D2.1-ES, September 2021

Auctions for the support of renewable energy in Spain

Results and lessons learnt

AURES II has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817619

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Submission date: M35
Project start date: 01 November 2018
Work Package: WP2
Work Package leader: REKK

Dissemination level: PU (Public)

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1 Characteristics of RES-E auctions in Spain

Spain has adopted ambitious targets for renewable energy deployment in its National Energy and Climate Plan (NECP) 2021-2030,[1] which foresees the deployment of 5GW/year of new renewable electricity-based capacity in the next decade. In order to comply with these targets, the NECP envisages using auctions, among other measures and mechanisms (such as the use of power purchase agreements (PPAs) and merchant plants).

During 2020, 43% of the total electricity production in Spain was generated using renewable energy sources (RES). The NECP establishes the targets of 74% of total power demand being covered by renewable energy by 2030, and 100% by 2050. The NECP also sets the objective of scaling up the use of energy storage technologies, to reach 6 GW power storage capacity by 2030, in order to provide greater system flexibility and management, to support the ever larger incorporation of variable and non-variable renewables-based generated electricity (BOE, 2021).

The Spanish NECP establishes that in 2030, 42% of the total energy consumption in Spain will come from RES (with interim targets of 24% in 2022 and 30% in 2025) (Spanish Government, Ministry of the Ecological Transition and Demographic Challenge, MITECO, 2020a, p.20). The Spanish NECP sets the strategic path for renewable energy expansion as set out within the Directive 2018/2001 on the use of energy from renewable sources. The Objective Scenario for renewable energy deployment, as proposed within the Spanish NECP, involves a considerable increase in renewable generation capacity compared to the current situation[2]. Spain's NECP further underlines that the distribution of renewable technologies in the period 2021-2030 will depend on their relative costs and the viability and the flexibility of their implementation. An overview of the planned scale up of renewable energy in Spain is shown in Table 1 below.

Table 1. Expected evolution of renewable electricity capacity in the Spanish NECP. Source: Spanish NECP

	Capacity (Objective Scenario) (MW)			
Year	2015	2020	2025	2030
Wind power	22 925	28 033	40 633	50 333
Solar PV plants	4 854	9 071	21 713	39 181
Solar thermal	2 300	2 303	4 803	7 303
Hydropower	14 104	14 109	14 359	14 609
Pumped hydro	6 024	6 024	6 899	9 524
Biogas power	223	211	241	241
Other renewable energies	0	0	40	80
Biomass power	677	613	815	1 408
Coal power	11 311	7 897	2 165	0
NGCC	26 612	26 612	26 612	26 612
Cogeneration	6 143	5 239	4 373	3 670
Fuel	3 708	3 708	2 781	1 854
Waste and others	893	610	470	341
Nuclear	7 399	7 399	7 399	3 181
Storage	0	0	500	2 500
Total	107 173	111 829	133 803	160 837

[1] In Spanish, the "Plan Nacional Integrado de Energía y Clima" (PNIEC). https://www.boe.es/boe/dias/2021/03/31/pdfs/BOE-A-2021-5106.pdf

[2] The PNIEC considers two scenarios: a Trend Scenario (Escenario Tendencial, without new policies) and a Target Scenario (Escenario Objetivo, with the policies considered in PNIEC).

The Spanish NECP reiterates the intention of the government to use auctions as the main policy tool to scale up renewable energy in Spain during the period to 2030 (and beyond). The Spanish NECP underlines that auctions should focus, at least initially, on those technologies that facilitate a more efficient energy transition. Therefore, in order to achieve the NECP goals, Spain has adopted a new auction scheme, which led to the organisation of the renewable energy auction held on 26 January 2021. Its design entails a rupture with the previous auction scheme which led to the organisation of three auctions in 2016 and 2017 (see below and del Río 2016, 2018). The call for the auction was published on 11 December 2020 and this was the first auction held under the new auction scheme, called the "Régimen Económico de Energías Renovables" (REER) which, for the first time, has an indicative schedule of auction rounds (in the period to 2025), whose aim is to achieve the renewable energy targets set in the NECP.

The legal framework of RES auctions in Spain (REER) is based on four pieces of legislation (the Royal Decree Law RDL23/2020, the Royal Decree RD960/2020, the Ministerial Order TED/1161/2020, and the Resolution of the Secretary of State for Energy published on 11 December 2020). The following box summarises these pieces of legislation with respect to the auction.

Box 1. Regulatory framework of the Spanish RES auctions (REER).

- Royal Decree Law (RDL) 23/2020: This law sets the legally-binding obligation to develop a retributive framework for renewable electricity generation which would be different to the (existing) specific retributive regime. The new remuneration framework would be based on the long-term recognition of a price for energy. The law creates the retributive framework for renewable electricity generation, which is called "Economic Regime for Renewable Energies" (REER).
- Royal Decree (RD) 960/2020: This Royal Decree regulates the juridical and economic regime of the REER.
- Ministerial Order (Orden TED/1161/2020): This Ministerial Order regulates the auction mechanism: 1) it sets the values of the retributive parameters of the different technologies; 2) it sets the necessary particularities and adaptations of the general methodology for bid selection, with the goal of adjusting the methodology to the characteristics of the specific calls for auctions; 3) it regulates the associated procedures, steps and documents to be submitted that are associated to the electronic Registry of the REER; 4) it sets the mechanism to control the feasibility and maturity of projects allocated though this auction; 5) it develops the penalties foreseen in article 20 of RD 960/2020 in order to encourage compliance with the minimum renewable electricity generation requirements ("energía minima de subasta" or "minimum energy of the auction") for the installations that receive the REER (see next section); 6) it sets an indicative auction schedule for the period 2020-2025, which includes indicative deadlines, the frequency of the calls, the expected capacity and technologies.
- Resolution of the Secretary of State for Energy on 10 December 2020: This resolution served as the call of the auction. The following aspects are defined in this call: a) the date on which the bidding process is actually conducted and its schedule; b) the volume of auctioned product and the two minimum reserves of 1000 MW for solar PV and onshore wind; c) the detailed specifications and the forms which should be filled in in order to participate in the auction; d) the information and documents which should be included in bidders' applications to participate in the auction; e) The deadline for when the installation has to be available (built); f) The date on which the installation would cease to participate in the REER; g) the date of the end of the maximum delivery period; h) the date of the start of the maximum delivery period; i) the reserve price (ceiling price); j) the risk price (minimum price); k) the maximum size of an offered indivisible segment; j) percentage of excess volume in the bid merit order selection process.

It is mentioned both in RDL 23/2020 and in RD960/2020 that the aim of the new regulation is to "favour the predictability and certainty, to encourage new investments in new renewable energy capacity". "The new regulatory framework favours the stability of the revenue streams and the financing of new installations" (MITECO 2020a, p.18). Furthermore, it is stated that facilitating the financing of the projects by providing attractive conditions for investors (e.g., greater certainty) enables investments (MITECO 2020a, p.20).

In addition, in order to comply with its international commitments on RES and decarbonisation, the goals of the government when organising the auction are (MITECO 2020a): a) to facilitate the financing of the new projects avoiding the risk of "price cannibalisation" which would be the result of a massive integration of renewables, b) to immediately transfer the cost savings from renewable energy generation to consumers, c) to facilitate planning through a schedule which provides certainty to the whole associated value chain, avoiding periods of technology and equipment shortages which threaten the continuation and permanence of the involved sectors and value chains in the Spanish territory, and d) to encourage the green economy and to facilitate the green recovery. Furthermore, when reading all the prefaces of the different pieces of legislation which make up the regulatory framework of the new auctions, it is clear that there are also other important goals such as promoting the diversity of renewable energy actors and project sizes and encouraging some degree of market exposure for RES installations[3].

It should be mentioned that the design of the new auctions in Spain implies a radical change with respect to the previous ones (conducted in 2016 and 2017). The new auctions provide support for electricity generation in the context of a medium-term schedule and a long-term price for renewable electricity[4]. This is in contrast to the previous auctions, which were organised on an ad-hoc basis and provided support for investment. The different design may be related to different context conditions (e.g., overcapacity and the need to mitigate the electricity system's chronic tariff deficit), the different goals of respective governments or because there is now extensive experience of the design of RES auctions, which may have had an influence on the design of the new auctions[5].

[3] For instance, the RD 960/2020 mentions that "additionally, when this is set in the call, for example in the case of auctions for dispatchable technologies or technologies with storage, this royal decree facilitates the announcement and holding of auctions, with a formula which includes an additional exposure to the market price in order to encourage the shift of generation to the hours with more scarcity, thereby encouraging renewable generation to play a more active role in efforts to balance overall system demand and supply.(...) This will enable the optimisation of the integration of electricity in the electricity market and will guarantee that renewable energy producers respond to the market price signals and optimise their market revenues, in line with article 4.3 of the Directive" (RD 960/2020, p.7).
[4] The Spanish government itself highlights the difference with respect to the previous auctions when, in the preface of RD960/2020, it mentions that "the Spanish Government establishes the obligation to develop regulations for a retributive framework for renewable electricity generation on the basis of a recognized long term energy price".
[5] For a detailed assessment of the previous auctions in Spain, see del Río (2016 and 2018).

2 Design elements of RES-E auctions

Table 2 summarises the main characteristics of the auction, while Table 3 presents the general auction design[6].

Table 2. Main characteristics of auctions and framework conditions

Characteristics	Description of the auction
Characteristics of the national electricity market	Spain and Portugal have integrated their electricity markets into a single Iberian Electricity Market, MIBEL. They share a common spot market operator, OMIE, which has been operating in both countries since July 2007, and a forward market operator, OMIP, launched in July 2006 (IEA 2016, p.87).
Name of auction scheme	Régimen Económico de Energías Renovables (REER)
Contractual counterparty	-The market operator (OMIE) is the institution that manages the auction. -The energy sector regulatory authority (the CNMC) is the institution that supervises the auction. -OMIE and the national electricity system operator (REE) are responsible for the control of the energy sold and its payment (settlement). -The call of the auction is decided and published by the Secretary of State for Energy.
Main features	Pay-as-bid (PAB) static auction with a hybrid design (technology-neutral and technology-specific minimum reserve capacities), contract-for-differences (CfD) and a commitment to deliver a minimum amount of energy (energía mínima de subasta) by a given date.
Technology focus and differentiation (eligible technologies)	A hybrid design (technology-neutral and technology-specific reserved capacities). In this first auction, the overall auctioned volume is 3000 MW, with two minimum technology reserves: 1000 MW for solar PV and 1000 MW for onshore wind. According to RD 960 (article 3.2), different renewable electricity technologies might be distinguished in the calls of the auction "depending on their technical characteristics, size, levels of dispatchability, location criteria, technological maturity and those other criteria which guarantee the transition to a decarbonised economy".
Lead time before auction	-RDL 23/2020 (habilitation of the REER), published on 23 June 2020. -RD 960/2020 (regulation of the juridical and economic regime of the REER) published on 3 November 2020.

[6] An in-depth analysis of each design element chosen in the new Spanish auction in an international perspective is provided in del Río (2021).

	-Order TED/1161/2020 (regulation of the auction procedure and features of the REER) published on 4 December 2020. -Resolution of the Secretary of State for Energy published on December 10th 2020. This resolution includes the date of organising the auction, the auctioned volume and the minimum reserves, the reserve price, the date when the installation must start generating electricity, the date when the installation would no longer be supported (the expulsion from the REER) and the maximum delivery period. -Date of conducting the auction: 26 January 2021.
Min./max. size of project	Neither a minimum nor a maximum size is set in this auction. According to RD 960/2020 (article 3.2), the order which regulates the auction mechanism may exempt small-scale installations and demonstration projects from this mechanism. In such cases, the result of the auction may be used as the reference for their remuneration. Small-scale installations are considered to be those with an installed capacity below 5 MW.
What is auctioned? Auctioned bids (in terms of budget, electricity or installed capacity)	Auctioned product: capacity (MW) Capacity has been auctioned in the latest (i.e., January 2021) auction, but electricity generation can also be the auctioned product in future auctions undertaken within this auction scheme. According to article 7 of RD960/2020, the auctioned product will be the installed capacity, electricity generation or a combination of both and the bid variable will be the price per unit of electricity, expressed in €/MWh. According to article 9 of RD960/2020, if the auctioned product is generated electricity, a minimum capacity which should be built is defined for each project. This minimum capacity is calculated from the energy awarded and the maximum annual number of full load hours of each technology, whose value is set in the ministerial order which regulates the auction (which was later the Order TED/1161/2020). According to the Ministerial Order (OM), the minimum number of annual full-load hours is 1500 for PV, 2200 for wind, 3000 for concentrated solar power (CSP), 1600 for small hydro and 6000 for biomass). The maximum number of annual full-load hours for PV is 2300 and 3500 for wind (CSP: 4000; small hydro: 2500; biomass: 8000).
Budgetary expenditures per auction and per year	Budgetary expenditures are undefined. According to MITECO (2020a, 2020b), the approval of this regulation will not have a direct budgetary impact

	since the specific remuneration regime will not be financed by the public budget.
Frequency of auctions	There is an indicative schedule for the allocation of the REER for the 2020-2025 period, which includes indicative deadlines, the frequency of the calls, the expected capacity and technologies. Minimum capacity volumes: • Wind: 1000 MW (2020), 1500 MW (in each of the years of the period 2021-2025). • PV: 1000 MW (2020), 1800 MW (in each of the years of the period 2021-2025). • CSP: 200 MW (2021), 200 MW (2023), 200 MW (2025). • Biomass: 140 MW (2021), 120 MW (2023), 120 MW (2025). • Other technologies: 20 MW (2021), 20 MW (2023), 20 MW (2025).
Volume of the tender	Capacity (3034 MW) Possibility of ex-post volume adjustment. According to article 8.5 of RD 960/2020, the ministerial order which regulates the auction design may establish a mechanism which allows a moderate increase of the volume. According to number 3.2 of the Resolution, the percentage of excess volume in the merit order bid clearing process is 6% and, thus, the capacity which is finally awarded can exceed 3000 MW but not 3180 MW.
Costs related to grid connection/access	Grid connection costs fall on the awarded bidder.
Balancing and profile costs	Producers are responsible for the scheduling and payment of deviations as well as the access tariffs. Article 21 of RD 960/2020 states that the owners of installations which have been awarded will freely participate in the day-ahead and intraday markets but will not be able to sign bilateral contracts. The installations subject to the REER will be able to participate in the provision of balancing and adjustment (ancillary) services.

Table 3 General auction design

Design elements	Description
Auction format	Geographically-neutral, multi-unit auction. Participants in the auction may submit one different bid per each product and one or several technologies. Each bid may include up to 40 tranches and each tranche will include the capacity offered in blocks of 1 kW and the price offered for the energy. The tranches may be defined as divisible or indivisible.

Auction procedure	Price-only, static auction, PAB.
Pre-qualification requirements	Guarantee for the participation in the auction: 60 €/kW (given back to the awarded bidders after the installation has been inscribed in the pre-allocation registry). Guarantee for the registration in the REER: 60 €/kW. It is given back gradually after some milestones are accomplished: identification of the installation (18 €/kW), securing the construction permit (12 €/kW) and inscription in the exploitation registry (30 €/kW). The awarded bidders have to request registration in the electronic registry of the REER in pre-allocation state within two months. Once they have registered, they will have: 1) 6 months to identify the installations (including, at a minimum, the name, project location and the installed capacity); 2) 12 months to prove that they have the administrative permit to build such installations; 3) one month to request the registration in the Registry in exploitation state. In addition, the awarded bidders will need to submit a supply-chain plan (a strategic plan with estimations of the socioeconomic impact of the installations). Non-compliance (and, thus, the enforcement of the guarantee) may be partial if the milestone is accomplished for a part of the capacity.
Auction volume	See "Volume of the tender" above.
Pricing rule	Pay-as-bid (PAB)
Award procedure	Static auction with PAB.
Price limits	-Confidential ceiling price. According to RD 960/2020, the Resolution will set a maximum price, which may be confidential. In order to set such a value, the following considerations will be taken into account: the prices of the electricity market, the values of the forward market and the generation costs of each technology at the moment when the call of the auction is published. The Resolution sets a confidential maximum price. -Minimum price (risk price). According to article 8 of RD 960/2020, a minimum price can be set, which may be confidential. Bids under this price will be excluded. The aim is to remove reckless bids (i.e., extreme underbidding). The Resolution sets this price at 0.00 €/MWh for this auction.
Support period	12 years (15 years for biomass and biogas projects).
Favourable treatment of specific actors	Not in this auction, but considered and addressed within the regulation.

	It is stated in RD960/2020 that the retributive framework will need to facilitate actor diversity and take into account the particularities of renewable energy communities (RECs) in order for them to compete to access the retributive framework in equal conditions with respect to other participants. The particularities of RECs can be taken into account when defining the criteria and the functioning of the auction.
Realization time limit	• Deadline for construction of the plants: 28 February 2023 (solar PV), 28 February 2024 (onshore wind). For the rest of the technologies (not awarded): CSP (2024), offshore wind (2025), rest of the renewable energy technologies (RETs) (2025). • Electricity delivery date: 30 September 30 2023 (PV), 30 September 2024 (onshore wind). For the rest of technologies (not awarded): CSP (2024), offshore wind (2025), rest of RETs (2025).
Penalties	The non-realisation of projects entails the withholding of the performance bond (60 €/kW). There is a penalty that is applied in the event that the minimum energy of the auction is not reached when the maximum delivery period ends (see end of section 2). Automatic penalties of 5 €/MWh per three-year milestones (regarding the electricity being delivered) are set during the maximum delivery period (defined in the Resolution), with a flexibility factor of 0.8. The penalties and the enforced guarantees are considered as revenues of the electricity system.
Form of support auctioned	Two-sided sliding feed in premium (CfD). According to RD960/2020 (p.8), "the market operator will settle the difference, which can be either negative or positive, between the prices in the day-ahead and intraday markets received for the energy negotiated by each installation subject to the REER and the recognised price of those installations". The "recognised price" is the "price that is received by the installation" (see below).
In case of premium schemes describe the method of reference wholesale price calculation	The installation will participate in the day-ahead and intraday markets and will receive a price for energy which will be calculated from the awarded bid in the auction and the hourly price of the day-ahead market. Installations have the right to receive the price for the energy (or awarded price). This awarded price is one of the parameters which will be used in order to

	calculate the specific remuneration for each technology, which will be a function of such awarded price, the energy of the auction sold in the day-ahead and intraday markets and an adjustment factor (percentage) applied to the difference between the awarded price and the price of electricity in the day-ahead and intraday markets (see text).
Support level adjustments	No adjustments for inflation. The adjustment factor is established in the Ministerial Order (Orden TED/1161/2020): it is 0.25 (25%) for technologies with "the capacity to manage their production and 0.05 (5%) for technologies which do not have such capacity" (Annex of the Order TED/1161/2020). Installations are considered to have such capacity if they have storage capacity equivalent to two hours of the project's installed generation capacity (Annex of the Order TED/1161/2020). See end of this section 2 for details. The aim of this adjustment factor (when it is greater than zero) is to provide an additional exposure to the market price which encourages the shifting of generation to the hours when the electricity has more value (i.e., it is more scarce).
Transferability of support right	Non-transferable.
Other	Minimum competition level. The volume of offered product will need to exceed the volume of auctioned product (by 20% or more). The aim is to ensure competition between participating bidders. In case that this 20% level is not realised, the auctioned volume (and the minimum reserves) will be reduced accordingly. Seller concentration rule. In order to ensure competition, a single firm (or corporate group) cannot be awarded more than 50% of the auctioned volume (i.e., 1500 MW in the last auction). Organisational costs of the auction. These will fall on the awarded bidders, with a unitary cost of 0.08 €/kW, which will be collected by the entity which manages the auction (i.e., OMIE). Strategic Plan. There is an obligation on the developer to provide a strategic plan with estimations on the impact of the installation on local employment and the industrial value chain. This plan should include, at least, the following information: a) a general description of the investments that will be undertaken; b) a strategy of purchases and contracting; c) an estimation of the direct and indirect employment created during construction and operation of the plants, distinguishing between the local, regional or national levels; d) opportunities

	for the local, regional, national and EU industrial value chain. This would include an analysis of the share (%) that the economic value of equipment manufacturing, supplies, assemblage, transport and the rest of the activities carried out by firms located in the aforementioned territorial areas with respect to the whole investment; e) a circular economy strategy with respect to the treatment of the equipment at the end of its useful lifetime; f) analysis of the carbon footprint during the lifecycle of the installations, including the manufacturing and transport of the main equipment.

Two main design elements require further explanation. One is the concept of "energy of the auction". The other is the retribution of the installations and, particularly, the so-called "adjustment factor".

- Concept of "energy of the auction"

A main concept in the REER is the "energy of the auction". According to RD960/2020 (art.13), the "energy of the auction" (*energía de subasta*) is the energy sold in the day-ahead or intra-day markets which is linked to the REER. The electricity which is negotiated in hours in which the price of the day-ahead or intra-day markets is below 0 €/MWh and the electricity which is sold in the market before the start and after the end of the so-called "maximum delivery period" are not considered "energy of the auction". In addition, the energy sold once the "maximum energy of the auction" is reached is also not considered "energy of the auction".

The **"maximum energy of the auction"** of each installation is the maximum volume of energy from the auction which can benefit from the REER (article 15 RD 960/2020). When it is reached, the installation must abandon the REER. It will be calculated as a function of the maximum number of annual full-load hours of each technology and the maximum delivery period, according to the following formula:

Maximum energy of the auction = Capacity * maximum number of annual full-load hours * Maximum delivery period (years).

The maximum number of annual full-load hours is set in the Resolution (see Table 3 above).

On the other hand, the **"minimum energy of the auction"** refers to the minimum volume of energy from the auction which needs to be delivered by each installation benefiting from the REER before the end of the maximum delivery period (12 years). If it is not reached, a penalty applies. When it is reached, the installation may voluntarily abandon the mechanism. There are two possible situations:

- If the product auctioned is electricity, the minimum energy of the auction of each installation will coincide with the maximum energy of the auction.
- If the product auctioned is installed capacity, the minimum energy of the auction of each installation will be calculated using the following formula:
    - Minimum energy from the auction = Capacity * minimum number of annual full-load hours * Maximum delivery period (years).
    - The minimum number of annual full-load hours is set in the Resolution (see Table 3 above).

Finally, the **maximum delivery period** is the maximum period within which the installations benefiting from the REER have to comply with the obligation to sell the minimum energy of the auction (article 16 RD 960). When the deadline is exceeded, the installation leaves the mechanism and can participate freely in the market. The maximum delivery period is set at 12 years for both solar PV and wind in the Resolution and starts on 30 September 2023 for solar PV and on 30 September 2024 for onshore wind. For other renewable energy technologies (RETs): CSP (2024), offshore wind (2025), rest of RETs (2025).

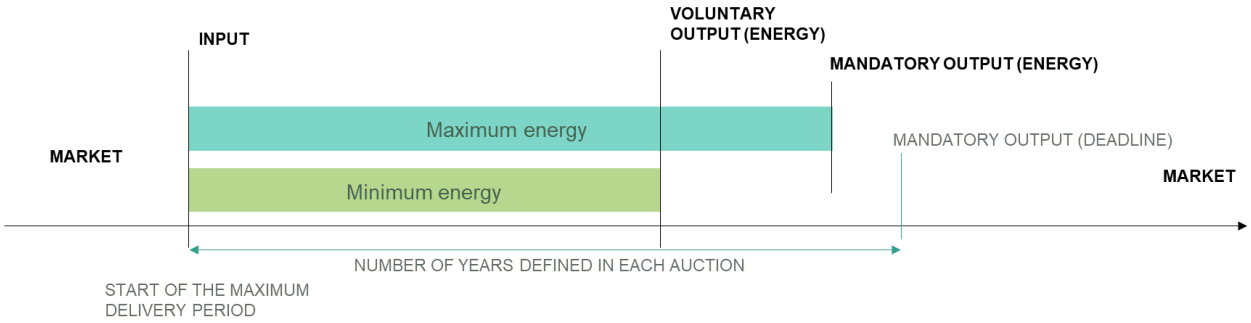
The end of the "energy of the auction" (and, thus, the end of the REER) for the particular installation takes place either when the maximum energy of the auction is reached or when the maximum delivery period is reached. On the other hand, when the minimum energy of the auction is reached, the installation can quit the

REER and sell the electricity in the market (article 17). If the minimum energy is not reached, it can quit the REER and sell the electricity in the market, but there is a penalty for doing so (defined in article 20 in RD960/2020).

Therefore, the installations may receive the market price before the start of the maximum delivery period and may also receive it after the end of such period. The installations will be able to participate freely in the electricity market (and receive its remuneration) in the three following cases: a) when they have reached the maximum energy of the auction; b) when the maximum delivery period expires; c) when the minimum energy of the auction has been reached and the installation opts to cease its participation in the REER. d) When, even if they have not exceeded the minimum volume of the auction, the installation rejects the REER (with a penalty).

The following Figure 1 illustrates the aforementioned concepts and their relationships.

Figure 1. Illustration of the concepts of maximum and minimum energy of the auction.



Source: MITECO (2020c)

- Retribution of the energy of the auction:

According to article 18 of RD 960/2020, the price to be received by the installations subject to the REER, in each negotiation period, will be its award price in the auction corrected by some symmetrical incentives of market participation through the market adjustment factor (percentage). The price received by the producer is calculated according to the following formula:

$PR = AP + AF * (MP - AP)$

Where PR is the price received by the installation, AP is the awarded price in the auction, MP is the day-ahead hourly market price and AF is the adjustment factor.

The AF is a percentage in the range of 0% to 50%. Its aim is to provide an additional element of market exposure, encouraging electricity generation in the most expensive hours of the day in order to reduce the price of electricity in those hours. It encourages those installations which are able to shift their production. The adjustment factor increases the price received by the installation when the market price is higher than the AP and reduces PR when the market price is lower than the AP (MITECO 2020a, p.24).

The AF is set by the Resolution. In order to set its level, the following variables will be taken into account: the maturity of technologies, their competitiveness, their dispatchability, their generation profile and other technical characteristics as well as the size of the installations. It represents the percentage of energy which is remunerated at the market price, with the rest being remunerated at the awarded price. Two adjustment factors are set: 25% if the installation is dispatchable and 5% otherwise. It is considered that the installation has such dispatchable capacity if it has storage capacity for 2 hours.

Therefore, for non-dispatchable installations, the formula would be:

$PR = 95\% * AP + (5\% * MP)$

For dispatchable installations, the formula is:

$PR = 75\% * AP + (25\% * MP)$

The retribution scheme can be deemed a CfD. If the price received (PR) is above the market price (MP), then there is a payment obligation for the market to the installation. If the PR is below the MP, there is a revenue stream to the market (article 23 of the RD 960/2020):

If PR > MP→ Payment obligation on the market (payment to the generator).

If PR < MP → Revenue for the market (payment obligation from the generator).

Therefore, the premium to be received (or paid) by the generator would be PR-MP.

The following box provides a numerical example in three cases (low, intermediate and high market prices).

Box 2. An illustrative numerical example of the Spanish CfD

Assumptions:

Adjustment factor (AF) = 0.2

Awarded price in the auction (AP) = 25 €/MWh

PR is calculated according to the following formula: PR = AP + AF ∗ (MP − AP)

- CASE 1. LOW MARKET PRICE. AP > MP

MP = 20 €/MWh

PR = 25 + 0.2 (20-25) = 24 €/MWh

Since PR (24 €/MWh) > MP (20 €/MWh) → Payment obligation for the market = 24 - 20 = 4 €/MWh

- CASE 2. HIGH MARKET PRICE. AP < MP

MP = 30 €/MWh

PR = 25 + 0.2 (30-25) = 26 €/MWh

Since PR (26 €/MWh) < MP (30 €/MWh) → Revenues for the market = 30 - 26 = 4 €/MWh

- CASE 3. INTERMEDIATE MARKET PRICE. AP = MP

MP = 25 €/MWh

PR = 25 + 0.2 (25-25) = 25 €/MWh

Since PR (25 €/MWh) = MP (25 €/MWh) → Neither a payment nor a revenue for the market

The example shows why the adjustment factor encourages electricity generation during the hours of the day when electricity is most expensive (i.e., when market prices are relatively high). When the market price of electricity is low, the remuneration for generators is low. So, the lower the market price, the lower the received price (ceteris paribus). In contrast, the higher the market price, the greater the incentive to sell electricity in the market, because the payment obligation for the market is greater.

There is a penalty that is applied in the event that the minimum energy of the auction is not reached when the maximum delivery period ends. There are also automatic penalties for not reaching the minimum energy of the auction in the established intermediate milestones (i.e., every three years). The automatic penalties will apply through the reduction of the award price. This reduction will apply from the milestone in which the minimum energy of the auction is not achieved until the next milestone (article 20 RD 960/2020). The energy negotiated after such non-compliance will be penalized with 5 €/MWh (article 19 of the Order TED/1161/2020).

3 Evaluation of the auction results

In this section, a preliminary evaluation of the results of the January 2021 auction in Spain is provided, taking into account the perceptions of different stakeholders[7]. Different information sources have been used: official data, regulation, informal talks with energy experts, webinars on the Spanish auctions, reports from the regulatory authority (CNMC), websites of Spanish Renewable Energy Associations, expert opinions included in energy and economic journals, and the record ("memory") of the analysis of the regulatory impact of the RD960/2020 and the proposal of the Order TED 1161.

3.1 Effectiveness

3034 MW of renewable capacity was awarded in this auction, with 32 awarded bidders. Regarding ex-ante effectiveness (the amount of the volume auctioned which was contracted), the auction was oversubscribed. 84 bidders bid in the auction with a total bid volume of 9700 MW. However, it is clearly still too early to venture conclusions regarding ex-post effectiveness (i.e., about the project realization rates, which will only be known when the deadlines for construction are reached; specifically in February 2023 for solar PV, and in February 2024 for onshore wind). Whether the projects will be built, and whether they will be built on time, will depend on whether they will be able to get financing and whether they will get the required administrative permits (Márquez 2021). The Spanish Renewable Energy Association (APPA) considers that, overall, the awarded bidders will be able to develop their projects in line with the realisation periods specified in the auction rules.[8]

An important aspect regarding effectiveness is whether the new auction will contribute to the achievement of the ambitious renewable energy targets as set in the Spanish NECP. A linear trajectory to achieve the goals of the NECP suggest that, on average, 5 GW would need to be added every year between 2021 and 2030. The 3 GW awarded in this auction are below this 5 GW level. However, this is the first year in the period and the first auction with the new design. In addition, the aforementioned trend does not have to be linear, but rather a lower level of new capacity deployment can occur in the first years, with an acceleration in later years. Thus, it is probably very early to tell, but some actors are sceptical in this sense. For example, according to the Spanish Wind Energy Association (AEE), "the auction is a tool which helps to speed up the deployment of renewables. Notwithstanding, the auctions are insufficient to achieve the targets of the NECP. The annual deployment of wind should be around 2200 MW in order to achieve the 50333 MW from wind that should be installed by 2030. Therefore, the auctioned volume of the current auction for wind (1000 MW), plus the planned annual volumes of 1500 MW until 2025 are insufficient to meet the 2030 target. Ensuring a steady annual stream of projects is vital in order to avoid tensions in the supply chain" (AEE 2021).

The Spanish solar PV association (Unión Española Fotovoltaica, UNEF) also refers to a study undertaken by the consultancy Antuko to argue that the NECP target in 2030 will not be reached, even if the capacity awarded within auctions is added to the capacity built as merchant plants or with PPAs (UNEF 2021b). An important aspect of ex-post effectiveness is the possible presence of underbidding. Ojea (2021) argues that the minimum awarded prices have been very low, even lower than the profitability threshold: 14.89 €/MWh for solar PV and 20 €/MWh for onshore wind (Ojea 2021). Indeed, according to Donoso (2021), there was some concern that very aggressive pricing would occur, as had been the case in the Portuguese auctions held a year before (in early 2020). However, according to the same author, "the sector has shown its maturity with the virtual absence of this type of behaviour" (Donoso 2021, p.108)[9].

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[7] For an assessment of each design element in the Spanish auction, see del Río (2021).

[8] Based on an interview held with APPA in May 2021 (APPA 2021a). However, APPA also understands that numerous developers of RE projects in Spain are concerned about the level of supply of key materials for renewable energy projects. For instance, there currently appears to be a bottleneck in the supply of aluminium, and consequently there has been a significant increase (e.g., around 30%) in the prices of this metal in the Spanish market. Whilst the reasons underlying the supply chain issues aren't currently fully clear, project developers generally consider that the issue will normalise soon.

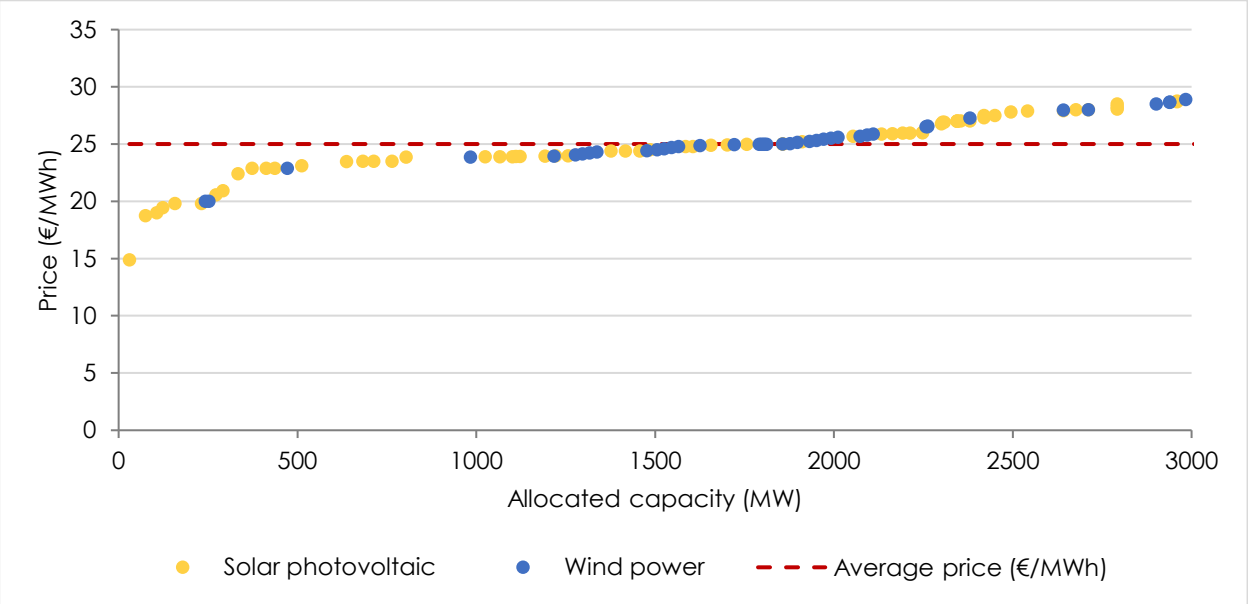
[9] When interpreting the results for PV, (Donoso 2021, p.108) states that "those prices are concentrated in the average values, with the largest majority (88%) of bids awarded falling in the range of 22 €/MWh to 29 €/MWh. Therefore, the

On the question of whether Spain's recent and planned auctions will help Spain meet its NECP objectives, the Spanish Renewable Energy Association (APPA) considers that auctions are a valuable tool, for several reasons, and not least because they help promote order in the development of the country's renewable energy sector(s). For instance, in the context of major oversubscription of potential project developers to obtain grid connections in Spain, auctions can help to make the process of assigning grid connection rights more orderly and coordinated (although the grid connection assignment process takes place outside of the auction process itself). Furthermore, APPA considers that, as the rules of forthcoming auctions can be shaped to promote specific ad-hoc objectives, auctions will be a key tool for achieving the NECP-established objectives of promoting "community RE energy" projects in Spain (APPA, 2021a).

3.2 Minimisation of consumer costs

Figure 2 shows the awarded bids differentiated per technology. The auction has resulted in weighted average prices of 24.47 €/MWh for solar PV and 25.31 €/MWh for onshore wind. The bid price ranges have been 14.89-28.90 €/MWh for solar PV and 20.00-28.89 €/MWh for onshore wind (MITECO 2021a). 42% of all awarded bids had prices in a narrow range between 24 €/MWh and 26 €/MWh. Of all bids received, only 7% were lower than 80% of the average awarded price. At the other end of the bid price spectrum, 16% of awarded bids were 10% (or more) higher than the average awarded price. The following figure shows the distribution of awarded bid prices for solar PV and onshore wind power projects.

Figure 2. Distribution of awarded bid prices



Source: Own elaboration, based on MITECO (2021b)

Table 4 shows the distribution of awarded solar PV and wind power projects, within discrete generation capacity ranges. A similar number of bids were awarded for solar PV and wind power projects with generation capacities in the range of 1 – 5 MW, and with 12 and 9 awarded bids, respectively.

In the generation capacity range of 5 – 20 MW, most awarded bids were wind power projects. Specifically, twice the number of wind power project bids were awarded as compared to solar PV projects (i.e., 24 vs 12,

bids can be considered representative of the estimated costs of the bidders, taking into account the supply conditions. In this sense, it should be pointed out that it is difficult to say if those bids reflect the expected costs, since the auction rules state that this price (bid) will be received only for 12 years, leaving 18 years afterwards to receive the market price. The different estimations of the bidders regarding the market price in the latter 18 years may have significantly influenced the bids offered".

respectively). In fact, and as can be seen in Table 4 of the total awarded wind power bids, the majority (24 of 42; equivalent to 57%) were clustered within the generation capacity range of 5-20 MW.

According to the Spanish Wind Energy Association (Asociación Empresarial Eólica (AEE), 2021), the capacity awarded to wind power in the auction will translate to an investment volume of more than € 1,000 million, anticipated to create employment for more than 30,000 people. The combined awarded capacity for wind power plants was 998 MW, distributed across seven companies.

By comparison, most of the awarded bids with larger-scale generation capacities (i.e., 40 MW and above) were for solar PV. The total combined generation capacity for solar PV plants was 2,036 MW. According to UNEF (2021a), the distribution of awarded bids among companies, and the distribution in project generation capacities should be considered as an overall success, with a wide variety of actors participating (and being awarded) in the auction.

In the auction, the competitiveness of solar PV projects has been shown. Currently, solar PV is the lowest cost generation technology option on the market.

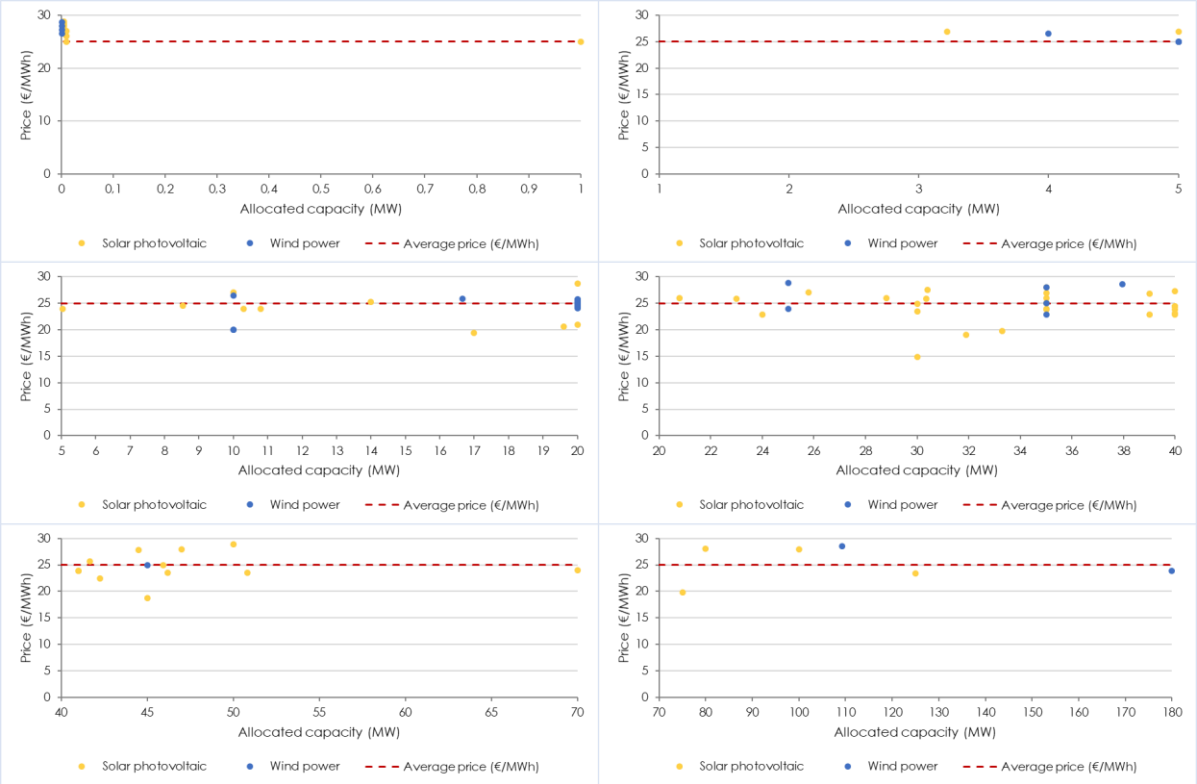
Table 4. Relative distribution of awarded bids, by technology and project size range

Capacity range (MW)	Number of auctions solar PV	Number of auctions wind power	Solar PV	Wind power
0-1	10	4	71%	29%
1-5	2	5	29%	71%
5-20	12	24	33%	67%
20-40	27	6	82%	18%
40-70	12	1	92%	8%
70-180	4	2	67%	33%

Source: Own elaboration based on MITECO (2021b)

Figure 3 shows the awarded bid prices within six power generation capacity ranges. For reference, the average awarded bid price is represented as the dashed red line.

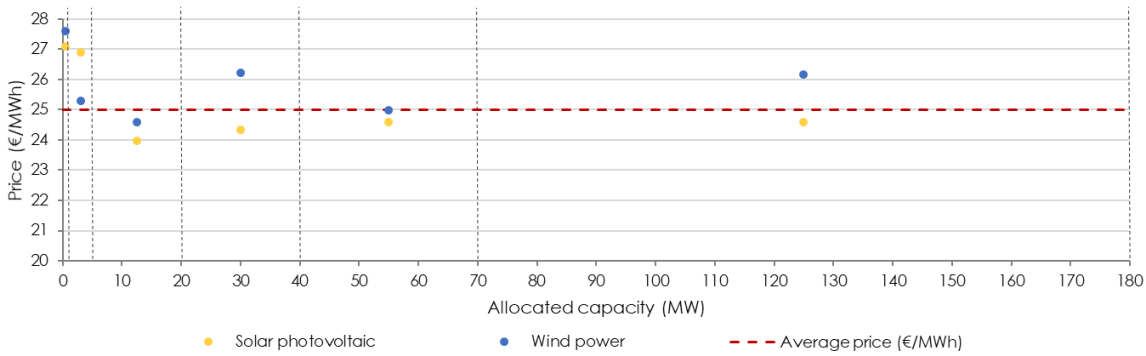
Figure 3. Awarded bid prices within six power generation capacity ranges.



Source: Own elaboration based on MITECO (2021b)

Figure 4 shows the average awarded bid prices per capacity range. In general, medium- and large-scale power generation projects are close to the respective technology-specific average awarded bid prices. By contrast, generation projects of less than 5 MW capacity have prices that are slightly higher than the average awarded bid price. During the auction, nine very small solar PV projects and four very small wind power projects (<1 MW)[10] had awarded bid prices in the range 26.99-28.74 €/MWh and 26.56-28.66 €/MWh, respectively, (slightly higher than the average price 25 €/MWh).

Figure 4. Average prices per capacity range.



Source: Own elaboration based on MITECO (2021b)

[10] Solar projects: RIOS RENOVABLES, S.L.U.: 6 bids of 5 kW each; ENERGY INVESTMENT AND CONSULTANCY, S.L.U.: 3 bids of 10 kW each
Wind projects: GREEN CAPITAL POWER, S.L.U.: 4 bids of 1 kW each

The low awarded bid prices were more or less as expected and are due to several factors: the low costs of the technologies, the existence of very favourable solar and wind resources in Spain and the high level of bidder competition in the auction, which was clearly oversubscribed, with 9700MW of submitted bids but only one third of those being awarded (i.e., 3034 MW). The certainty provided by the auction system had probably helped bidders to secure financing of prospective projects with low financing costs. This in turn will have facilitated their submission of lower (more price competitive) bids. In addition, it is understood that the existence of the so-called "tail of the project" has had an influence on the bids submitted by the bidders. These projects can continue to sell their electricity within the wholesale market after the 12 years of "energy of the auction" (or even earlier, if they deliver the "minimum energy of the auction" before the completion of the 12-year period). They can also have different expectations regarding the level of the wholesale price after those 12 years.

According to the Spanish Ministry of Energy, the aforementioned weighted average prices of the auction are 43% lower on average than the estimation of long-term prices and will translate into direct savings in the electricity bill, which will increase in the successive calls (MITECO 2021a). Similarly, Stafkraft (2021) argues that, although the prices by wind and PV as produced are different to base load prices, the awarded bids in the auction are, on average, 40% lower than the forward prices for baseload generation in the integrated Iberian power market (OMIP) as of 26 January 2021. "A very important reduction of 28% in the average price of the auction with respect to the average pool price in 2020 (and 62% with respect to the price in 2021) has been achieved" (Rosell and Sánchez 2021). The average price of 24.47 €/MWh represents a reduction of 28% with respect to the market price of electricity in 2020, which was a year with a particularly low price (due to the substantial drop in demand as a consequence of the economic slowdown related to the COVID-19 pandemic), and 49% lower than the prices in 2019 (UNEF 2021a). With respect to the forward market prices, the average awarded prices represent a 40% reduction (Donoso 2021, p.108).

The prices are below the LCOEs for both technologies, as published by IRENA (2021) or Lazard (2019)[11]. It is true that the solar PV prices are higher than those in the auctions in Portugal in August 2020, which reached a minimum price of 11.14 €/MWh (compared to 14.89 €/MWh in Spain). As argued by Protermosolar (2021), this difference is due to the fact that, in Portugal, the awarded bidders are guaranteed a specific level of remuneration for generated electricity over a 15-year period and a grid connection point. However, in Spain, the remuneration set by the regulation (auction) is for a 12-year period and the management of the grid access and connection process takes place in parallel (and is separate to) the auction itself. Therefore, for Protermosolar (2021), the project developers in Portugal could have had an interest, which went beyond the regulatory life of the project whereas, in Spain, the auction is another retributive scheme, which is additional to the market or a private PPA. However, it is important to note that bidders in the Spanish auction have also taken into account the fact that the installation can earn revenues from sales to the electricity market after the regulatory life of 12 years.

The awarded prices are deemed to be low according to international standards. In contrast to the similarly competitive prices yielded in recent auctions in Portugal and the Netherlands; it is worth underlining that the average awarded bid prices in auctions held in 2019-2020 in several other European countries - such as Greece, Germany, Slovenia, or Estonia, with awarded prices ranging between 45.5 €/MWh and 68.3 €/MWh - were higher than those awarded within the Spanish auction. The average awarded price of solar PV and wind power in Ireland and Italy in 2020 was even higher, with awarded bid prices ranging from 71.5 €/MWh to 90.1 €/MWh (Martín et al., 2020; AURES II, 2021).

The Spanish Renewable Energy Association (APPA, 2021a) considers that the awarded prices of the recent auction were low overall. They consider that some project developers will likely have sacrificed profits to achieve their objectives of entering the Spanish renewables market, or to consolidate their market share. Furthermore, APPA considers that the very competitive prices obtained may be a consequence of this being the first auction in a considerable time period in Spain. In the forthcoming yearly auctions, it will be telling to observe whether awarded bid prices remain as low as those awarded in the recent auction. If the perceived

[11] According to IRENA (2021), the global weighted-average LCOE of onshore wind was 0.033 €/kWh and the global weighted-average LCOE of solar PV in 2020 was 0.049 €/kWh. The weighted-average LCOE of onshore wind in Europe was 0.038 €/kWh (0.056 €/kWh for the 95th percentile). The LCOE for utility-scale PV in Spain was 0.039 €/kWh in 2020. (Exchange rate: 1 USD = 0.854 € (as of 20 September 2021).

underbidding continues throughout various forthcoming auctions, it may generate concerns around the mid-term financial health of the electricity sector as the share of renewables in the generation mix continues to grow.

As mentioned in APPA (2021b), for the first time, the awarded projects will receive a price below the market price, which will be the same in the future. According to the government (MITECO 2021a), as a result of the recent auction, the reduction of the market price of the electricity will be around 1.3 €/MWh, which is due to two effects:

1. A reduction in the clearing price in the day-ahead and intraday markets as a consequence of a greater penetration of renewable electricity in the system. This will displace the electricity generated by more expensive thermal-based plants, which are the generation plant that set the marginal price. This would involve a reduction in the average annual price of electricity of around 0.8 €/MWh.
2. An additional reduction can be expected due to the settlement mechanism associated with the REER. When the energy from the auction is integrated in the electricity market, the average annual price will be reduced by a further 0.5 €/MWh, since the awarded prices in the auction are lower than the market electricity price.

According to the Spanish government (MITECO) (2021a), this first auction will involve an average saving of 5 €/year in the electricity bill for the average Spanish household, 800 €/year for a small industrial consumer (equivalent to 1.5% of its electricity bill) and up to 35,000 €/year savings for a large industrial consumer (equivalent to 2.2% of its electricity bill). MITECO (2020b) concludes that the cost reductions would be between 500 and 2,000 million euros in the period 2021-2030. Overall, MITECO (2020a, p.34) has calculated that the cost reductions (which represent a saving for electricity consumers) will amount to 173 million euros per year.

An interesting issue, which is beyond the scope of this case study, is the comparison of the prices of the auction with those of the PPA and merchant plants and, indeed, the need for the auction to take into account that those two alternatives exist. It should be taken into account that three mechanisms provide different products with different return-risk profiles. According to Donoso (2021, p.107), during 2020, 2,450 MW of ground-mounted solar PV plants have been connected to the grid (merchant projects and PPAs), without benefiting from any support policy (neither administratively-set FITs, nor via remuneration as set within auctions). According to ENERGES (2021), 3,400 MW of PPAs have been signed in Spain in 2020 at an average price of 35 €/MWh, which is also below the electricity pool price (ENERGES 2021)[12].

However, as discussed in Donoso (2021), there are several barriers to the use of both alternatives (i.e., PPA and merchant) to auctions in Spain. In the first case (PPA) might no longer be attractive for investors due to the likely saturation of the currently most common modality of PPAs (pay-as-produced, signed between producers and traders) and the lack of baseload PPAs signed between producers and consumers. In the second case (merchant plants), it is linked to obtaining the necessary financing. In addition, the choice for one mechanism or the other strongly depends on the risk-return profile required by each actor (with PPAs and merchant plants offering potentially more revenues but a higher risk than auctions). It should be taken into account that the organization of auctions influences the PPAs, i.e., they are interrelated to some extent. The recent auctions have pushed down the prices of the PPAs which had previously been signed at around 38 to 40 €/MWh (Donoso 2021, p.113). However, according to Aleasoft (2021), the final prices in the auction will have a very low or even negligible impact on the electricity market prices or the prices of the PPA which are signed in 2021. Auctions will be the main mechanism driving investments in RES projects in Spain. According to Antuko (2021), it is highly likely that, on average, only 80% of the capacity built is subject to the REER. The rest is, thus, exposed to merchant or PPA power sales arrangements. This is probably related to the certainty of revenues provided by the auction, in contrast to the volatility of the revenues coming from the market.

Finally, it should be mentioned that a design element which encourages market exposure in order to reduce the system costs has been adopted (see section 2). The design aims to reduce the system costs to some extent by encouraging generation in the hours with more value for the system (through the adjustment factor), avoiding that the energy of the auction has negative market prices and ensuring that installations

[12] According to Donoso (2020), sales to the market were done at very competitive prices (an average of 47.6€/MWh in 2019).

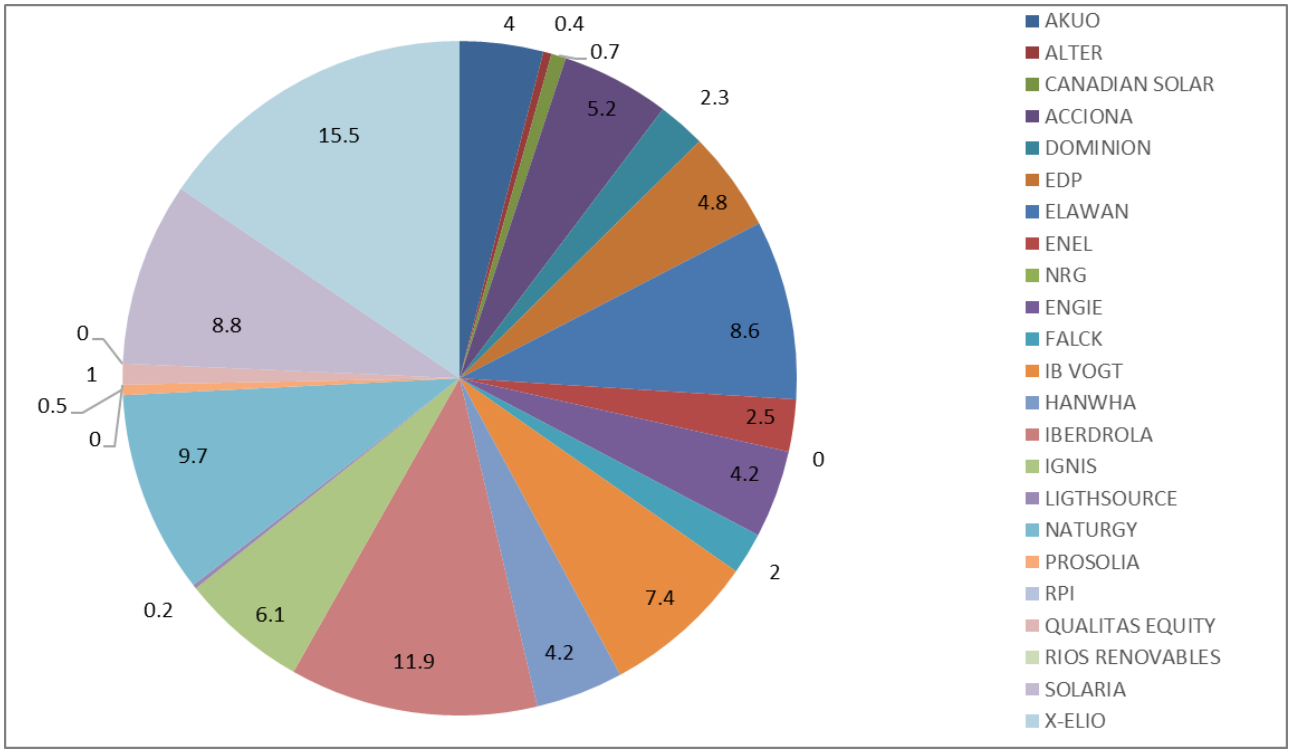
operate with the same balancing obligations as other (i.e., non-renewable) generators. However, the design provides limited incentives to minimise the system costs. In particular, it is not possible to assert which of the projects awarded are cheaper for the electricity system (Márquez 2021, p.95). Following Márquez (2021), it is necessary to provide signals to encourage that projects are awarded taking into account their value and not their price, capturing the real value of each technology in the most effective and efficient manner.

However, the regulatory authority (CNMC) argues that this new REER is not the appropriate instrument to encourage power storage installations. The incentive should come from the market itself (i.e., market signals as a result of an excess of renewable energy concentrated in certain moments). The CNMC recommends using an adjustment factor of 0.2, but it recommends that the adjustment factor should be zero only for those auction calls oriented towards smaller installations or for those using less mature technologies. These installations would hardly be economically viable if they perceived prices which are close to those of the day-ahead or intraday markets (CNMC 2020, p.9).

3.3 Actor diversity

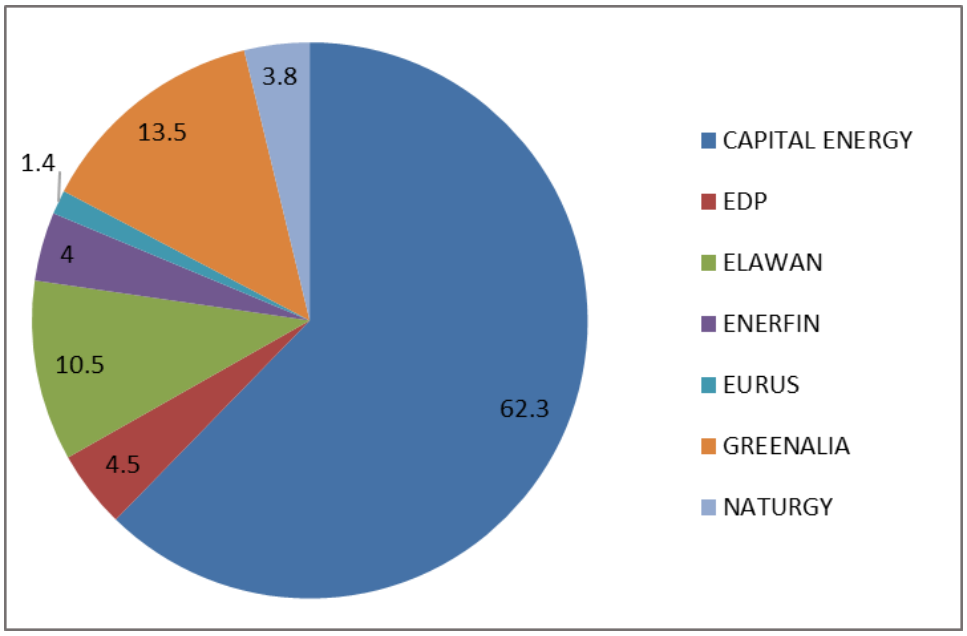
Figure 5 and Figure 6 below show the concentration of the solar PV and wind power awarded bidders in the auction.

Figure 5. Share of solar PV awarded bidders (%).



Source: Own elaboration.

Figure 6. Share of wind power awarded bidders (%).



Source: Own elaboration.

Regarding solar PV, there have been 26 awarded bidders (although the real awarded bidders are 23, since some firms belong to the same company group). The concentration ratio of the largest three awarded bidders (CR3) is 37.1%. The largest awarded bidder was X-Elio (315 MW), but they only captured 15% of the total awarded capacity. In the case of wind, it can be observed that the concentration is greater. There are 8 awarded bidders and the concentration ratio of the largest three awarded bidders (CR3) is 76%, with the largest bidder having a share of 62.3%. The Herfindahl-Hirschman Index (HHI) is very low for solar PV (838) and very high for wind (4226).

However, some authors are critical about the degree of actor diversity, suggesting that the small firms have been underrepresented and that further efforts should be made in the future in this regard, e.g., supporting smaller actors. For example, the Renewable Energy Foundation claims that "the auction strengthens the concentration of the 3,043 MW in a handful of large awarded bidders, forgetting about the incorporation of other, smaller ones (…). The design of the auctions has generated a concentration of awarded bidders, with a profile of large projects behind" (Fundación Renovables 2021) and hopes that the next auctions will encourage more diversity. Rosell and Sánchez (2021) state that "the auction deepens even more the gap between the large and the small actors". However, the PV association UNEF (2021a) argues that the awards have been highly distributed between firms, encompassing a wide array of sizes and including a wide diversity of actors. UNEF (2021b) stresses that large plants have not been awarded (only 5 plants are larger than 50 MW) and that there hasn't been a high concentration in a handful of firms. UNEF (2021a) calls for a specific auction with a volume of 600 MW for projects smaller than 10 MW. The Director General of the Renewable Energy Association (APPA) states that "it is very difficult to compete for medium-size firms and we defend that there are quotas for small firms and technologies". The Renewable Energy Foundation also criticizes that there were no quotas for distributed generation and argues that "for the next auctions, a level of maturity of the projects should be required and anti-speculation clauses should be implemented, in order to avoid the imbalance as regards actor concentration and to further diversify the profiles of the awarded bidders" (Fundación Renovables 2021).

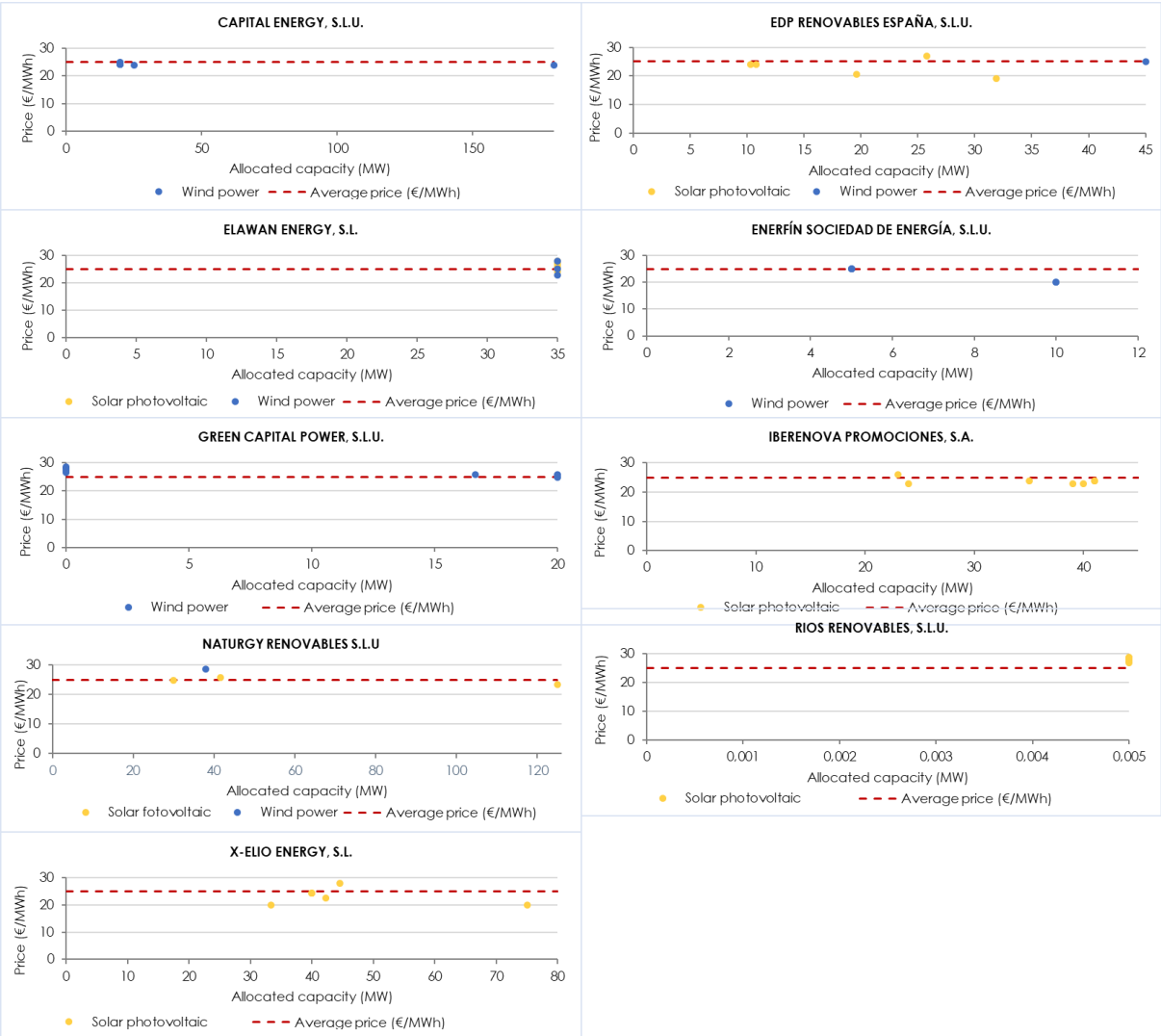
Regarding the distribution of awarded bids amongst the companies that participated in the auction, the companies that were awarded the largest number of wind power project bids were Green Capital Power S.L.U and Capital Energy S.L.U (15 and 12 bids, respectively). Out of these bids, both companies were awarded 10 bids each with a generation capacity of exactly 20 MW. Furthermore, Green Capital Power S.L.U was awarded 4 bids of the lowest awarded power generation capacity (1 kW) in the auction. Capital Energy S.L.U. was awarded the bid with the largest generation capacity in the auction (180 MW).

The companies that were awarded the largest number of solar PV project bids were Iberenova Promociones, S.A. and X-Elio Energy, S.L. Both companies were awarded 7 bids each. The capacity range of Iberenova Promociones, S.A. was 23-41 MW while the capacity range of projects awarded to X-Elio Energy, S.L was slightly higher (40-75 MW).

In contrast to companies that were awarded multiple bids in the auction, eleven participating companies were awarded one (single) bid. These included Canadian Solar Spain, S.L; Desarrollos Renovables Eólicos y Solares, S.L.; Dominion Energy, S.L.U.; Enel Green Power España, S.L.; Lightsource Renewable Energy S.P.; Develop. S.L.; NRG Park 2017 II, S.L.; Parque Eólico Escepar; Parque Eólico Peralejo; Planta Fotovoltaica Pirámides II, S.L.; Q-Energy Torozos, S.L.; Solar Bolarque, S.L.

Figure 7 shows the generation capacity ranges of several companies that were awarded in the auction, showing the higher and lower ends of those ranges.

Figure 7. Higher and lower ends of capacity ranges for some companies awarded in the auction.



Source: Own elaboration based on data from MITECO (2021b).

It is true that the traditional actors in the sector, i.e., the utilities, such as Endesa, Naturgy, Iberdrola, Acciona or Elawan were present, in some cases with significant shares, in this auction. Repsol is an important actor which was not awarded. It was the first time that it participated in a RES auction and, according to Martos (2021), has not been awarded as a result of a higher bid given its desired profitability level. A further

interesting case is Forestalia, which was awarded a significant proportion of the auctioned capacity in the previous Spanish auctions organised in 2016 and 2017. Forestalia participated in the recent (January 2021) Spanish auction but was not awarded (Martos 2021, Ojea 2021).

Most awarded bidders were Spanish companies, and most capacity was awarded to these firms (70%, according to UNEF 2021b). However, there was also a significant level of participation of international market players. International companies that were awarded in the Spanish auction include Akuo Renovables (France), Canadian Solar Spain (Canada), Dominion Energy (USA), Erus Desarrollos Renovables (Netherlands), Falck Renewables Power 2 (Italy), Garnacha Solar S.L. belonging to IB Vogth (Germany), Hanwha Energy Corporation Europe (a Korean company present in Hungary/Poland), Lightsource Renewable Energy SP Develop (UK), and NRG Park 2017 II (Prosolia, USA).

3.4 Dynamic efficiency

Whilst all RETs were eligible to participate in the latest auction (with two minimum reserves of 1,000 MW for solar PV and onshore wind), only two technologies were awarded (solar PV and onshore wind). Solar PV captured two thirds of the awarded volume (2,036 MW) and onshore wind captured one third (998 MW). In this hybrid auction, in addition to the technology-specific component (the minimum reserves) there was a technology-neutral component (1,000 MW), which was fully captured by solar PV. Other generation technologies were not awarded. Given the need for decarbonisation of the electricity system, the increasing shares of variable renewables and the decommissioning of fossil-fuel fired power generation plants with synchronous generation which provide baseload to the system, a minimum reserve for dispatchable RETs, such as biomass and CSP, should have been included. Nevertheless, minimum volumes for these technologies are envisaged in the future, according to the schedule mentioned in section 2 of this report. Encouraging electricity storage will also be increasingly important and future auctions should include a design that is more favourable for storage.

It is likely (but difficult to quantify) that there are tangible positive impacts on the whole industry value chains of the awarded technologies (solar PV and onshore wind) and, thus, on technological innovation, as a result of the 2021 auction and the envisaged auction schedule for the next five years. MITECO (2020a, p.33) stresses the "favourable impact on innovation of the new electricity generation plants which will be deployed as a result of the auction". According to MITECO (2021a, p.2), "these plants will result in the mobilisation of around 2,100 million euros of economic resources associated with the manufacturing of equipment and construction of awarded installations. The Spanish industry has broad capabilities throughout the value chains for equipment manufacturing and the construction of renewable energy installations."

The positive impact of the auctions on the respective value chains for the two awarded technologies is shared by several actors in both sectors. For example, the solar PV association UNEF argues that "the auction provides certainty to a national solar PV industrial sector in which there are cutting-edge firms with their own technology, which manufacture in Spain (Donoso 2021, p.108). The Spanish wind energy association (AEE) argues that a greater volume than 1,500 MW should be auctioned in the second auction (envisaged by the end of 2021) in order to support the value chain. "From the point of view of the use of our national industry, it would be very important to appropriately set the minimum reserve for wind, taking into account that the existing industrial capacity in our country is close to 4,000 MW/year" (Márquez 2021, p.98). It should be noted that, according to number 9 of the Resolution, the awarded bidders will have to provide a strategic plan with the estimations of the impact on local employment and the industrial value chain. However, it is unclear how this design element will encourage the national and local value chains. It is likely that the existence of a schedule with reserved volumes per technology will have a more relevant role in this regard, since it allows the firms in the value chain to plan their investments accordingly.

Finally, it should be mentioned that demonstration projects may be exempted from the auction. The result of the auction may be used as a reference to set the remuneration for these projects.

3.5 Other impacts

The Spanish government has stressed that, in addition to the positive effects on electricity prices paid by the electricity consumers and the local and national value chains, there will be other positive impacts from the auction, particularly on:

- Employment creation. The government argues that the installation of 3,034 MW and the associated mobilisation of 2,100 million euros of investment will generate 27,000 jobs, which will be scattered throughout the entire Spanish geographic territory (MITECO 2021a). This employment is direct, indirect and induced in nature, and is associated to the manufacturing of equipment and the construction of the installations (MITECO 2021a).
- Reduction of the raw material imports used in the fossil-fuel fired electricity generation plants which have been replaced by the new renewable energy plants (MITECO 2020b, p.17), although this is not quantified.
- CO_2 emissions. The government expects that the new renewable energy delivered in the electricity system will displace fossil-fuel generation (mostly combined cycle natural gas fired plants), which will lead to an annual emissions reduction of 2.5 million tCO_2-eq (and corresponding savings in the purchase of EU ETS allowances of about 61 million euros) (MITECO, 2021a).

4 Conclusions

Spain has adopted ambitious targets for the deployment of renewable energy sources in its NECP 2021-2030. Renewable electricity will need to account for 74% of total electricity generation in 2030, which, in turn, is coherent with a trend towards a fully renewable electricity system in 2050. Since the share of renewable electricity was 43% in 2020, a large effort has to be made, which implies the deployment of around 5 GW per year of new capacity during the next decade.

A new auction scheme was passed into law in 2020 and an auction, based on the new auction scheme, was conducted on 26 January 2021, to put the country on a compliance path with the required capacity additions. In addition to achieving the international commitments on RES and decarbonisation, the goals of the government when organising the auction have been (MITECO 2020c): to facilitate the financing of new projects, avoiding the risk of "price cannibalisation" (which is due to a large penetration of renewable electricity); to transfer the savings in electricity generation costs stemming from the use of renewable electricity to consumers; to facilitate the planning of investments through a schedule that provides certainty to the whole value chain and to boost the green economy and facilitate the economic recovery. Other important goals include the promotion of a diversity of actors and project sizes and encouraging greater levels of market exposure of RES installations.

With regard to the results of the recent auction, 3,034 MW of RES capacity was awarded to 32 bidders. The auction was oversubscribed, with 84 bidders bidding a total level of 9,700 MW. However, it is too early to reach conclusions regarding the project realization rates, which will only be known when the deadlines for construction are reached (February 2023 and 2024 for PV and onshore wind, respectively). The auction resulted in a weighted average price of 24.47 €/MWh for solar PV and 25.31 €/MWh for onshore wind. The awarded bids are 43% below the estimated long-term electricity prices (MITECO 2021a). There was a very small concentration of the solar PV awarded bidders, and a high concentration of wind awarded bidders. 26 bidders were awarded in solar PV. Whilst all renewable electricity technologies were eligible to participate (with minimum reserves of 1000 MW for solar PV and onshore wind), only solar PV and onshore wind were awarded. Solar PV captured two thirds of the awarded volume and onshore wind captured the rest.

The design of this auction was structurally very different to the previous auctions held in 2016 and 2017 in Spain, probably as a result of different context conditions and goals. In those previous auctions, the remuneration was capacity (investment)-based. They were also uniform-pricing ad-hoc auctions. In contrast, the new auction regime remunerates generation with a PAB pricing rule, and in the context of a long-term auction schedule (see del Río 2021 for further details on the differences with respect to the previous auctions). Furthermore, an important difference within the new auction scheme with respect to the previous one was the procedure which led to its implementation. This involved a long and quite open process, with extensive consultations with different actors, both from the academic and business fields, on possible options and their relative acceptability and appropriateness.

As concerns the design of the auction itself, the new scheme is less complex, much easier to understand and more aligned with international best practice in auctions, which has led to simpler auctions taking place around the world. Overall, the main actors within the Spanish sector have praised and welcomed the relative simplicity of the new auction (see, e.g., González 2021, Donoso 2021) The choice of the design elements in the auction scheme is instrumental to achieve the goals of the government and, in particular, to provide an attractive regulatory framework for investors by favouring the predictability and certainty for them; which in turn facilitates the financing of the projects and enables the planning of investments within the entire supply chain. This is clearly the case in the first auction conducted under the new scheme. However, other important goals in the auction scheme, such as promoting a diversity of actors, project sizes and technologies have not been encouraged in the first auction within the new scheme, but this can be justified precisely for being the first (or "pilot") auction under the new scheme.

The auction is characterised by the inclusion of some design elements which are still novel in international policy practice. These include the following: 1) Capacity volumes are auctioned, but there is a commitment to deliver a minimum amount of energy (*energía mínima de subasta*) by a given date. 2) A hybrid design has been chosen which includes technology-neutral and technology-specific reserved capacities; 3) The indicative schedule includes minimum capacity volumes per year; 4) A favourable treatment of specific actors is envisaged in the new auction scheme, although this possibility was not used in this auction held in

January 2021; 4) There is some incentive for participation in the power market, via an additional exposure to the market price which encourages the shifting of generation to the hours when electricity has more market value (e.g., when it is more scarce); 5) Possible existence of a minimum price; 6) A minimum competition level (1.2 rule) is required and, if not achieved, the auctioned volume is reduced accordingly; 7) An ex-ante upward volume adjustment is adopted (6%); 8) There is a seller concentration rule of 50%; 9) There is an obligation to provide an strategic plan with estimations on the impact of the installation on the local employment and the industrial value chain.

The lack of reserve capacities for dispatchable technologies (such as biomass and CSP) will be corrected in the near future, as suggested by the indicative auction schedule. Furthermore, the diversity of actors and, particularly, renewable energy communities need to be promoted in the next auction rounds. This latest auction provides an opportunity for policy learning and extracting lessons for the improved design of future auction rounds.

5 References

AEE (2021). Asociación Empresarial eólica. El sector eólico valora los resultados de la subasta para el otorgamiento del Régimen Económico de Energías Renovables como un avance que permite áreas de mejora. Available at: https://www.aeeolica.org/comunicacion/la-actualidad-eolica/4460-el-sector-eolico-valora-los-resultados-de-la-subasta-para-el-otorgamiento-del-regimen-economico-de-energias-renovables-como-un-avance-que-permite-areas-de-mejora

Aleasoft (2021). Los resultados de la subasta disparan el interés internacional por las renovables en España EL PERIODICO DE LA ENERGÍA. 1/2/2021 https://elperiodicodelaenergia.com/los-resultados-de-la-subasta-disparan-el-interes-internacional-por-las-renovables-en-espana/

APPA (2021a). Interview with the Spanish Renewable Energy Association (APPA). Interview held with Ms Lucia Dolera (Project Director), on 25 May 2021.

APPA (2021b) APPA Renovables aplaude la celebración de la primera subasta renovable de 2021 que constata la competitividad alcanzada. https://www.appa.es/appa-renovables-aplaude-la-celebracion-de-la-primera-subasta-renovable-de-2021-que-constata-la-competitividad-alcanzada/

AURES II, 2021. Renewable Energy Auctions Database. Excel file. Accessed via: http://aures2project.eu/auction-database/

BOE, 2021. Resolución de 25 de marzo de 2021, conjunta de la Dirección General de Política Energética y Minas y de la Oficina Española de Cambio Climático, por la que se publica el Acuerdo del Consejo de Ministros de 16 de marzo de 2021, por el que se adopta la versión final del Plan Nacional Integrado de Energía y Clima 2021-2030

CNMC 2020. ACUERDO POR EL QUE SE EMITE INFORME SOBRE EL PROYECTO DE REAL DECRETO POR EL QUE SE REGULA EL RÉGIMEN ECONÓMICO DE ENERGÍAS RENOVABLES PARA INSTALACIONES DE PRODUCCIÓN DE ENERGÍA ELÉCTRICA Expediente nº: IPN/CNMC/014/20, 30 de julio de 2020

del Río, P. (2016). Implementation of Auctions for Renewable Energy Support in Spain: A case study, in Report of the EU-funded AURES project. 2016.

del Río, P. (2018). An analysis of the design elements of the third renewable energy auction in Spain. Renewable Energy Law and Policy Review, 8(3), p. 17-30.

Del Río, P. (2021). An assessment of the design of the new renewable electricity auctions in Spain under an international perspective. Papeles de Energía 13, p.69-102.

Donoso, J. 2021. El tiempo de la energía fotovoltaica. Cuadernos de la Energía 65, 107-118.

ENERGES (2021). Así ha resultado la subasta de energías renovables 2021-2025 https://www.energes.net/asi-ha-resultado-la-subasta-de-energias-renovables-2021-2025/ 4 febrero, 2021

Fundación Renovables (2021). La Fundación Renovables se congratula por los resultados de las nuevas subastas de renovables. January 27th 2021. https://fundacionrenovables.org/notas/la-fundacion-renovables-se-congratula-por-los-resultados-de-las-nuevas-subastas-de-renovables/#:~:text=Madrid.,incorporaci%C3%B3n%20de%20otros%20m%C3%A1s%20peque%C3%B1os.

González J.M. (2021). Las subastas renovables, vientos de cambio energético Cuadernos de la Energía 65, 101-106

IEA (2016). Energy Policies of IEA Countries. Portugal, 2016 Review, Available at: https://webstore.iea.org/energy-policies-of-iea-countries-portugal-2016-review

IRENA 2021. Renewable power generation costs in 2020.

Lazard (2019). Levelized Cost of Energy and Levelized Cost of Storage 2019. https://www.lazard.com/perspective/lcoe2019

Márquez, J.V. 2021. Análisis de las subastas de renovables desde el punto de vista del sector eólico.

Martín, Helena; Coronas, Sergio; Alonso, Àlex; de la Hoz, Jordi, Matas, José (2020) Renewable Energy Auction Prices: Near Subsidy-Free? Energies 13, 3383.

Martos, A. (2021), Capital Energy, X-Elio, Iberdrola y Naturgy, grandes adjudicatarias de la subasta de renovables. Cinco Días, January 27th 2021. https://cincodias.elpais.com/cincodias/2021/01/26/companias/1611651437_110731.html

Ministerio para la Transición Ecológica y el Reto Demográfico (MITECO)(2020a). MAIN DE RDL 23. MEMORIA DEL ANÁLISIS DE IMPACTO NORMATIVO DEL REAL DECRETO POR EL QUE SE REGULA EL RÉGIMEN ECONÓMICO DE ENERGÍAS RENOVABLES PARA INSTALACIONES DE PRODUCCIÓN DE ENERGÍA ELÉCTRICA. 25/6/2020

MITECO (2020b). MEMORIA DEL ANÁLISIS DE IMPACTO NORMATIVO DE LA PROPUESTA DE ORDEN POR LA QUE SE REGULA EL PRIMER MECANISMO DE SUBASTA PARA EL OTORGAMIENTO DEL RÉGIMEN ECONÓMICO DE ENERGÍAS RENOVABLES Y SE ESTABLECE EL CALENDARIO INDICATIVO PARA EL PERIODO 2020-2025 6/11/2021

MITECO (2020c). RÉGIMEN ECONÓMICO DE ENERGÍAS RENOVABLES S.G. Energías Renovables. Presentation on 16 de diciembre 2020. https://energia.gob.es/electricidad/energias-renovables/convocatorias/Documents/SEE_Presentacion_subasta_renovables_16dic2020_DEF.pdf

MITECO (2021a). El MITECO celebra la primera subasta renovable del periodo 2020-2025 para facilitar la acción climática y reducir la factura eléctrica. Press Note MITECO January 26th 2021.https://www.miteco.gob.es/es/prensa/ultimas-noticias/el-miteco-celebra-la-primera-subasta-renovable-del-periodo-2020-2025-para-facilitar-la-acci%C3%B3n-clim%C3%A1tica-y-reducir-la-factura-el%C3%A9ctrica/tcm:30-522090

MITECO (2021b). Official State Communication ("Boletin Oficial del Estado"), Thursday 28 January 2021, Resolution of January 26, 2021, of the Directorate General of Energy Policy and Mines, which resolves the first auction held for the granting of the economic regime of renewable energies under the provisions of Order TED/1161/2020, of December 4. Number 24, Section III, page 8571.

Ojea (2021). La subasta renovable multiplica por tres la oferta con precios mínimos en el límite de la rentabilidad https://www.elespanol.com/invertia/empresas/energia/20210127/subasta-renovable-multiplica-oferta-precios-minimos-rentabilidad/554195927_0.html

PROTERMOSOLAR (2021) Se celebra la primera subasta renovable sin grandes sorpresas https://www.protermosolar.com/editorial/

Rosell, A., Sánchez,P. 2021. Análisis de la subasta: vamos bien, pero debemos mejorar. PV-MAGAZINE, January 27th 2021. https://www.pv-magazine.es/2021/01/27/analisis-de-la-subasta-vamos-bien-pero-debemos-mejorar/

STAFKRAFT 2021. Por qué los resultados de la subasta en España no pueden compararse con los precios de PPAs. 19 FEB, 2021 https://www.statkraft.es/noticias/noticias-e-historias/Archivo/2021/por-que-los-resultados-de-la-subasta-en-espana-no-pueden-compararse-con-los-precios-de-ppas/

UNEF (2021a). Unión Española Fotovoltaica. UNEF celebra el éxito del modelo de la subasta en el que la energía fotovoltaica demuestra su competitividad. Available at: https://unef.es/2021/01/unef-celebra-el-exito-del-modelo-de-la-subasta-en-el-que-la-energia-fotovoltaica-demuestra-su-competitividad/

UNEF (2021b) CONCLUSIONES WEBINAR «Análisis de resultados de la subasta REER» Comunicados de prensa. https://unef.es/2021/02/webinar-analisis-de-resultados-de-la-subasta-reer/

AURES II is a European research project on auction designs for renewable energy support (RES) in the EU Member States.

The general objective of the project is to promote an effective use and efficient implementation of auctions for RES to improve the performance of electricity from renewable energy sources in Europe.

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AURES II has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817619