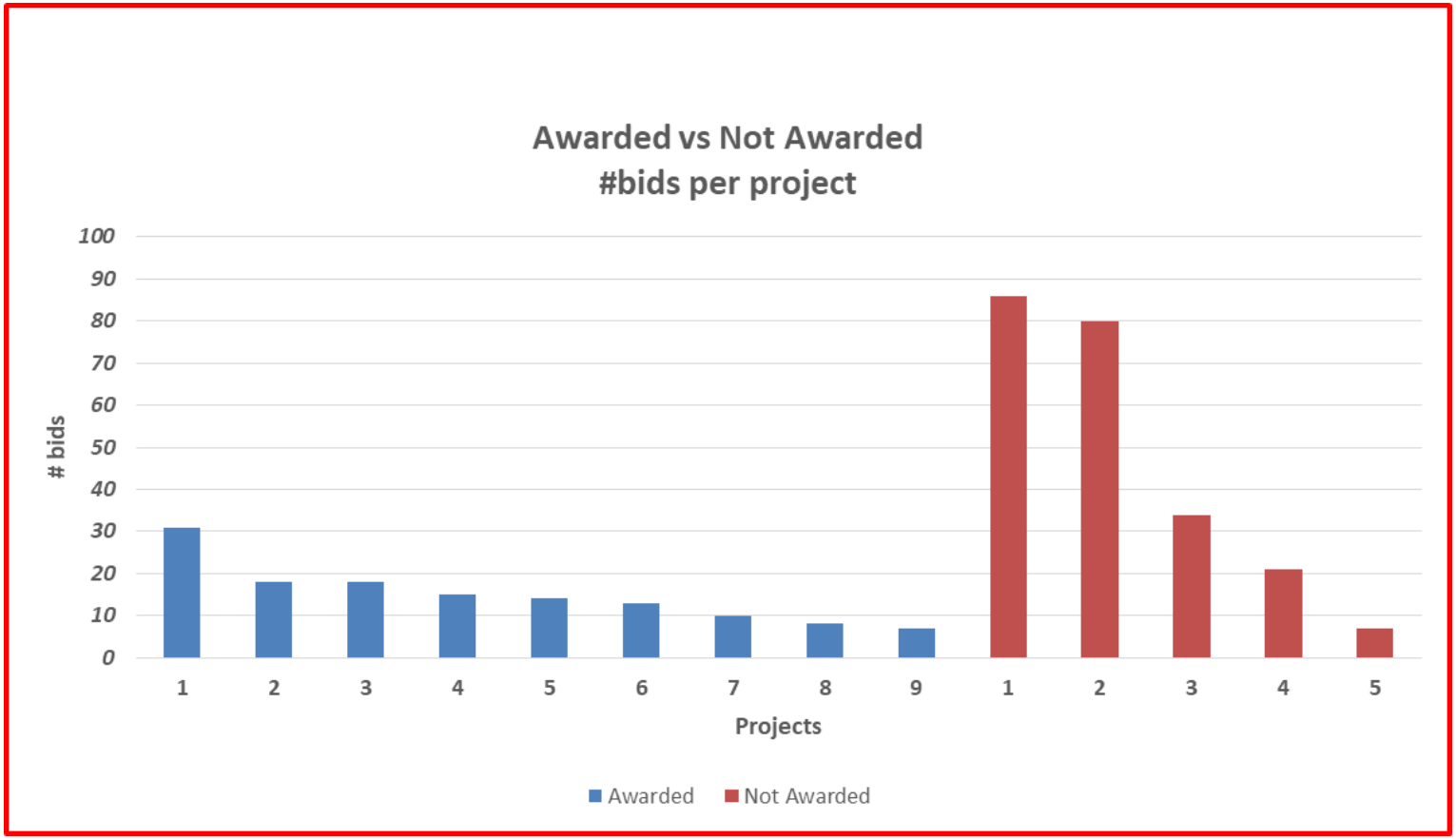


Category III, 3MW < Wind ≤ 50MW, Dec. 2018

Category III, 3MW < Wind ≤ 50MW, Dec. 2018



Category III, 3MW < Wind ≤ 50MW, Dec. 2018

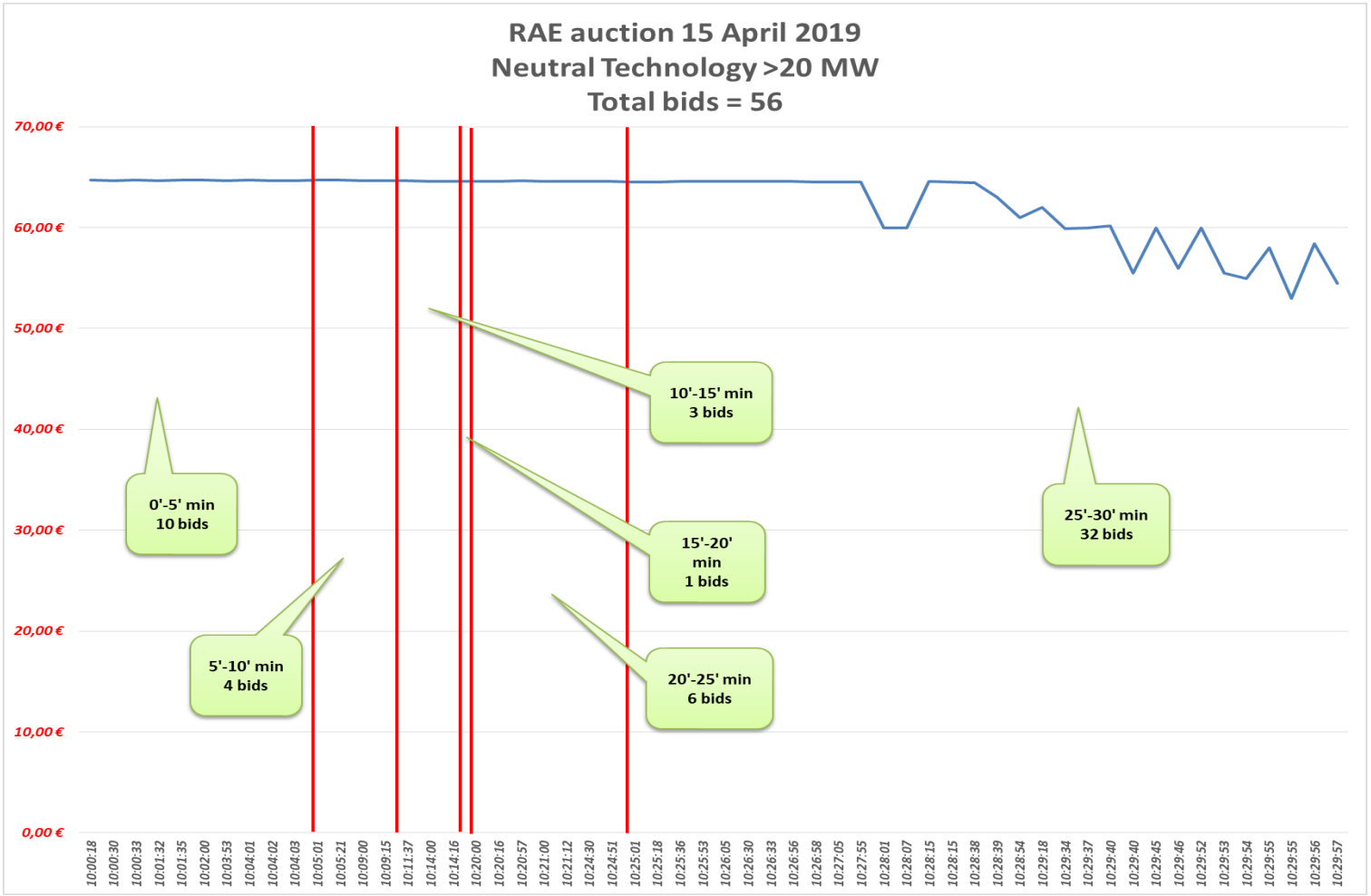


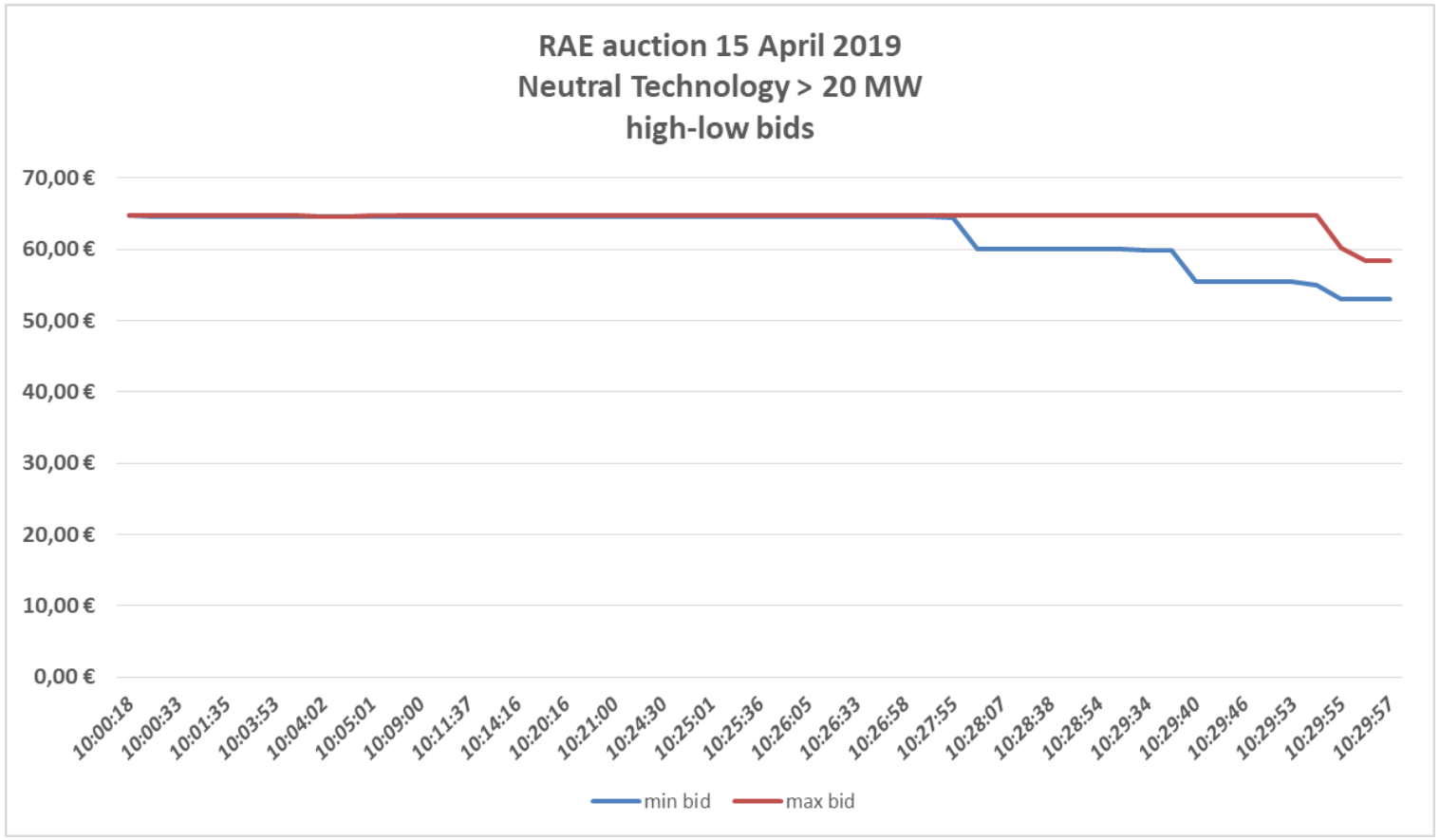
1st Cycle Auction, Technology Neutral, April 2019 - Results

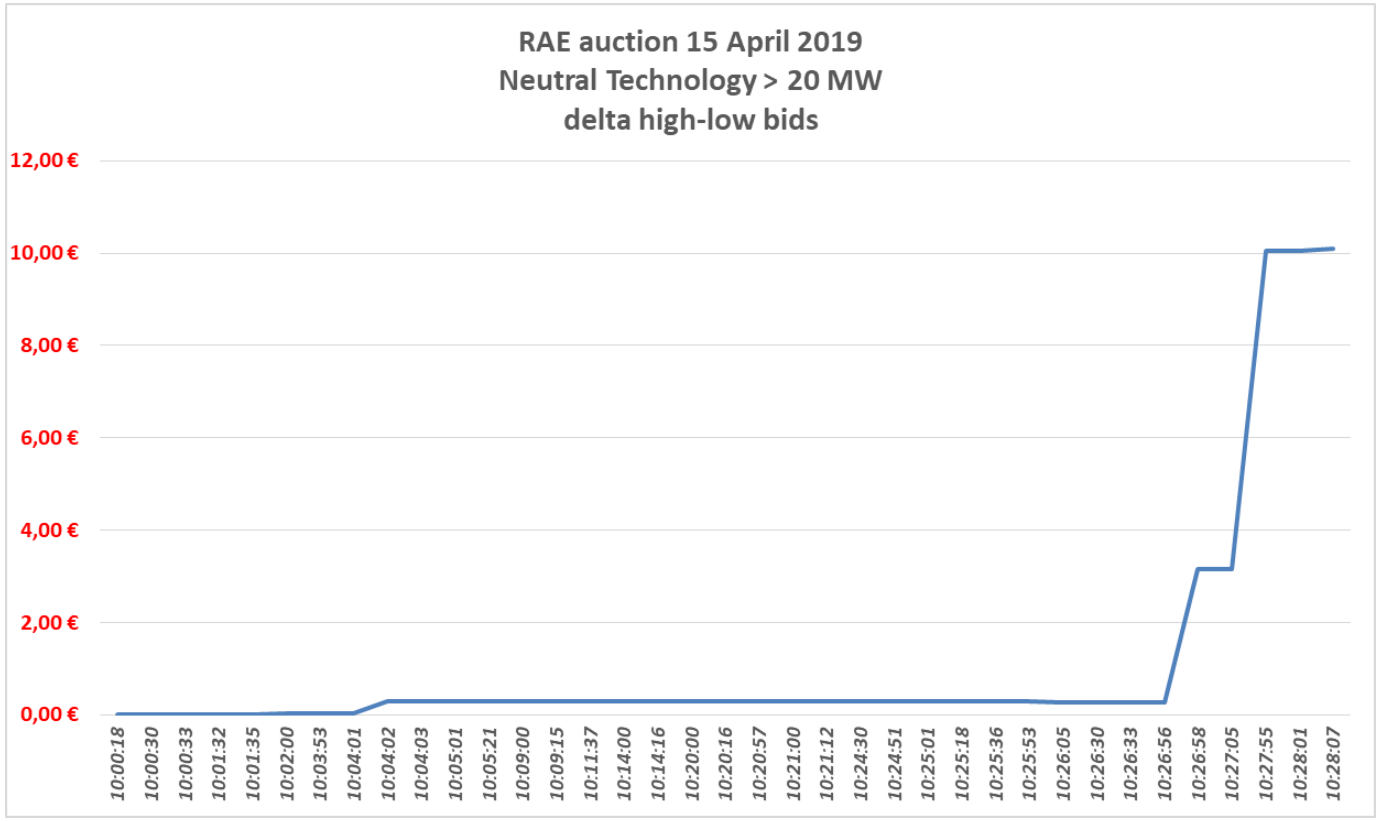
Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
Technology Neutral	600	**455,56**	8	637,78	8	637,78	7	437,78	56	**64,72**	64,72	53	**57,03**

7,69 €/MWh (-11,88%)

Category IV, Neutral technology >20 MW




RAE auction 15 April 2019
Neutral Technology > 20 MW
high-low bids
70,00 €
60,00 €
50,00 €
40,00 €
30,00 €
20,00 €
10,00 €
0,00 €
10:00:18
10:00:33
10:01:35
10:03:53
10:04:02
10:05:01
10:09:00
10:11:37
10:14:16
10:20:16
10:21:00
10:24:30
10:25:01
10:25:36
10:26:05
10:26:33
10:26:58
10:27:55
10:28:07
10:28:38
10:28:54
10:29:34
10:29:40
10:29:46
10:29:53
10:29:55
10:29:57
min bid
max bid


RAE auction 15 April 2019
Neutral Technology > 20 MW
delta high-low bids
12,00 €
10,00 €
8,00 €
6,00 €
4,00 €
2,00 €
0,00 €
10:00:18
10:00:30
10:00:33
10:01:32
10:01:35
10:02:00
10:03:53
10:04:01
10:04:02
10:04:03
10:05:01
10:05:21
10:09:00
10:09:15
10:11:37
10:14:00
10:14:16
10:20:00
10:20:16
10:20:57
10:21:00
10:21:12
10:24:30
10:24:51
10:25:01
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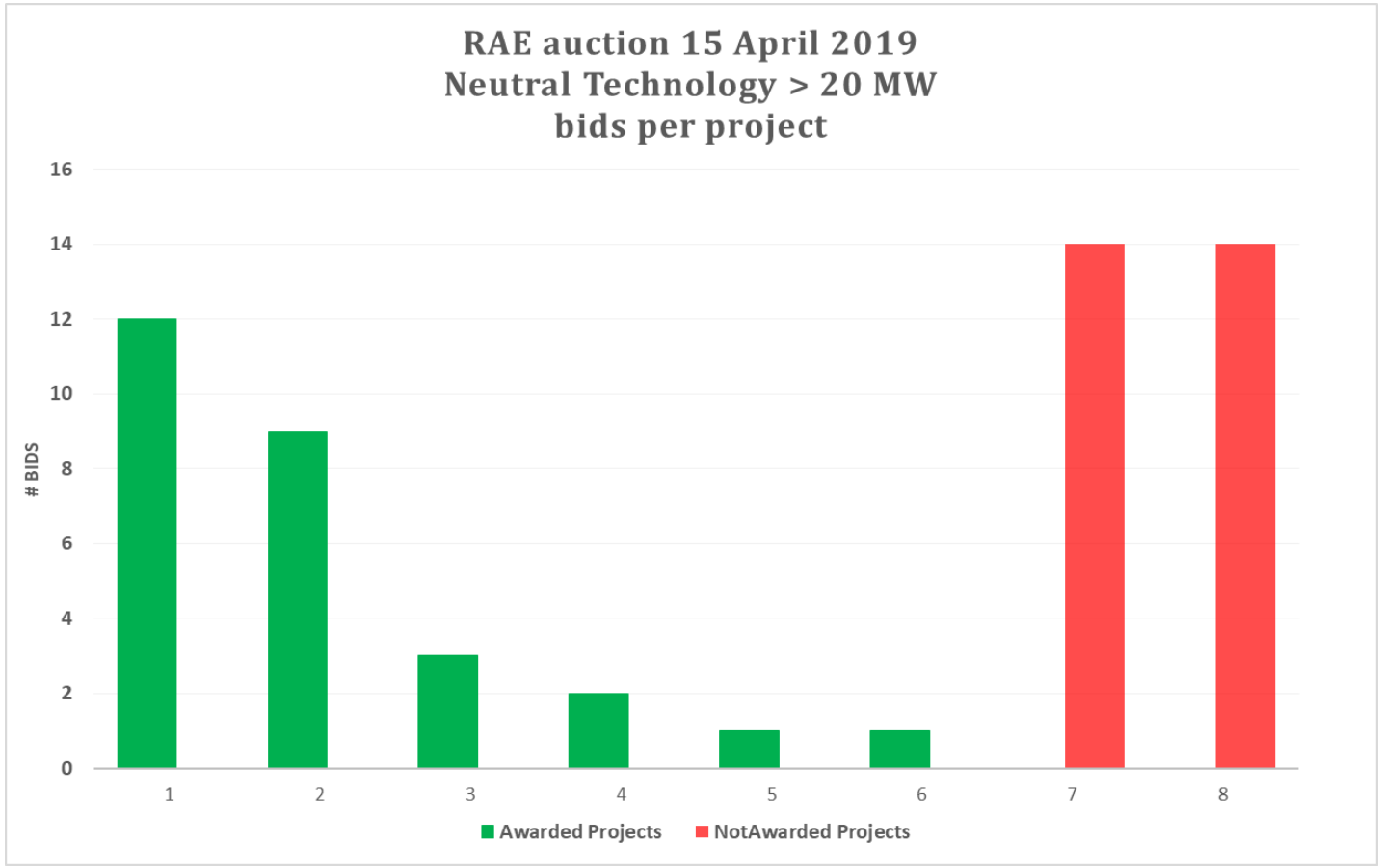
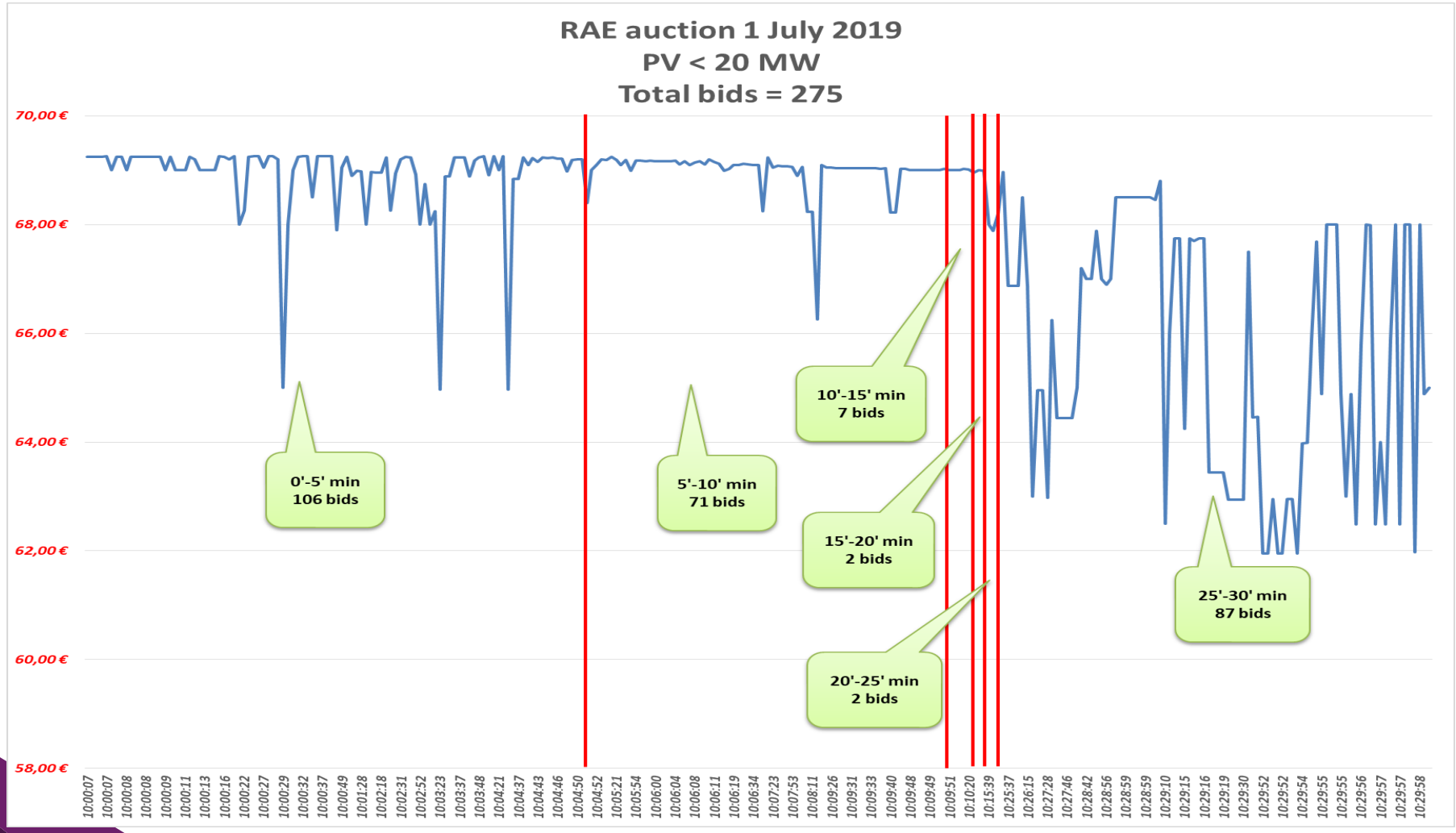
10:28:07


RAE auction 15 April 2019
Neutral Technology > 20 MW
bids per project
BIDS
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
Awarded Projects
NotAwarded Projects

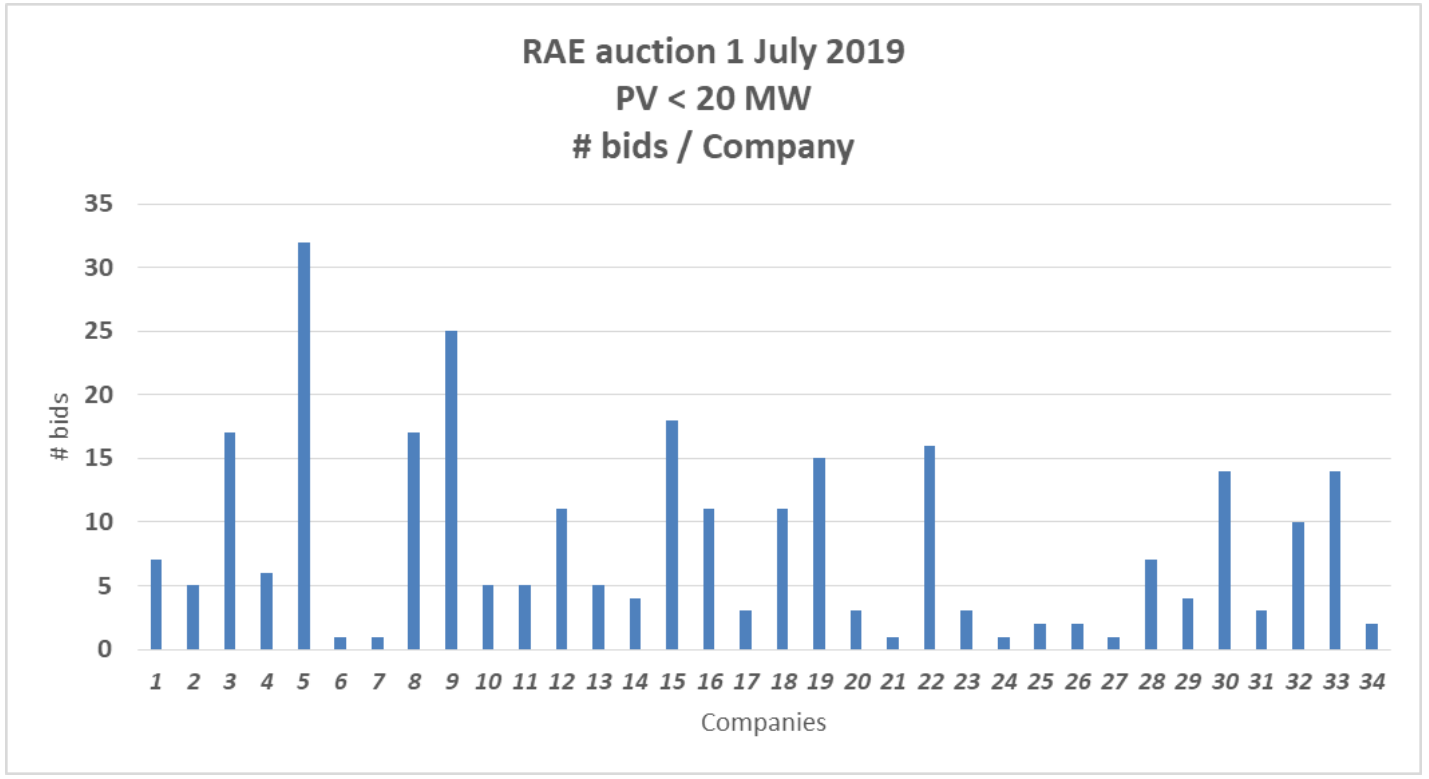
2nd Cycle Auction, Technology Specific, July 2019 - Results

Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
PV stations $P_{PV} \leq 20W$	300	**143,04**	68	200,26	68	200,26	24	**142,88**	275	**69,26**	67,7	61,95	**62,77**
Συμμετοχή στην Ηλεκτρονική δημοπρασία						200,26				**6,49 €/MWh (-9,37%)**			
Wind Stations $P_{Wind} \leq 50$ MW	300	**186,96**	12	261,75	12	261,75	9	**179,55**	37	**69,18**	69,18	59,09	**67,31**
Συμμετοχή στην Ηλεκτρονική δημοπρασία						261,75				**1,87 €/MWh (-2,7%)**			

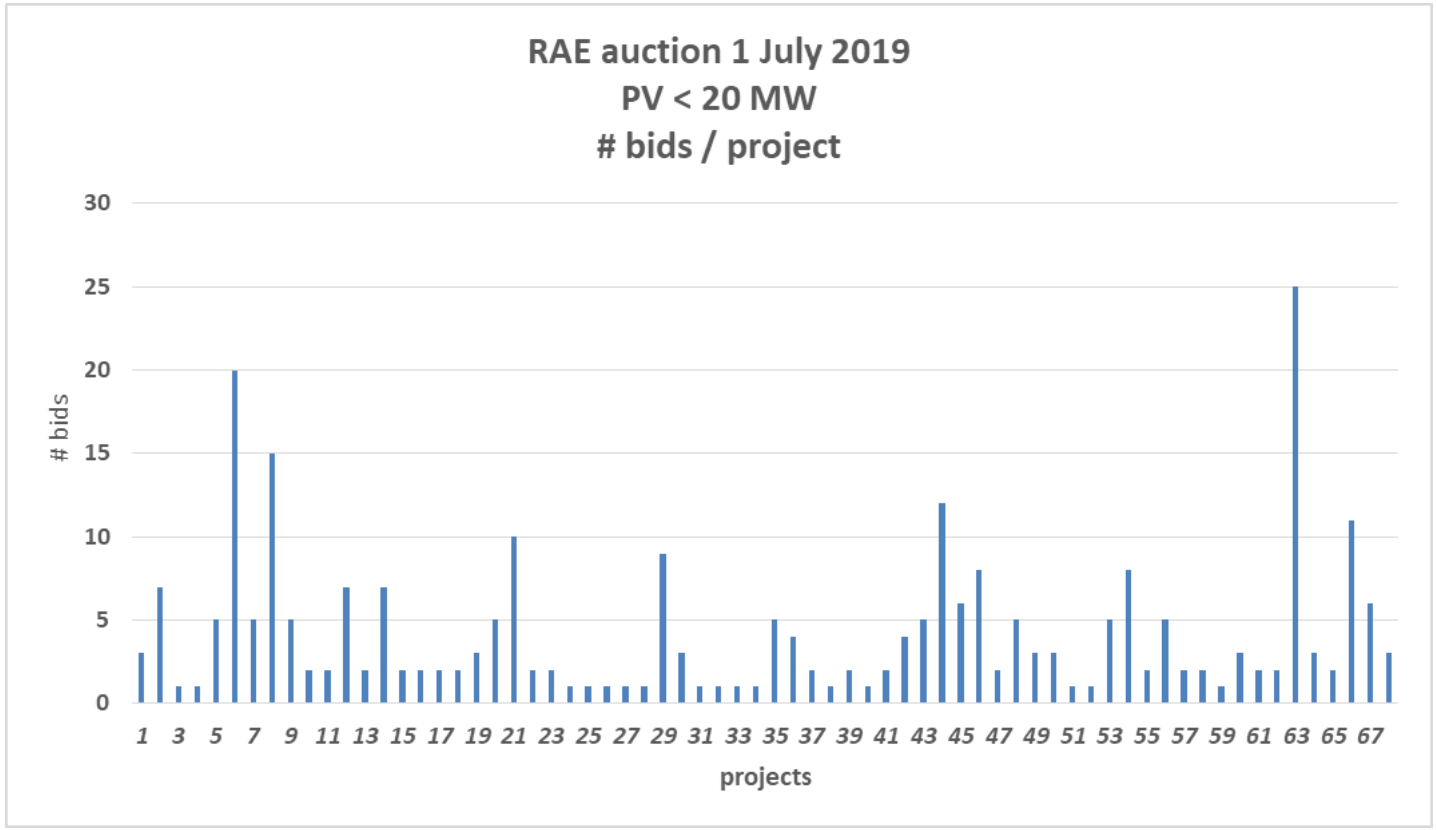
Analysis (1)


RAE auction 1 July 2019
PV < 20 MW
Total bids = 275
70,00 €
68,00 €
66,00 €
64,00 €
62,00 €
60,00 €
58,00 €
0'-5' min
106 bids
5'-10' min
71 bids
10'-15' min
7 bids
15'-20' min
2 bids
20'-25' min
2 bids
25'-30' min
87 bids

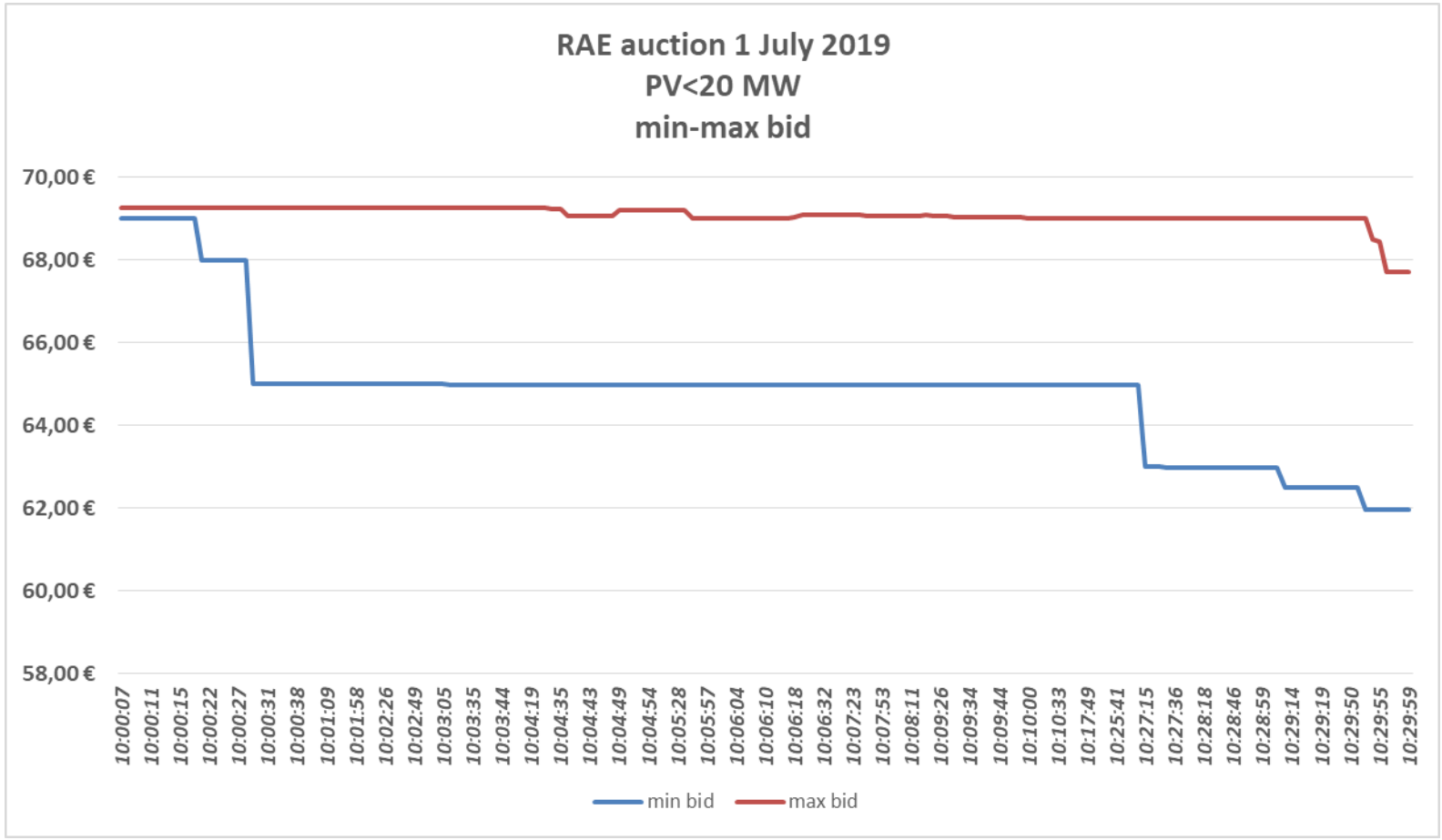
Analysis (2)


RAE auction 1 July 2019
PV < 20 MW
bids / Company
bids
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
Companies

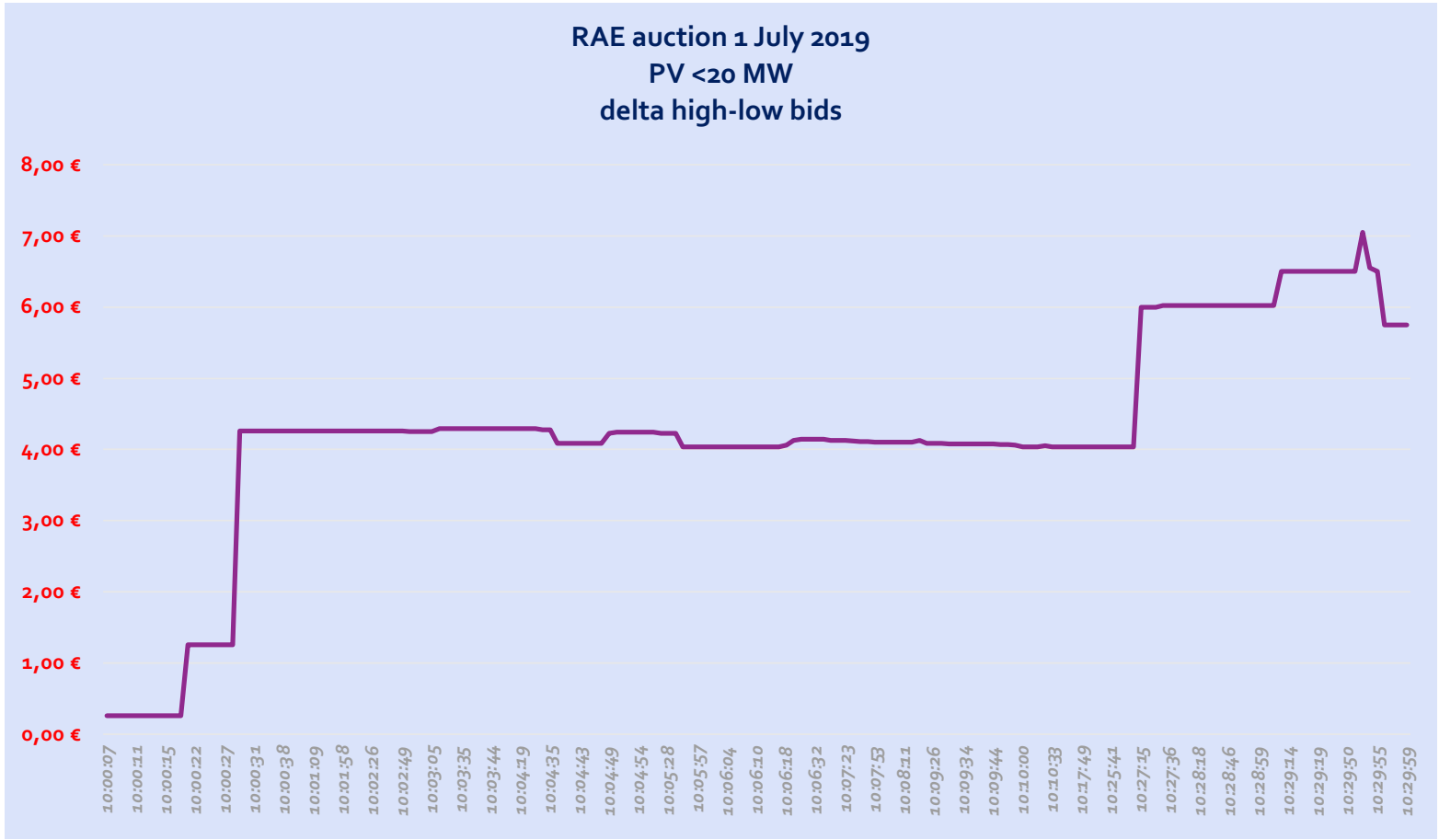
Analysis (3)


RAE auction 1 July 2019
PV < 20 MW
bids / project
30
25
20
15
10
5
0
bids
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
projects

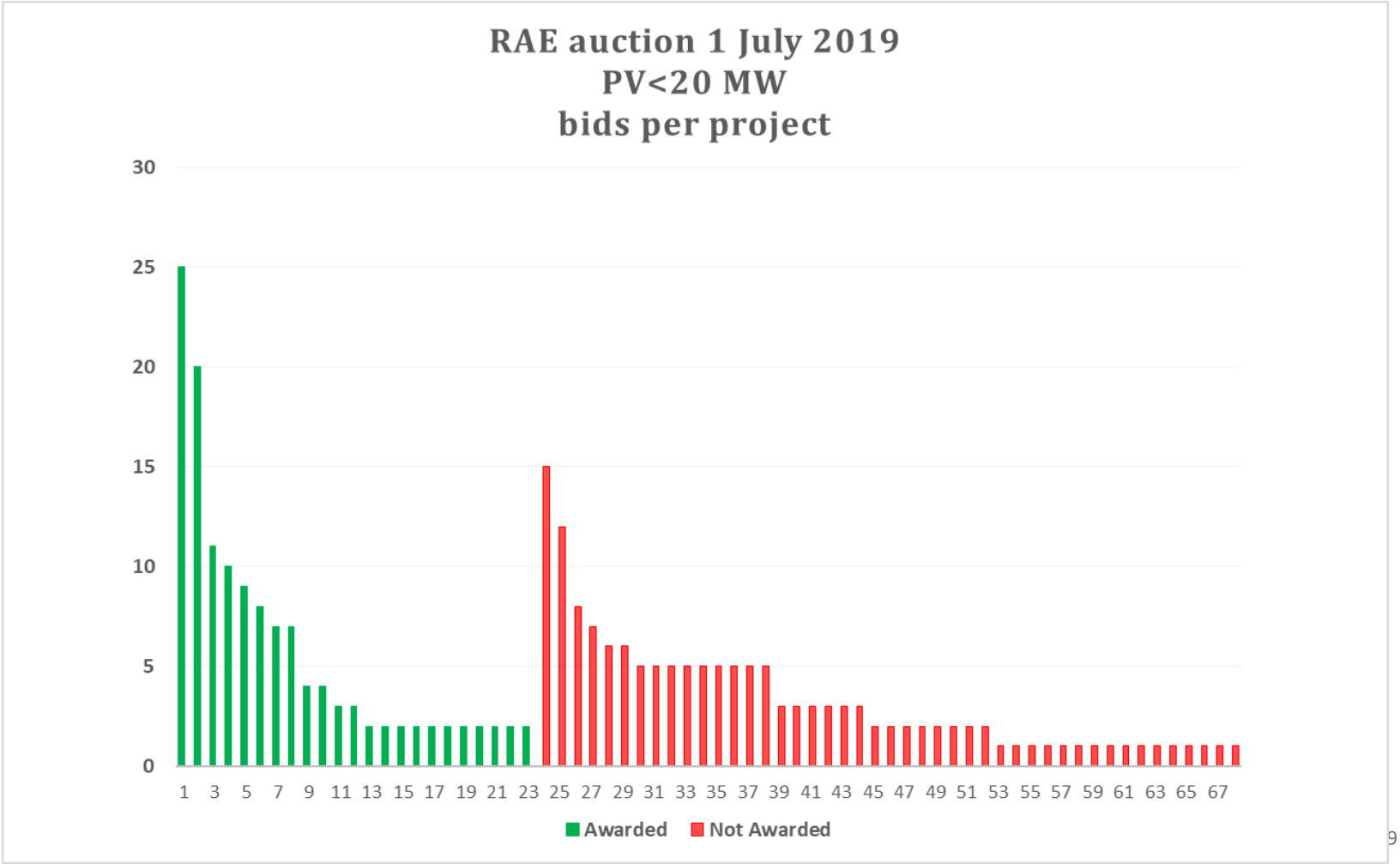
Analysis (5)

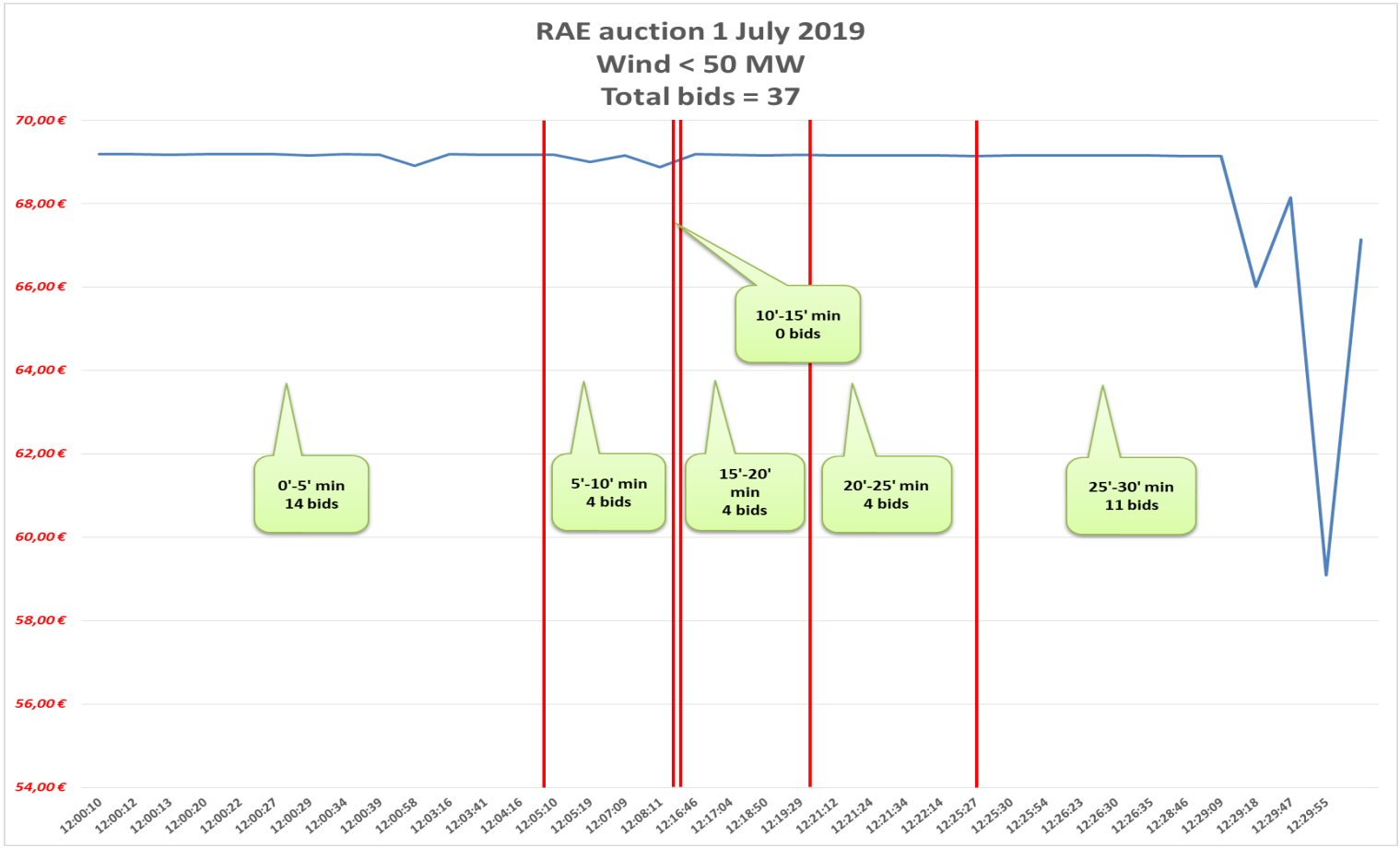

RAE auction 1 July 2019
PV<20 MW
min-max bid
70,00 €
68,00 €
66,00 €
64,00 €
62,00 €
60,00 €
58,00 €
10:00:07
10:00:11
10:00:15
10:00:22
10:00:27
10:00:31
10:00:38
10:01:09
10:01:58
10:02:26
10:02:49
10:03:05
10:03:35
10:03:44
10:04:19
10:04:35
10:04:43
10:04:49
10:04:54
10:05:28
10:05:57
10:06:04
10:06:10
10:06:18
10:06:32
10:07:23
10:07:53
10:08:11
10:09:26
10:09:34
10:09:44
10:10:00
10:10:33
10:17:49
10:25:41
10:27:15
10:27:36
10:28:18
10:28:46
10:28:59
10:29:14
10:29:19
10:29:50
10:29:55
10:29:59
min bid
max bid

Analysis (6)

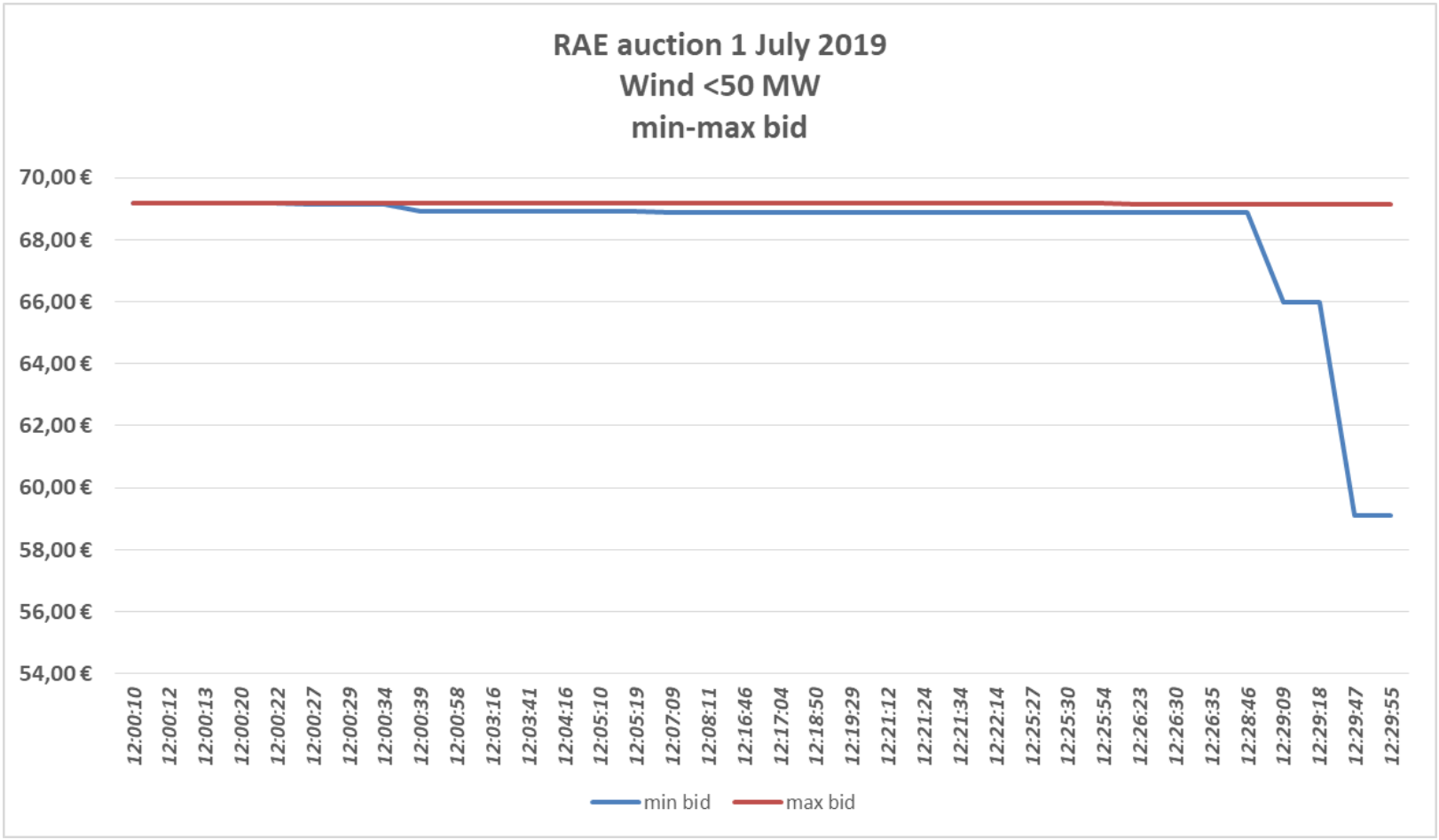

RAE auction 1 July 2019
PV <20 MW
delta high-low bids
8,00 €
7,00 €
6,00 €
5,00 €
4,00 €
3,00 €
2,00 €
1,00 €
0,00 €
10:00:07
10:00:11
10:00:15
10:00:22
10:00:27
10:00:31
10:00:38
10:01:09
10:01:58
10:02:26
10:02:49
10:03:05
10:03:35
10:03:44
10:04:19
10:04:35
10:04:43
10:04:49
10:04:54
10:05:28
10:05:57
10:06:04
10:06:10
10:06:18
10:06:32
10:07:23
10:07:53
10:08:11
10:09:26
10:09:34
10:09:44
10:10:00
10:10:33
10:17:49
10:25:41
10:27:15
10:27:36
10:28:18
10:28:46
10:28:59
10:29:14
10:29:19
10:29:50
10:29:55
10:29:59

Analysis (4)

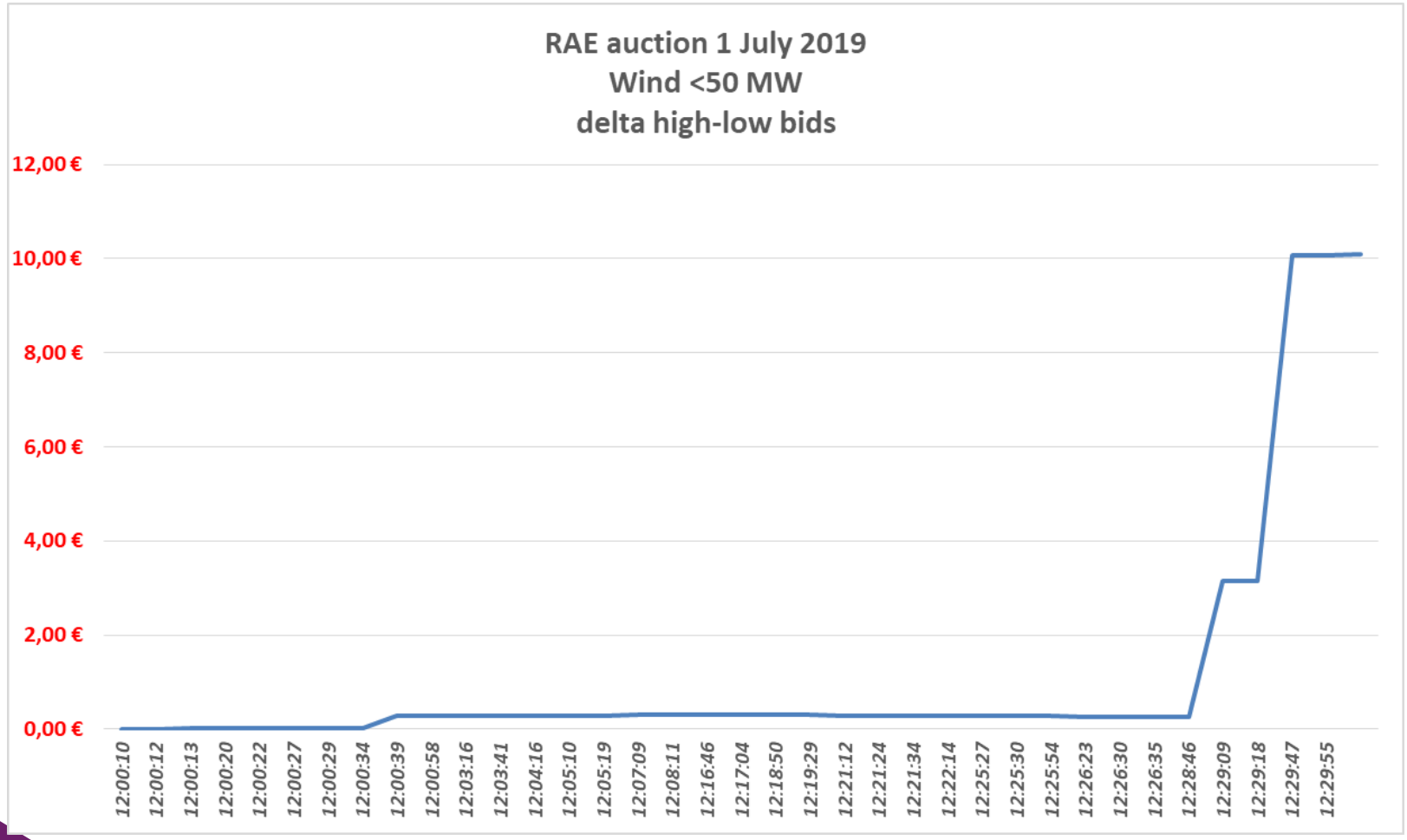

RAE auction 1 July 2019
PV<20 MW
bids per project
30
25
20
15
10
5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67
Awarded
Not Awarded


RAE auction 1 July 2019
Wind < 50 MW
Total bids = 37
70,00 €
68,00 €
66,00 €
64,00 €
62,00 €
60,00 €
58,00 €
56,00 €
54,00 €
0'-5' min
14 bids
5'-10' min
4 bids
10'-15' min
0 bids
15'-20' min
4 bids
20'-25' min
4 bids
25'-30' min
11 bids
12:00:10
12:00:12
12:00:13
12:00:20
12:00:22
12:00:27
12:00:29
12:00:34
12:00:39
12:00:58
12:03:16
12:03:41
12:04:16
12:05:10
12:05:19
12:07:09
12:08:11
12:16:46
12:17:04
12:18:50
12:19:29
12:21:12
12:21:24
12:21:34
12:22:14
12:25:27
12:25:30
12:25:54
12:26:23
12:26:30
12:26:35
12:28:46
12:29:09
12:29:18
12:29:47
12:29:55

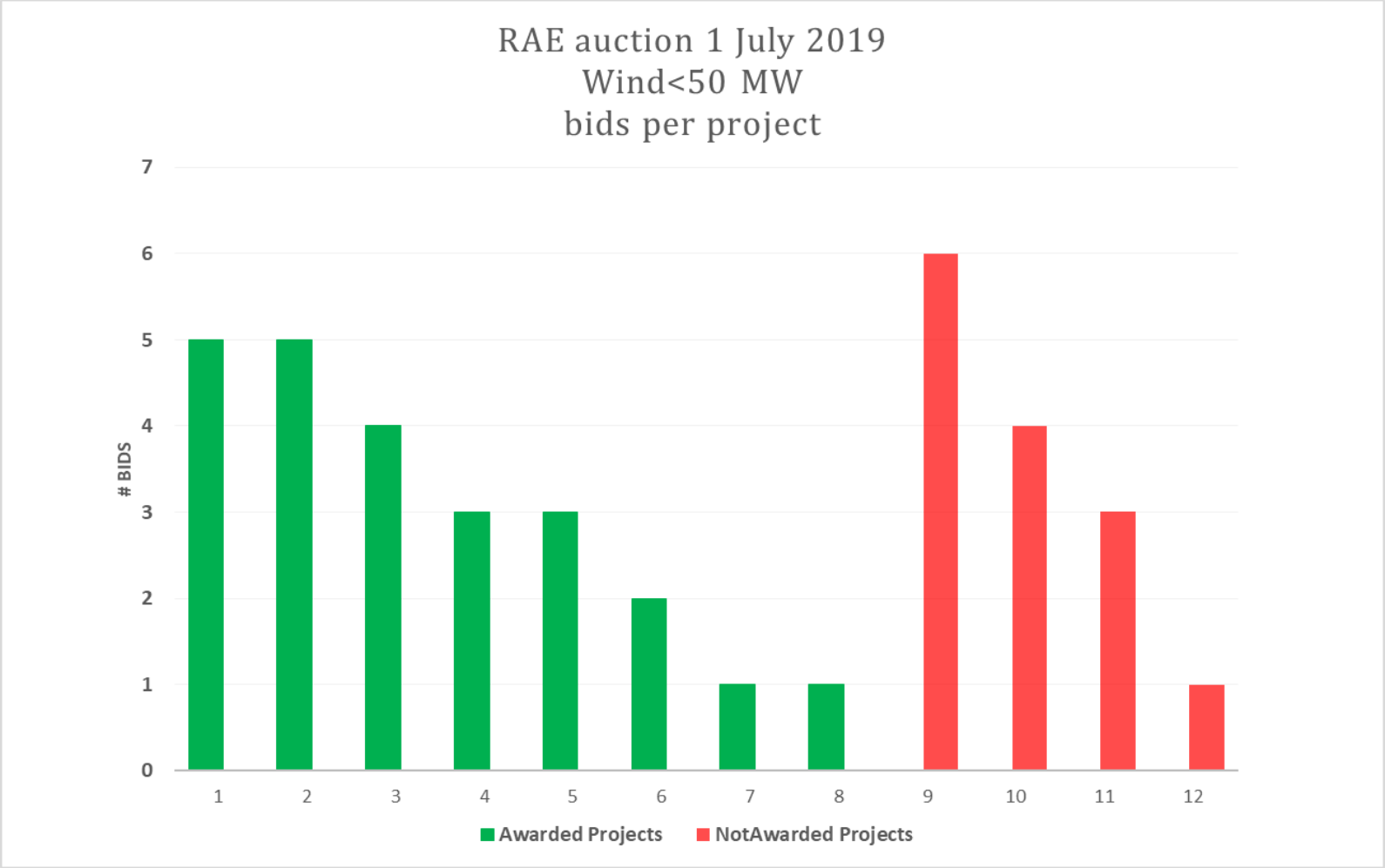
Analysis (2)


RAE auction 1 July 2019
Wind <50 MW
min-max bid
70,00 €
68,00 €
66,00 €
64,00 €
62,00 €
60,00 €
58,00 €
56,00 €
54,00 €
12:00:10
12:00:12
12:00:13
12:00:20
12:00:22
12:00:27
12:00:29
12:00:34
12:00:39
12:00:58
12:03:16
12:03:41
12:04:16
12:05:10
12:05:19
12:07:09
12:08:11
12:16:46
12:17:04
12:18:50
12:19:29
12:21:12
12:21:24
12:21:34
12:22:14
12:25:27
12:25:30
12:25:54
12:26:23
12:26:30
12:26:35
12:28:46
12:29:09
12:29:18
12:29:47
12:29:55
min bid
max bid

Analysis (3)


RAE auction 1 July 2019
Wind <50 MW
delta high-low bids
12,00 €
10,00 €
8,00 €
6,00 €
4,00 €
2,00 €
0,00 €
12:00:10
12:00:12
12:00:13
12:00:20
12:00:22
12:00:27
12:00:29
12:00:34
12:00:39
12:00:58
12:03:16
12:03:41
12:04:16
12:05:10
12:05:19
12:07:09
12:08:11
12:16:46
12:17:04
12:18:50
12:19:29
12:21:12
12:21:24
12:21:34
12:22:14
12:25:27
12:25:30
12:25:54
12:26:23
12:26:30
12:26:35
12:28:46
12:29:09
12:29:18
12:29:47
12:29:55

Analysis (1)


RAE auction 1 July 2019
Wind<50 MW
bids per project
BIDS
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
8
9
10
11
12
Awarded Projects
NotAwarded Projects

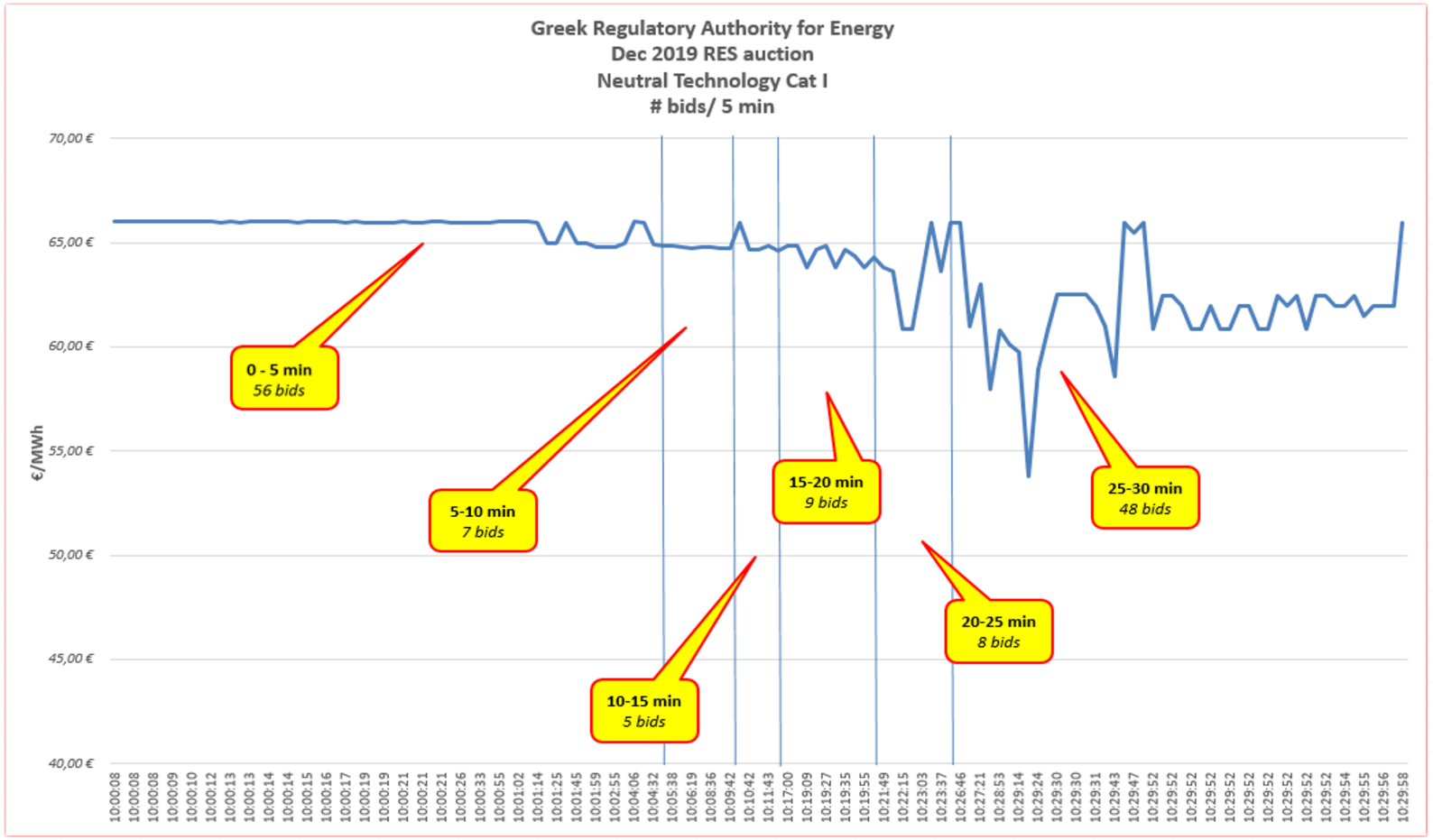
2nd Cycle Auction, Technology Specific, December 2019 - Results

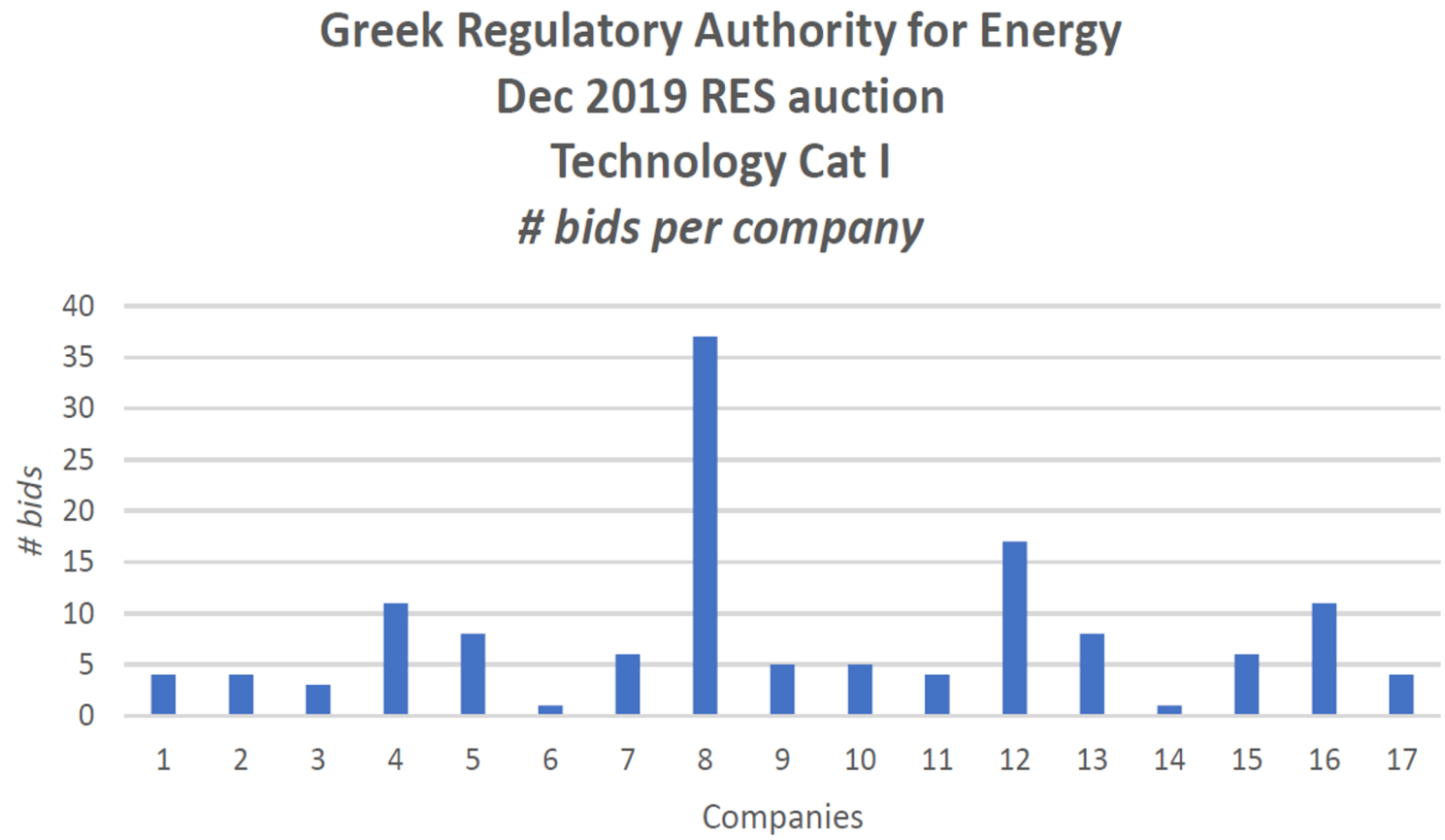
Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
PV stations $P_{PV} \leq 20W$	287,11	**105,46**	44	148,64	43	147,65	17	**105**	130	**66,02**	65,99	53,82	**59,98**
Participation on electronic auction						147,65							
Wind Stations $P_{Wind} \leq 50$ MW	225,45	**225,45**	16	491	16	491	7	**224**	114	**68,25**	61,94	55,77	**57,74**
Participation on electronic auction						491							

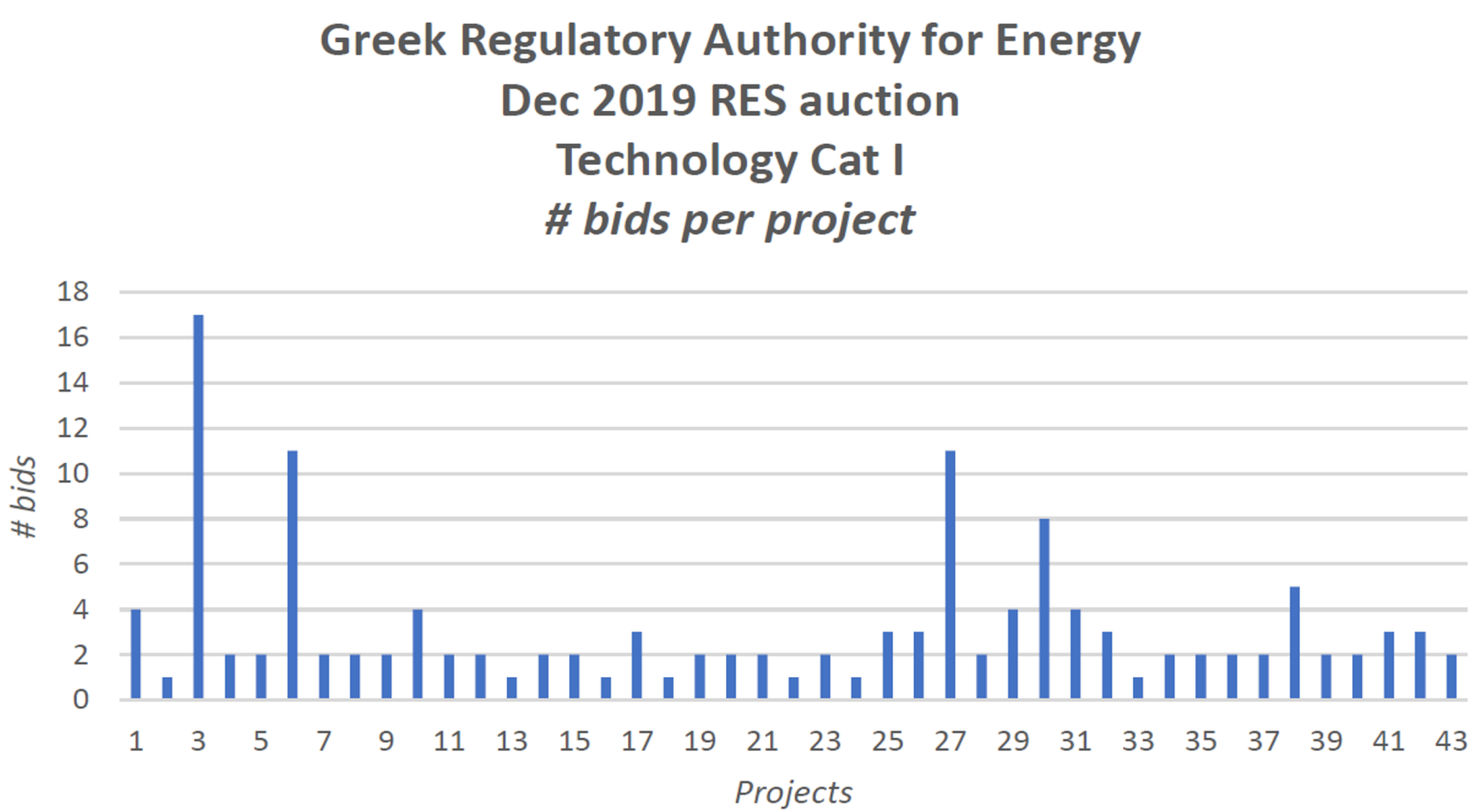
6,04 €/MWh (-9,15%)

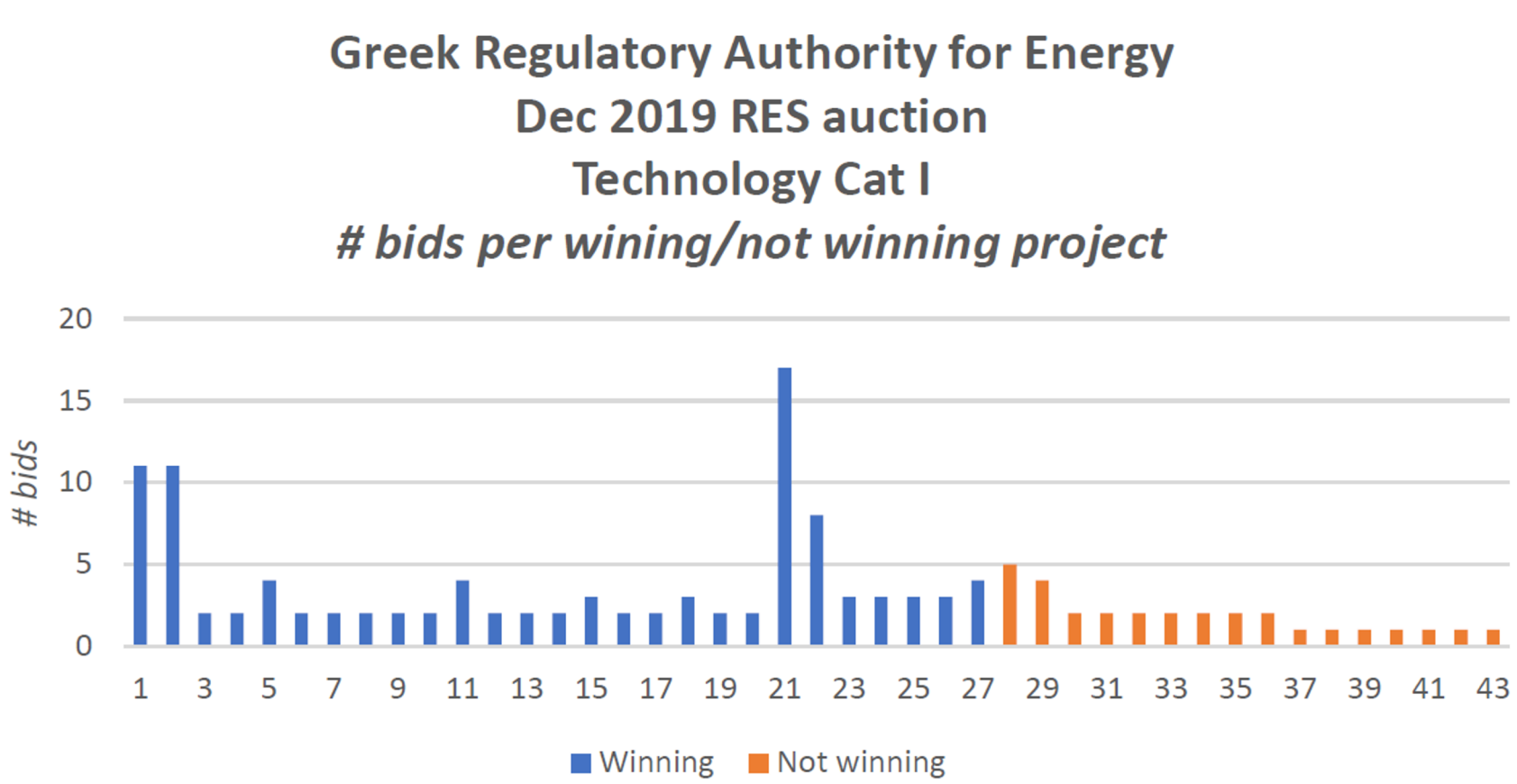
10,51 €/MWh (-15,4%)

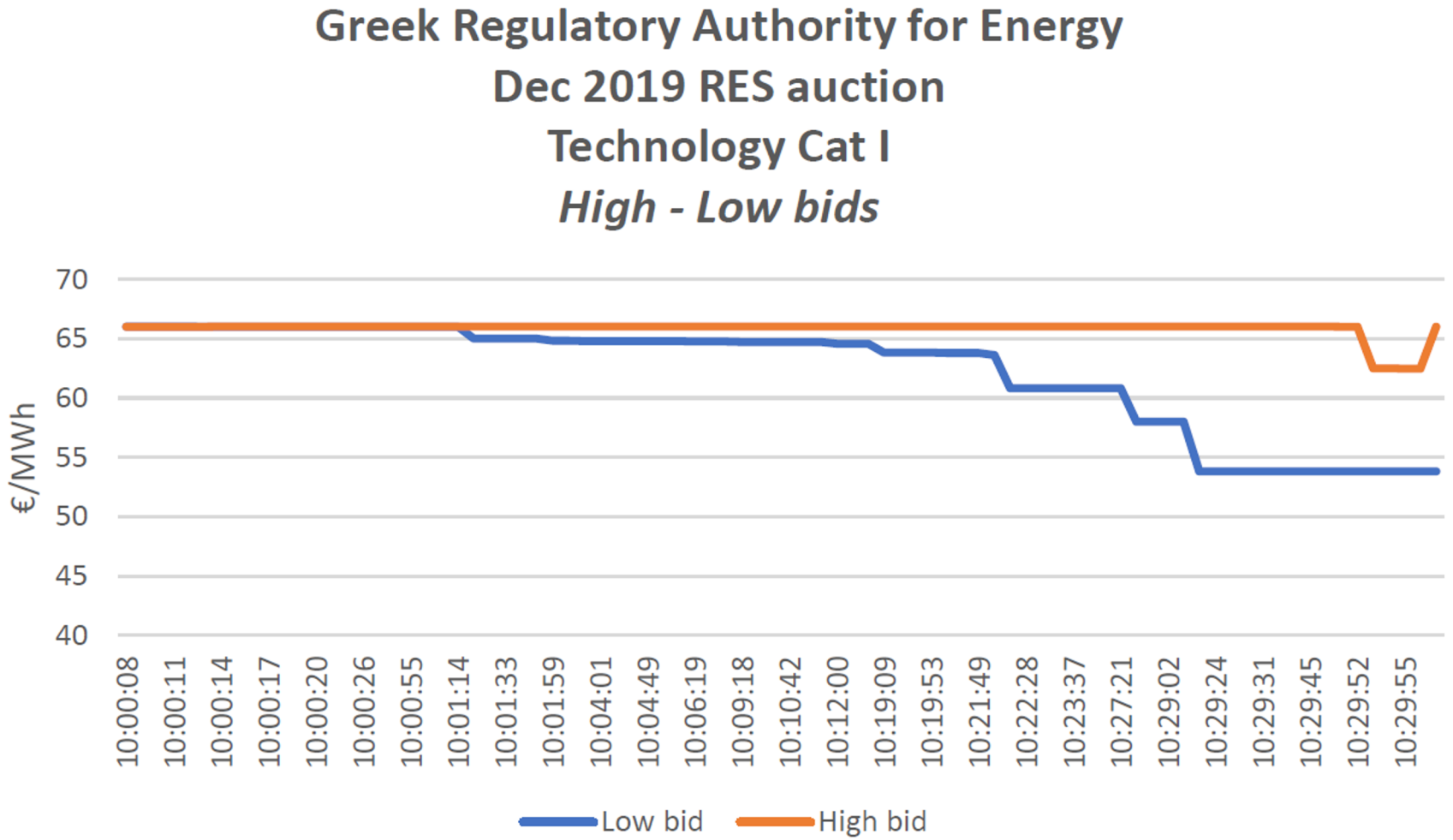
PAE RAE
ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY

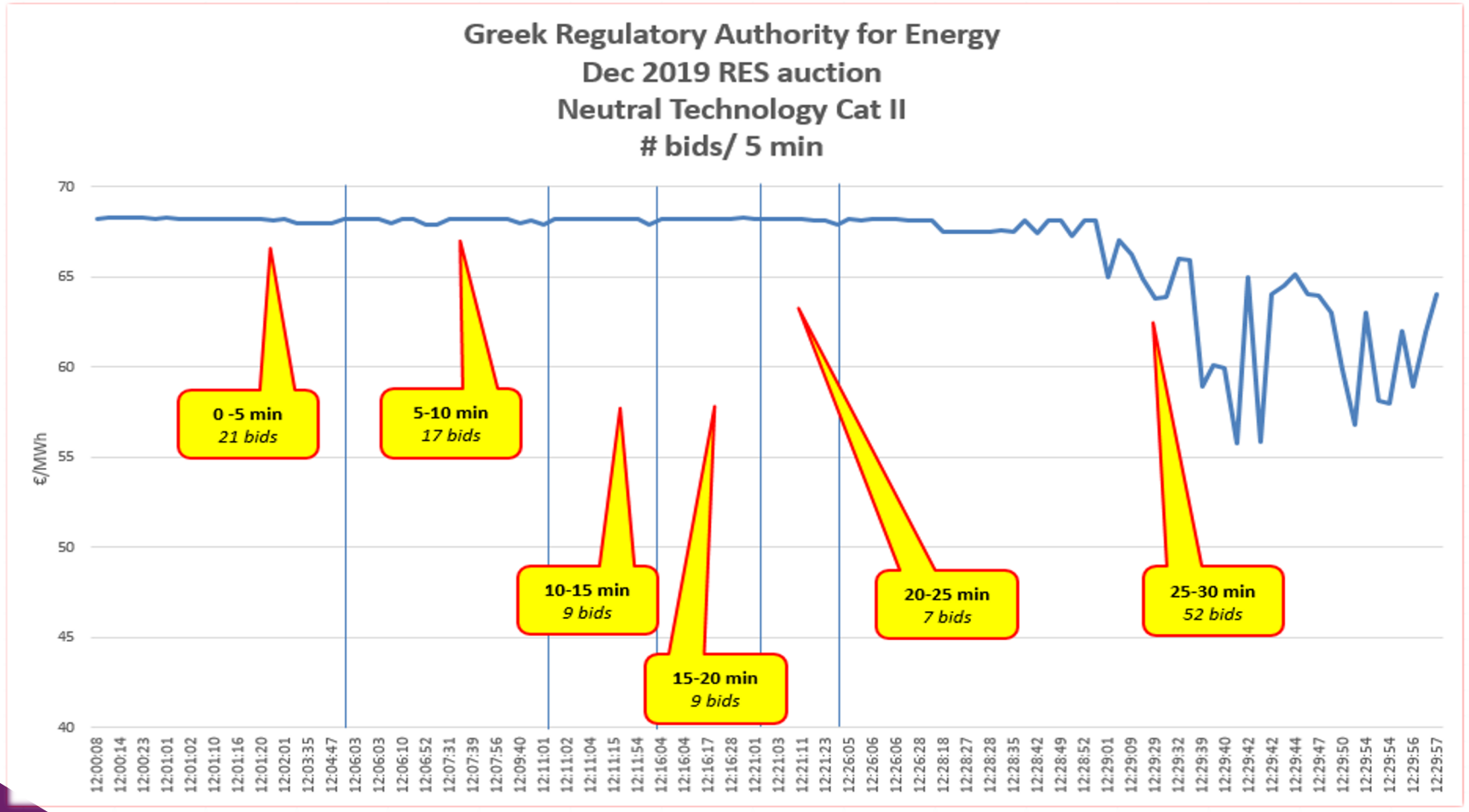

Greek Regulatory Authority for Energy
Dec 2019 RES auction
Neutral Technology Cat I
bids/ 5 min
€/MWh
70,00 €
65,00 €
60,00 €
55,00 €
50,00 €
45,00 €
40,00 €
0 - 5 min
56 bids
5-10 min
7 bids
10-15 min
5 bids
15-20 min
9 bids
20-25 min
8 bids
25-30 min
48 bids


Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat I
bids per company
40
35
30
25
20
15
10
5
0
bids
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
Companies

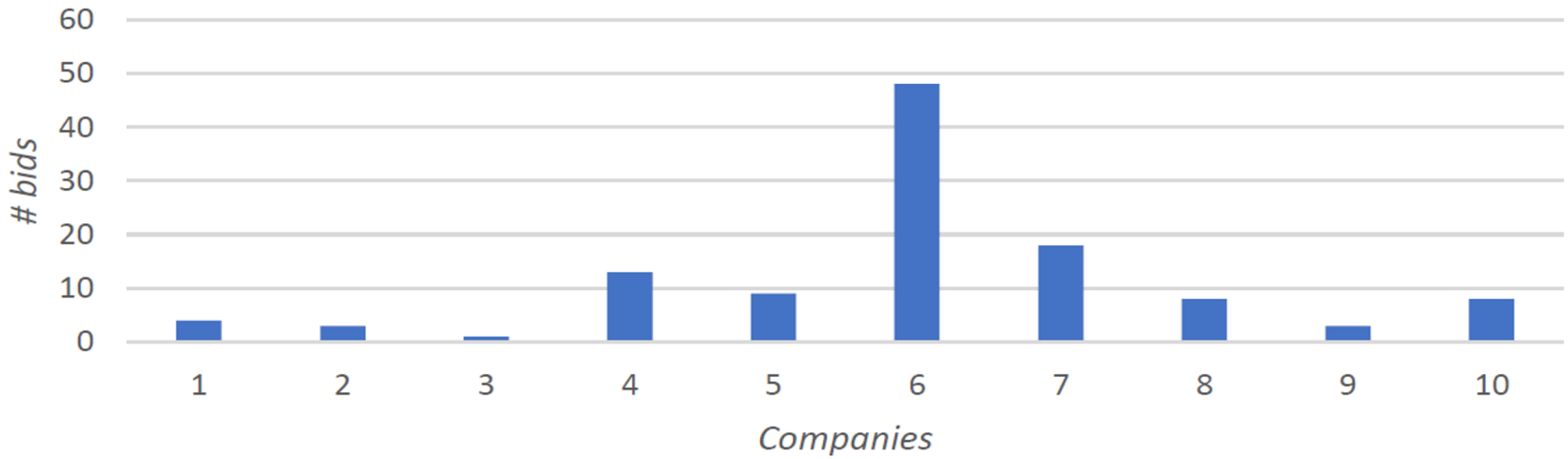

Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat I
bids per project
bids
0
2
4
6
8
10
12
14
16
18
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
Projects


Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat I
bids per wining/not winning project
bids
20
15
10
5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43
Winning
Not winning


Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat I
High - Low bids
€/MWh
70
65
60
55
50
45
40
10:00:08
10:00:11
10:00:14
10:00:17
10:00:20
10:00:26
10:00:55
10:01:14
10:01:33
10:01:59
10:04:01
10:04:49
10:06:19
10:09:18
10:10:42
10:12:00
10:19:09
10:19:53
10:21:49
10:22:28
10:23:37
10:27:21
10:29:02
10:29:24
10:29:31
10:29:45
10:29:52
10:29:55
Low bid
High bid

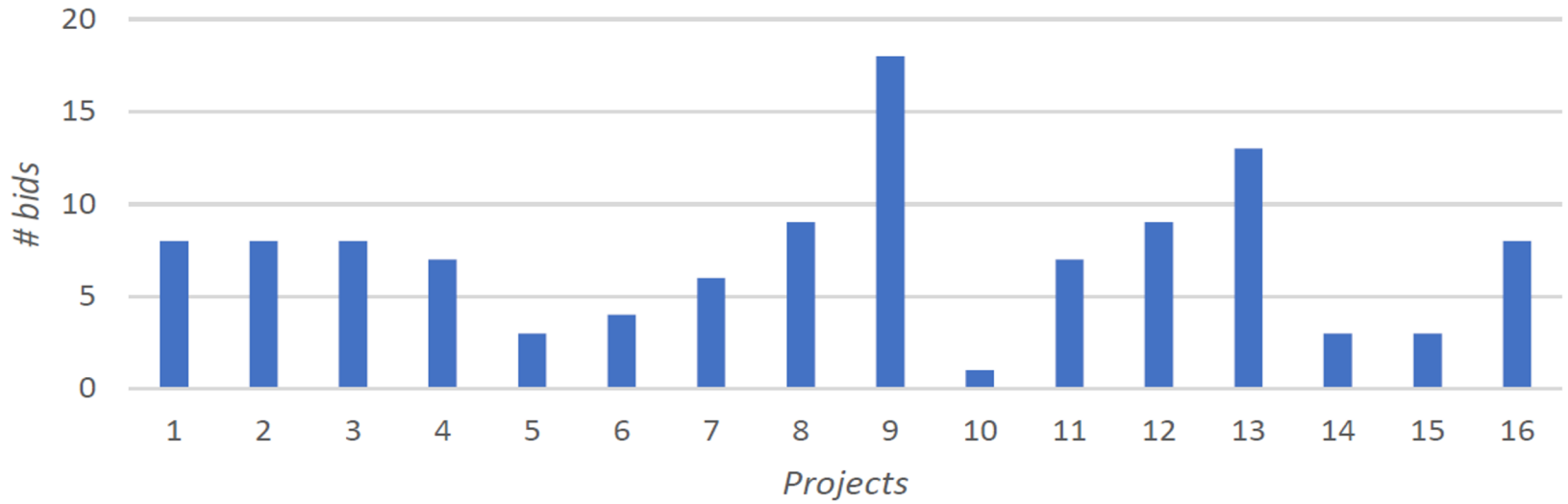

Greek Regulatory Authority for Energy
Dec 2019 RES auction
Neutral Technology Cat II
bids/ 5 min
€/MWh
70
65
60
55
50
45
40
0 -5 min
21 bids
5-10 min
17 bids
10-15 min
9 bids
15-20 min
9 bids
20-25 min
7 bids
25-30 min
52 bids
12:00:08
12:00:14
12:00:23
12:01:01
12:01:02
12:01:10
12:01:16
12:01:20
12:02:01
12:03:35
12:04:47
12:06:03
12:06:03
12:06:10
12:06:52
12:07:31
12:07:39
12:07:56
12:09:40
12:11:01
12:11:02
12:11:04
12:11:15
12:11:54
12:16:04
12:16:04
12:16:17
12:16:28
12:21:01
12:21:03
12:21:11
12:21:23
12:26:05
12:26:06
12:26:06
12:26:28
12:28:18
12:28:27
12:28:28
12:28:35
12:28:42
12:28:49
12:28:52
12:29:01
12:29:09
12:29:29
12:29:32
12:29:39
12:29:40
12:29:42
12:29:42
12:29:44
12:29:47
12:29:50
12:29:54
12:29:54
12:29:56
12:29:57

Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat II
 # bids per company

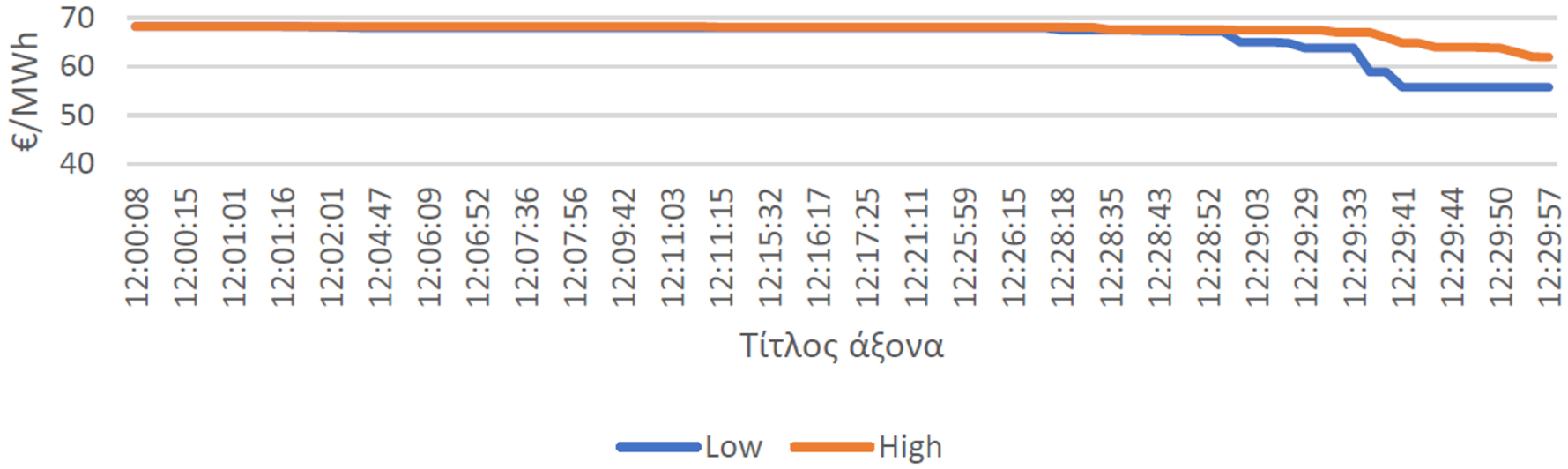


Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat II

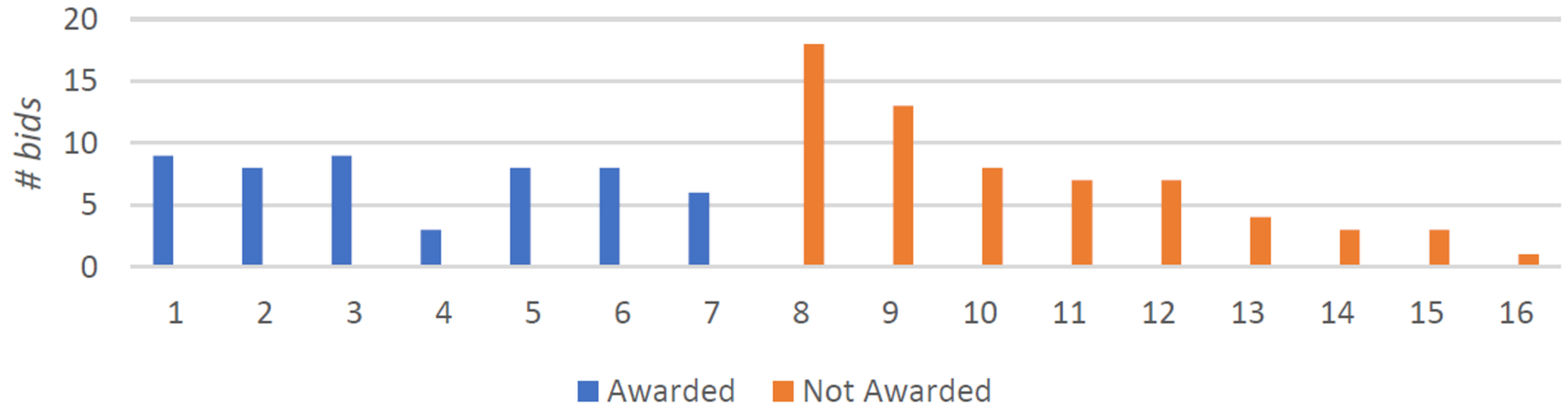
 # bids per project



Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat II
High - Low bids



Greek Regulatory Authority for Energy
Dec 2019 RES auction
Technology Cat II
 # bids per awarded/not awarded project

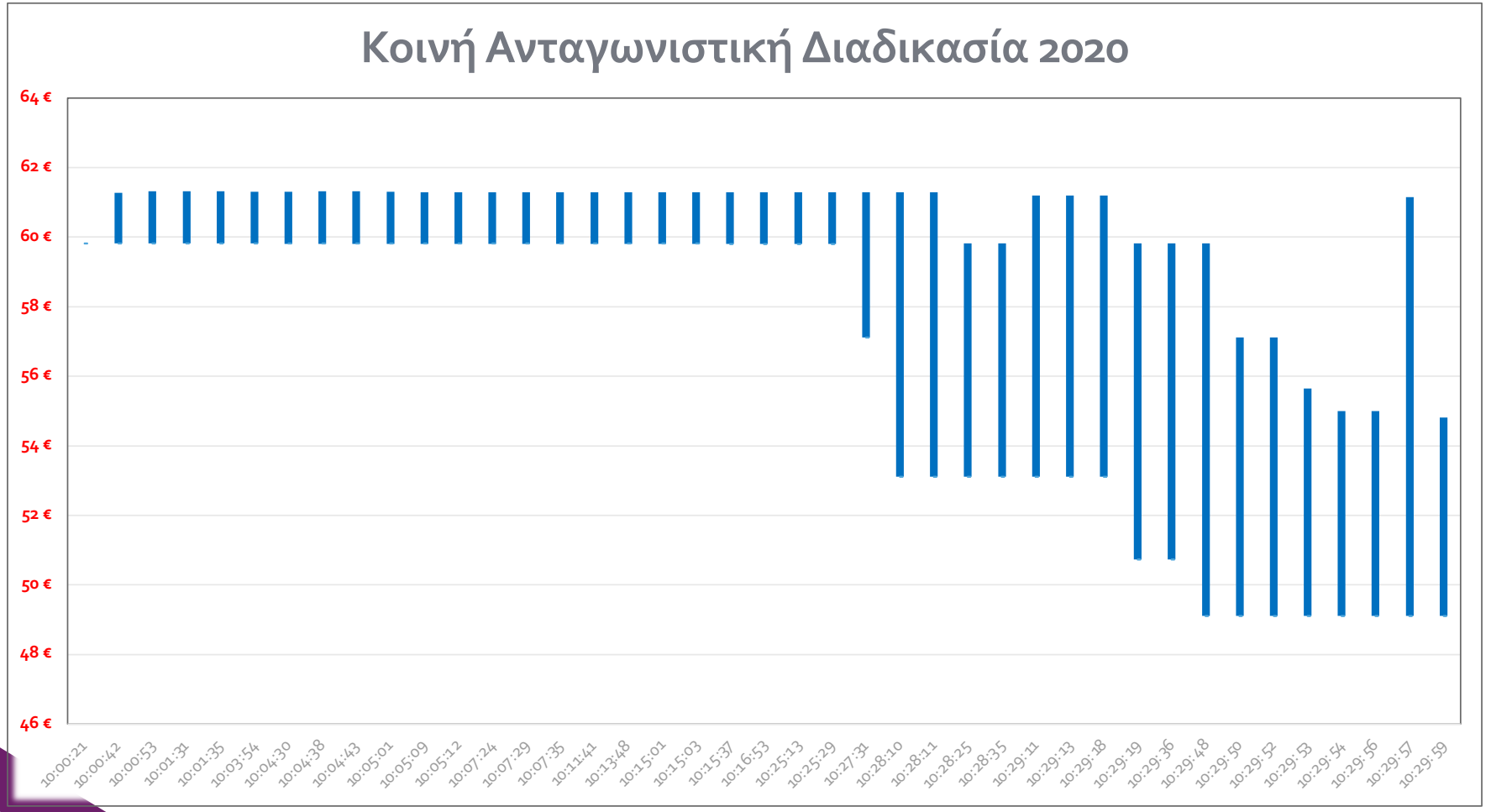


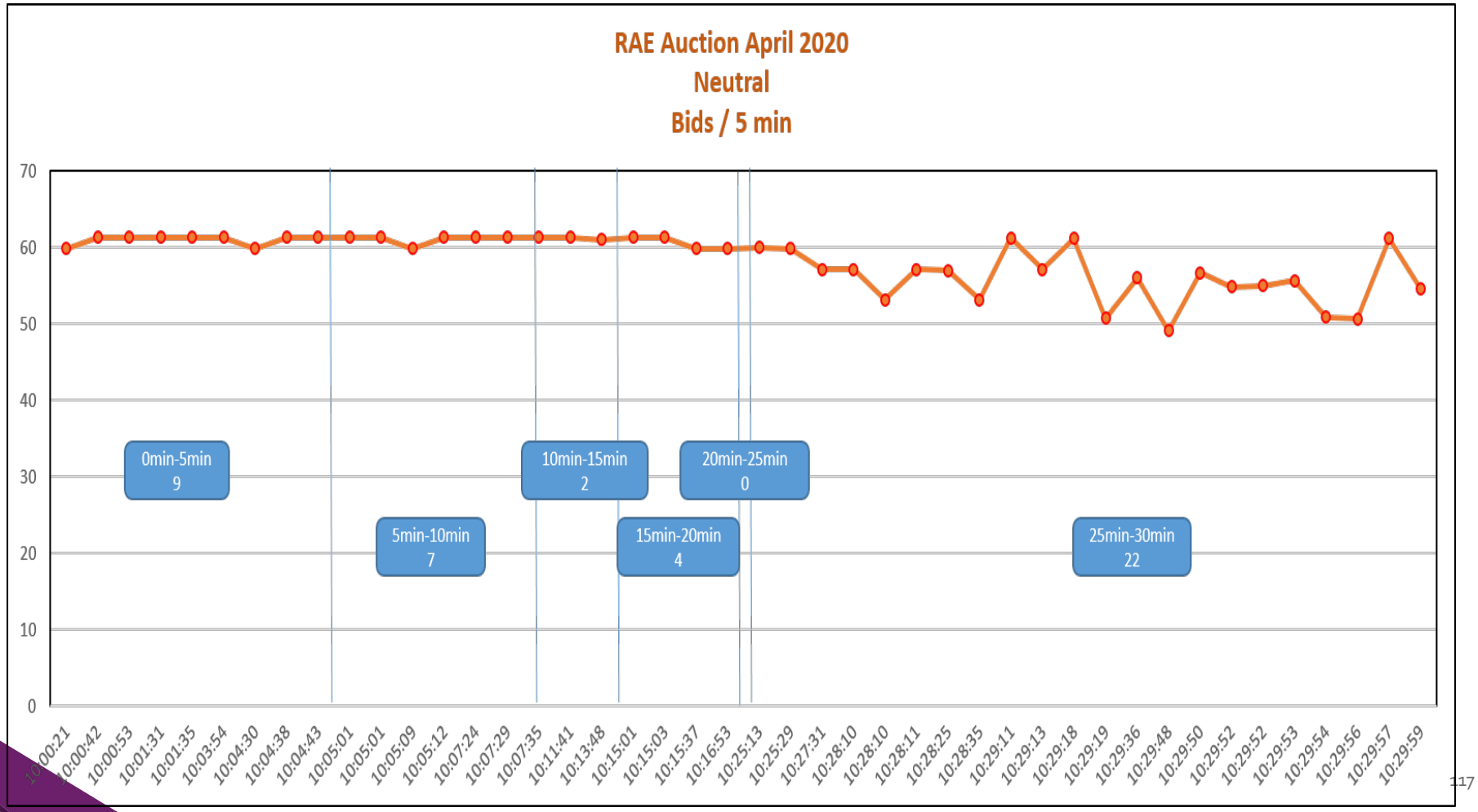
1st Cycle Auction, Technology Neutral, April 2020 - Results

Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
Technology Neutral	600	**508,35**	9	711,69	9	711,69	5	**502,94**	44	**61,32**	54,82	49,11	**51,59**

9,73 €/MWh (-15,87%)

PAE RAE
ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY


Κοινή Ανταγωνιστική Διαδικασία 2020
64 €
62 €
60 €
58 €
56 €
54 €
52 €
50 €
48 €
46 €
10:00:21
10:00:42
10:00:53
10:01:31
10:01:35
10:03:54
10:04:30
10:04:38
10:04:43
10:05:01
10:05:09
10:05:12
10:07:24
10:07:29
10:07:35
10:11:41
10:13:48
10:15:01
10:15:03
10:15:37
10:16:53
10:25:13
10:25:29
10:27:31
10:28:10
10:28:11
10:28:25
10:28:35
10:29:11
10:29:13
10:29:18
10:29:19
10:29:36
10:29:48
10:29:50
10:29:52
10:29:53
10:29:54
10:29:56
10:29:57
10:29:59


RAE Auction April 2020
Neutral
Bids / 5 min
70
60
50
40
30
20
10
0
0min-5min
9
5min-10min
7
10min-15min
2
15min-20min
4
20min-25min
0
25min-30min
22
10:00:21
10:00:42
10:00:53
10:01:31
10:01:35
10:03:54
10:04:30
10:04:38
10:04:43
10:05:01
10:05:01
10:05:09
10:05:12
10:07:24
10:07:29
10:07:35
10:11:41
10:13:48
10:15:01
10:15:03
10:15:37
10:16:53
10:25:13
10:25:29
10:27:31
10:28:10
10:28:10
10:28:11
10:28:25
10:28:35
10:29:11
10:29:13
10:29:18
10:29:19
10:29:36
10:29:48
10:29:50
10:29:52
10:29:52
10:29:53
10:29:54
10:29:56
10:29:57
10:29:59

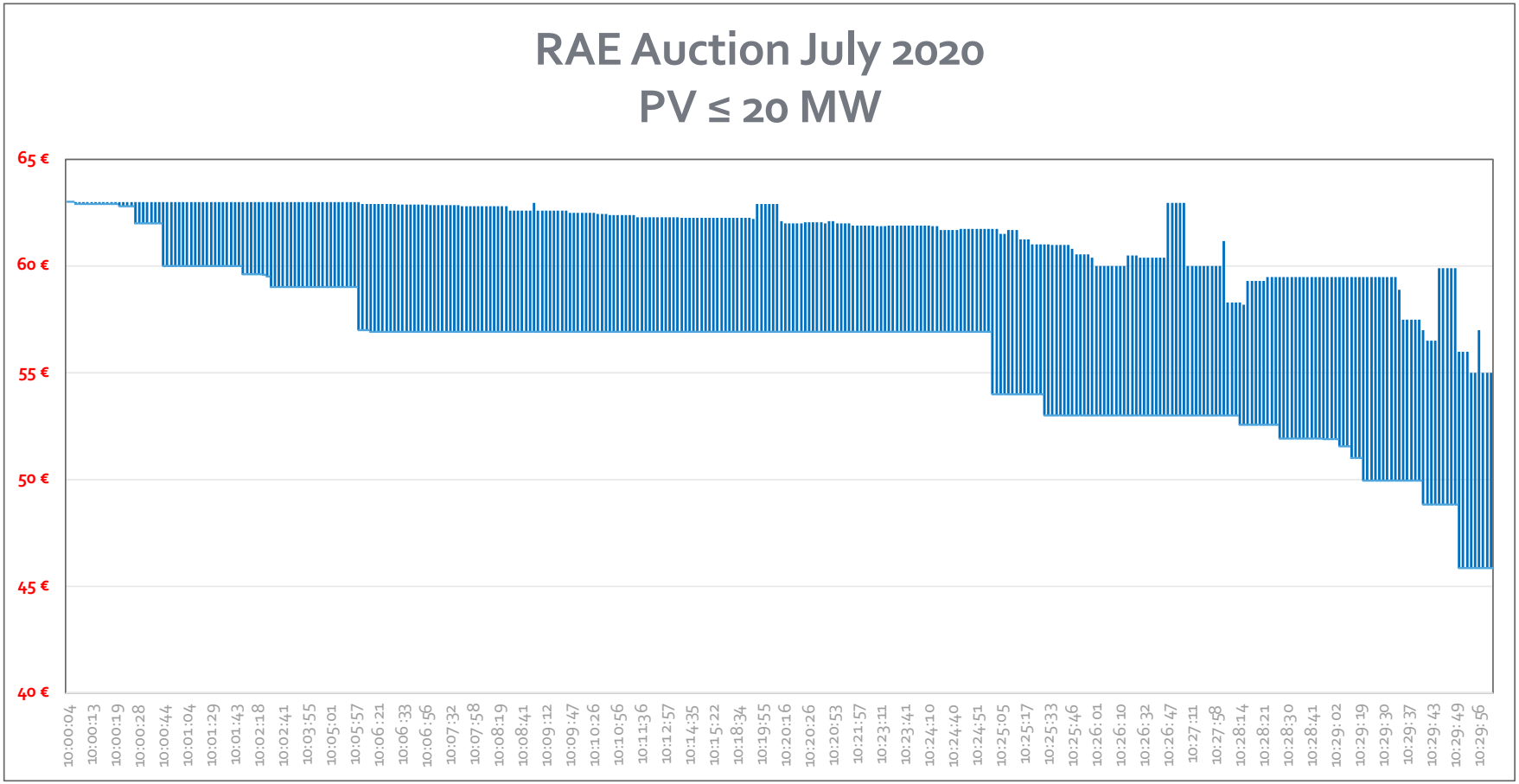
1st Cycle Auction, Technology Specific, July 2020 - Results

Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)						Auction				
			Applied		Approved		Granted		Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
PV stations P_{PV} ≤ 20W	482	**142,45**	52	199,427	52	199,427	39	**141,933**	1532	**63**	62,45	45,84	**49,81**
Participation on electronic auction						147,65							
Wind Stations P_{Wind} ≤ 50 MW	481,45	**481,45**	25	748,375	25	748,375	15	**471,825**	118	**62,99**	57,7	53,86	**55,67**
Participation on electronic auction						491							

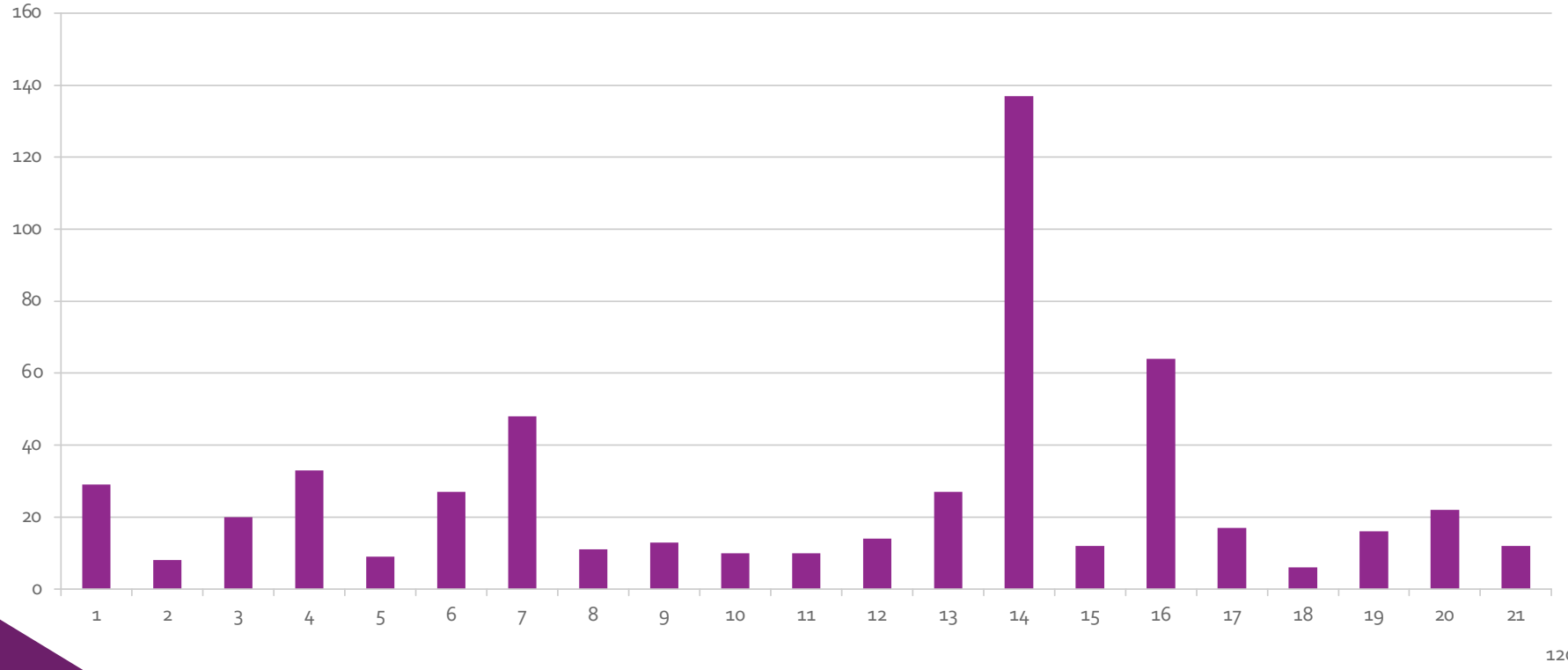
13,19 €/MWh (-20,94%)

7,32 €/MWh (-13,14%)

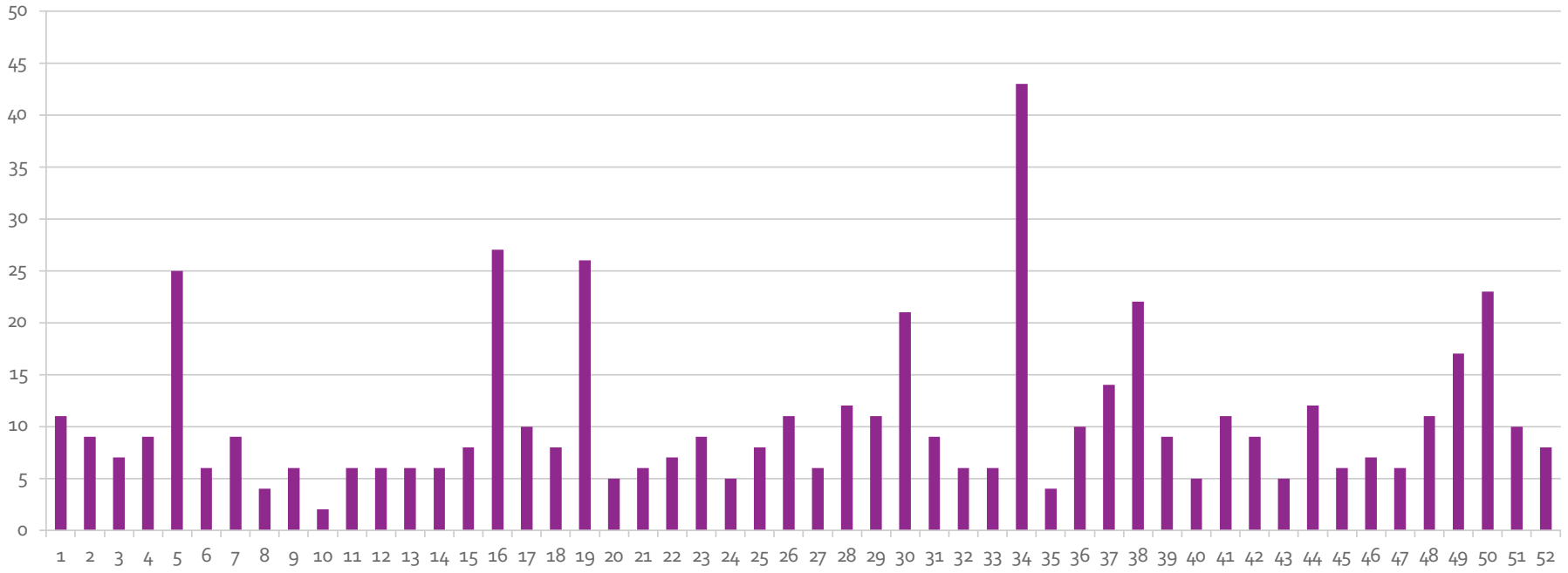
PAE RAE
ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY


RAE Auction July 2020
PV ≤ 20 MW
65 €
60 €
55 €
50 €
45 €
40 €
10:00:04
10:00:13
10:00:19
10:00:28
10:00:44
10:01:04
10:01:29
10:01:43
10:02:18
10:02:41
10:03:55
10:05:01
10:05:57
10:06:21
10:06:33
10:06:56
10:07:32
10:07:58
10:08:19
10:08:41
10:09:12
10:09:47
10:10:26
10:10:56
10:11:36
10:12:57
10:14:35
10:15:22
10:18:34
10:19:55
10:20:16
10:20:26
10:20:53
10:21:57
10:23:11
10:23:41
10:24:10
10:24:40
10:24:51
10:25:05
10:25:17
10:25:33
10:25:46
10:26:01
10:26:10
10:26:32
10:26:47
10:27:11
10:27:58
10:28:14
10:28:21
10:28:30
10:28:41
10:29:02
10:29:19
10:29:30
10:29:37
10:29:43
10:29:49
10:29:56

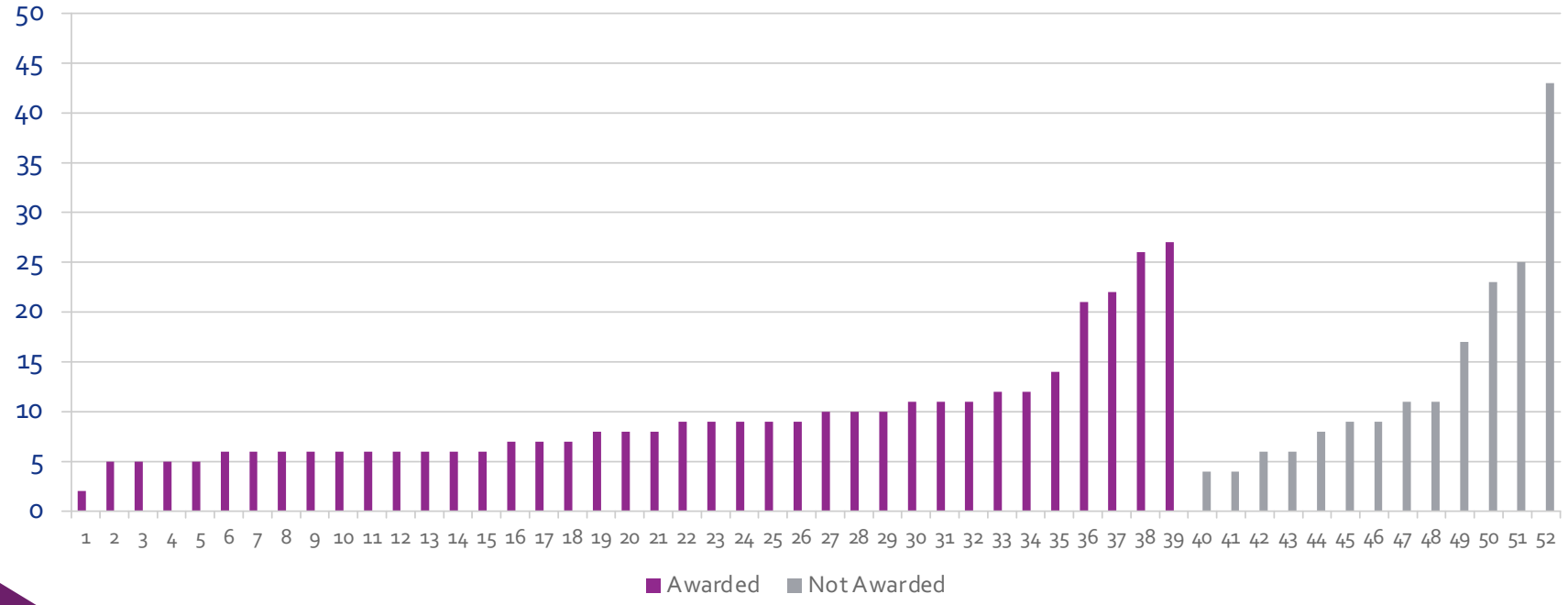
RAE Auction July 2020
PV ≤ 20 MW
Bids / Company



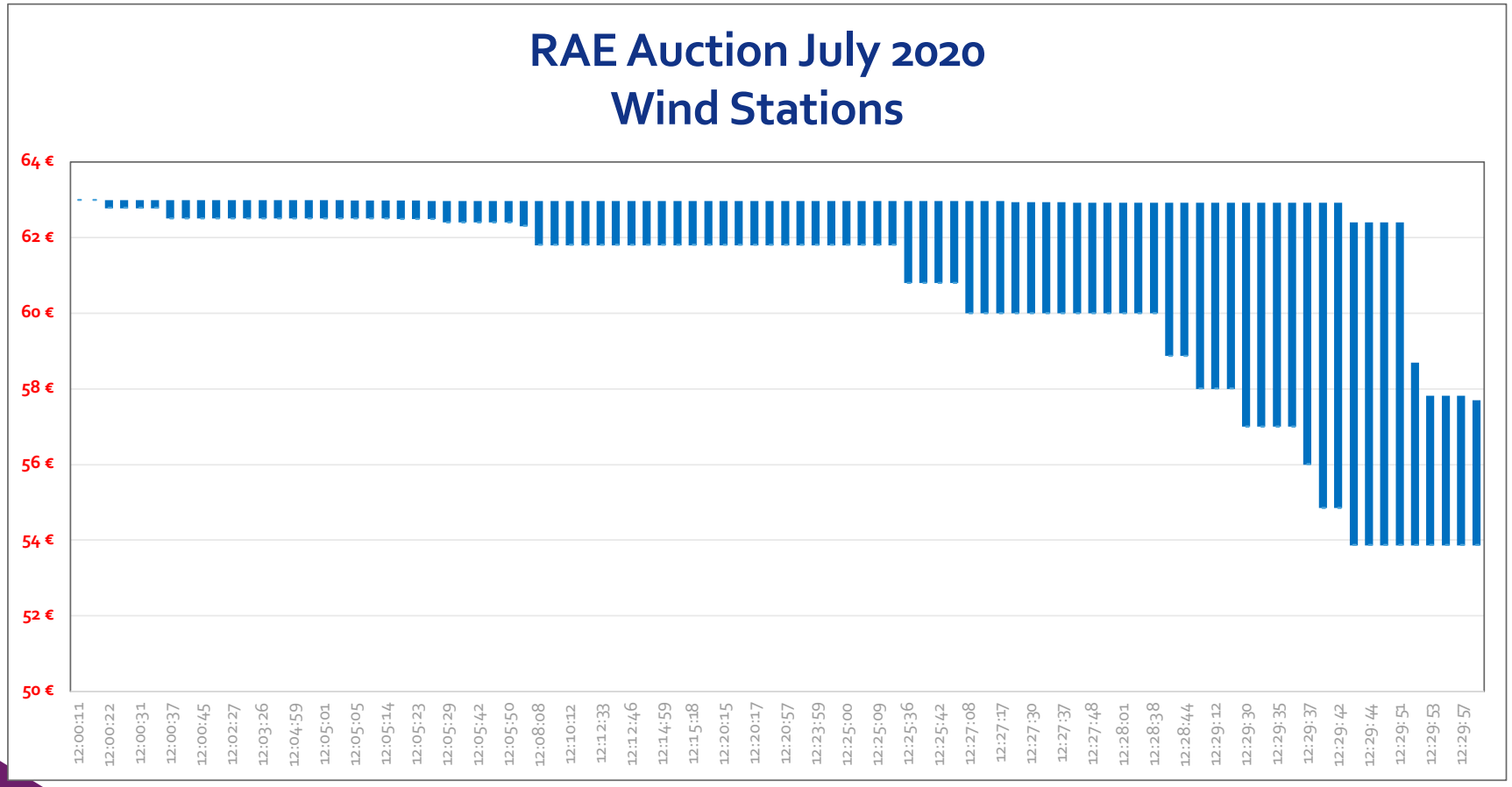
RAE Auction July 2020
PV ≤ 20 MW
Bids / Project



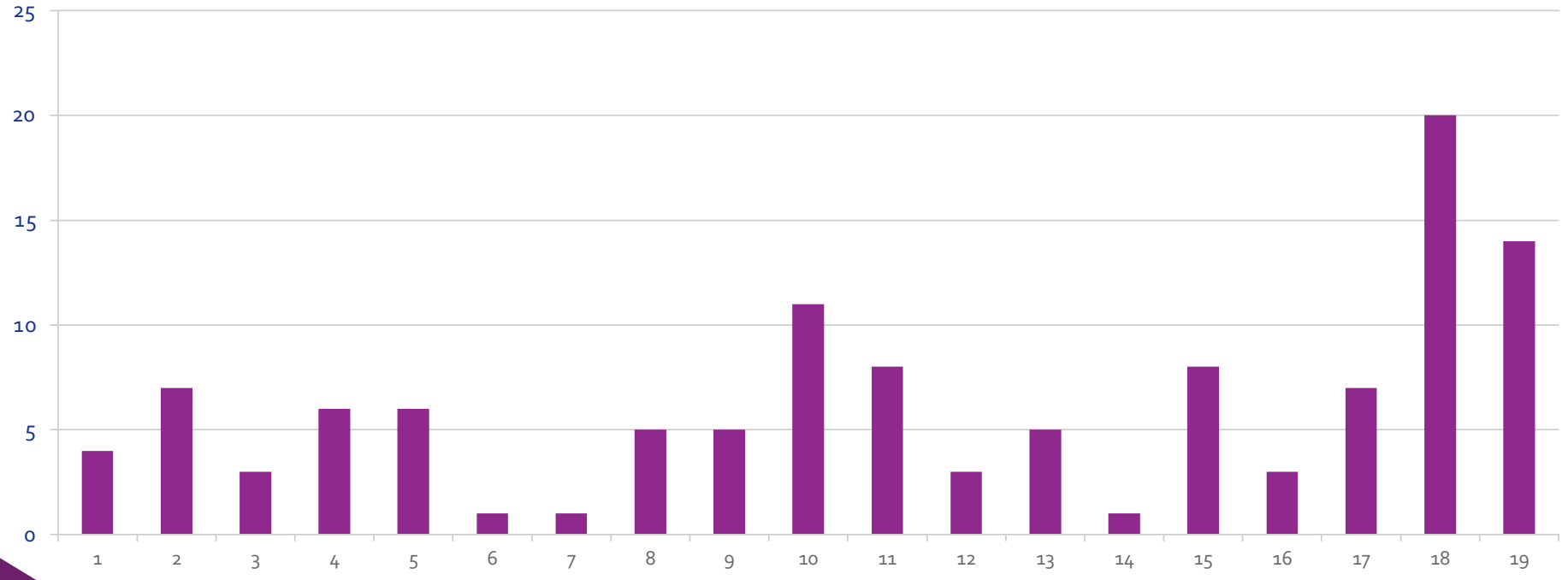
RAE Auction July 2020
PV ≤ 20 MW
Winning - Not Winning



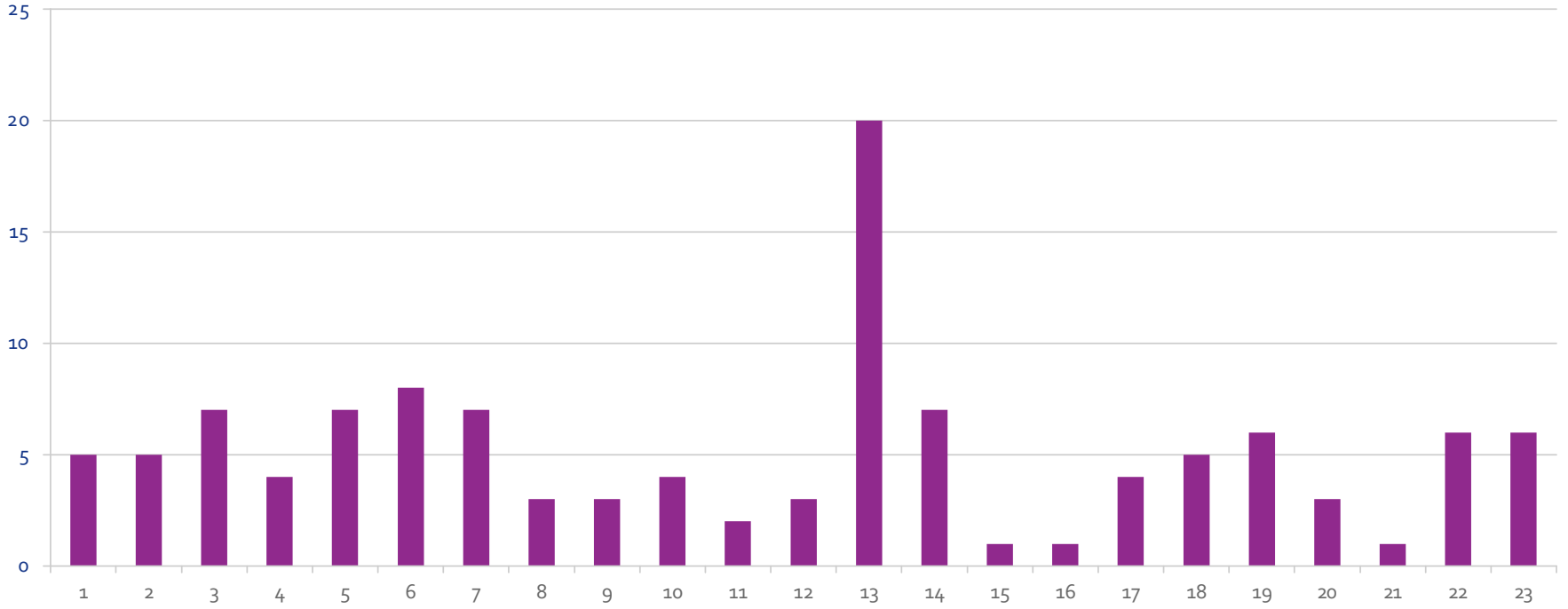
RAE Auction July 2020
Wind Stations



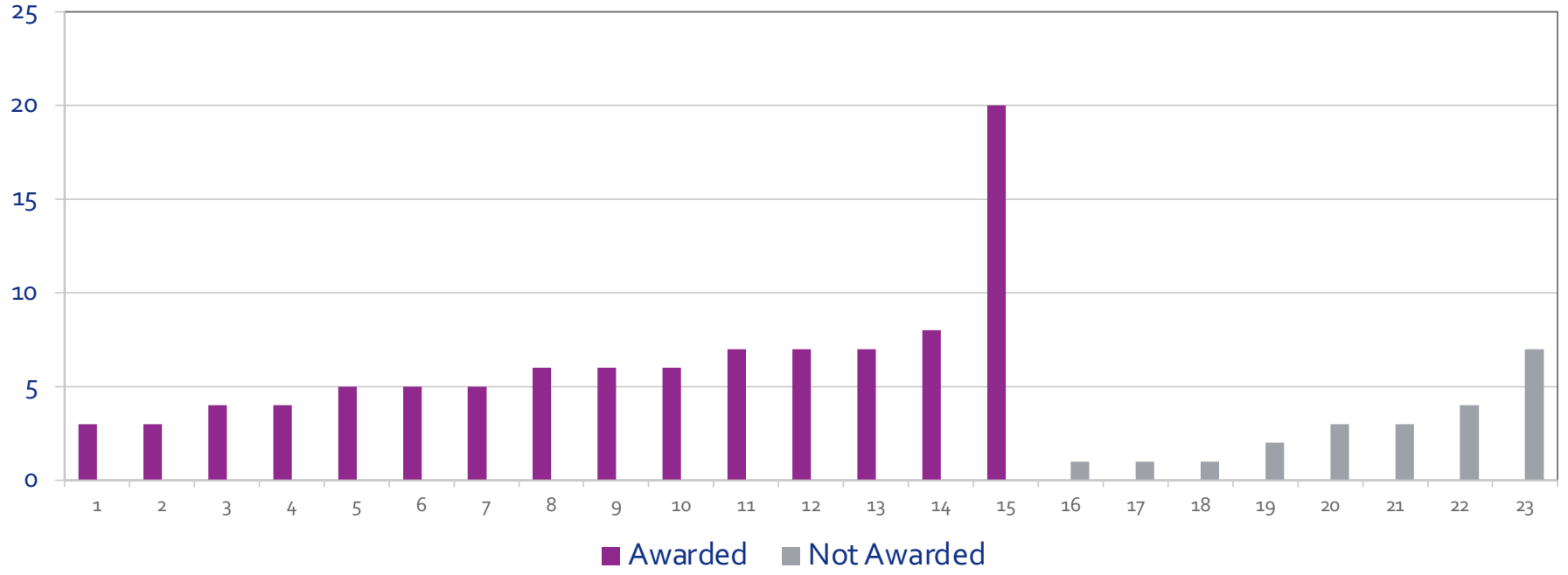
RAE Auction July 2020 - Wind Stations
Bids / Company



RAE Auction July 2020 - Wind Stations
Bids / Project



RAE Auction July 2020 - Wind Stations
Winning - No Winning projects



No. of Auctions	Type of Auction	Date	Granted PV Projects (MW)	Granted Wind Projects (MW)
2	1st Pilot Auction (TS)	December 2016	40 MW connected to the Grid	
3	Technology Specific	July 2018	106,40	170,93
3	Technology Specific	December 2018	61,94	159,65
1	Technology Neutral	April 2019	84,8% 371,18	15,2% 66,60
2	Technology Specific	July 2019	142,88	179,55
2	Technology Specific	December 2019	105,09	224
1	Technology Neutral	April 2020	69,58% 349,94	30,42% 153
2	Technology Specific	July 2020	142	472

437,78 MW

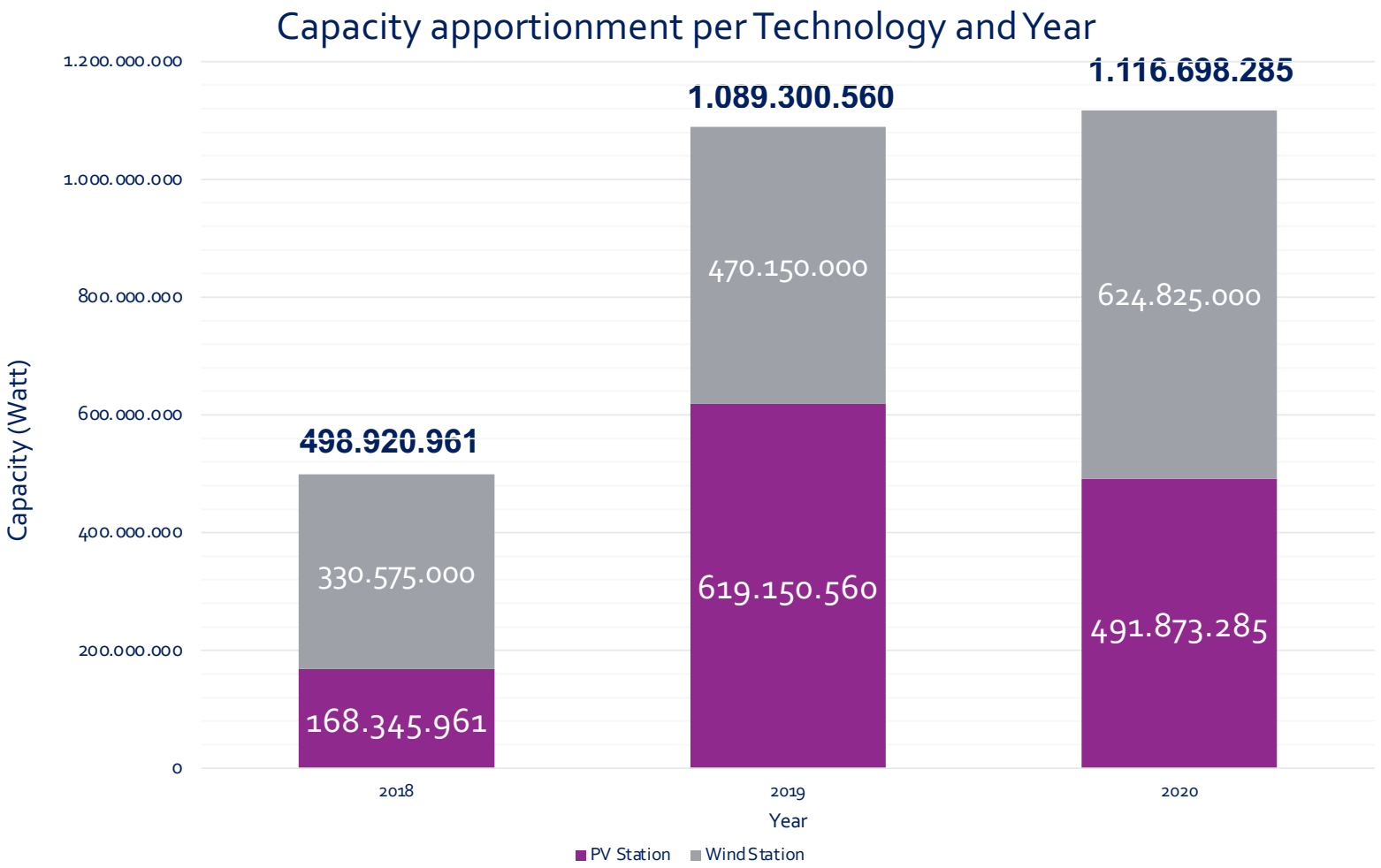
502,94 MW

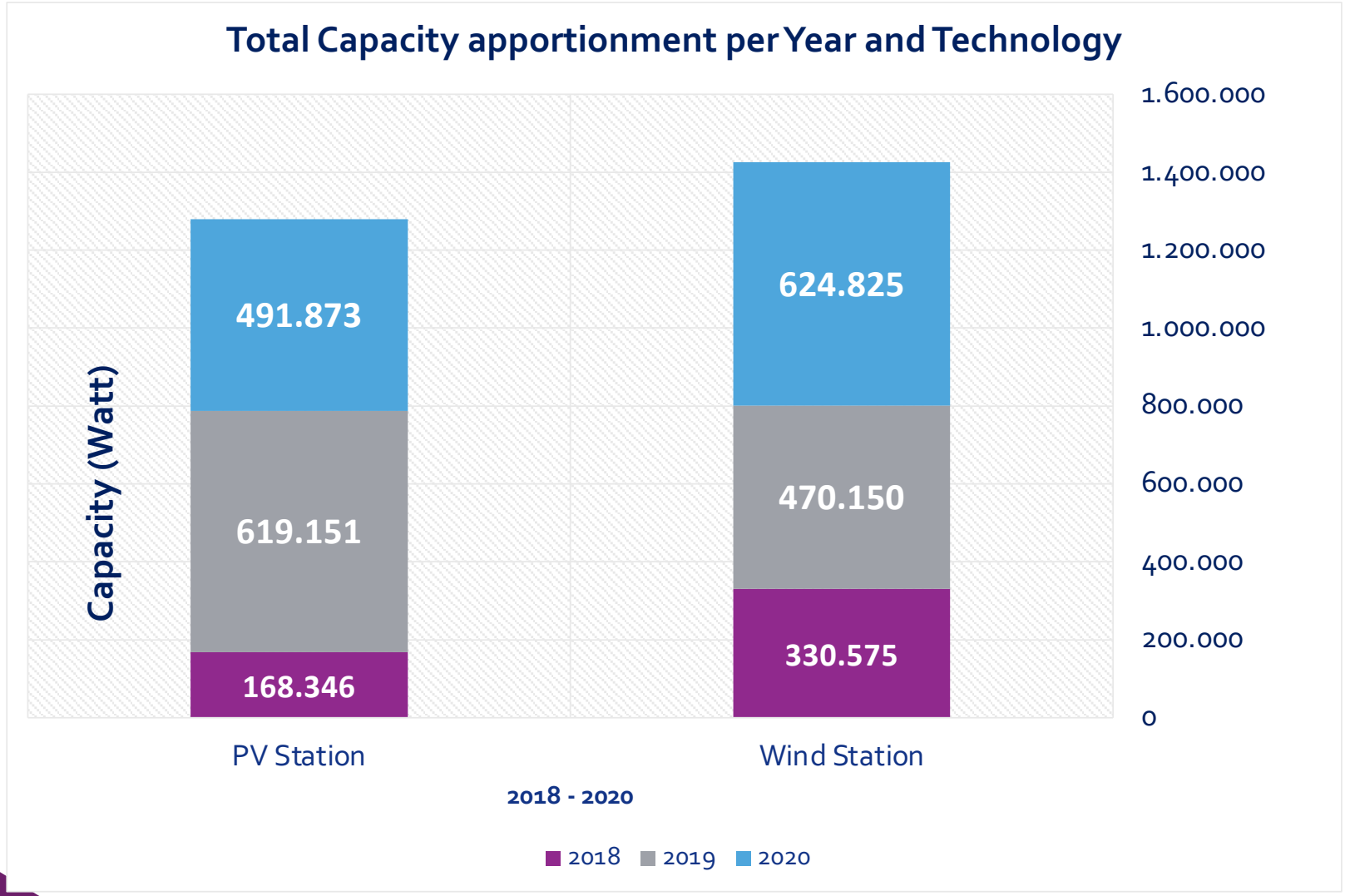
16 Auctions

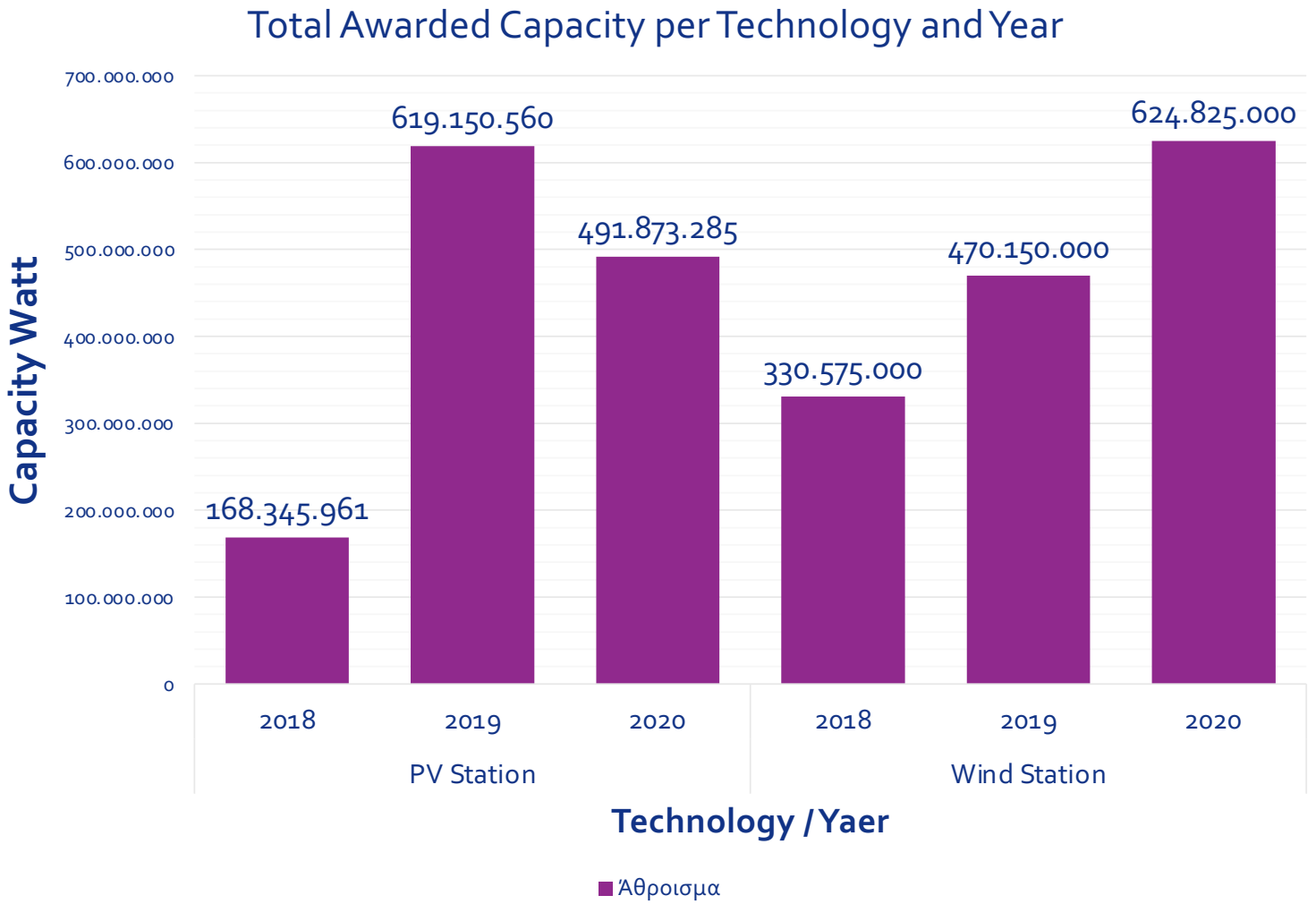
PV: 1.279,43 MW

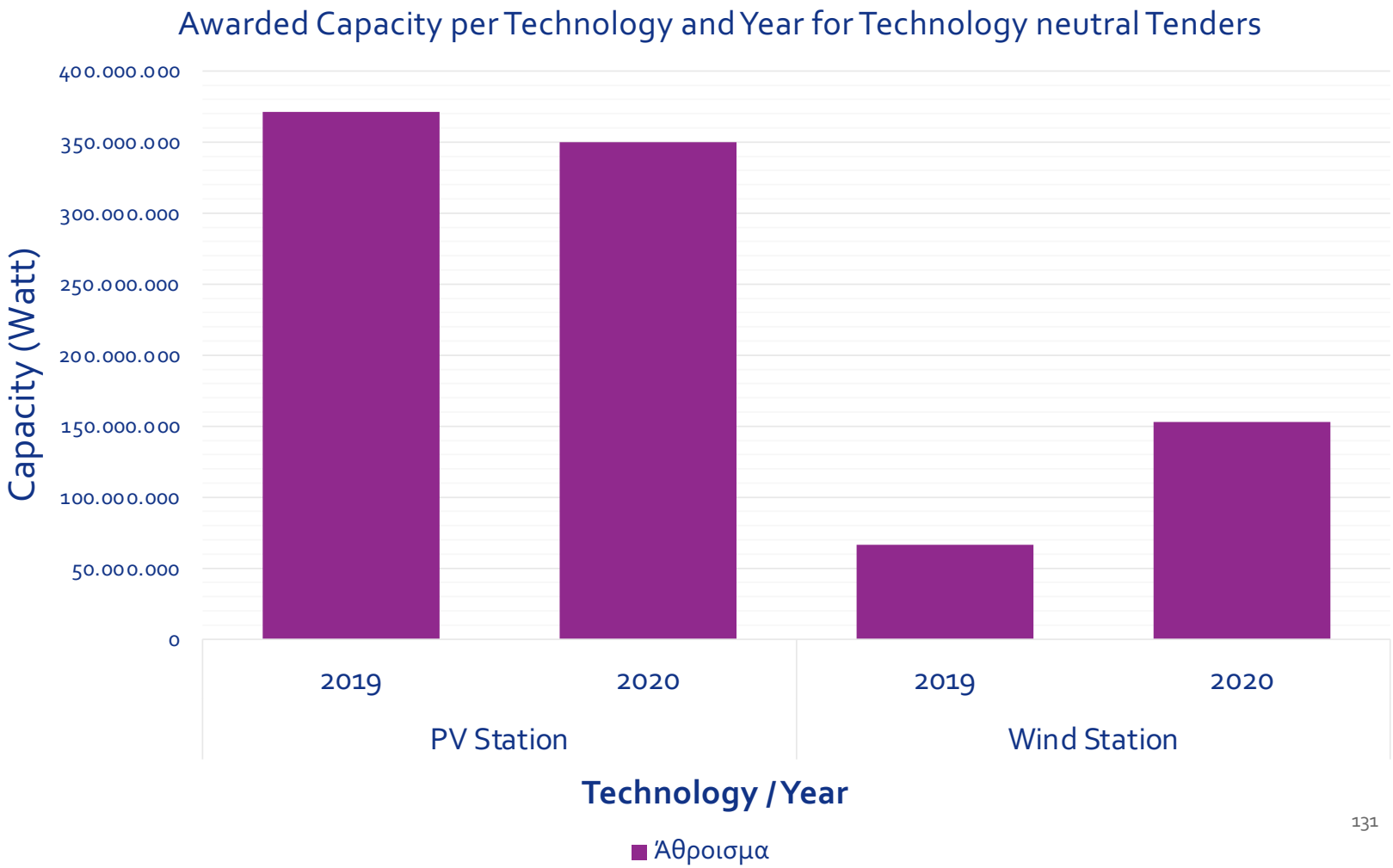
~2,71 GW

Wind: 1.426,73 MW

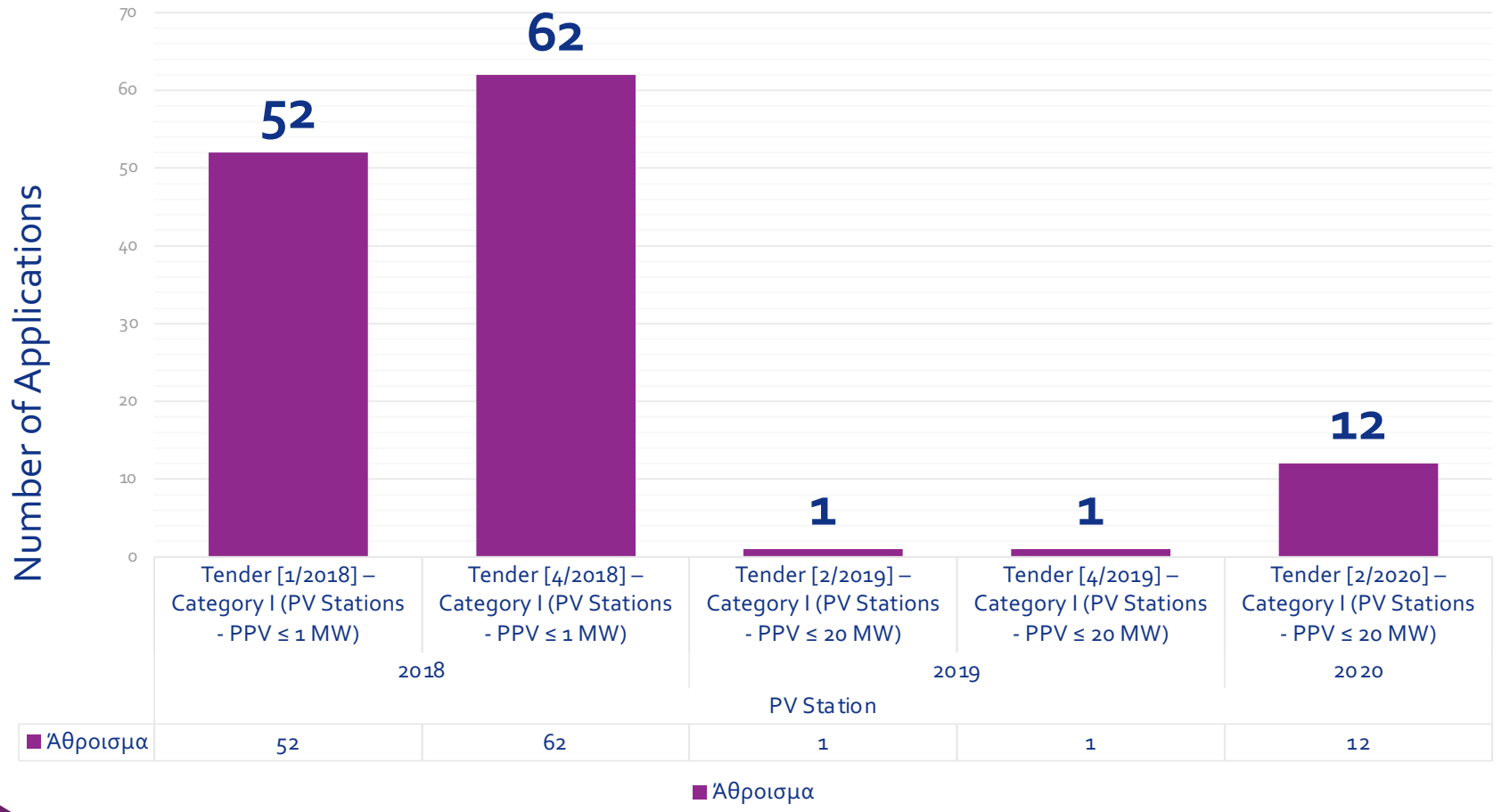

Capacity apportionment per Technology and Year
1.200.000.000
1.000.000.000
800.000.000
600.000.000
400.000.000
200.000.000
0
Capacity (Watt)
498.920.961
330.575.000
168.345.961
1.089.300.560
470.150.000
619.150.560
1.116.698.285
624.825.000
491.873.285
2018
2019
2020
Year
PV Station
Wind Station

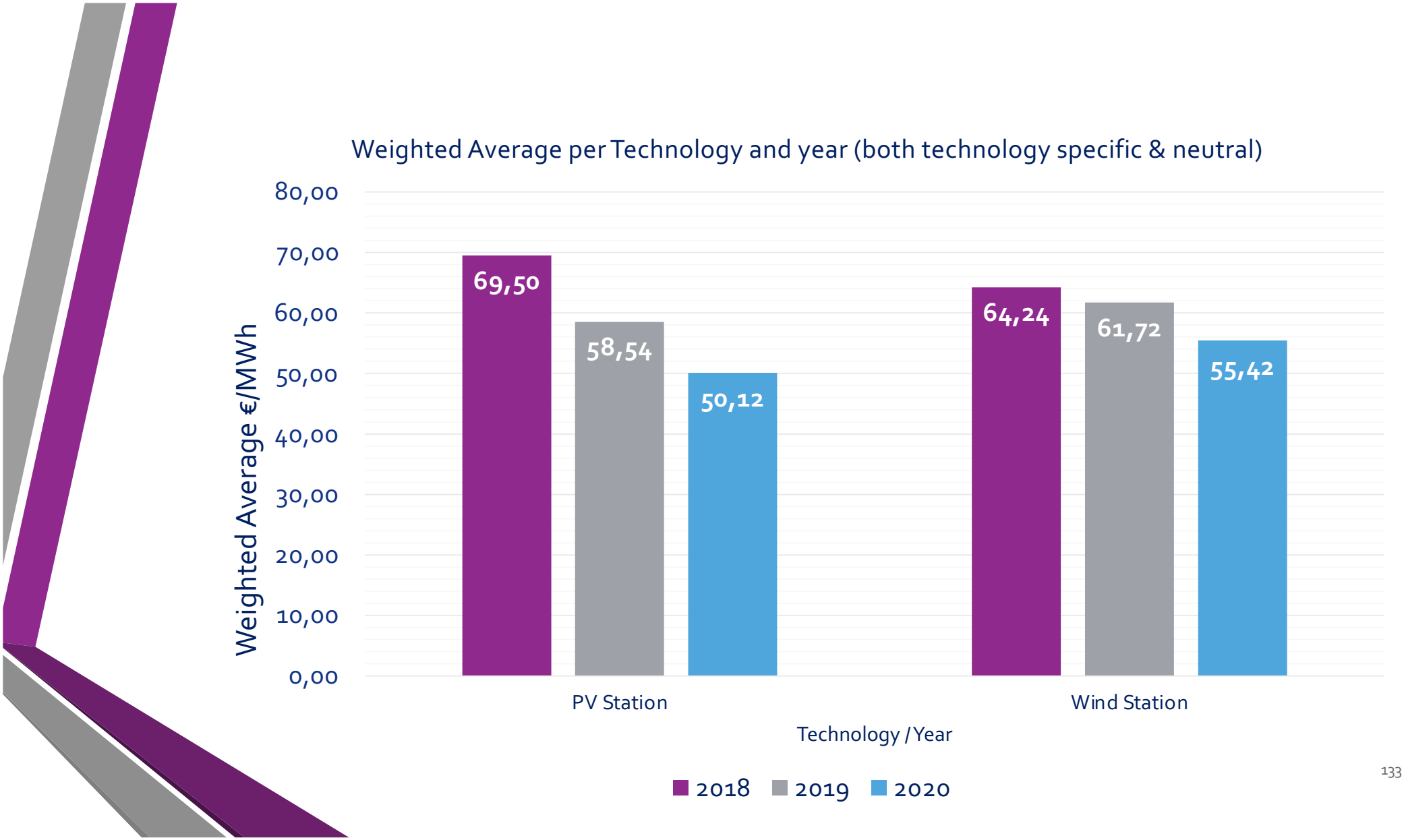

Total Capacity apportionment per Year and Technology
Capacity (Watt)
1.600.000
1.400.000
1.200.000
1.000.000
800.000
600.000
400.000
200.000
0
491.873
619.151
168.346
624.825
470.150
330.575
PV Station
Wind Station
2018 - 2020
2018
2019
2020

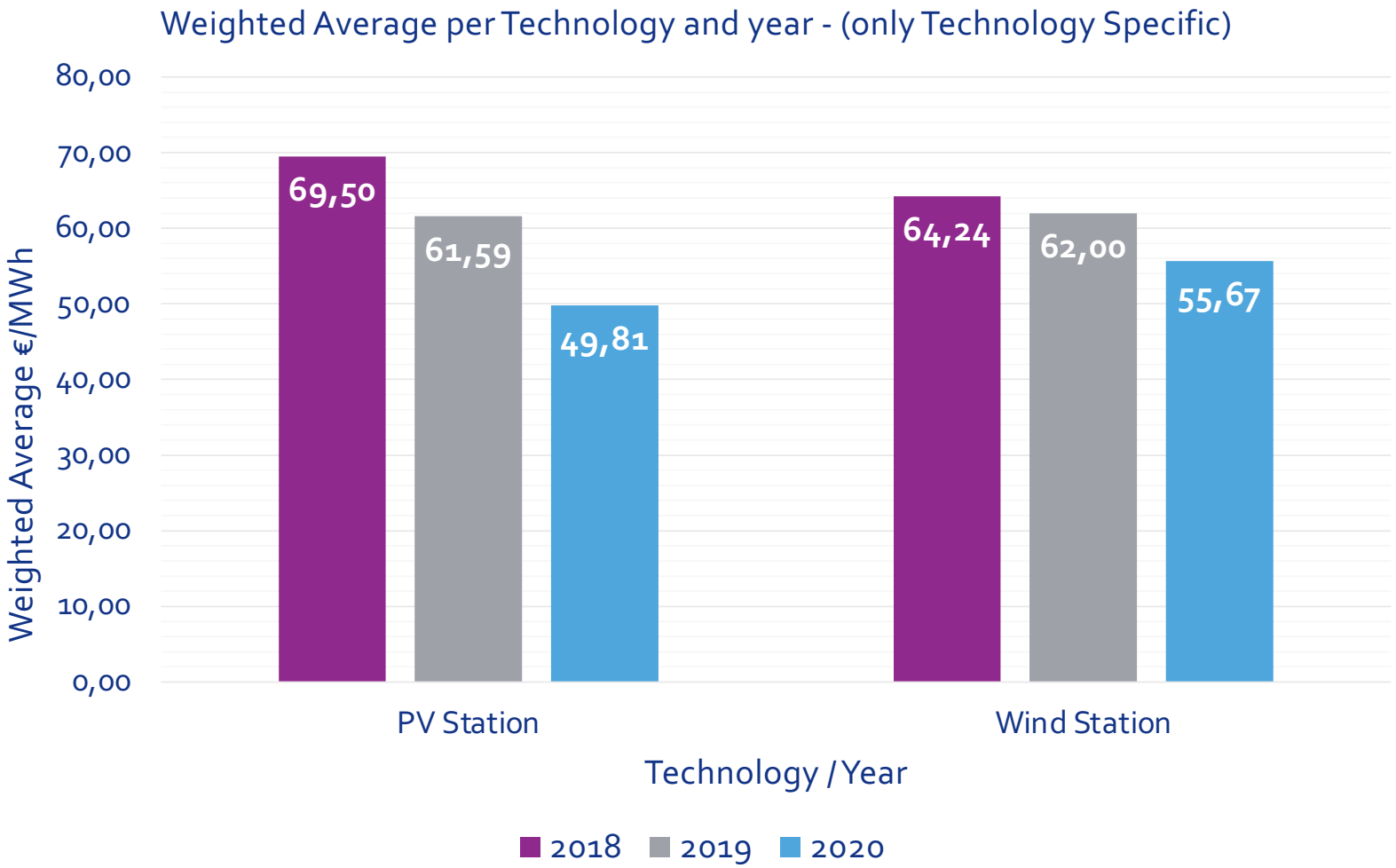

Total Awarded Capacity per Technology and Year
700.000.000
600.000.000
500.000.000
400.000.000
300.000.000
200.000.000
100.000.000
0
Capacity Watt
168.345.961
619.150.560
491.873.285
330.575.000
470.150.000
624.825.000
2018
2019
2020
2018
2019
2020
PV Station
Wind Station
Technology / Yaer
Άθροισμα

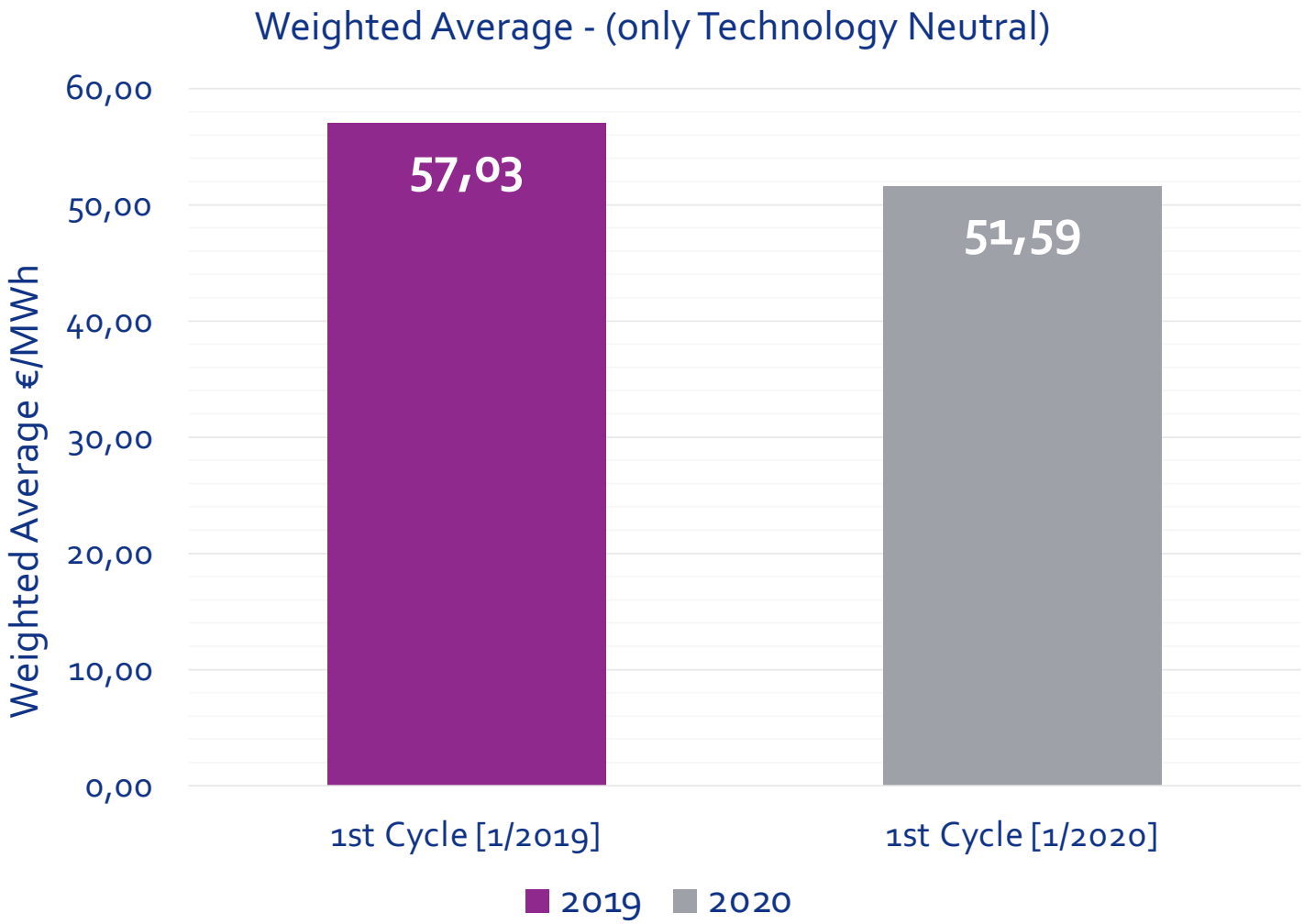

Awarded Capacity per Technology and Year for Technology neutral Tenders
400.000.000
350.000.000
300.000.000
250.000.000
200.000.000
150.000.000
100.000.000
50.000.000
0
Capacity (Watt)
2019
2020
2019
2020
PV Station
Wind Station
Technology / Year
Άθροισμα

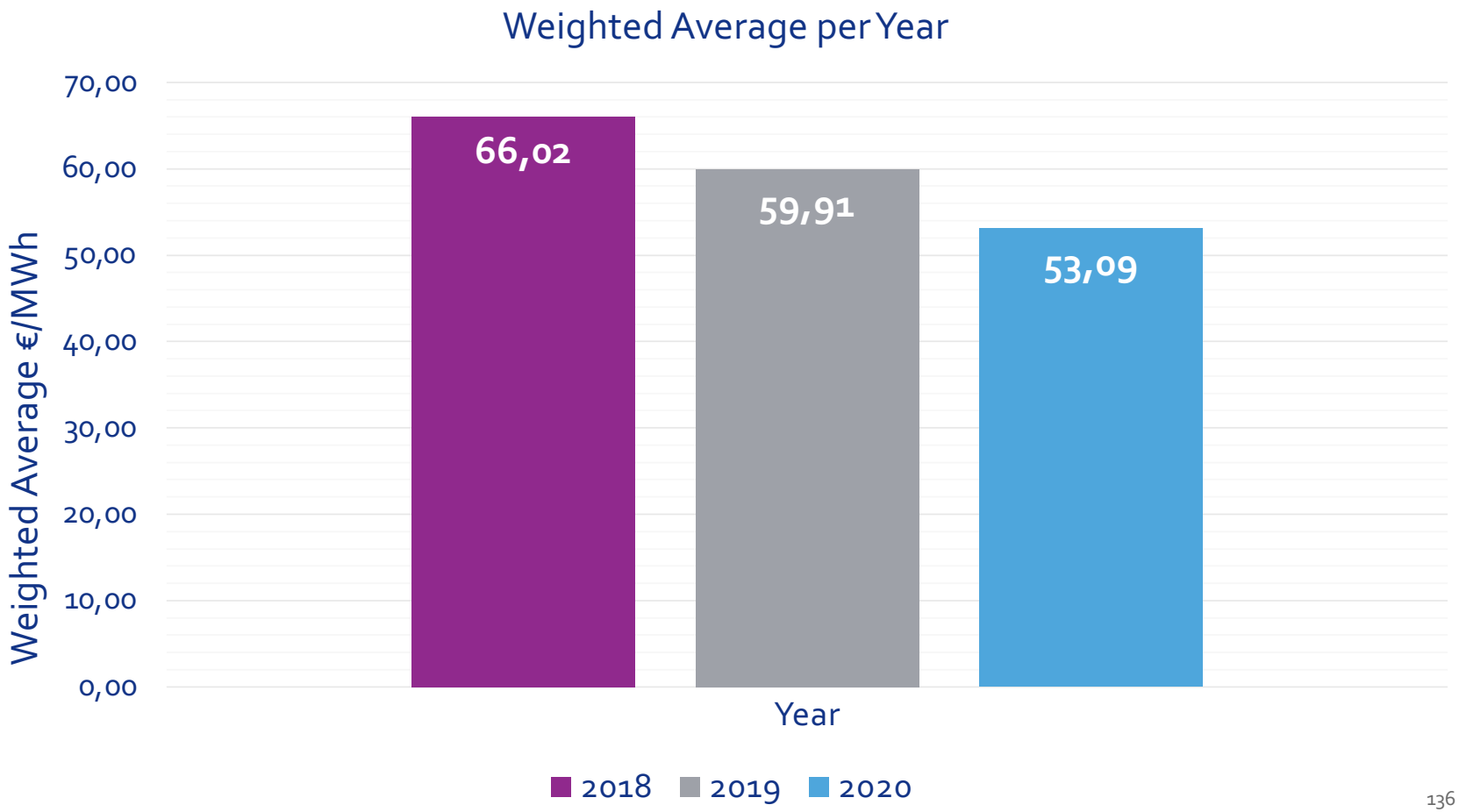
Number of Applications per Tender and Year for Capacity ≤ 500 kW

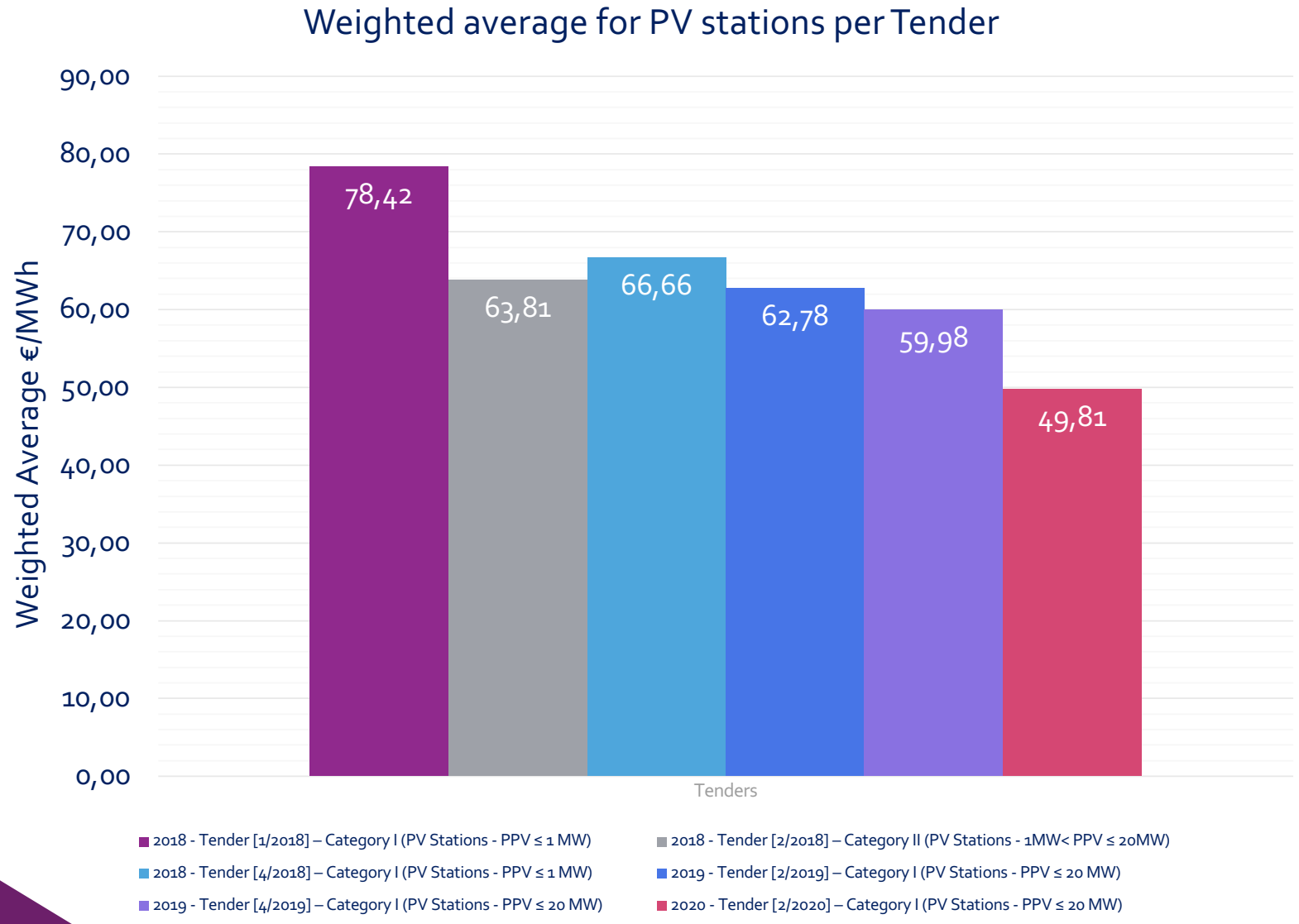



Weighted Average per Technology and year (both technology specific & neutral)
Weighted Average €/MWh
80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
69,50
58,54
50,12
64,24
61,72
55,42
PV Station
Wind Station
Technology / Year
2018
2019
2020

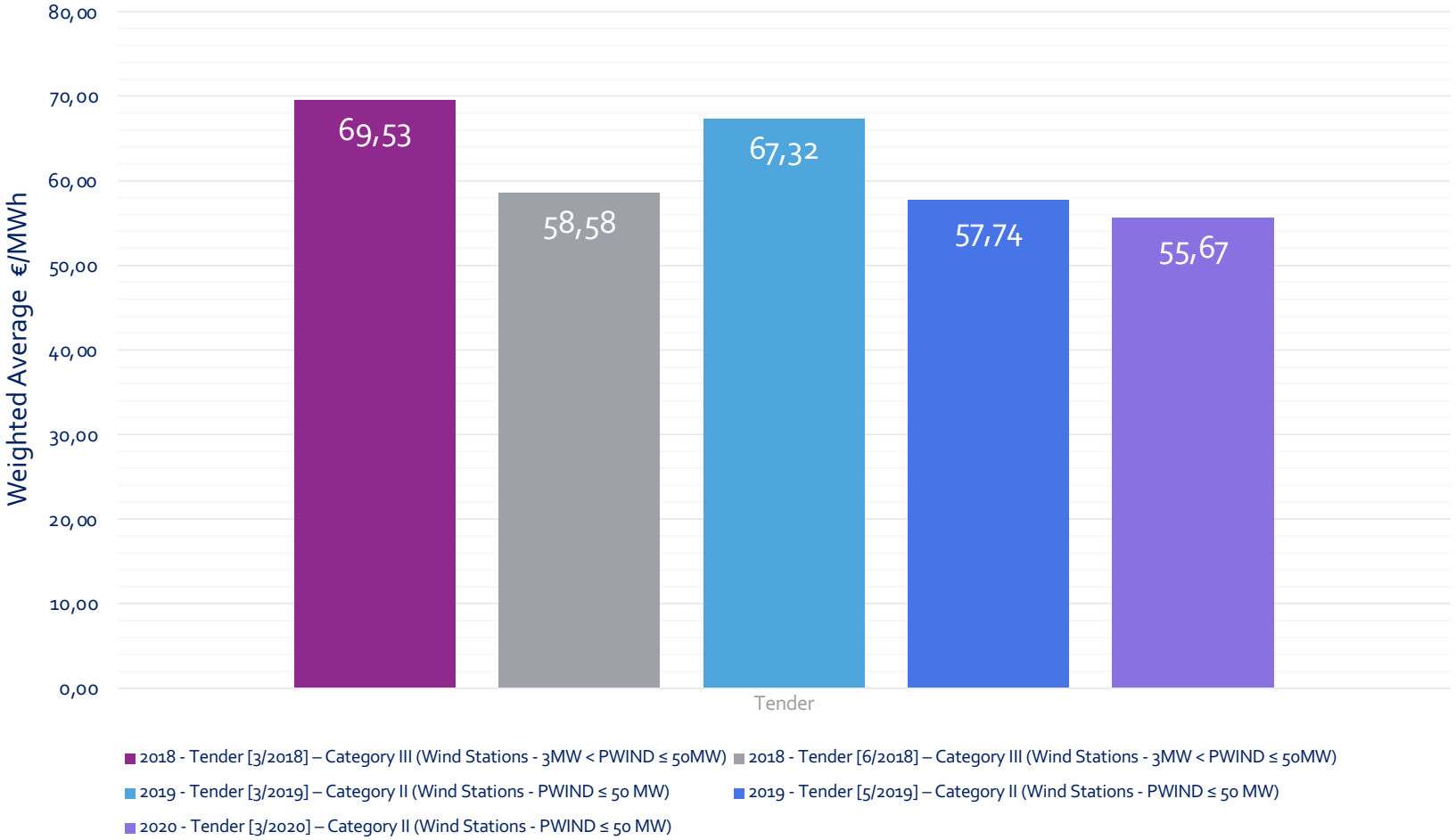

Weighted Average per Technology and year - (only Technology Specific)
80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
Weighted Average €/MWh
69,50
61,59
49,81
64,24
62,00
55,67
PV Station
Wind Station
Technology / Year
2018
2019
2020


Weighted Average - (only Technology Neutral)
Weighted Average €/MWh
60,00
50,00
40,00
30,00
20,00
10,00
0,00
57,03
51,59
1st Cycle [1/2019]
1st Cycle [1/2020]
2019
2020


Weighted Average per Year
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
Weighted Average €/MWh
66,02
59,91
53,09
Year
2018
2019
2020


Weighted average for PV stations per Tender
Weighted Average €/MWh
90,00
80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
78,42
63,81
66,66
62,78
59,98
49,81
Tenders
2018 - Tender [1/2018] – Category I (PV Stations - PPV ≤ 1 MW)
2018 - Tender [2/2018] – Category II (PV Stations - 1MW< PPV ≤ 20MW)
2018 - Tender [4/2018] – Category I (PV Stations - PPV ≤ 1 MW)
2019 - Tender [2/2019] – Category I (PV Stations - PPV ≤ 20 MW)
2019 - Tender [4/2019] – Category I (PV Stations - PPV ≤ 20 MW)
2020 - Tender [2/2020] – Category I (PV Stations - PPV ≤ 20 MW)

Weighted average for Wind stations per Tender



Level of competition – Wind technology (2018)

- For 2018 → 300MW for Wind installations
- July 2018 → 170,93MW succeeded and the remaining capacity for December 2018 was ~129MW.
- After RAE's opinion we can bring infront 1/3 of the auction capacity of 2019, this means that the auctioned capacity on December was finaly (129+100=**229MW**).
- If we remain to the auctioned capacity of 129MW, then the level of competition would be **118 %** (participants **281,65MW**).
- With the term of the minimum level of competition of 75%, the final auctioned capacity on December 2018 was 160,94MW.
- **The succeded wind capacity for 2018 was 330MW (30MW above the initial target)**

Conclusions (1)

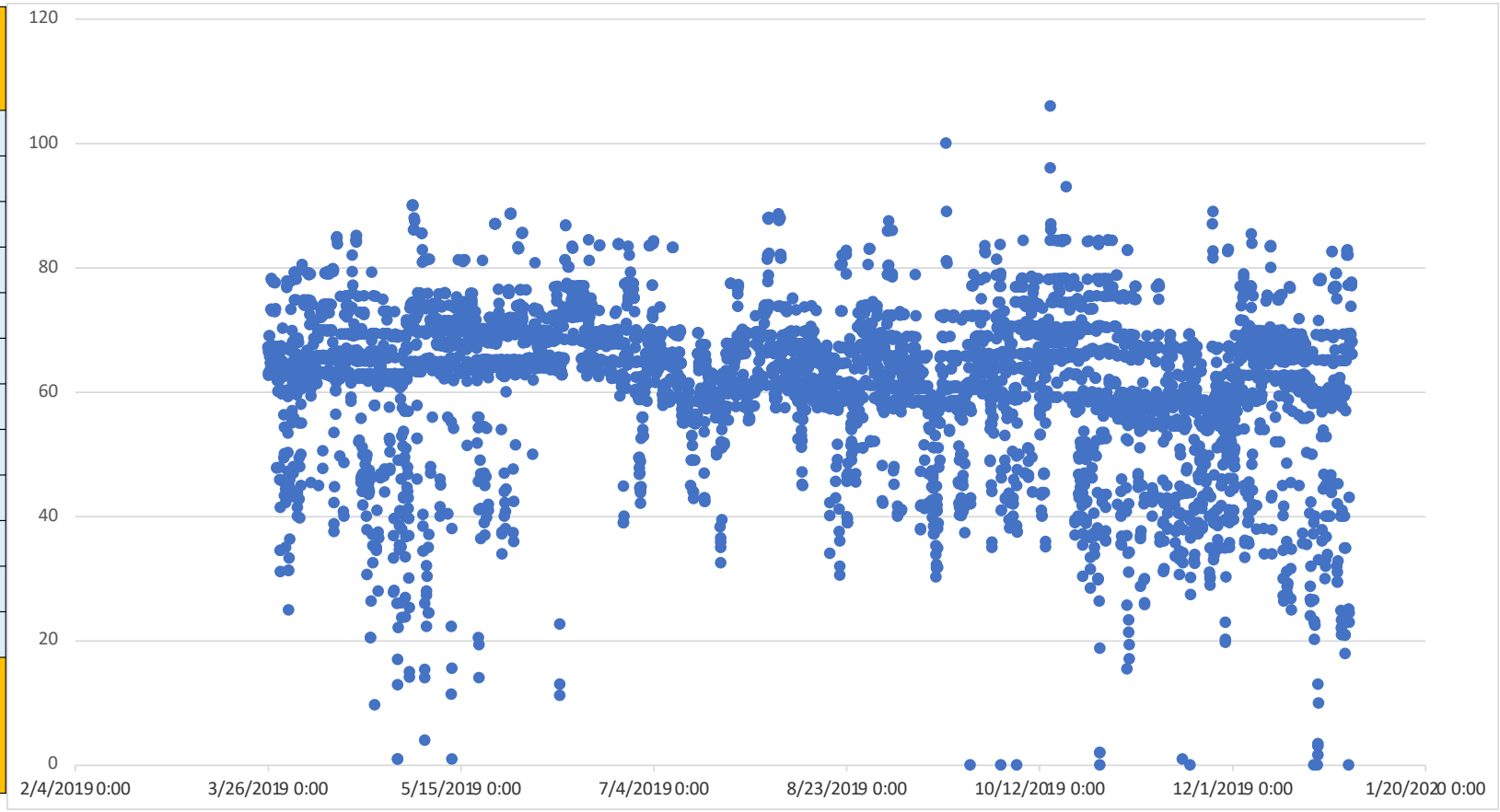
- **The whole process was innovative, simplified, transparent, valid and reliable.**
- A specific online platform was modified according to the decisions of RAE.
- **Achievement of significant reduction in prices.**
- The minimum level of competition starts from 75% drive to a significant reduction of the prices (July 2018 & December 2018) and then drops to 40% (April 2019 (neutral), July 2019, December 2019, April 2020, July 2020) to give more capacity via the auctions. Also the next auctions on December will take place with 40%.
- The minimum level of competition for the next neutral competitive procedure is increased to 100%.
- There were no problems understanding and using the applications during the users' training.
- The "virtual auctions" solved any questions about the procedure of the tenders.
- No mistakes in participants' registration process, procedure of application and suspension supporting documents in the online platform.

Conclusions (2)

- The electronic submission of the applications → This made possible the immediate beginning of the evaluation of applications by RAE, by significantly reducing the time which would be required under any other conditions
- **Approximately 100% of the auctioned Capacity was covered according to the tender procedure**
- All selected candidates comply with the Rule of 4% about Performance Guarantees
- All the Projects connected to the grid according to the timetables of the proclamation

System Marginal Price (SMP) - 2019

Average	SMP €/MWh
Jan 2019	75,28292
Feb 2019	69,00658
March 2019	59,87107
Apr 2019	62,40584
May 2019	65,91308
June 2019	68,12549
July 2019	62,15368
Aug 2019	64,03718
Sep 2019	60,92765
Oct 2019	63,31361
Nov 2019	55,3472
Dec 2019	59,68141
Total 2019	**63,81976**



RES Auctions results - Weighted average prices			
July 2018	Max	Min	W.Average
Category I	80	75,87	78,42
Category II	71	62,97	63,81
Category III	71,93	68,18	69,53
December 2018	Max	Min	W.Average
Category I	68,99	63	66,66
Category III	65,37	55	58,58
April 2019	Max	Min	W.Average
neutral	64,72	53	57,03
July 2019	Max	Min	W.Average
Category I	67,7	61,95	62,77
Category II	69,18	59,09	67,31
December 2019	Max	Min	W.Average
Category I	65,99	53,82	59,98
Category II	61,94	56,77	57,74
April 2020	Max	Min	W.Average
neutral	54,82	49,11	51,59
July 2020	Max	Min	W.Average
Category I	62,45	45,84	49,81
Category III	57,7	53,86	55,67

SMP(2019) vs auction results	Number of hours (2019)	% of hours (2019)
SMP>=80€/MWh	445	5,1%
SMP>=75,87€/MWh	933	10,7%
SMP>=78,42€/MWh	523	6,0%
SMP>=71€/MWh	1690	19,3%
SMP>=62,97€/MWh	5418	61,8%
SMP>=63,81€/MWh	5133	58,6%
SMP>=71,93€/MWh	1553	17,7%
SMP>=68,18€/MWh	3036	34,7%
SMP>=69,53€/MWh	2382	27,2%
SMP>=68,99€/MWh	2754	31,4%
SMP>=63€/MWh	5409	61,7%
SMP>=66,66€/MWh	3740	42,7%
SMP>=65,37€/MWh	4432	50,6%
SMP>=55€/MWh	7597	86,7%
SMP>=58,58€/MWh	6907	78,8%
SMP>=57,03€/MWh	7305	83,4%
SMP>=55,67€/MWh	7500	85,6%
SMP>=59,98€/MWh	6382	72,9%
SMP>=57,74€/MWh	7163	81,8%
SMP>=51,59€/MWh	7766	88,7%
SMP>=49,81€/MWh	7847	89,6%

Auctions for Non Mature Projects

Regions with available electricity capacity for new RES

- **Crete – now** available capacity for new 100MW pv & new 100MW Wind stations
- **Crete – after the 2nd interconnection** – (>**1,5-2GW**)
- **Region of Evia** → new RES capacity of 200-250MW
- **Interconnection of Cyclades** → new RES capacity of 200-250MW

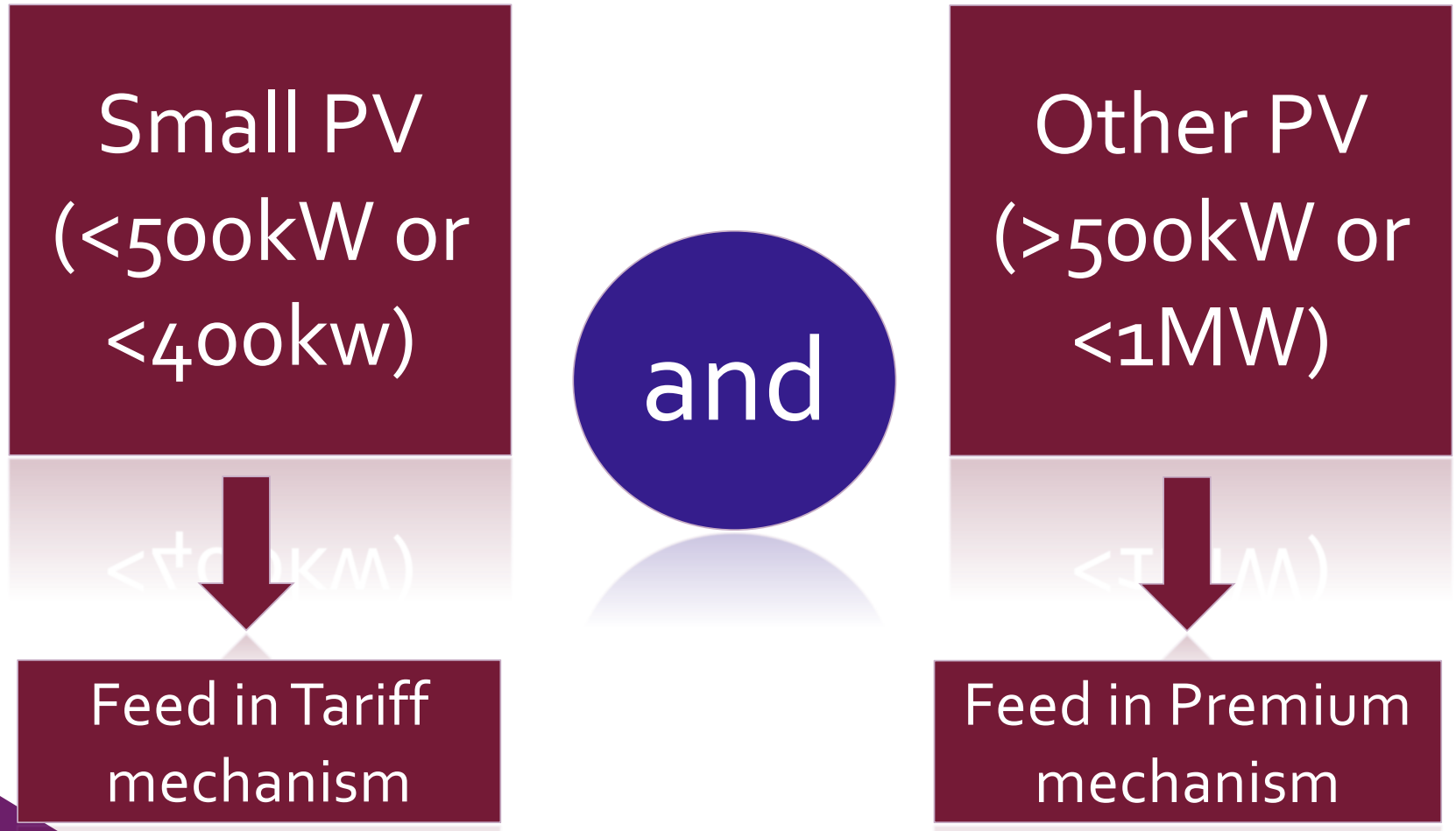
Subject 1

Technology Specific

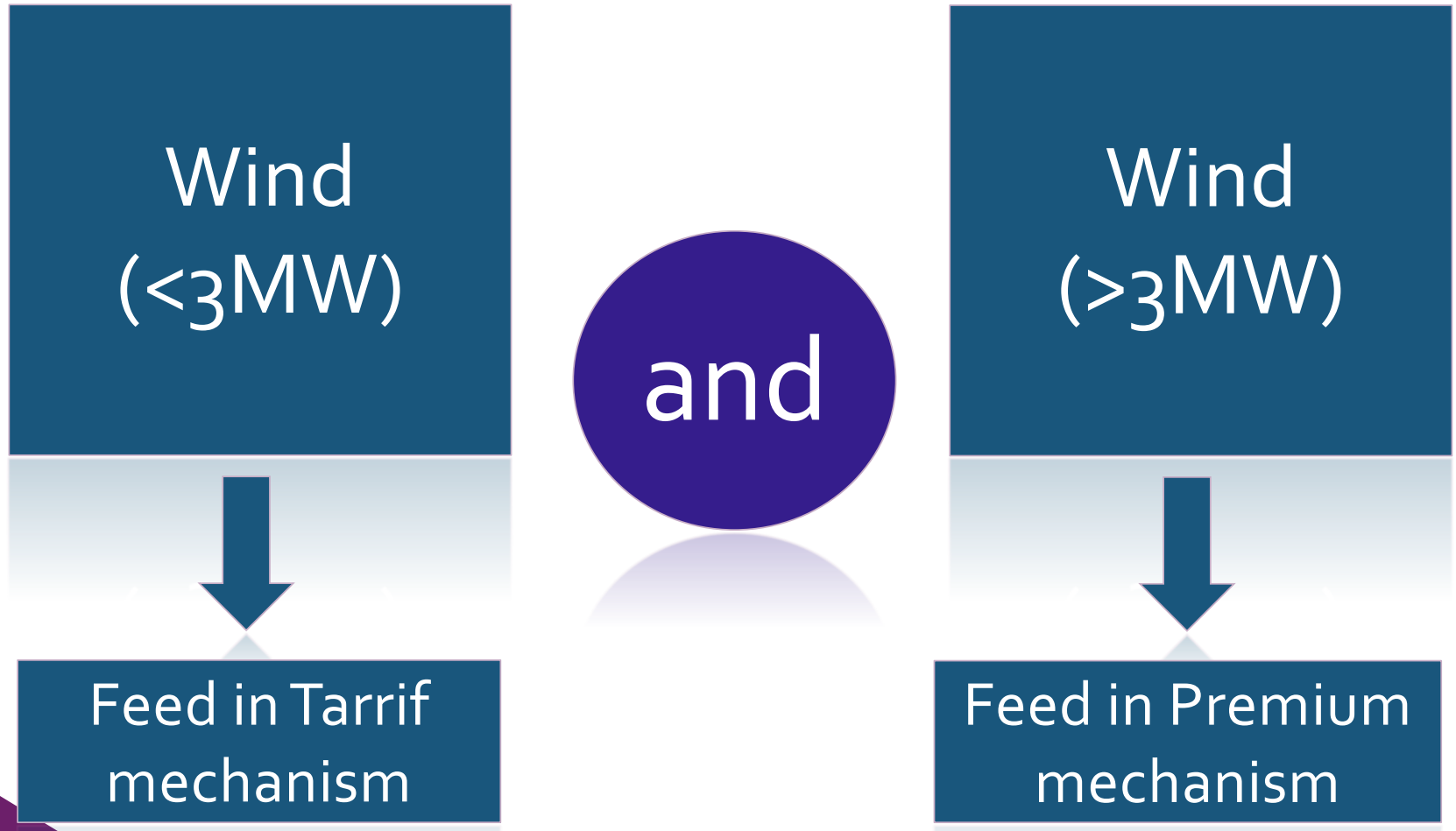
or

neutral

PV Projects - Subject 2



Wind Projects - Subject 3



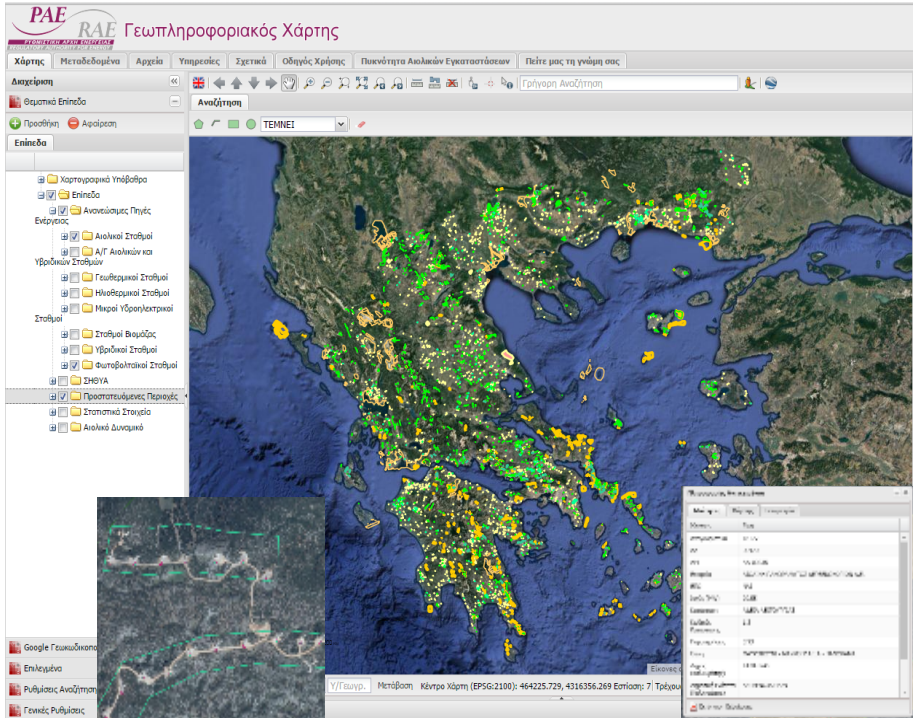
Energy Communities – Subject 4

Priority to local communities (Non profit organizations) (?MW)

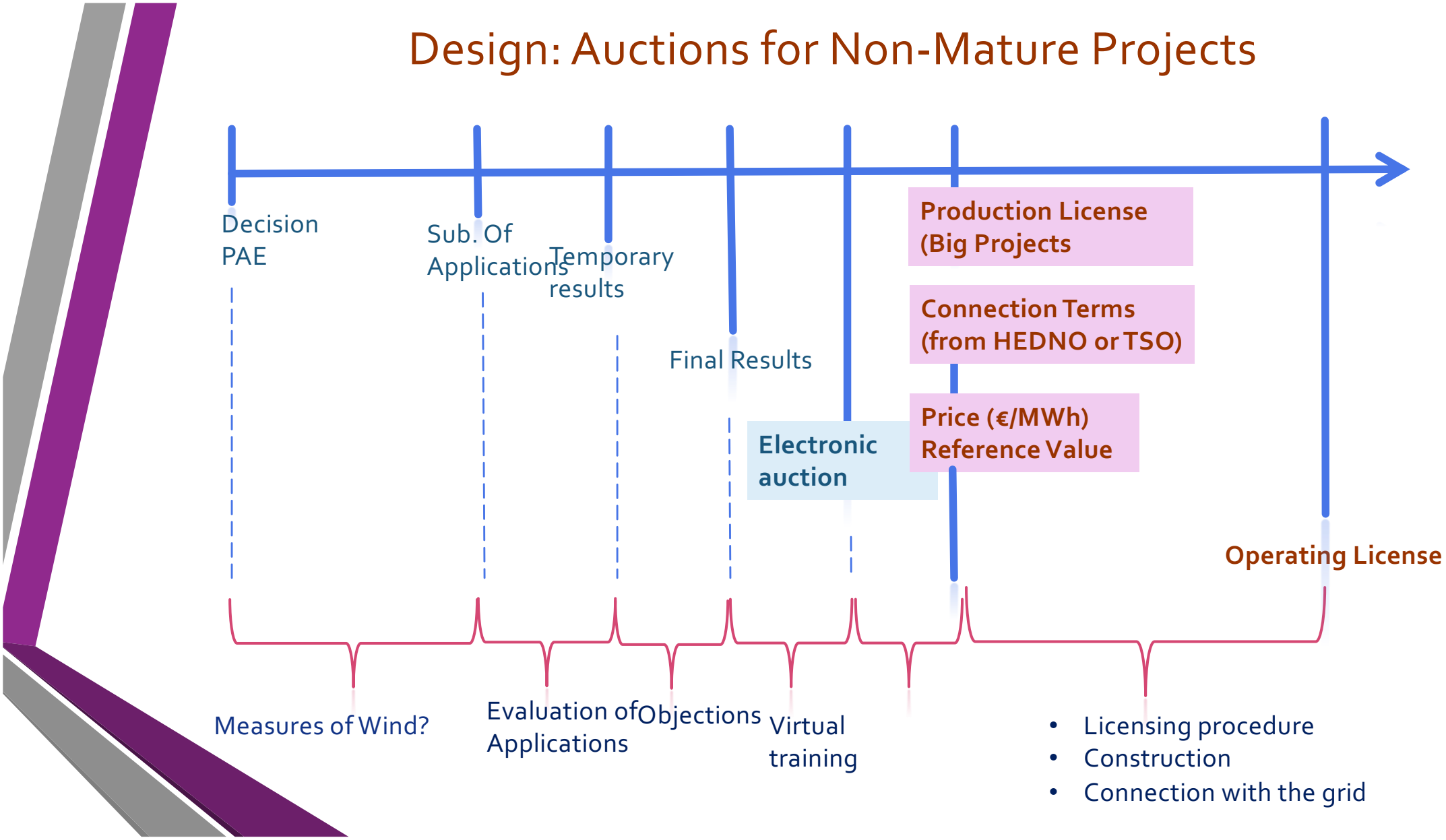
Thoughts of RAE

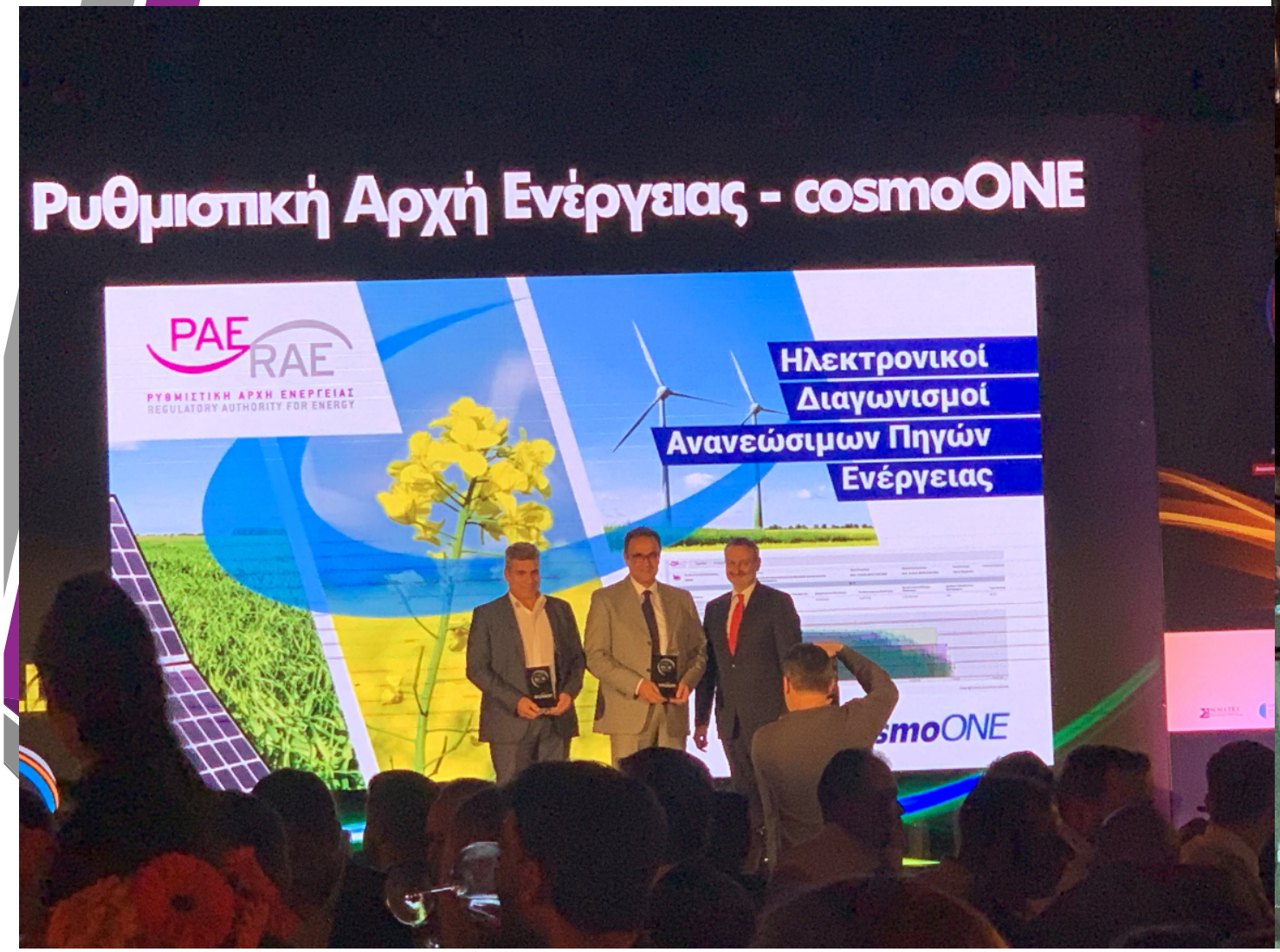
Huge interest for new RES
Μεγάλο πλήθος αιτήσεων
Estimation > 2.000 for PV
Huge Interest also for Wind projects

Electronic submission of applications



Design: Auctions for Non-Mature Projects




Ρυθμιστική Αρχή Ενέργειας - cosmoONE
PAE RAE
ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY
Ηλεκτρονικοί
Διαγωνισμοί
Ανανεώσιμων Πηγών
Ενέργειας


IMPACT.
bite
Awards 2019
Business I.T. Excellence
GOLD
Ρυθμιστική Αρχή Ενέργειας & cosmoONE
Εξειδικευμένες Κλαδικές Εφαρμογές / Ενέργεια

EUROPEAN COURT OF AUDITORS

Transparency in auctions fosters competition: the Greek regulatory authority's IT platform

https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=50079

The EU Court of Auditors presents the RES Auction in Greece held by Greek Regulatory Authority as best practice

3rd Cycle Auction, Nuetral, Dec. 2020 – May 2021

Categories	Auctioned Capacity (max) (MW)	Final Auctioned Capacity (MW)	Project Applications (No/MW)			Auction				
			Applied	Approved	Granted	Bids	Ceiling price (€/MWh)	Highest Bid (€/MWh)	Lowest Bid (€/MWh)	Weighed Price (€/MWh)
PV stations $P_{PV} \leq 20W$ & Wind Stations $P_{Wind} \leq 50$ MW	350						53,86			

Neutral – "small projects"
Dec. 2020 – May 2021

(PV<20MW & Wind<50MW) 350MW - 53,86 €/MWh

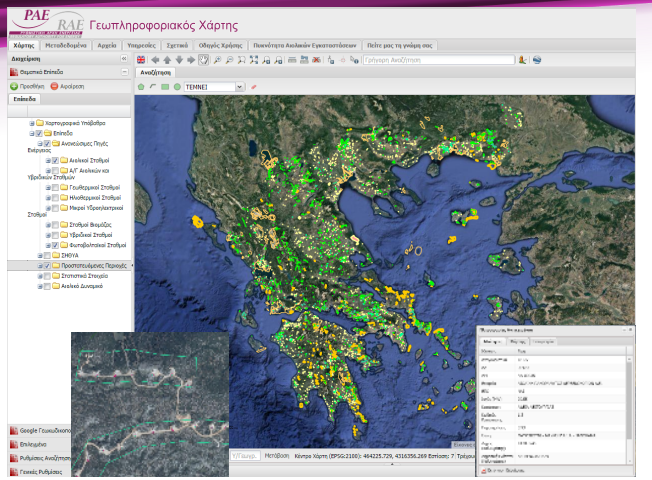
PAE RAE
ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY

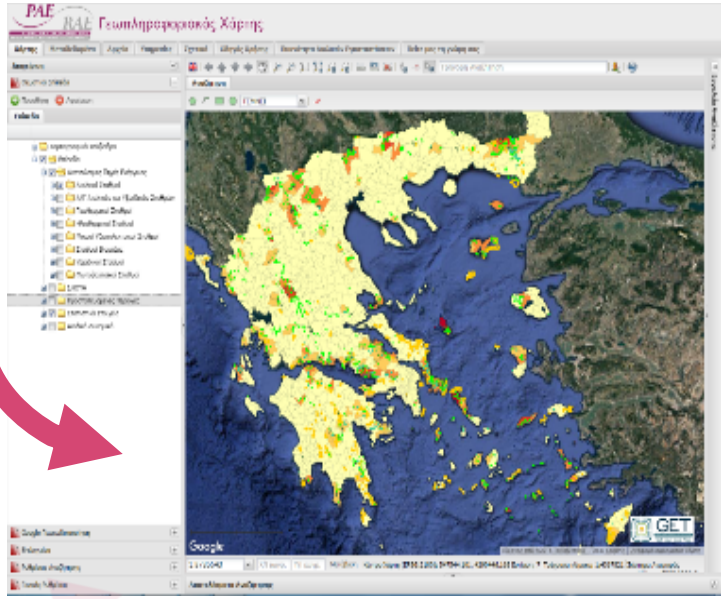
Simplify the licensing procedure

From July 2019 → Proposal of RAE

Electronic submission

- Registration
- Submission of applications
- Automatic tools





Applications under evaluation by RAE (cycle Sept. 2018 – cycle Dec. 2019)

YEAR	2018				2019								Total / technology	
Technlogy/cycle	September		December		March		June		September		December			
	Number	Cap.(MW)	Number	Cap.(MW)	Πλήθος	Ισχύς (MW)	Number	Cap.(MW)	Number	Cap.(MW)	Number	Cap.(MW)	Number	Cap.(MW)
Wind	28	192,9	86	677,3	83	622,1	67	351,0	18	353,0	93	1838,1	**375**	**4.034,37**
PV	84	811,8	139	2071,1	131	1627,4	121	2119,5	76	1508,2	430	12886,2	**981**	**21.024,12**
Small Hydro	0	0,0	6	9,7	8	11,1	10	8,1	8	9,7	24	30,6	**56**	**69,09**
Biomass	1	5,0	1	2,0	0	0,0	0	0,0	1	2,0	4	12,0	**7**	**20,98**
HECHP	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	1	6,0	**1**	**6,00**
Hybrid	0	0,0	0	0,0	0	0,0	0	0,0	3	13,8	0	0,0	**3**	**13,78**
Total RES Projects	113	1009,7	232	2760,0	222	2260,6	198	2478,6	106	1886,7	552	14772,8	**1423**	**25.168,34**

Applications (up to cycle of June 2018) **10 GW** + Applications (Sept. 18 – Dec. 19) **25 GW** = **35 GW**

ΕΠΙΒΕΒΑΙΩΣΗ
& ΕΠΙΚΑΙΡΟΠΟΙΗΣΗ
ΠΑΛΑΙΩΝ ΑΙΤΗΜΑΤΩΝ

Applications up to June 2018

Designed and developed the 1st IT Platform

ΕΠΙΒΕΒΑΙΩΣΗ
& ΕΠΙΚΑΙΡΟΠΟΙΗΣΗ
ΠΑΛΑΙΩΝ ΑΙΤΗΜΑΤΩΝ

Applications [cycle Sept. 2018 – cycle Dec. 2019]

Designed and developed the 2nd IT Platform

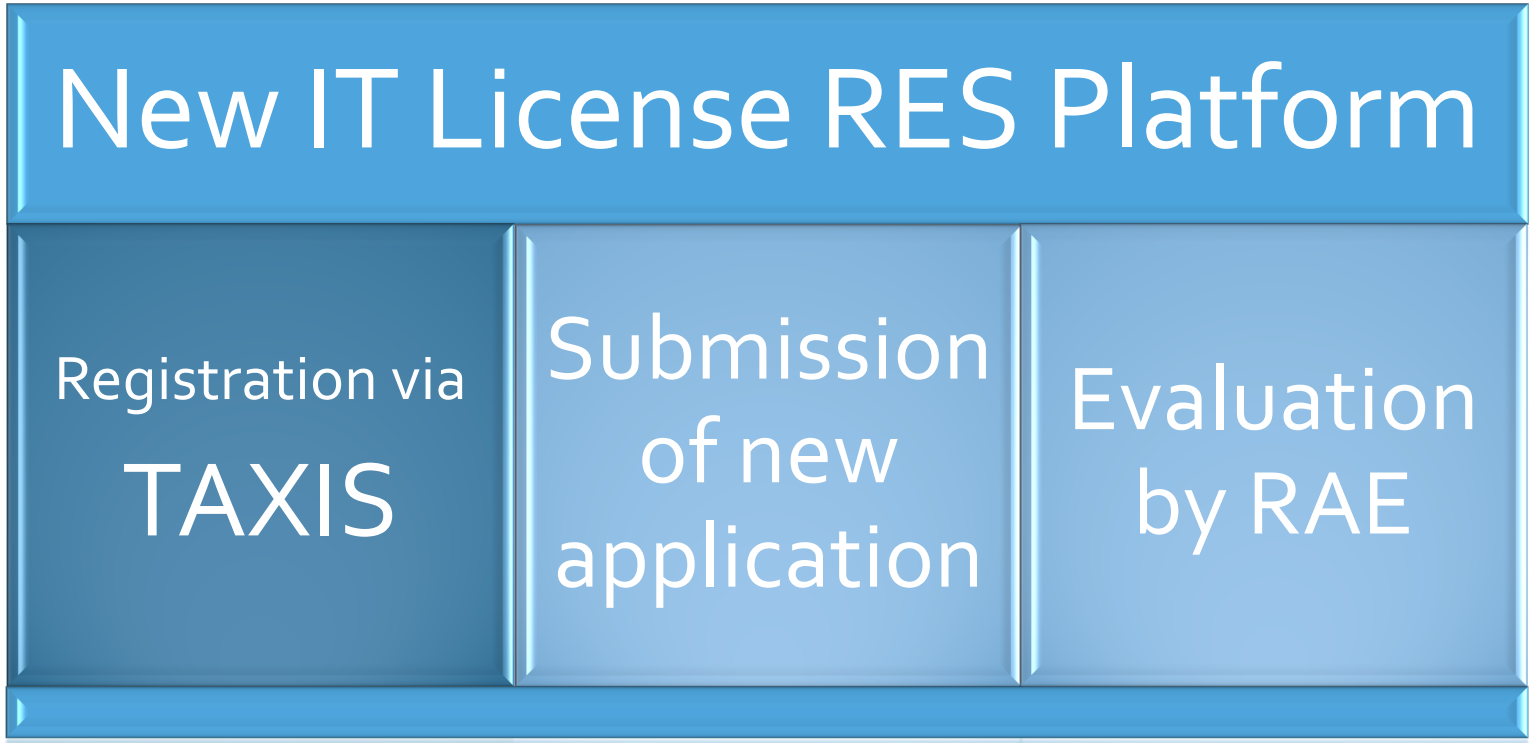
A new IT License RES Platform designed for new applications

- Innovate
- Fully transparent
- Simple
- Reliable
- Effective
- Efficient
- User friendly

The Objective of the IT Lisence RES Platform

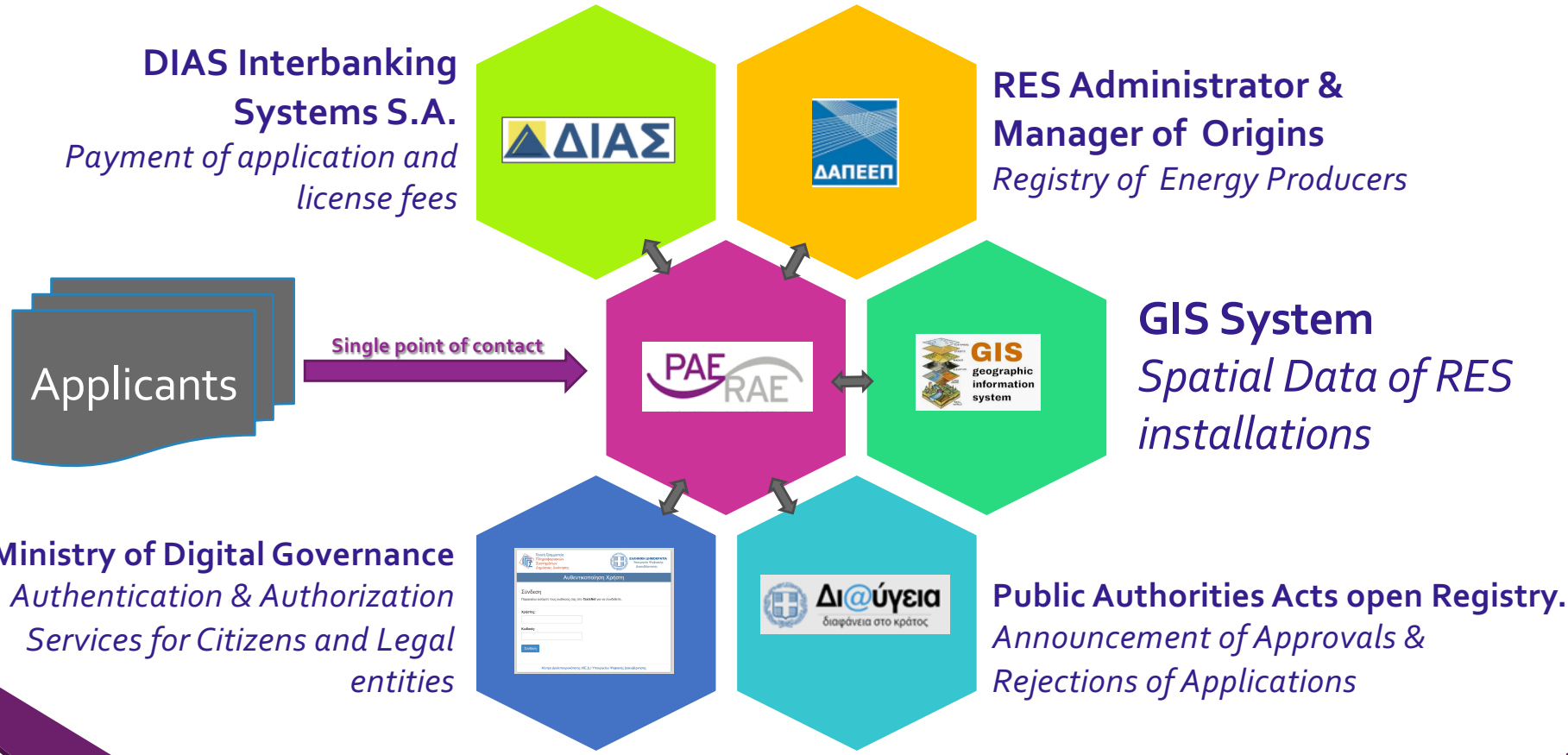
- Manage the processing of new applications, as a first step towards the installation of RES to achieve the Country target of 2030
- Make administration of applications user friendly
- Improve effectiveness of RAE by administrating with less resources, larger volumes of applications
- Increase efficiency of RAE by reducing applications evaluation time
- Assist applicants in bearing limited admin burdens
- Grow a "RAE digital ecosystem" where applications, licenses and relevant data flow seamless from system to system without human intervention

Description of the new IT License RES Platform



Innovate, Fully transparent, Simple
Reliable, Effective, Efficient, User friendly

The interoperability with other IT Systems



The process

Registration via Tax Public Services

- Company
- Administrator
- Users

Application Submission

- Company Documents
- Application Documents
- Spatial Data
- Application Fee

Application Evaluation

- Legal (shareholders etc)
- GIS cross checking
- Systems data synchronization

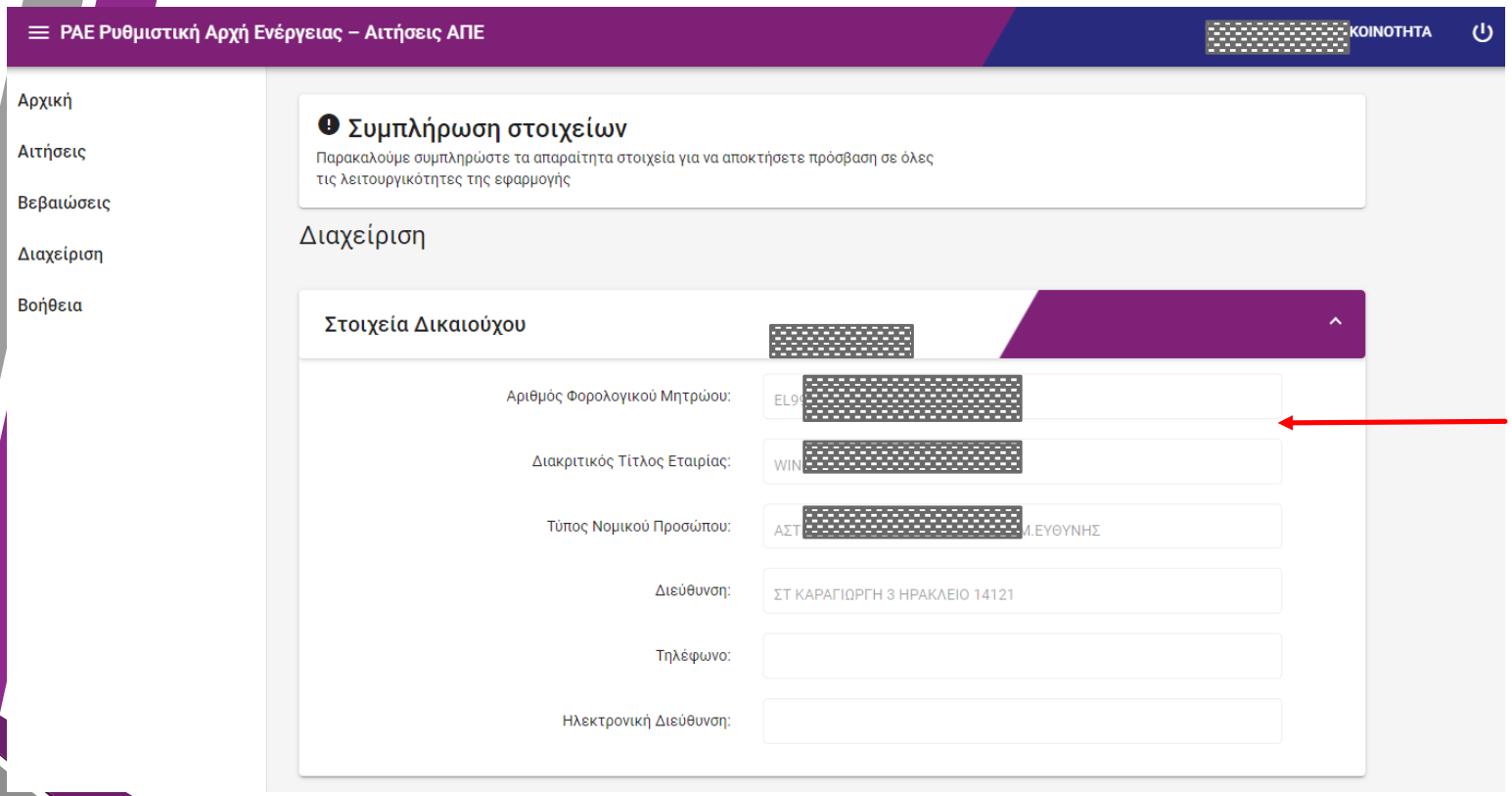
Application Approval

- License fee calculation
- Payment slip generation
- Update Registry

License Issuing

- Final RAE automatic Authorization
- Public Announcement

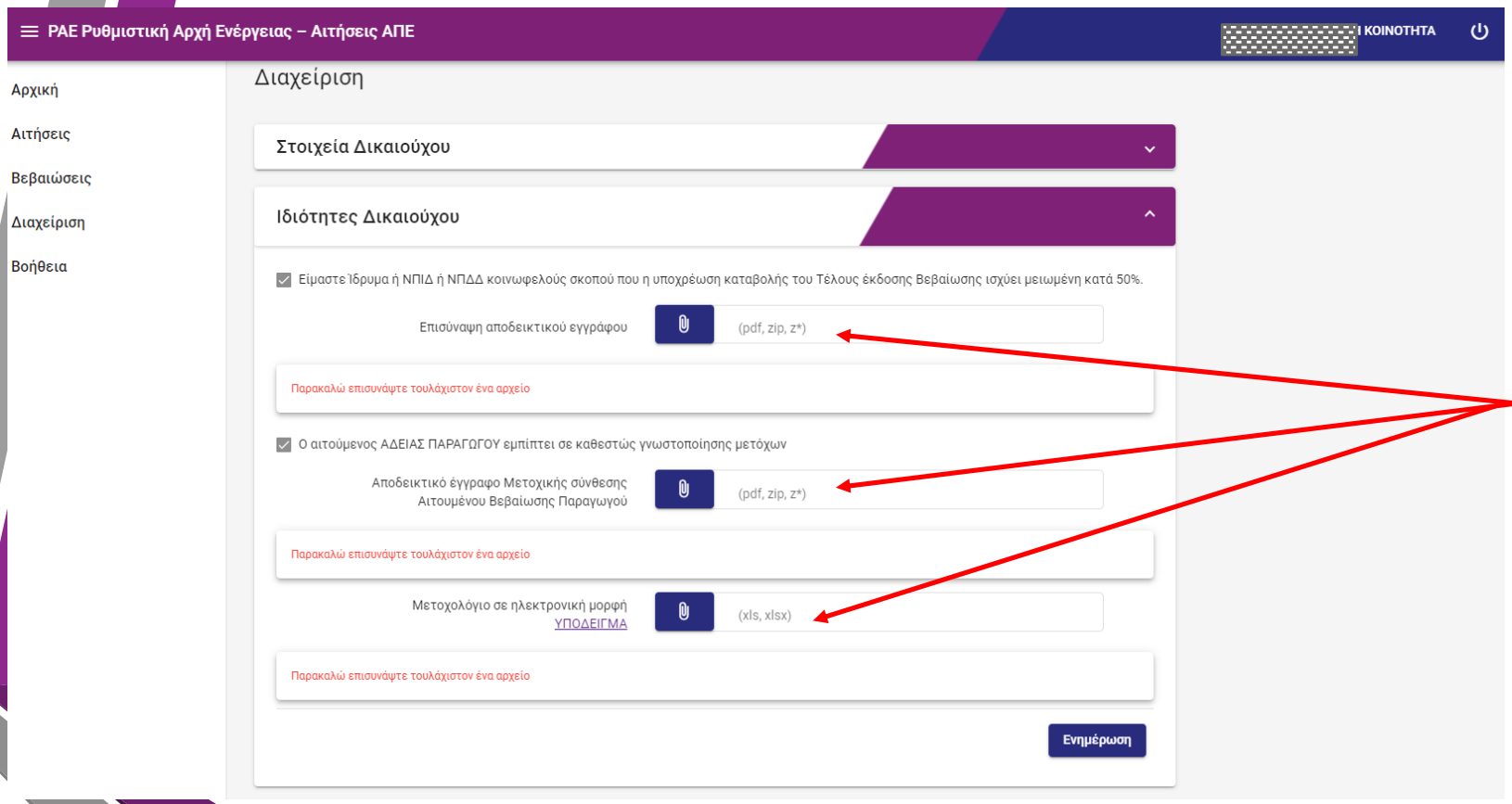
Sample user screen- Company Info



Data retrieved by the Tax Public System

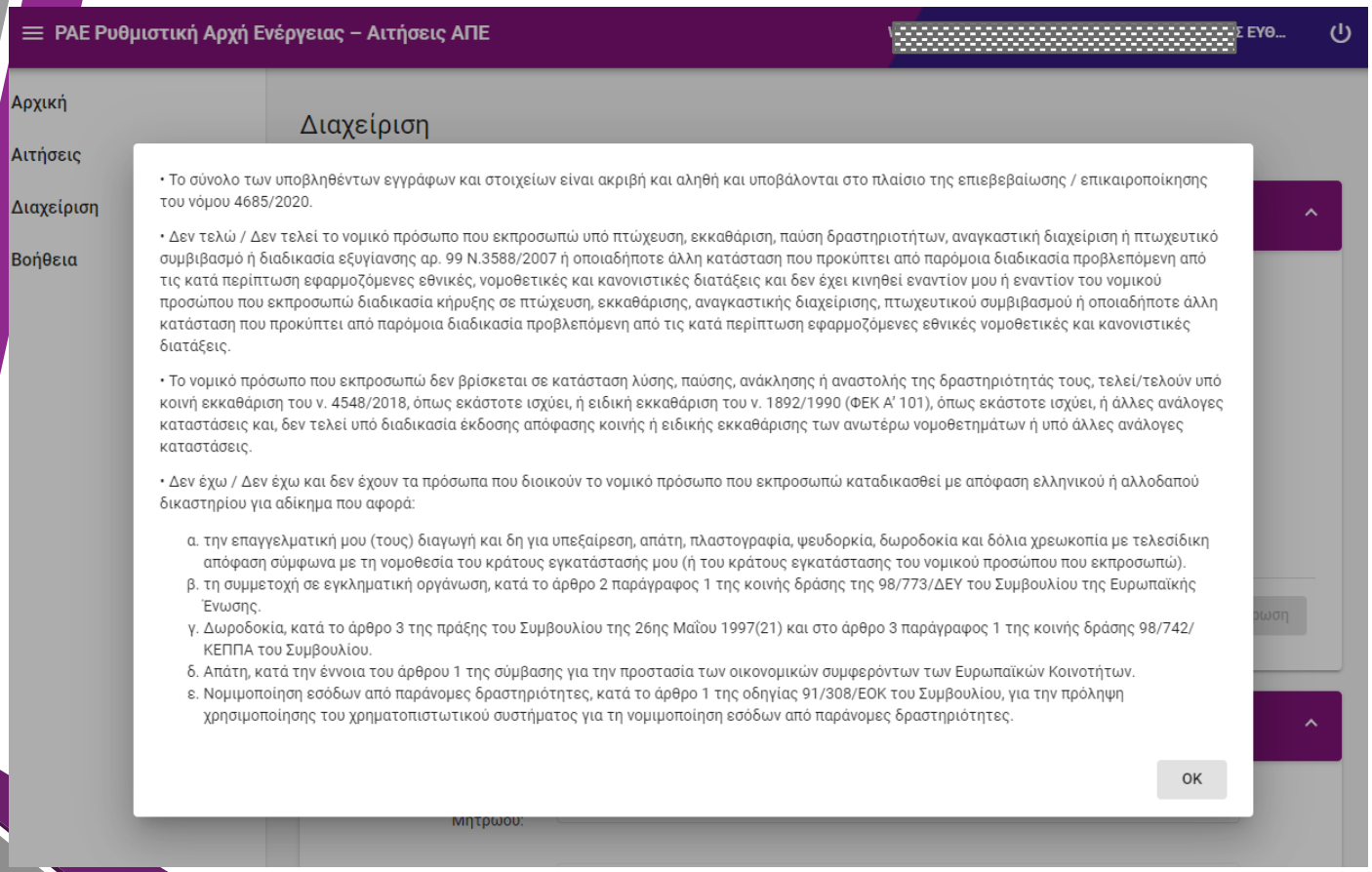
- VAT unique number
- Company Title
- Legal Entity Type (S.A., etc)
- Address
- Tel
- E-mail

Sample user screen- Attachments



Structured procedure for uploading attachments, indicating the file type, where applicable

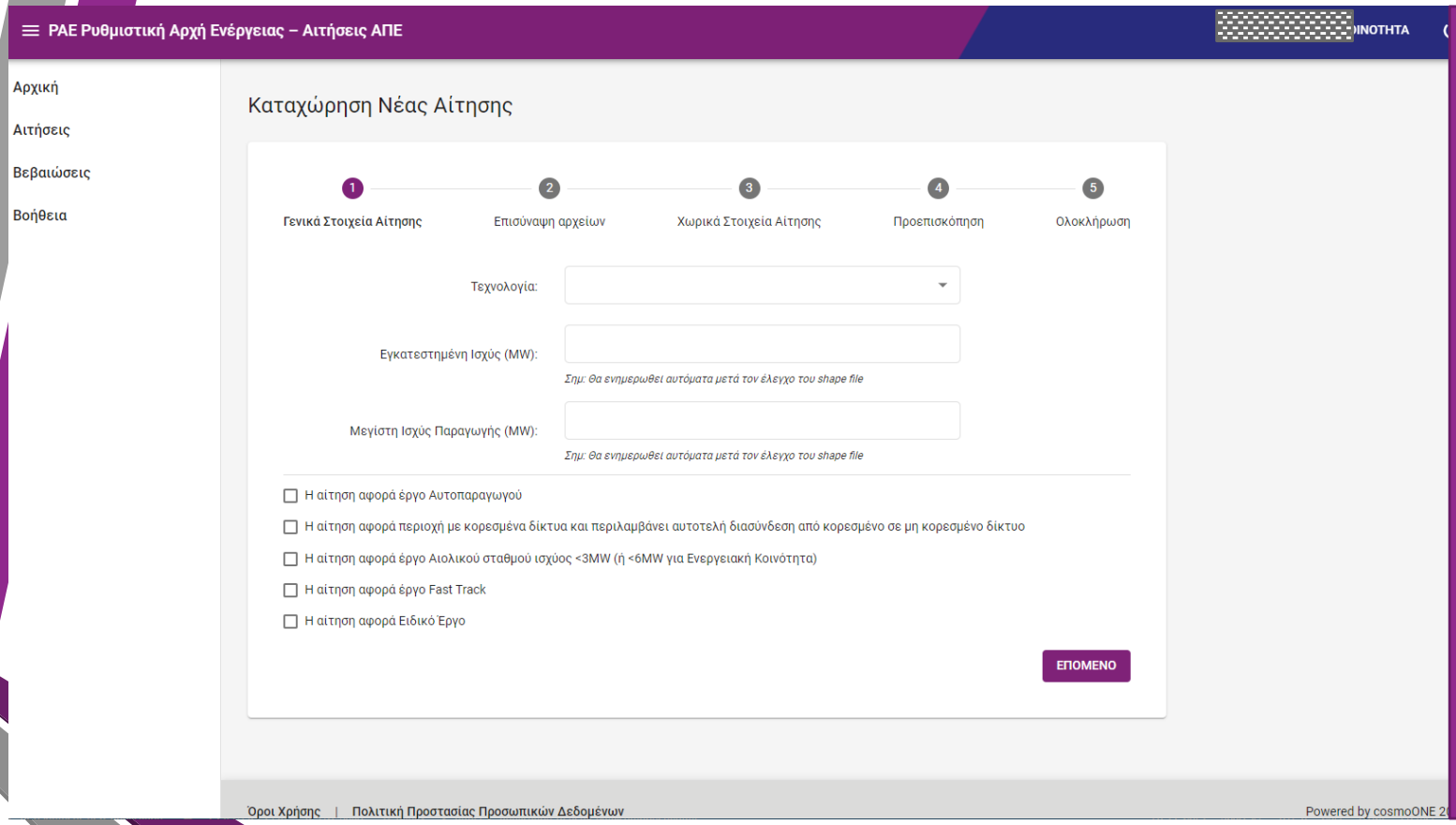
Sample user screen- Declarations



Declarations

All legal declaration in one page that have to be accepted by the applicant

Sample user screen- WorkFlow



5 steps to application submission

1° step
- General data, RES technology and special cases by ticking

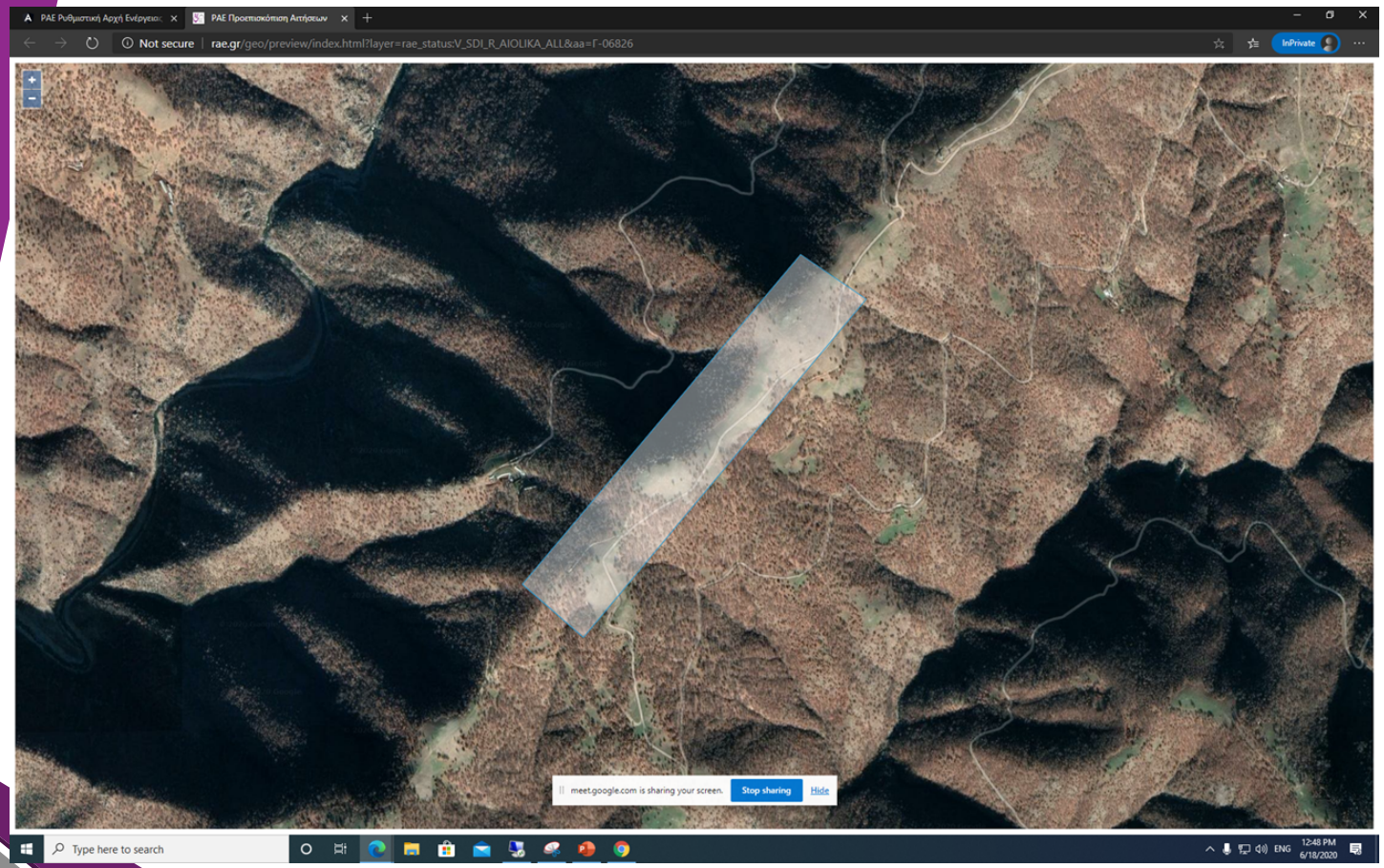
2° step
- All attachments according to 1st step choices

3° step
- Spatial Data in shape file format and topographic diagrams

4° step
- Preview and final check of application

5° step
- Issuing of submission fee, pay slip and registration of application

Sample user screen- Maps



Capability to draw on screen the map of the RES installation, as generated by the declared spatial data, for an immediate inspection

Automatic Creation of License, based on templates per technology

ΑΔΑ: 69ΧΝΡΩ2-Ν99

Demo Client

Digitally signed by Demo Client
Date: 2020.09.10 17:04:56 EEST
Reason:
Location: Athens

ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY

Πειραιώς 132
118 54 Αθήνα
Τηλ.: 210-3727400
Fax: 210-3255460
E-mail: info@rae.gr
Web: www.rae.gr

ΒΕΒΑΙΩΣΗ ΠΑΡΑΓΩΓΟΥ ΡΑΕ ΥΠ' ΑΡΙΘΜ. ΒΕΒ-1007/2020

Για αιολικό σταθμό παραγωγής ηλεκτρικής ενέργειας, εγκατεστημένης ισχύος 3 MW και μέγιστης ισχύος παραγωγής 2.99 MW στη θέση ΠΑΛΙΟΦΗΒΑ, της Δημοτικής Ενότητας [redacted] του Δήμου [redacted], της Περιφερειακής Ενότητας ΒΟΙΩΤΙΑΣ, της Περιφέρειας ΣΤΕΡΕΑΣ ΕΛΛΑΔΑΣ, της εταιρείας με την επωνυμία «[redacted] ΕΝΕΡΓΕΙΑΣ» και δ.τ. «». ()

Ο Πρόεδρος της Ρυθμιστικής Αρχής Ενέργειας

Cycle of December 2020

Extremely Huge Interest

- 1864 new applications for **45,54 GW**

Three roads for development of RES in Greece (10/2020)

New RES up to 2030

10-12 GW

Participation in RES Auctions (Technology Specific, Neutral – mature projects) & Auctions for Non Mature Projects (on process!)

350MW neutral (PV&Wind) (2020-21 – On process…)

An extension for Technology Specific tenders & exceptions [Small hydro, Biogas] (2021-2022) → open issue

The current SA 44666 already has a period up to 2024 for neutral auctions

Projects > 250 MW – Individual Notification Letter

The current National legislation framework:

A Ministers Decision for the criteria

Submission of application (Committee of article 12 of 4414/2016 Law) → Opinion to the Minister

Participation in the Market

Now: Day ahead market

From 1st of November 2020: Target model

Forward Products, Day ahead market, Intraday Market, Balancing market

Currently small units take prices directly from the law and ministers decision (PV< 500kW (up to 2 projects each), Wind < 3MW)

Technical Video for RES auctions in Greece

Video: https://youtu.be/RXIOEof8v9c

Thank you for your attention

ΡΥΘΜΙΣΤΙΚΗ ΑΡΧΗ ΕΝΕΡΓΕΙΑΣ
REGULATORY AUTHORITY FOR ENERGY

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Dr. Dionysios Papachristou
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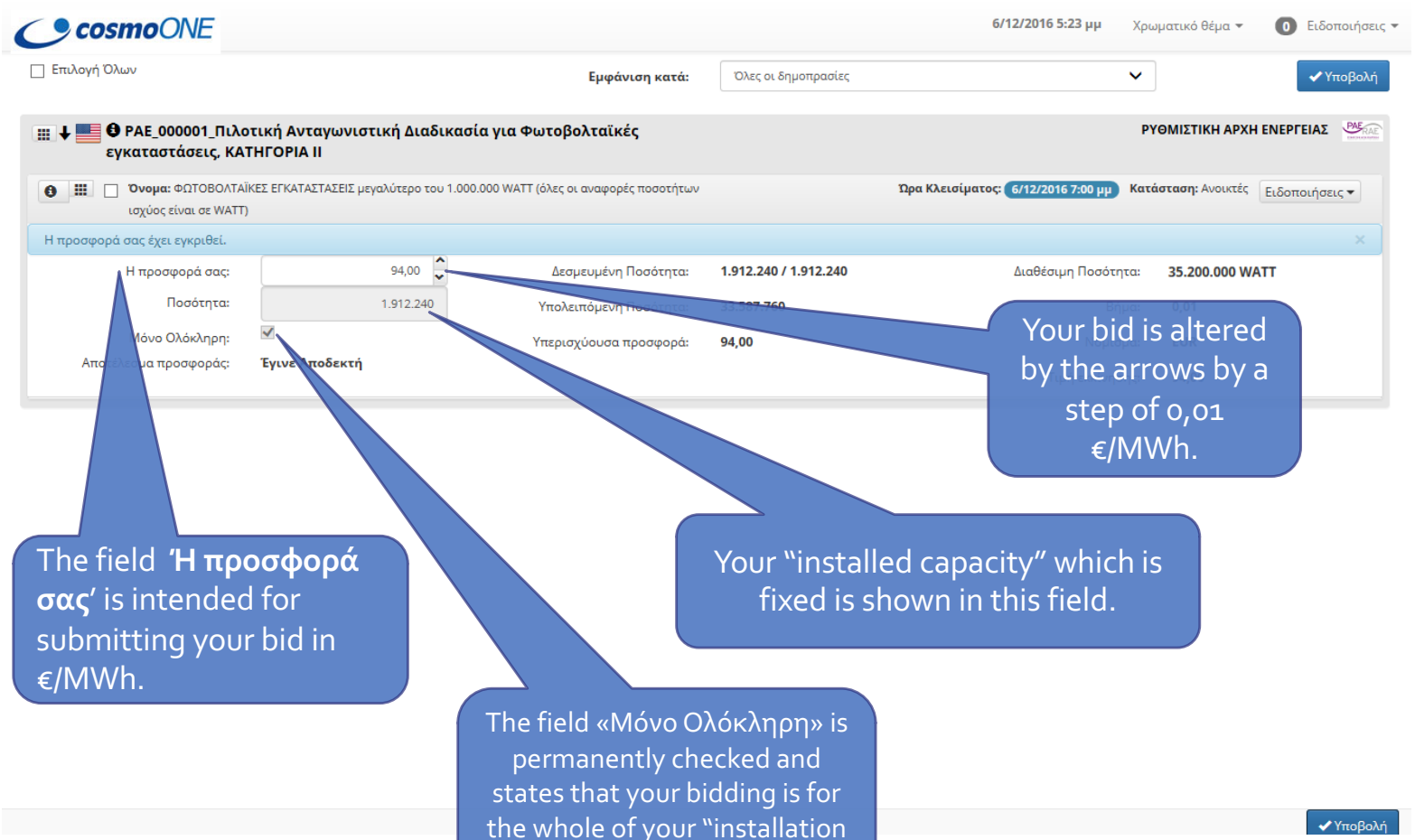
Coordinator of Design & implementation of Auction Unit
Director, Press & Public Relations Office
Regulatory Authority for Energy

Tel.: *+30 210 3727409*
E-mail: *papachristou@rae.gr*

Appendix

The screen during the electronic auction

Important Fields of the Tender Screen 1/3



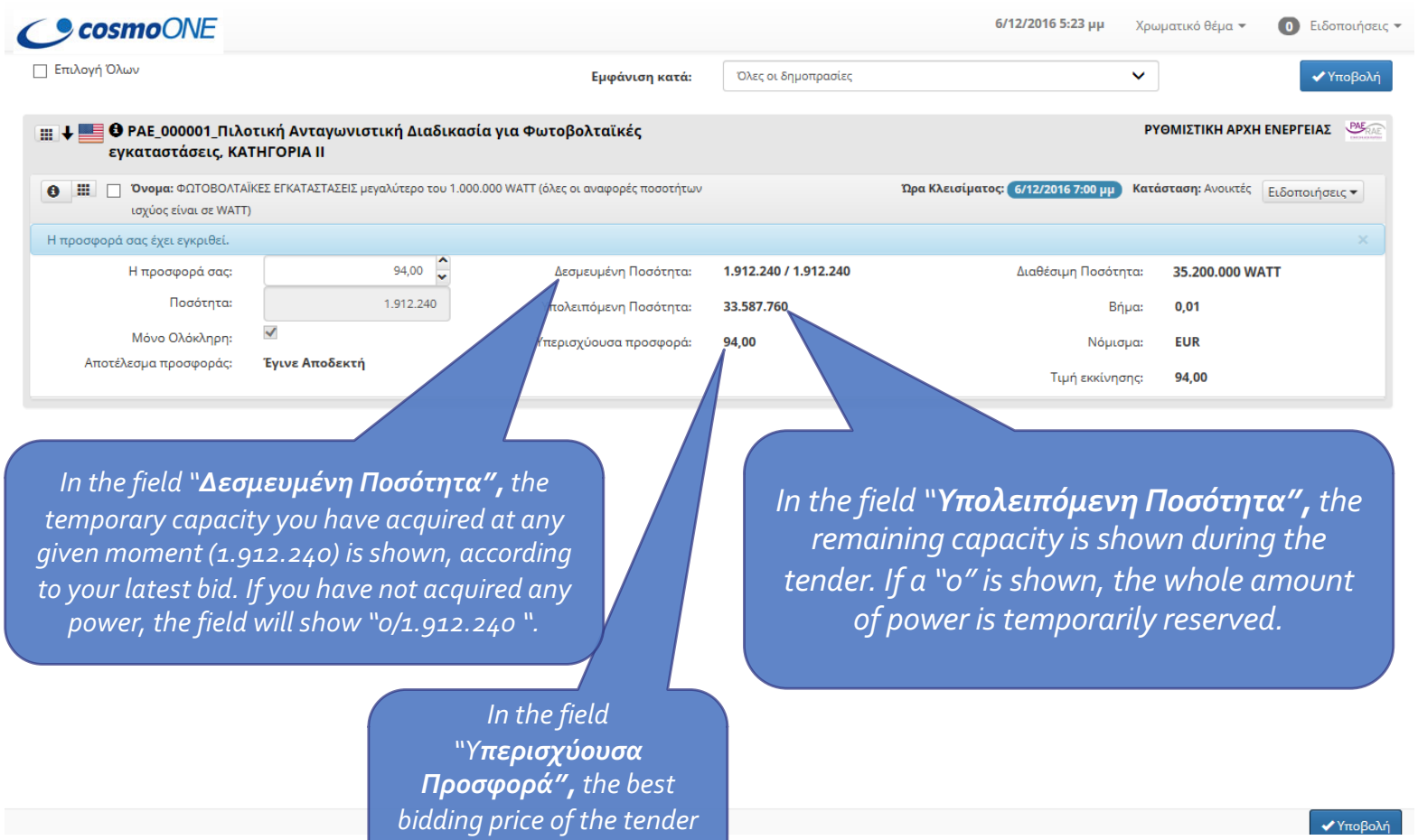
Your bid is altered by the arrows by a step of 0,01 €/MWh.

The field **'Η προσφορά σας'** is intended for submitting your bid in €/MWh.

Your "installed capacity" which is fixed is shown in this field.

The field «Μόνο Ολόκληρη» is permanently checked and states that your bidding is for the whole of your "installation capacity"

Important Fields of the Tender Screen 2/3

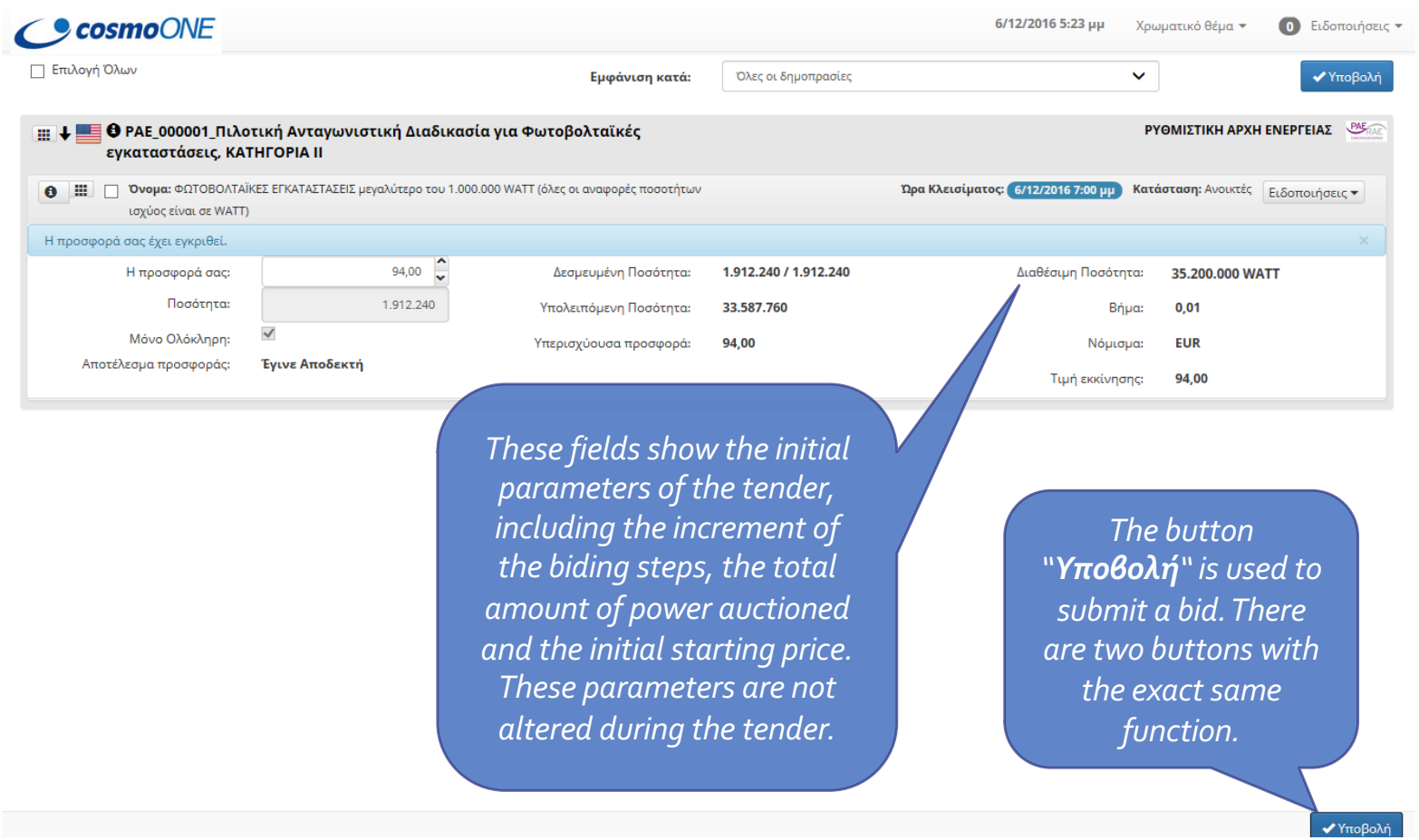


*In the field "**Δεσμευμένη Ποσότητα"**, the temporary capacity you have acquired at any given moment (1.912.240) is shown, according to your latest bid. If you have not acquired any power, the field will show "0/1.912.240 ".*

*In the field "**Υπολειπόμενη Ποσότητα"**, the remaining capacity is shown during the tender. If a "0" is shown, the whole amount of power is temporarily reserved.*

*In the field "**Υπερισχύουσα Προσφορά"**, the best bidding price of the tender at any given moment is shown.*

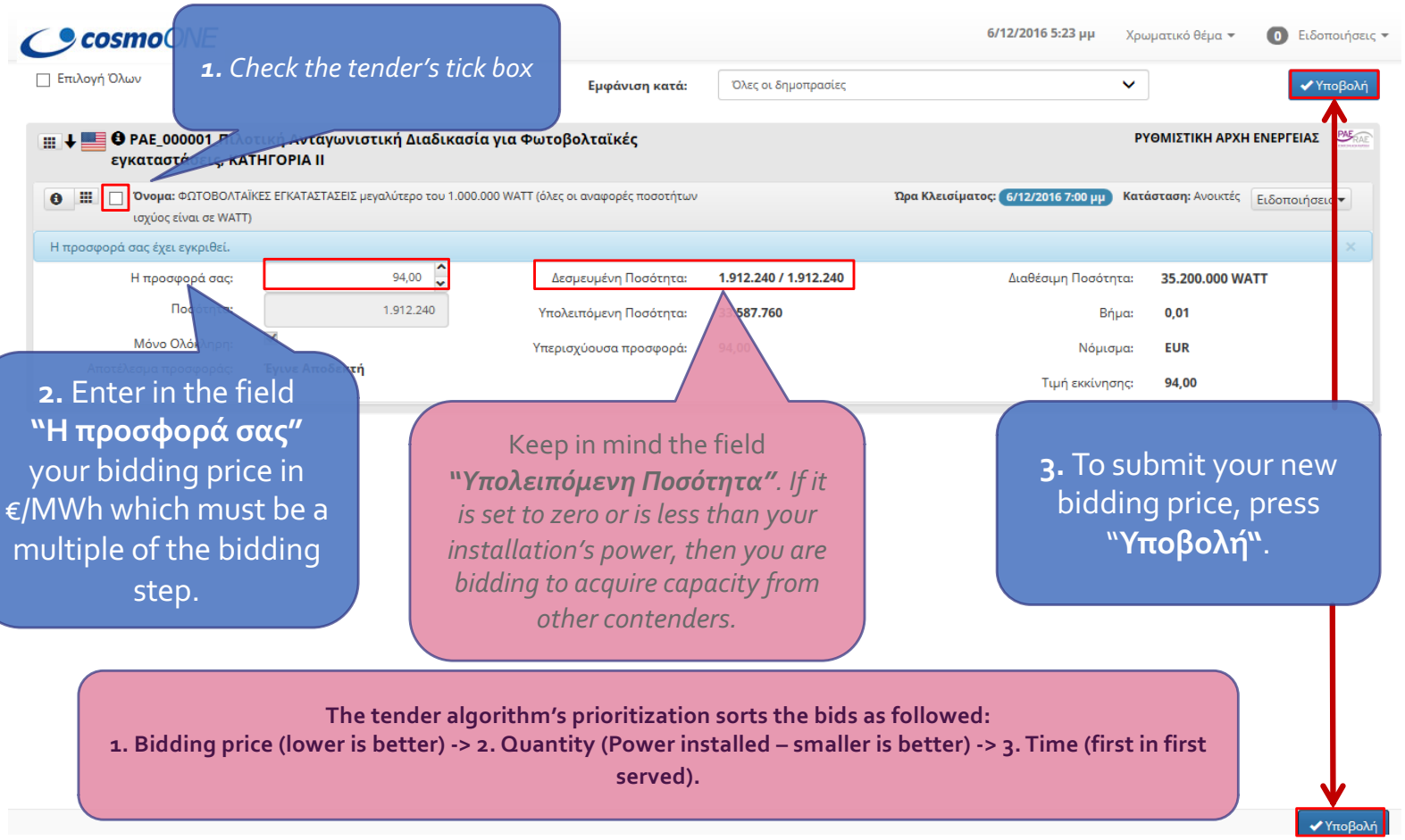
Important Fields of the Tender Screen 3/3



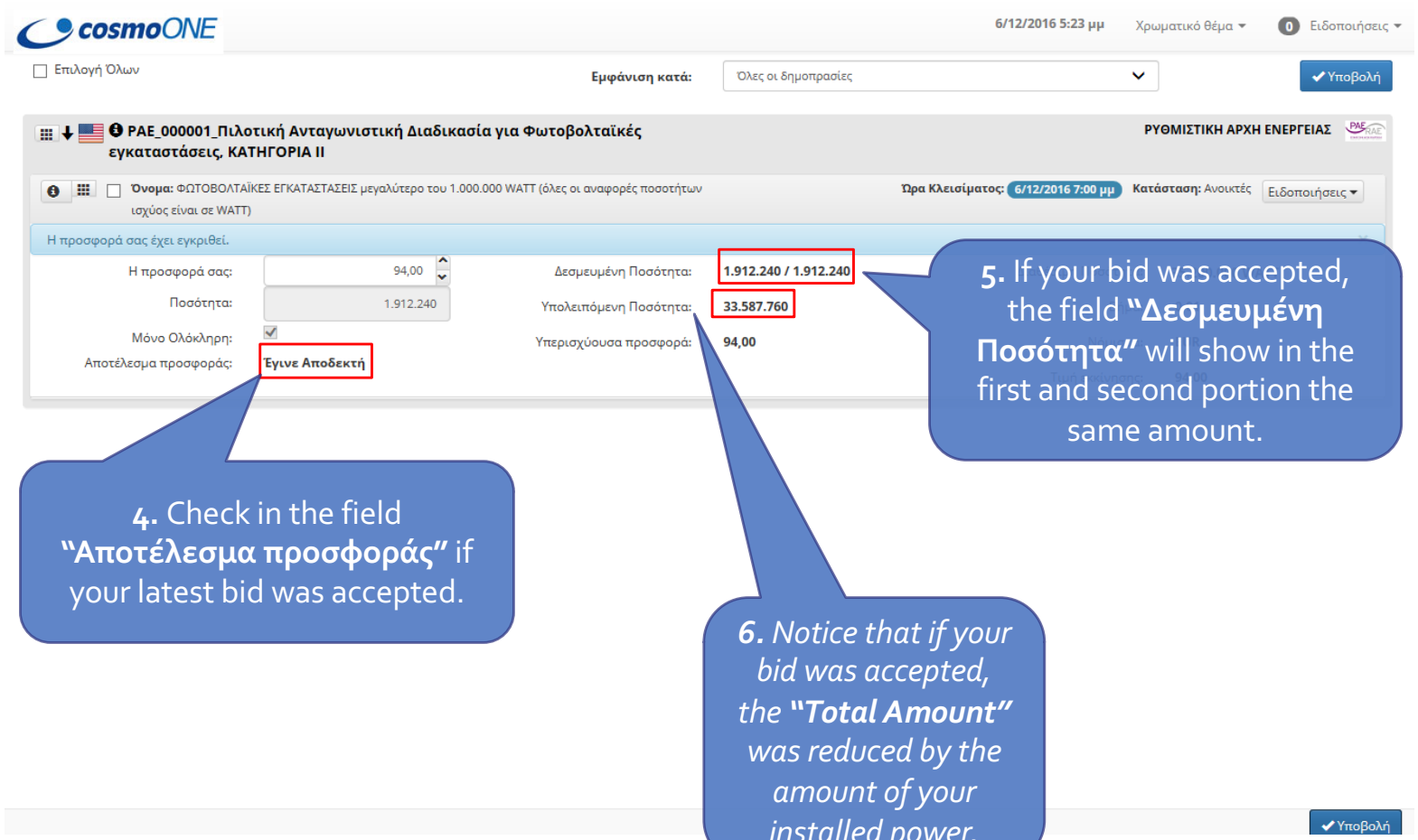
These fields show the initial parameters of the tender, including the increment of the biding steps, the total amount of power auctioned and the initial starting price. These parameters are not altered during the tender.

*The button "**Υποβολή**" is used to submit a bid. There are two buttons with the exact same function.*

How to submit a bid



After submission

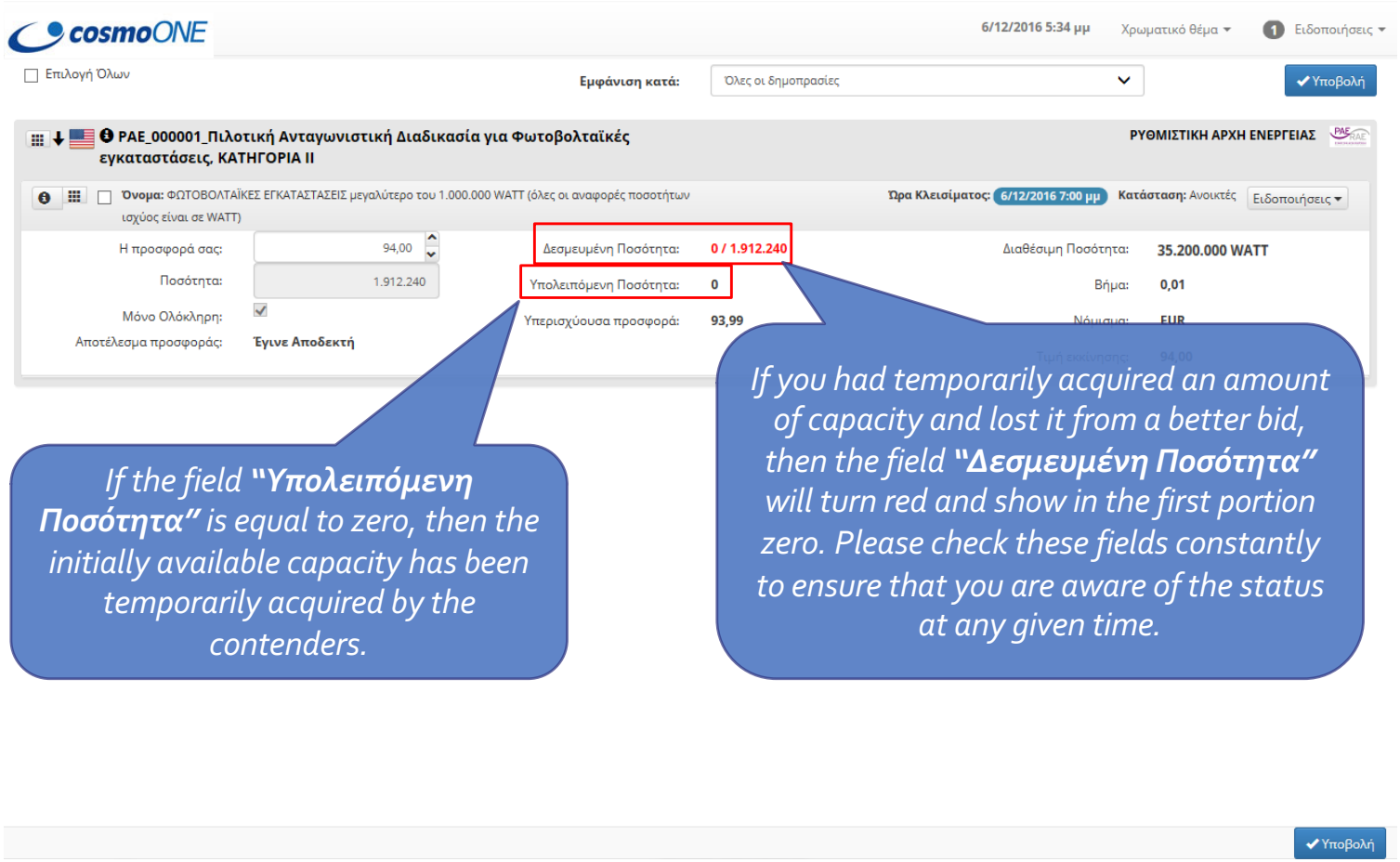


4. Check in the field **"Αποτέλεσμα προσφοράς"** if your latest bid was accepted.

5. If your bid was accepted, the field **"Δεσμευμένη Ποσότητα"** will show in the first and second portion the same amount.

6. *Notice that if your bid was accepted, the* ***"Total Amount"*** *was reduced by the amount of your installed power.*

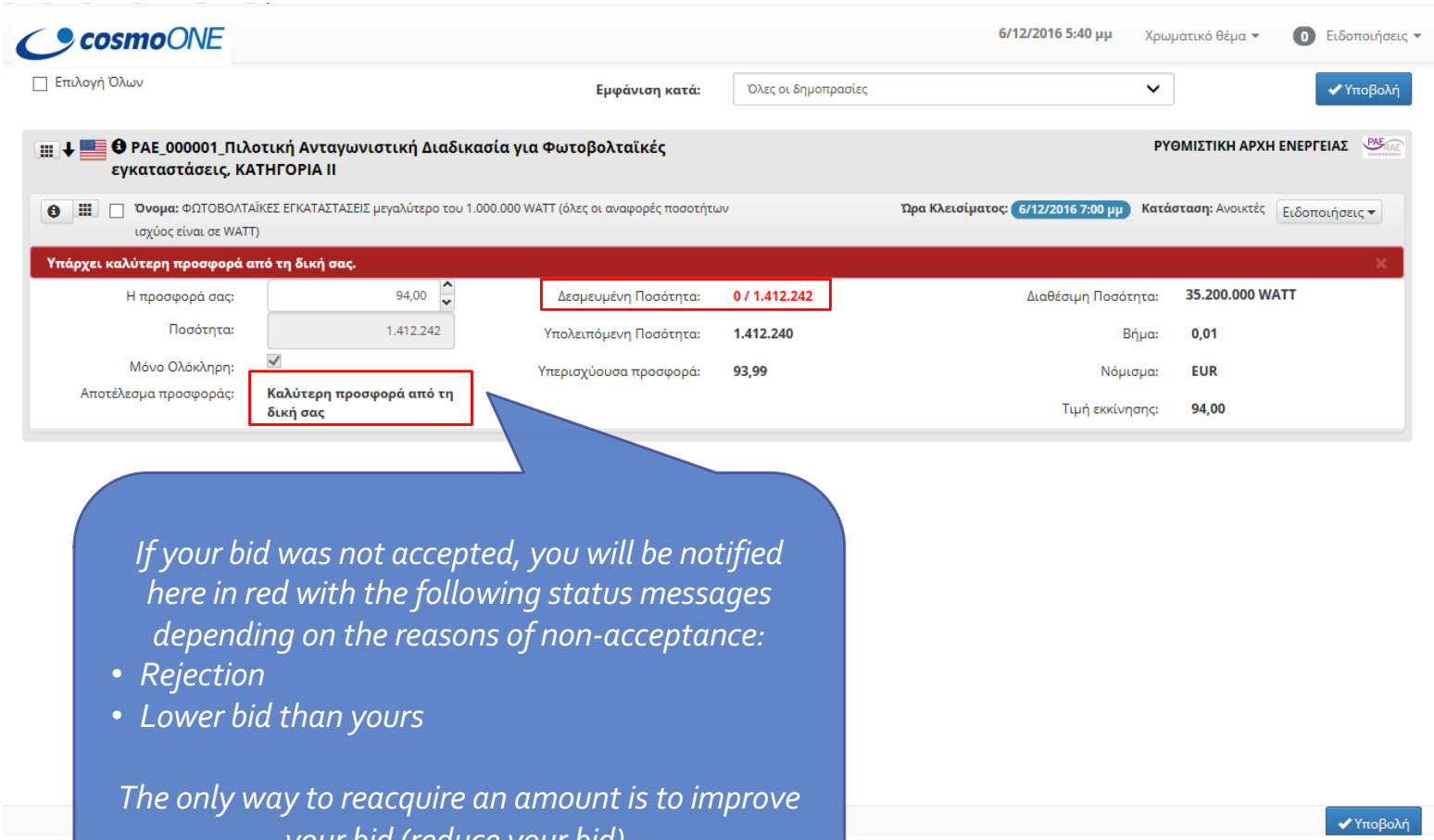
Checking available and temporary acquired amount



*If the field **"Υπολειπόμενη Ποσότητα"** is equal to zero, then the initially available capacity has been temporarily acquired by the contenders.*

*If you had temporarily acquired an amount of capacity and lost it from a better bid, then the field **"Δεσμευμένη Ποσότητα"** will turn red and show in the first portion zero. Please check these fields constantly to ensure that you are aware of the status at any given time.*

Rejected Bid



If your bid was not accepted, you will be notified here in red with the following status messages depending on the reasons of non-acceptance:

- *Rejection*
- *Lower bid than yours*

The only way to reacquire an amount is to improve your bid (reduce your bid).