An assessment of the design of the new renewable electricity auctions in Spain under an international perspective

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Abstract

In order to comply with its renewable energy targets, a new auction scheme has been adopted in Spain, and the first auction with the new scheme was conducted in January 2021. The design of the new auction implies a radical rupture with the previous auction scheme, on the basis of which auctions were organized in 2016 and 2017. The aim of this paper is to assess the design element choices made in the new auction scheme, identifying its pros and cons according to several criteria and goals, comparing them with the choices made in the previous auctions and with the international practice. The main conclusion is that the design elements of the new auctions are generally in line with international practice and are appropriate to achieve the goals set in the National Climate and Energy Plan (NECP). Nevertheless, some suggestions for changes in the scheme are provided.

Key words: auctions, renewable energy, policy, design, Spain.

1. INTRODUCTION

Given its alleged advantages in terms of cost-effectiveness, auctions have been chosen as the main instrument to support the deployment of renewable energy projects worldwide. As of 2019, 106 countries had organized at least one renewable energy (RE) auction, increasing from only 6 in 2005 (IRENA, 2019).

Spain is no exception in this regard. The country conducted three rounds of auctions under the same model between 2016 and 2017, and 8.7 GW were awarded. In order to comply with its renewable energy (RE) targets, a new auction scheme has been adopted in Spain, and the first auction with the new scheme was conducted in January 2021. The design of the new auction

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implies a radical rupture with the previous one. This paper aims to assess the design element choices made in the new auction scheme, identifying their pros and cons, comparing them with the previous choices and with the international practice.

It is obviously too soon to judge the effectiveness of the new auction scheme, although other aspects, such as the relatively low prices, are clearly positive. The auction awarded 3034 MW to solar PV and wind projects (2/3 and 1/3 of the awarded capacity, respectively) at a weighted average price of 24.47 €/MWh for solar PV and 25.31 €/MWh for onshore wind (see section 2).

The literature on RE auctions stresses the importance of their design in order to have a successful outcome. The comparison of the design elements adopted in the new auction scheme in Spain with the international practice and the analysis of the pros and cons of the auction is based on a database of auction design features built by the author (see del Río and Kiefer, 2021), the perception of some stakeholders (included in secondary material) and relevant institutions (including the Comisión Nacional de los Mercados y la Competencia, CNMC), economic theory and previous work carried out in the AURES and AURES II projects (for a summary of the results of both projects, see Mora *et al.*, 2017 and Anatolitis and del Río, 2021, this issue).

The analysis of the functioning of RE auctions in the world has captured the attention of academics (see del Río and Kiefer, 2021 for an overview) and non-academic institutions from around the world, in tandem with their worldwide implementation (see, *e.g.*, IRENA, 2015, 2019; CEER, 2020). The analyses of RE auctions in Spain have been scarce and focused exclusively on the previous auctions (see, *e.g.*, del Río 2016a, 2017b, 2018). Two exceptions are worth mentioning. On the one hand, the very general analysis by del Río and Kiefer (2019), which focuses on the main differences in approach between the previous auction scheme and the guidelines of the new one included in the National Integrated Energy and Climate Plan (NECP), at a time when the specifics of the design of the new auctions were unknown. On the other hand, and after taking into account the opinion of several experts, the Fundación Renovables published a report on July 2020, making recommendations for the design of the new auction (Fundación Renovables, 2020). This was also before the actual design features of the scheme were known, although some guidelines of the new scheme had already been published at that time in Royal Decree Law (RDL) 23/2020. Thus, this paper covers this gap in the literature.

Accordingly, the paper is structured as follows. The next section briefly discusses the main goals of the new auction in Spain and its main results. The design element choices in the auction are described and analyzed in section 3, while section 4 concludes.

2. THE NEW RENEWABLE ENERGY AUCTION IN SPAIN: GOALS AND RESULTS

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 in the next decade.

In addition to compliance with the international commitments on RE and decarbonisation, the goals of the government when organising the auction are (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. 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, including the promotion of a diversity of actors and project sizes and encouraging the market exposure of RE installations (see, *e.g.*, RD 960/2020).

The legal framework of the Renewable Energy Economic Regime (REER) in Spain, based on RE auctions, is developed by three pieces of legislation which were passed in 2020. It was habilitated by the RDL 23/2020. The Royal Decree RD 960/2020 regulated the juridical and economic regime of the REER. The Order TED/1161/2020 regulated the auction procedure and the features of the REER. In addition, the first auction under this new regulatory framework was set up on December 10th 2020 by a Resolution of the State Secretary for Energy. This Resolution includes the date for the conduct of the auction, the auctioned volume and the minimum reserves (quotas), the reserve price, the date when the installation must generate electricity, the date when the installation would no longer be supported (the expulsion from the REER) and the maximum delivery period. The auction was conducted on January 26th 2021.

Regarding the results of the auction, 3034 MW of RE capacity were awarded to 32 bidders[1]. The auction was oversubscribed, with 84 bidders bidding 9700 MW. However, it is obviously very early to tell about the project realization rates, which will only be known when the deadlines for construction are reached (February 2023 and 2024 for PV and on-shore wind, respectively). The auction has resulted in a weighted average price of 24.47 €/MWh for PV and 25.31 €/MWh for wind, which are 43 % below the estimation of long-term electricity prices (MITECO, 2021).

There have been 26 awarded bidders in solar PV. The concentration ratio of the largest three awarded bidders (CR3) is 37.1 %, with the largest awarded bidder capturing only 15 % of the total awarded volume. A greater concentration can be observed in the case of wind. There were 8 awarded bidders and the largest three awarded bidders accounted for 76 % of the awarded capacity, with the largest bidder having a share of 62.3 %.

Although all the RE technologies were eligible to participate (with minimum quotas of 1000MW for PV and wind), only two technologies were awarded. PV captured 2/3 of the awarded volume (2036MW) and wind captured the rest (998 MW). In addition to the technology-specific component (the minimum

1 See del Río and James (2021, forthcoming) for more details on the outcome of the auction.

reserves), there was a technology-neutral component (1000 MW) in this hybrid auction, which was fully captured by PV.

3. DESIGN ELEMENT CHOICES IN THE SPANISH AUCTIONS FROM AN INTERNATIONAL PERSPECTIVE

This section analyses the design element choices in the new auction scheme, which can be grouped into several categories. We follow the same structure for all the design elements: we describe the choices, briefly mention their pros and cons[2], identify the design elements in the new Spanish auctions and compare them with the design elements in the previous auctions in Spain as well as with the design choices in the rest of the world (see Annex 1). For each element, a synthesis of the assessment of the choice of design elements in the Spanish auction is provided.

When commenting on the design element choices in the Spanish auction, an important distinction should be made. Some design element choices are prescribed by RD 960/2020, whereas the Ministerial Order and the Resolution provide further details on the choices which have been made.

3.1. Volume

Regarding the category of auction volume, several subcategories should be considered. These include the auctioned product (or the metrics for volume setting), whether the volume should be disclosed before the auction (or not), its level (which can be "too high" or "too low") and whether there is some flexibility in setting this level (*ex post* adjustments).

- There are three possible *metrics* to set the volume auctioned in RE auctions: capacity (MW), generation (MWh) or budget (*e.g.*, million €). A generation-based metric provides certainty on support costs, but effectiveness cannot easily be assessed until the end of the remuneration period. In a budget-based metric,

2 The analysis of these pros and cons is based on del Río (2017a).

there is absolute certainty on the support costs, but the degree of electricity generation or capacity that will result from this budget is uncertain when the auction is launched. With a capacity-based metric, it is easy to assess the building of the renewable energy projects early in the process and it provides better signals to equipment manufacturing firms on the relevant market size, although there will be uncertainty on the total costs of support (see del Río, 2017a for a full discussion).

The volume has been set in capacity terms both in the new and old Spanish auctions. However, a generation volume can be set in the future in the new Spanish auctions. In addition, there is a requirement to provide a given amount of energy by a given date (see section 3.10). An overwhelming majority of countries have also chosen a capacity-based metric. The choice of a capacity metric is reasonable taking into account the aforementioned advantages, the international practice and the fact that the NECP trends are defined in capacity terms. Nevertheless, the option of generation would also make sense, given that the target for the share of renewables in total electricity generation is set in percentage terms (74 %). Notwithstanding, it is easy to translate one (capacity or generation) into the other.

- *Publication* of the auctioned volume provides certainty and transparency for potential investors. This encourages participation, enhances competition and, thus, reduces the support costs. It also provides a better signal to equipment manufacturers and facilitates local industry creation. However, potential bidders can also use this information strategically. The volume in the new Spanish auction is published *ex ante* (3000 MW) and this was also the case in the previous auctions, although the government included the possibility to increase the volume awarded in case of sufficiently low bids (see below). The volume is also generally published before the auction in other countries. Some countries have decided not to publish it in order not to provide too much information, discouraging strategic behavior and collusion, as in Brazil (Förster and Amazo, 2016) and South Africa (del Río, 2016b).

- Regarding the *level*, a too high volume may lead to low competition and high bids[3], whereas a too low volume would obviously mean that the speed of RE deployment would be low. It is clear that the volume in the Spanish auction was not high, given the oversubscription (9700 MW of submitted bids) and the resulting low prices (section 2). It may be argued that it has been too low, given that it was slightly below the NECP trend (5 GW/annually, not 3 GW as in this auction), that the last auction was conducted 3.5 years ago and also taking into account the needs of the supply chain[4]. However, usually the first auctions with a new model have a lower volume, since they are considered to be a "pilot" to test whether the auction works well in practice.

- Two possible ex post *adjustments* of the volume are considered in the Spanish auction. First, in order to encourage sufficient competitive pressure and a minimum competition level in the auction, the volume of product being offered should be 20 % higher than the volume of product being auctioned. If this is not the case, then the latter is reduced after all the bids have been submitted in order to comply with this requirement. Second, there is the possibility to increase the volume (up to 6 %, *i.e.* 3.180 MW) in case there are "attractive bids"[5]. This was also allowed in the previous auctions (although to a much greater extent, *i.e.*, by 1000 or 2000 MW). These volume adjustments seem reasonable, in order to avoid the detrimental effects of low competition (the first one) and, thus, high prices, and to benefit from low bids (the second one), but they are not common elsewhere. An exception is Greece, where a 40 % rule (recently increased to 75 %) exists (see Anatolitis, 2019; del Río, 2020). In the French auction for roof-top PV, if the tendered volume is not reached in a round, the higher bids are eliminated (up to 20 % of the volume of the submitted bids) (CEER, 2020).

3 This seems to have been the case in Germany with solar PV (see IRENA, 2019) and some rounds of the roof-top PV auction in France (see CEER, 2020).
4 For example, the Spanish Wind Energy Association (AEE) states that the 1000 MW of reserved volume for wind in the auction entails a lower work burden than the capacity of the sector, which is close to 4.000 MW/year (AEE, 2021).
5 See article 8.5 of RD 960/2020 and number 3.2 in the Resolution.

3.2. Schedule and frequency

In this case, two subcategories are worth considering: the decision on whether to set a schedule (or not) and the level of frequency (number of rounds per year). This distinction is important. A schedule of auctions implies a commitment to launch an auction at regular intervals. The alternative is to organize ad-hoc auctions. But, even if there isn't a schedule of auctions, these may be organized on a regular basis (*i.e.*, with a high frequency) and vice versa.

A *schedule* or a high frequency, *i.e.* a minimum of auction rounds per year, suggests a longer-term commitment to RE deployment over time, in addition to encouraging a supply chain. It reduces the sunk costs of participation if the required administrative permits can be used in successive rounds in case of not being awarded. This reduces the risks for investors, facilitates financing of projects and encourages participation in the auction, which would lead to lower generation and support costs. A schedule may also mitigate the existence of too aggressive bidding behavior in order to be awarded when there is a single round, which may lead to underbidding and underbuilding. Finally, an auction schedule provides certainty and a signal to the industry (equipment manufacturers) which may plan and adapt their strategies accordingly. On the other hand, a lack of schedule provides more flexibility to auctioneers, enabling them to adapt to changing circumstances.

A schedule has been set for the REER in the period 2020-2025 which includes indicative deadlines, the frequency of the rounds, the expected capacity and the envisaged technologies. Minimum capacity volumes for each technology in the period have been set[6]. This is also deemed an appropriate design element choice, and one which is in contrast to the previous auctions, which were organized on an *ad hoc* basis and also in contrast to most countries, which do not have a schedule of auctions (see Annex 1).

6 These are: 1) Wind: 1000 MW (for 2020), 1500 MW (in each of the years of the period 2021-2025); 2) PV: 1000 MW (in 2020), 1800 MW (in each of the years of the period 2021-2025); 3) CSP: 200 MW (in 2021), 200 MW (2023), 200 MW (2025); 4) Biomass: 140 MW (in 2021), 120 MW (2023), 120 MW (2025); 5) Other technologies: 20 MW (2021), 20 MW (2023), 20 MW (2025).

Regarding its *frequency*, setting minimum volumes per year and the existence of at least an annual auction are deemed appropriate choices. There is not a requirement to conduct a predetermined number of auctions, since this would reduce the flexibility for the government and could lead to a narrow market in a given round. CEER (2020) attributes the increase in prices in Germany's technology-neutral tenders to the existence of too many rounds (it was the only country that held two rounds each in 2018 and 2019) and suggests that it might be beneficial for countries to have fewer rounds (CEER, 2020, p. 40; see also IRENA, 2019). Nevertheless, the absence of an auction per year would lead to a detrimental stop-and-go process for the value chain.

3.3. Lead times

Lead times refer to the period between the announcement of the auction and the submission of bids. They need to be long enough so that potential participants may prepare their bids with enough time. However, the deadline to submit bids should not extend too long, since this delays the outcome of the auction (Fundación Renovables, 2020). In the new scheme, the RDL 23/2020 was published on June 23rd 2020, RD 960/2020 was published on November 3rd 2020, the Ministerial Order TED/1161/2020 was published on December 4th 2020, the Resolución of the State Secretary for Energy was published on December 10th 2020 and the bids had to be submitted on January 26th 2021. Therefore, bidders had a little bit more than a month (with Christmas holiday in the middle) to prepare their bids. This period can be deemed rather short, but it may be justified due to the urgency to conduct an auction in order to comply with the 2020 milestone. According to the Council of European Energy Regulators (CEER), in most European countries, "bidders have between one and six months to prepare the requisite documentation for submission", *i.e.* between the announcement of the submission dates and the moment when they have to submit their bids (CEER, 2020, p. 14). Therefore, 3 months seems to be an appropriate lead time. In the previous auctions, the periods were quite similar to this one.

3.4. Technological diversity

Regarding technological diversity, auctions can be technology-neutral (TN), when all renewable energy technologies are eligible to participate and be awarded, and technology-specific (TS) when only one technology is eligible to participate. In multi-technology auctions (MT), several of them can participate. TN auctions should be the preferred choice if minimization of support costs is the policy goal, since all technologies compete with each other and the cheapest ones are awarded, which could also lead to the lowest bids[7]. However, TS auctions lead to a greater diversification of energy sources, support for different RE value chains and different products. TS auctions could reduce the indirect costs (and, thus, lead to lower system costs) since different types of technologies which are complementary from an electricity system point of view (*i.e.*, variable and dispatchable) can be promoted. If the goal is to have a local industry, then TS auctions should also be preferred. It is difficult to design an auction which is really neutral for all technologies, since these have different features and, thus, are affected differently by the same prequalification requirements, realization periods and penalties.

According to RD 960 (article 3.2), a distinction in the auction can be made between the different generation technologies depending on their technical characteristics, size, dispatchability levels, locational criteria and technological maturity. A hybrid design (technology-neutral and technology-specific reserved capacities) has been adopted in Spain in this new auction. The Resolution includes two minimum reserves (1000 MW for solar PV and another 1000 MW for wind on-shore), in addition to the overall volume (3000 MW). Most auctions around the world are TS (Annex 1) and we do not know of any auction which includes this hybrid combination of TS and TN. The previous auctions in Spain were TS (January 2016), TN (May 2017) and MT (July 2017).

This hybrid design is quite innovative, since it allows simultaneously capturing the advantages of TS and TN auctions. However, we miss minimum reserves for

7 However, taking into account the principle of third-degree discrimination, some authors argue that technology-specific auctions may be more suitable if minimization of support costs is the goal (Mora *et al.*, 2017).

dispatchable technologies, although these are foreseen in the schedule every two years (2021, 2023, 2025). We also deem appropriate that demonstration projects are exempted from the auction scheme (article 3 in RD 960/2020), since the suitability of auctions has not been demonstrated for them.

3.5. Geographical diversity

Auctions can be geographically-neutral (there isn't any requirement or incentive to deploy the project in a given location) or not (the location is either pre-selected by the government or an incentive to locate in given places is provided). In auctions which are not geographically-neutral, the indirect and, thus, system costs are likely to be lower (since congestion in specific places and grid constraints would be taken into account when setting the locations) but the direct generation costs (LCOE) could be higher, since the best locations in terms of renewable energy resources would not necessarily be exploited first. Therefore, if the goal is to minimize the direct costs, then geographical neutrality would be a better choice, since usually only direct costs are considered in auctions. But if minimization of indirect generation costs (and system costs) is the goal, then it would be preferable to have geographical diversity, especially in countries with a weak grid. The auctions in Spain (both the previous and the new ones) have been geographically-neutral. The choice is balanced worldwide (see Annex 1). In the future, auctions with geographical incentives or geographically-specific auctions could be recommendable in order to reduce congestion and grid connection costs or to favour places which are particularly depressed or affected by the closing of coal power stations or mines and to avoid NIMBYsm. We believe that it might be better to have those location-specific auctions (*i.e.*, segmentation) rather than including adjustment factors in either the merit order or the remuneration to favor certain locations over others, since this reduces the transparency and simplicity of the auctions.

3.6. Actor and size diversity

In actor-neutral auctions, large actors are likely to dominate participation and awarding, since they are more likely to offer low bids (Jacobs *et al.,* 2020).

Compared to auctions which promote actor diversity (for example, by providing additional remuneration for smaller actors, or organizing contingents for them), actor-neutral auctions would lead to lower generation costs and support costs but, maybe, a higher likelihood that the projects will be built (if large actors are more professional firms with a long-standing experience in building renewable energy projects). However, a more diversified, less concentrated market has also positive economic features, *i.e.*, a lower risk of collusion. Having a large number of actors ensures that a given actor will not have a dominant position and the resulting prices will be more attractive (Fundación Renovables, 2020)[8]. Indeed, actor diversity is a policy goal in some countries (*e.g.*, Germany and Spain). A greater size reduces costs through economies of scale, but the small RE projects developed by citizens or SMEs show multiple benefits, such as encouraging distributed generation, the closeness to consumption points (which reduces losses), the lower need to develop electricity grids and a lower environmental impact than a large project (Fundación Renovables, 2020; Jacobs *et al.,* 2020).

Actor diversity is an explicit goal of the NECP and the auction regulatory package. According to RD 960, art. 8.13, "the particularities of RE communities can be taken into account in the definition of the criteria and the functioning of the auction so that they can compete with other participants in the market on equal conditions". Size diversity is also encouraged. In its article 3.2, the RD 960/2020 states that the ministerial order will be able to exempt small-size installations (<5 MW) and demonstration projects from the auction. In this case, the result of the auction can be used as a reference for their remuneration. However, as in the previous auctions, different sizes and actors have not been promoted in this auction. There has been neither a maximum size limit nor a promotion of RE communities in the new auction. However, this is understandable, since this was the first auction with the new scheme and the government probably wanted to know its functioning without being "polluted" with additional aspects which would not allow identifying the effects of the basic design on its results. It is important to acknowledge that, worldwide, the auctions which facilitate

8 For example, CEER (2020, p. 22) argues that one of the reasons for the lower level of competition in the latter German rooftop PV tenders was that, due to high competition at the start, smaller installations could have seen themselves as not competitive enough and did not participate further. This situation led to lower levels of competition and thus higher prices.

the participation of small actors are an exception, although most set project size limits (see Annex 1). We believe that, in the future, specific auctions for RE communities and small projects should be implemented in order to have a more diversified sector. In the case of small projects, a FIT with the remuneration being indirectly set in the auction may be a better alternative, given the usual difficulties of small actors to participate in the auction (see Jacobs *et al.,* 2020).

3.7. Prequalifications

Prequalification (or qualification) requirements in order to participate in the bidding procedure may be financial or material. The latter may fall on the bidder (*e.g.*, previous experience, a good financial record or economic guarantees) or the project (*e.g.*, pre-development of sites or possession of administrative permits) to mitigate the risk of non-realization. They are adopted in order to ensure the seriousness of bids and encourage the construction of projects[9]. However, if they are too stringent, they may reduce the incentive to participate in the auction (which affects competition) and, in addition, entail higher costs which are translated into higher bids. Therefore, they should be set at reasonable levels (neither too high nor too low) (del Río, 2017a).

In the new Spanish auction, and similarly to previous auctions, a guarantee for the participation in the auction of 60€/kW has been required. This is given back to the awarded bidders after the installation has been inscribed in the "pre-allocation registry". A guarantee for the registration in the REER of 60€/kW is also required. It is given back gradually after some milestones are accomplished: identification (name, location and capacity) of the installation (18€/kW, needed in six months), securing the construction permit (12€/kW, 12 months) and inscription in the "exploitation registry" (30€/kW, 1 month). In addition, the awarded bidders will need to present a supply-chain plan (a strategic plan which includes estimations on the socioeconomic impact of the installations). Virtually all countries include prequalifications in their design and the difference between them is the more or

9 Matthäus (2020) shows a positive correlation between the realisation rate of projects and the setting of qualifications (indeed, the author shows that qualification requirements is the design element with the largest effect on the effectiveness of the auction in his econometric model).

less stringent levels[10]. The prequalifications being adopted are deemed suitable ones. They retain a line of continuity with respect to the previous auctions, which proved to be adequate to favour deployment[11]. The combination of economic guarantees and material prequalifications (identification of the installation and building permit) is in line with the practice in many countries, although it is less stringent than in those countries which require a grid connection point.

3.8. Seller concentration rules (SCRs)

SCRs promote competition and the auction may be cancelled if there is not a minimum number of participants. A single actor may be prevented from capturing a very high share of the market. A SCR has been included in the Spanish auction. The maximum volume which can be awarded to the same firm can not exceed 50 % of the total volume being awarded (art. 8.6 RD 960/2020). Therefore, a bidder can not be awarded more than 1500 MW.

The concentration rule is deemed a proper one since "it will encourage competition in the electricity market, allowing the entry of a greater number of actors" (MITECO, 2020b, p. 18). It can be questioned whether 50 % is excessive and if a lower percentage could have been set (40 % or 30 %). This rule was non-existent in the previous Spanish auctions and it is not common worldwide, although some governments have set a required minimum number of participants and/or awarded bidders in the auctions (*e.g.*, in Colombia, Portugal, California, India and Poland) (see del Río, 2020; del Río *et al.,* 2015, 2020; Jacobs *et al.,* 2020).

3.9. Remuneration type

Remuneration can be provided for generation (MWh) or capacity (MW). Certainty on the total amount of support costs is greater with capacity-based remuneration,

10 Due to limitations on data availability, prequalification requirements are not analysed in del Río and Kiefer (2021).
11 In the first auction (2016), the economic guarantee was arguably too low (20€/kW), despite the recommendation of the CNMC to set it at 50€/kW (CNMC, 2015). This was corrected in the second (May 2017) and third auction (July 2017), which set the economic guarantee at 60€/Kw.

since this is provided initially (up-front) and for a given amount of MW. It is not necessary to wait decades to know the total amount of support provided (as with generation-based support). However, efficiency in RE generation is greater with generation-based support, because the efficient functioning of plants and their proper maintenance are encouraged. Capacity-based remuneration is provided irrespective of the amount of electricity generated. Remuneration in the new Spanish auction is provided for generation (€/MWh), in contrast to the previous auction, which was capacity-based (€/MW). This is a standard choice almost everywhere (see Annex 1). However, some authors argue that capacity (investment) should be supported rather than generation (operating support). For example, von Blücher *et al.* (2020, p. 18) argue that "operating support generally incentivizes plant output, since support is paid per kWh. In contexts where support payments make up major parts of the project revenues, this increases the effectiveness in terms of (generation) target achievement compared to investment support and thereby also the cost-effectiveness of support. However, as support shares in total revenues continuously decrease in the European Union, this argument becomes less relevant. This is specifically true for variable RES which tend to maximize production in any case, as they have close-to-zero operating costs. (…). A general disadvantage of operating support is that it has a distortive effect on the dispatch of RES installations and therefore creates adverse effects on market integration".

3.10. Remuneration form

Generation-based remuneration can be provided as a full payment (FIT) or through a premium top-up on the market price (FIP). Within FIPs, a main distinction is between fixed and sliding FIPs. Fixed FIPs are set once and do not alter. Thus, the total remuneration depends on the evolution of market prices. Sliding FIPs are calculated at regular intervals to fill the gap between the average market price perceived by all generators of a given technology and the strike price set in the auction. Sliding FIPs can be one-sided or two-sided (commonly known as contract-for-differences). FITs lead to the lowest risks for investors but do not encourage electricity generation at times when this electricity would be more valuable for the electricity system. Fixed FIPs are a better option for the market integration of RE, because electricity generators have an incentive to generate electricity at times when the system needs it most, *i.e.*, at times of peak demand when the electricity price is higher. Sliding FIPs entail a compromise between both goals (see Noothout *et al.,* 2016 for further details). Under the current EU regulation, support has to be provided in the form of a FIP (see article 4.3 of Directive 2001/2018). Therefore, the choice is restricted to sliding or fixed premiums.

In the Spanish auctions, a two-side sliding feed-in premium (CfD) has been chosen. The installation will participate in the day-ahead or intra-day markets and will receive a price for the energy delivered which will be calculated from the awarded price in the auction and the day-ahead market price according to the following formula (article 18 of RD 960/2020):

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

Where PR is the price received by the installation, AP is the awarded price in the auction, MP is the day-ahead market price and AF is the adjustment factor. If PR is above MP, then there is a payment obligation for the market to the installation. If the PR is below the MP, then there is a revenue stream for the market (article 23 of RD 960/2020).

The installation has to deliver a given amount of energy within a certain period. If the auctioned product is capacity, then this energy is defined within a range given by the maximum and minimum energy of the auction and such energy is remunerated for 12 years, and can be sold in the market afterwards. The maximum and minimum energy would then be calculated according to the following formula: Maximum (minimum) energy of the auction = Capacity * Maximum (minimum) number of annual full-load hours * maximum delivery period (years)[12]. If the installation does not deliver the minimum energy, it is penalized.

12 The installations have to sell the minimum energy of the auction in the maximum delivery period (article 16 RD 960). This period is set by the Resolution (12 years for PV and wind) and starts on September 30th 2023 for PV and in September 30th 2024 for on-shore wind. For other technologies (not awarded), the period is: CSP (2024), off-shore wind (2025), rest of RE technologies (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 or when the maximum delivery period are reached. When the minimum energy of the auction is reached, the installation can quit the REER and sell the electricity in the market (even before the 12 years), and it would only receive the market remuneration (article 17 RD 960/2020). 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 (see article 20 in RD 960/2020).

The aim is to take into account the value of electricity (time-of-day diversity) and not only its price, in order to reduce the system costs. More and more countries are including design elements which allow them to consider the value of electricity (when and where it is produced). According to Lucas (2020), the market exposure of the awarded installations is guaranteed through the following provisions: 1) The installations have the obligation to bid in the day-ahead or intra-day markets with their best production forecast. 2) The installations will be able to participate in the adjustment and balancing services according to the applicable regulation, that is, on a level playing field with the rest of technologies. 3) The installations only sell under the REER a part of their energy (the maximum energy of the auction). After exiting the retributive mechanism, the rest of the energy which is generated by each installation during its useful lifetime can be sold in the market and at market prices. 4) Additionally, the Royal Decree envisages that, in given calls, it will be possible to include an additional element of market exposure, through a parameter called "percentage of market adjustment" or, as we call it, "adjustment factor (AF)".

The AF represents the percentage of energy which is remunerated at market prices (MP), with the rest being remunerated at the awarded prices (AP). It may range between 0 and 0.5 (0 % and 50 % in percentage terms). The aim of the AF is to encourage electricity generation in the most expensive hours of the day in order to reduce the price of electricity in those hours. This encourages the deployment of installations which are able to shift their production. The AF increases the remuneration received by the installation when the market price is above the award price and reduces it when it is lower (MITECO, 2020a, p. 24). When the market price of electricity is low, the remuneration is low. So, the lower the market price, the lower the received price. 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.

The AF is set by the Resolution, taking into account the maturity of the technologies, their competitiveness, their dispatchability, their generation profile and other technical characteristics, as well as the size of the installations. Two AFs are set: 25 % if the technology is dispatchable and 5 % if not. However, the AF for non-dispatchable RE technologies (0.05) is perhaps too low. Since the sale of electricity under the auction has only a 5 % exposure to the market price, it is highly independent from it. In line with CNMC (2020b), we would propose that it increases up to 0.25 (and to 0.50 for dispatchable technologies), in order for the installations to respond to the market price signal while simultaneously having foreseeable revenues (CNMC, 2020b).

We believe that the CfD option is a good choice, since it achieves the best balance between the aforementioned conflicting goals (lower investor risk and greater market exposure). In addition, many European countries have adopted this CfD mechanism, or a one-side sliding premium (see del Río and Kiefer, 2021 for details). In contrast to the previous auctions, this one allows the consumer to benefit from a lower electricity price from the penetration of RE in the market. This is the result of an indirect effect (the impact on the merit order due to a greater penetration of technologies with low variable costs, such as as RE technologies) and a direct one (since the lower price of energy resulting from the auction is integrated into the market, leading to an economic surplus). In contrast, the existing specific retributive regime (the previous auctions, see del Río, 2016a for details) does not allow to transfer the reduction of generation costs to the consumers (MITECO, 2020a, p. 21). As mentioned in RD 960/2020 (p. 5) "in those negotiation periods in which the last bid matched corresponds to technologies with high variable costs, the integration of renewables under the specific retributive regime does not lead to a reduction in the price received by the consumer, but rather to a profit for the installations with low variable costs".

A main effect of CfD (with respect to fixed FIPs) is that the risk for the project developers is reduced. However, this does not necessarily mean that, overall, the risks are reduced, since they may be transferred among actors (*e.g.*, a lower risk for investors at the expense of a higher risk for consumers). Some authors argue that, indeed, the risks are being transferred to the consumer (see, *e.g.,* Salmerón, 2020; Díaz, 2020; CNMC, 2020b).

3.11. Selection criteria

In price-only auctions, "the lowest bids" are the only award criterion. In multi-criteria auctions, price is the main criterion among other criteria (*e.g.* local content rules, industry or employment creation), which allow governments to achieve other goals besides "a low price". However, this is probably at the expense of higher bids. Multicriteria auctions are the exception, rather than the rule, especially in Europe (see Annex 1)[13]. This may be related to the higher simplicity and transparency of price-only auctions and the aforementioned higher bids in multicriteria auctions (Mora *et al.,* 2017). For the same reasons, we deem the choice for price-only auctions in the Spanish auctions an appropriate one. If the government wants to achieve non-price criteria, this should be done through the prequalification requirements, and not by including them in the merit order or in the remuneration.

3.12. Auction format

In a single-item auction, a single product is allocated to a single owner and the product cannot be split. In a multi-item auction, the auctioned product is split among different owners and bids are submitted for only part or the total auctioned amount (del Río, 2017a). The new Spanish auction is a multi-unit auction one (and this was also the case in the previous one). This is a standard choice worldwide for an auction such as the Spanish one, *i.e.*, with relatively high volumes and the participation of several (modular) tecnologies such as PV

13 One interesting exception is the French wind off-shore auction, where three key award criteria were weighted differently– price (80 %), occupancy of the area (11 %) and environmental impacts (9 %) (CEER, 2020, p. 36). In the PV tenders in France, the price offered by the bidders is not the only criterion. Other criteria such as the carbon footprint, the environmental relevance or the level of innovation are considered (CEER, 2020, p. 19).

and on-shore wind, and particularly in European countries, which do not have weak grids (see del Río and Kiefer, 2021). For most technologies, single-item auctions are not recommendable, for reasons of efficiency or diversification of the risk of non-compliance. Their use seems to be restricted to certain technologies for which spliting the auctioned volume in different projects is difficult or not convenient due to the existence of economies of scale (CSP or wind off-shore) or, as mentioned above, for countries with a weak grid, which makes it advisable to set the location, number and size of the projects (del Río, 2020).

3.13. Auction type

Auctions can be dynamic or static. In dynamic auctions, bidders interact with each other when submitting their bids, and can adjust them accordingly. In static (also called sealed-bid) auctions, bidders provide undisclosed bids to the auctioneer, who then ranks the projects accordingly. Sealed bid auctions mitigate the risk of collusion compared to dynamic ones. Dynamic auctions might be slightly preferable if effectiveness is the policy priority, since the information revealed during the process may reduce the risk of underbidding and, thus, underbuilding (del Río, 2017a). According to Fundación Renovables (2020), when several products are simultaneously auctioned, sealed-bid auctions would lead to less aggressive bidding behaviours by bidders, since they do not condition their bids if they do not see what is happening with the others, which would be the case under dynamic auctions.

The new (and previous) auctions in Spain have been static ones. This is a standard choice elsewhere, probably because of their simplicity and ability to mitigate the risk of collusion (see Annex 1). CNMC (2020a) calls the new auctions "repetition auctions", since they are conducted with a relatively high frequency. This favors the "learning of bidders as auctions are being conducted which, in practice, could increase the probability of collusory practices. Thus, under repetition auctions, it is recommendable to opt for a static auction format" (CNMC, 2020a, p. 13). Although dynamic auctions have been used in a few countries, del Río (2020) notes that there is a timid trend towards its use, for example in the recent auctions in Portugal and Greece.

3.14. Pricing rules

Under pay-as-bid (PAB) pricing, awarded bidders receive the price they bid for. Under uniform pricing, all bidders receive the same clearing price, *i.e.* the price of the last bid accepted or the first bid not accepted (Wigan, Föster and Amazo, 2016). There is an abundant literature on which pricing rule is preferable, although a consensus has not been reached (see Haufe and Ehrhart, 2015). Under simplified theoretical assumptions, both rules would lead to the same result, since both are allocative-efficient, as the product is awarded to the bidders with the lowest bids (Haufe and Ehrhart, 2018). In principle, bidders have a greater incentive to disclose their actual costs in uniform pricing, since their remuneration is independent from their bid (IRENA, 2015; Khan *et al.*, 2001; Vázquez, Rivier and Pérez-Arriaga, 2001). However, uniform pricing is not more incentive-compatible when bidders participate with more than one bid or in more than one auction, or their costs have a common component (Mora *et al.*, 2017). According to Haufe and Ehrhart (2018), a main advantage of PAB auctions is the simplicity in their implementation.

In practice, uniform pricing in RE auctions seems to have encouraged unexperienced bidders to submit very low offers (sometimes below their costs) in order to ensure that they are awarded (Wigan, Föster and Amazo, 2016). If the level of competition is very high, PAB may mitigate the risk of over-remuneration. However, it is unclear which option minimises the costs of support (see del Río, 2017a). In addition, the impact of the pricing rule on the realisation rate of RE projects is inconclusive in the empirical literature (Matthäus, 2020, see also the discussion in CNMC, 2020a). The pricing rule chosen in Spain has been the PAB rule. This is in line with the international experience (see Annex 1), but in contrast to the previous auctions in Spain.

3.15. Ceiling prices

Ceiling prices avoid the risks of high support costs in case of low competition levels and high bids. These prices should not be disclosed before the auction, because this would encourage bids which are marginally close to the ceiling (anchorage effect).

Article 8.4 of RD 960/2020 states that, in the Resolution of the Secretary of State for Energy, a ceiling price will be set, which may be confidential. In fact, such Resolution (number 8) states that the ceiling prices will be confidential, *i.e.* not published before the auction. For the reasons mentioned above, we deem this decision an appropriate one. The existence of ceiling prices is common in other countries (see Annex 1). Although some countries have decided not to reveal those maximum prices before the auction (in order to avoid the aforementioned "anchorage effect"), most countries do, since they may believe that this increases trasparency, the confidence of investors and their participation (del Río, 2017a).

3.16. Minimum prices

According to article 8 of RD960/2020, a minimum price can be set which may be confidential. A minimum price prevents that bids are below such a price and thus, it discourages underbidding. Although number 8 of the Resolution sets this price at 0 euros/MWh for this auction, the possibility that it has positive values in the future is appreciated. A few countries have adopted this design element in the past, including Italy, Cyprus and the Netherlands.

3.17. Realisation periods

The awarded projects should be built by a given date for reasons of effectiveness. The problem is to set the realization periods at appropriate levels. Too short periods may make it difficult to close the financing of projects or allow the project developers to obtain the necessary permits. Too long periods may lead to low bids (given the expectation of cost reductions of the technologies), but there is also a risk of ineffectiveness (if the projects are not built because the expected cost reductions do not materialize and projects are not profitable) (del Río, 2020). The realization periods are 3 years (for PV) and 4 years (for wind on-shore). The deadline for building the installation is February 2023 (for PV) and February 2024 (for on-shore wind). The date in which the maximum delivery period starts is September 2023 (PV) and September 2024 (for on-shore wind). We believe that this is an appropriate choice both for PV and for wind on-shore since they are periods which are neither too long nor too short. According to MITECO

(2020a, p. 20), 18 months are needed in order to build a PV project and 24 months are required to build a wind farm, although it may take longer due to administrative procedures. Thus, a longer deadline for wind projects is also deemed correct. According to del Río and Kiefer (2021), the average realization periods in the wind auctions worldwide have been 3.7 years, and 2 years for PV. Therefore, the aforementioned realization periods in the Spanish auction are normal ones.

3.18. Penalties

Countries usually choose a mix of strategies to discourage delays and non-realization of projects, including forbidding the participation in successive auctions, the enforcement of bonds, support reduction, reductions in support duration and penalty payments (Wigan, Föster and Amazo, 2016; del Río, 2017a). Setting the level of penalties is not an easy task, since too stringent ones would discourage participation and result in too high bids, but setting them too low would make them ineffective and underbidding and low project realization would be more likely with low penalties (Kreiss, Ehrhart and Haufe, 2017; Mora *et al.,* 2017), although high penalties are not a guarantee that the projects will be built (del Río and Linares, 2014). Striking a balance between pre-qualification requirements and penalties is of key importance, as well as adapting penalties to local circumstances (Wigan, Föster and Amazo, 2016). In early auctions, the lower prequalification requirements should be balanced by penalties[14]. In late auctions, lower penalty levels can be set, since prequalification requirements already incentivize bidders to be more "serious" (Mora *et al.,* 2017).

In the Spanish auction, the enforcement of bid bonds is the obvious most important penalty for failing to build the project, with some milestones in the middle (see section 3.7). But there is also a penalty for failing to provide the required energy (minimum energy of the auction) when the maximum delivery

14 Auctions can take place at different stages of the project development process. They could *e.g.* be conducted rather early in the project planning process (*early auctions*). Alternatively, projects can be required to wait until the permitting procedure concludes in order to participate in an auction (*late auctions*) (Mora *et al.,* 2017).

date is reached and automatic penalties of 5€/MWh for not reaching such minimum energy in the intermediate milestones (*e.g.*, every three years) apply (article 20 RD 960/2020 and article 19 of the Order TED/1161/2020). This is not an exceptional design element in the international practice. For example, in Brazil, there is a system of penalties for deviations of electricity production. Settlement rules to manage production deviations can help discourage developers from systematically over- or underestimating their generation expectations, and setting up early warning systems to identify delays at an early stage helps to constructively address delays in a timely manner (Wigan, Föster and Amazo, 2016).

The following table summarizes the design choices in the Spanish auctions and internationally.

Table
Summary of the design elements

Design element category	Design element choice	Auctions 2016-2017	New auctions (basic regulation)*	Auction January 26th 2021	International practice (most frequent)**
1. Volume	Volume auctioned (metric)	Capacity	Capacity or generation	Capacity	Capacity
	Volume auctioned (publication)	Yes	Yes	Yes	Yes
	Volume adjustments	Yes (large)	Yes	Yes (small)	No
2. Schedule and frequency	2. Existence of a schedule	No	Yes	Yes	No
	2. Frequency	Irregular (1 in 2016, 2 in 2017, none in 2018 and 2019)	At least once a year 2020-2025	January 2021	Variable

Table (continued)

Summary of the design elements

Design element category	Design element choice	Auctions 2016-2017	New auctions (basic regulation)*	Auction January 26th 2021	International practice (most frequent)**
3. Lead times		2016: 1.5 months	1.5 month (December 10th 2020, January 26th 2021		n.a.
4. Technological diversity		TS, TN and MT	TS or TN	Hybrid (a TS component and a TN component)	TS
5. Geographical diversity		Neutral	Neutral	Neutral	Mostly neutral
6. Actor and size diversity	Size diversity	Neutral	Diverse (possible exemption of small installations)	Neutral	Diverse
	Actor diversity	Neutral	Diverse (possible effect on RE communities)	Neutral	Neutral
7. Prequaification		1st auction (January 2016). Inexisting material prequalifications, low economic guarantees 2ª and 3ª auctions (2017). Material prequalifications: identification of the project, building permit, higher economic guarantees	Economic guarantees, identification of the project, building permit	Economic guarantees, identification of the project, building permit	Stringent

Table (continued)

Summary of the design elements

Design element category	Design element choice	Auctions 2016-2017	New auctions (basic regulation)*	Auction January 26th 2021	International practice (most frequent)**
8. SCR		No	Yes (<50%)	Yes (<50%)	Uncommon
9. Remuneration type		Capacity	Generation	Generation	Generation
10. Remuneration form		Capacity-based	CfD	CfD	FITs (sliding FIPs in Europe)
11. Selection criteria		Price (descuento Rinv)	Price	Price	Mostly price
12. Auction format		Multi-item	Multi-item	Multi-item	Mosty Multi-item
13. Auction type		Static	Static	Static	Static
14. Pricing rules		Uniform	PAB	PAB	PAB
15 Ceiling prices	Ceiling prices (existence)	Yes	Yes	Yes	Ceiling prices
	Ceiling prices (disclosure)	Disclosed	Possibility for confidentiality	Confidential	Disclosed ceiling prices
16. Minimum price		Yes	Possibility to set a minimum price	Yes (0€)	Uncommon
17. Realisation periods		Almost 4 years (2016 auction), 2.5 years (2017 auctions)	Yes	3 years (for PV) and 4 years (for wind on-shore)	Common
18. Penalties		Yes	Yes	Yes	Common

* As in RD960/2020.
** See Annex 1 and del Río and Kiefer (2021) for further details.

4. CONCLUSION

In order to comply with its renewable energy targets, a new auction scheme has been adopted in Spain, and the first auction with the new scheme was conducted on January 2021. The aim of this paper has been to assess the design element choices made in the new auction scheme, identifying its pros and cons according to several criteria and goals, comparing them with the previous choices and with the international practice.

There are two main conclusions from this paper. First, the design of the new auction implies a radical rupture with the previous auction scheme, on the basis of which auctions were organized in 2016 and 2017. Second, the design elements of the new auctions are generally in line with international practice and are appropriate to achieve the goals set in the NECP. However, some suggestions for minor changes in some design element choices have been provided throughout the analysis.

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ANNEX 1.

Design element choices in the RE auctions worlwide (nº of auctions)

Design category	Design choices	Nº of auctions
Volume	Generation	7
	Budget	8
	Capacity	78
	Hybrid	1
Disclosure	Y	78
	N	5
Timing	Schedule	25
	No schedule	57
Tech. diversity	Neutral	13
	Multi	11
	Specific	75
Geo. diversity	Neutral	40
	Diversity	41
Actor div.	Neutral	75
	Diversity	11
Size diversity	Neutral	22
	Diversity	70
LCRs	Yes	21
	No	67
SCRs	Yes	16
	No	64
Information provision	Yes	10
	No	61
Remuneration type	Capacity	3
	Generation	86
	Hybrid	2

Design element choices in the RE auctions worlwide (nº of auctions) (continued)

Design category	Design choices	Nº of auctions
Remuneration form	FIT	58
	fFIP	6
	sFIP	24
	Other	5
Selection criteria	Price-only	73
	Multicriteria	18
Auction format	Multi-item	61
	Single-item	29
Auction type	Static	83
	Dyn.	2
	Hybrid	7
Pricing rules	PAB	83
	Uniform	8
Ceiling prices	Yes	73
	No	11
Disclosure	Yes	58
	No	15

Source: Del Río and Kiefer (2021).