RECOMMENDATIONS FOR IMPLEMENTING AND EFFICIENTLY OPERATING RENEWABLE AUCTIONS FOR ENERGY COMMUNITY CONTRACTING PARTIES BASED ON EU BEST PRACTICES

REKK

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1 Introduction

Renewable auctions currently operate in almost all EU member states as the primary method for allocating operational financial support, mostly associated with renewable electricity installations. Zabala and Diallo (2022)[1] show that auctions are historically very successful allocation mechanisms, significantly contributing to the greater deployment of renewable capacities and the reduction of support costs.

However, policy and market conditions changed significantly in the early 2020s. First, addressing climate change and reducing GHG emissions became increasingly important priorities globally and within the EU, which shifted the objective of the auction design, placing less emphasis on cost-efficiency. As a second point, due to the high wholesale electricity prices in Europe, new wind and PV projects were completed without governmental support, meaning that market participants concluded long-term power purchase agreements (PPAs). And third, high prices also increased the risks of over-subsidisation of mature renewable energy technologies. As a result of these policy developments in parallel with market condition changes, new technologies such as RES + battery storage, became more and more competitive solutions.

In this changing environment, most of the Energy Community (ENC) contracting Parties (Energy Community countries/ENC countries) have either recently introduced or are planning to introduce competitive renewable auctions. Ideally, these new schemes should incorporate relevant measures to adapt to the current and expected future market environment and apply well-established European best practices in their design.

Thus, the main purpose of the current study is to provide recommendations for Energy Community countries on how to implement and efficiently operate their auction design in line with recent market trends, new innovative solutions, and EU best practices.

Section 2 summarises the most common design elements from EU auctions and the latest changes in these tenders[2] since 2020. Section 3 presents innovative new solutions that have emerged in response to current market trends, mainly in the EU, but using examples from third countries. Section 4 of the study analyses the current state of auction procedures in the ENC contracting parties and compares and contrasts with EU Member State auctions. The study concludes in Section 5, presenting recommendations for the optimal ENC auction design.

1 https://op.europa.eu/hu/publication-detail/-/publication/e04f3bb2-649f-11ed-92ed-01aa75ed71a1/language-en

2 Auctions and tenders can have different meaning in different countries and throughout this report they are used interchangeably as synonyms; the competitive allocation of (mostly) support.

2 EU auctions – Best practices & Recent trends

This section of this report summarises the most common design features and recent trends in EU Member State auctions.

2.1 Auction design - Best practices within EU

Auction designs throughout the EU are heterogeneous, which is advantageous because each country can tailor the design elements to their own specificities and conditions. On the other hand, unique design elements increase the costs for international investors that must adapt to different sets of specific rules where they would like to invest. Among the many design elements there are some which heavily influence the effectiveness or the efficiency[3] of the support scheme, while others are mainly administrative and can be adjusted to the country's own institutional setup without any real effect.

2.1.1 Auctioneer and average number of rounds

One of the basic auction characteristics refers to the responsible institution that organizes it. There are several options but the most common choice in the EU is the regulatory authority. There are also some cases where the relevant ministry for energy / environmental issues the auctioneer and one example (Ireland) of the TSO is. Alternatively, in some instances, the auction is organised by a non-governmental entity, such as the electricity market operator, or an Energy Agency. Figure 1 (Left) illustrates the responsible entity for each EU country.

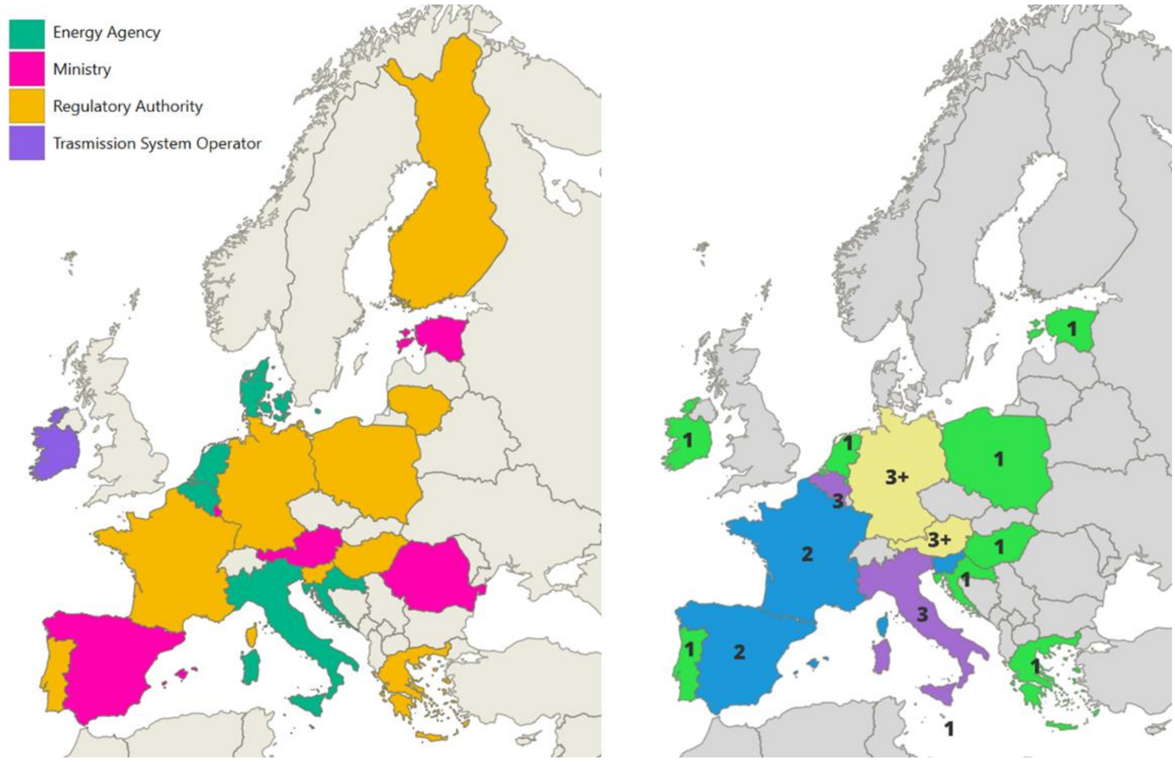
There is no clear evidence that the entity responsible for auctions influences the effectiveness of the auction scheme, so this aspect of the design is typically adapted to the institutional setup of a given country.

Some differences can also be identified with respect to the frequency of tenders, as shown in Figure 1 (Right). Most European countries organize one auction round per year, but there are a few countries - like France, Germany and Italy - which typically announce lots of auction rounds per year, both for onshore wind and PV.

If smaller volumes are auctioned in through several tenders, it can result in small capacity addition per round. On the other hand, if only one large round is organized per year, auction rules adapt slower to the market environment from round to round, which can result in shortfall of awarded capacities relative to plans.

[3] A renewable energy support scheme is deemed effective if it helps to achieve the desired RES capacity target, while its efficiency refers to the most cost-efficient way of reaching it.

FIGURE 1. AUCTIONEER BODY (LEFT) AND AVERAGE NUMBER OF ROUNDS (RIGHT) PER YEAR AND PER TECHNOLOGY FOR PV AND WIND



Source: AURESII database and REKK data collection

2.1.2 Technology focus

Two main design elements of competitive auctions define the participation of RES technologies: (i) the selection of eligible technologies and (ii) the way they compete against each other.

The list of eligible technologies varies from country to country and sometimes from one auction round to the other. The general tendency is for a wide scope of technologies to be eligible in EU auctions, however, this does not necessarily mean that they are awarded. European-wide, several countries allow for emerging technologies, which are discussed in more detail in section 2.2.3.

Auction outcomes, however, are mainly determined by the type of competition between these technologies. For the most part, in European countries one of the following three systems is applied:

- Multi-technology auctions (Technology neutrality[4]): all eligible technologies compete against each other.

[4] In European regulatory/policy discussion multi-technology auctions often referred as technology neutral auctions, however research shows that in many aspects these auctions are not in fact neutral, and thus multi-technology is a more appropriate naming. For more details see: https://www.sciencedirect.com/science/article/pii/S0301421523004494

- Technology baskets: technologies are grouped according to the maturity or their lifetime costs (LCOE[5]). Within the same groups (baskets) technologies compete against each other.
- Technology specific auctions: when a round is announced for one specific RES technology (for example PV only auctions)

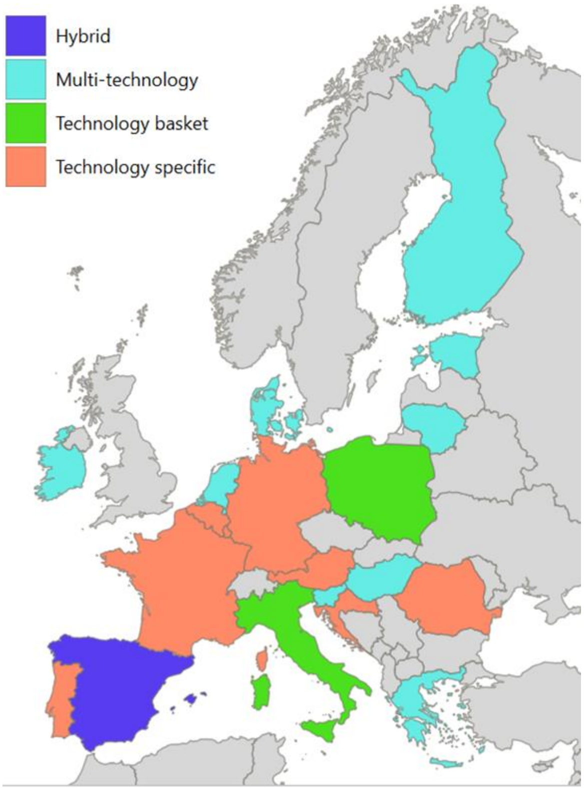
In multi technology auctions, governments have less control over the composition of awarded capacities, and the most cost-efficient technology wins in all cases. Thus, in a multi-technology auction one technology can perform very well while others have very limited success. On the other hand, with this setup the most cost-efficient outcome (the lowest support need) is achieved.

It can be argued that pure multi-technology auctions can hinder the technological development of less mature or more costly technologies, because they are not competitive with solar PV and onshore wind. Thus, some European countries, like Italy and Poland, apply technology baskets, to allow the realisation of projects of non-mature technology as well. In the short run, the support costs are higher with technology baskets, however in the long run the investment costs of non-mature technologies can be expected to fall, which may enhance long term efficiency.

Figure 2 shows that both multi-technology and technology specific auctions are popular in Europe, which means that there is no clear best practice. In many cases, PV and onshore wind compete against each other in multi-technology auctions and the experiences are convincing so far. These rounds result in competitive prices, and it is uncommon for one technology to win all of the announced volumes.

[5] Levelized cost of electricity

FIGURE 2. TECHNOLOGY FOCUS OF AUCTIONS IN EUROPE



Source: AURESII database and REKK data collection

Finally, it is important to highlight that offshore wind auctions are somewhat different from the other designs since they are usually announced at pre-defined locations almost exclusively in a technology specific way. Denmark, Netherlands, Germany, France are experienced in organizing offshore wind auctions while Lithuania, Estonia, Finland, Greece, Spain, Belgium, Poland have recently started or are planning to organize such auctions.

2.1.3 Remuneration scheme

The remuneration design defines the revenue stream investors receive for the electricity they produce. They differ significantly in terms of their predictability, their interplay with market volatility, and cost-efficiency from a regulatory perspective. Based on the Climate Energy and Environmental Aid Guidelines (CEEAG)[6], power plants with capacity above 0.5 MW are only meant to receive the operational support of a feed-in premium (FIP), yet several iterations are applied in the EU:

- Fixed premium: a fixed amount of financial support is paid for every unit of electricity produced, irrespective of the market price.
- One-sided sliding premium: producers are compensated for the difference of their bid price and the market price if the market price is the lower and keep the excess revenue if it is higher.

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022XC0218(03)

- Contract for differences (CfD) or two-sided sliding premium: producers are compensated for the difference of their bid price and the market price if the market price is lower and must pay back the difference if the market price is higher.

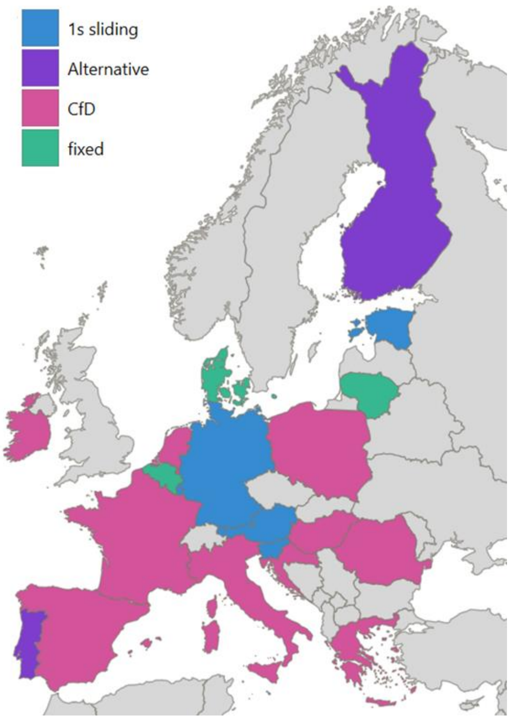
Compensation for a fixed premium is straight forward from the regulator's point of view and leads to a stable cost level even when market prices are high, however it raises the possibility of the over-subsidization. In other cases, when market prices are very low, the fixed premium cannot make RES installations profitable. As such, with most of the price risks borne by the RES promoter, the fixed premium can be considered the most "market friendly". Since the cash-flow is less predictable it is more difficult for these projects to secure financing.

A one-sided sliding premium protects investors when market prices are insufficient for RES projects to turn a profit and allows them to recoup increased revenues when market prices are high. Thus, it leads to greater RES market integration compared to a CfD but carries the risk of over-subsidisation.

The two-sided version of this (CfD) ensures stable revenue for investors and payments for the regulator in a high-price environment. The main issue with this scheme is that it can contribute less to RES market integration while incentivising market players to leave or suspend their participation in the scheme (if possible) in a high market price environment to avoid making payments back to the system.

Figure 3 shows that CfD is the most popular option in Europe and furthermore the new Electricity Market Design (EMD) is expected to further solidify this (see more details in 2.2.1).

FIGURE 3. REMUNERATION SCHEMES APPLIED IN EUROPE



Source: AURESII database and REKK data collection

2.1.4 Prequalification criteria

Bidder prequalification is an extremely important auction design element carrying significant impact both on the intensity of competition and the realisation rate of projects. Generally, strict prequalification criteria tend to reduce the number of participants in the auction, which may lead to higher support costs. At the same time, realisation rates tend to be higher[7].

All European auctions feature some form of a prequalification procedure, but significant differences emerge across European Member States. The first important element is whether a prequalification round is incorporated or not. Where it is incorporated, the prequalification requirements are usually submitted in the first stage and, after the prequalification process, the eligible investors can submit a bid. When this is omitted from the procedure, the bid and the prequalification criteria are submitted simultaneously, and only those bids which fulfil the qualification requirements are considered valid. There is no clear best practice between these two procedures observed across Member States.

On the other hand, a very important part of EU auctions is the automation of the eligibility check, alluding to how well the qualification criteria is defined, and subsequently the need for "soft/human decision based"[8] evaluation in the procedure. Therefore, it can be argued, that the inclusion of a prequalification round in the design is not so critical as how well the criteria are defined and measurable.

Two main types of prequalification criteria dominate European auctions: a) material and b) financial conditions. Material prequalification criteria refer to the permits and documents which must be submitted by the project promoter in order to participate in the tender. Table 1 presents some examples of applied material prequalification criteria applied in EU Member States.

TABLE 1: EXAMPLES OF MATERIAL PREQUALIFICATION CRITERIA IN EU MS

Denmark	Germany	Greece	Poland
No debt exceeding 100 000 DKK, offshore wind: former experience, minimum annual turnover, equity ratio of min. 20% or investment grade credit rating	Onshore wind: environmental permits. PV: Proof of access to the site, adopted land use plan and eligibility of site for ground mounted plants	Generation license, Grid connection agreement/offer	Building permit, environmental permit, grid connection agreement, land use plan, schedule of works and expenditures

Source: Szabó et al (2020): Auctions for the support of renewable energy: Lessons learnt from international experiences[9]

Regarding the material criteria, two important conclusions can be drawn. Firstly, most required documents are directly linked to the implementation process (such as the grid connection

[7] http://aures2project.eu/wp-content/uploads/2021/07/design_elements_october2015.pdf

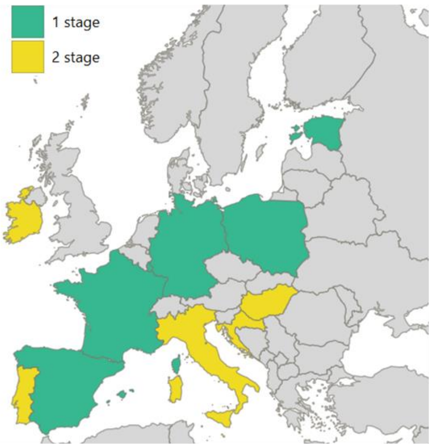
[8] For example, the project is not eligible because of its larger than the allowed size, or the promoter did not provide the financial security.

[9] http://aures2project.eu/wp-content/uploads/2021/06/AURES_II_D2_3_case_study_synthesis_report.pdf

agreement, environmental permit, operational licence etc). Secondly, some countries accept projects which in the early implementation process (like Hungary) while others only accept mature projects that have obtained all the necessary permits for operation (like in the Netherlands).

In addition to the material criteria, most EU auctions require proof of financial security in the form of either a direct payment or bank guarantee, referred to as bonds. Some countries require a bind bond (1st stage bid bond) to enter the auction and a performance bond (2nd stage bid bond) upon winning the tender, but some Member States require it in a single stage (usually after winning in the auction). Financial securities are lost at least partially if the projects are not completed on time. Figure 4Hiba! A hivatkozási forrás nem található. (Left side) illustrates which recent European auctions applied one-stage or two-stage bonds and (Right side) the approximate level[10].

FIGURE 4: APPLICATION OF ONE- AND TWO-STAGE BID BONDS (LEFT) AND THEIR APPROXIMATE MAGNITUDE (RIGHT) IN EU MS



(EUR/kW)	1st stage bid bond	2nd stage bid bond
Croatia	6.6	39.6
Estonia	13.7	
France	30	
Germany	50	
Hungary	11.25	37.5
Ireland	6.8	22.7
Italy	37.5	75
Poland	14	
Portugal	10	20
Spain	60	

Source: Aures II auction database[11] & REKK data gathering based on national sources

2.2 Recent trends of EU auctions

This sub-section focuses on the latest developments in EU auctions. First, the most relevant policy and regulatory changes are summarised, followed by the evolution of prices and competition and lastly the most recent changes in the underlying structure.

2.2.1 Recent changes in regulation

The revised Directive on Renewable Energy (REDII, 2018/2001/EU, amended by EU/2023/2413) came into effect on 20 November 2023 as part of the Fit for 55 regulatory package. It was updated to align renewable energy targets with the emission reduction targets for 2030 (55%) and 2050 (net zero). RED II started with a RES target of 32% by 2030, which was to be revised

[10] The extent of financial security is given in different form in different MS. Some country applies capacity-based payments (EUR/MW), some countries specify expected production-based securities (EUR/MWh), while other formulate is a certain percentage of the investment cost. In the Figure the different calculation measures are approximately converted to EUR/MW for easier comparison.

[11] http://aures2project.eu/auction-database/

up to 40% in the 2021 revision proposal. However, under the REPowerEU Plan (COM/2022/230), aiming to reduce dependency on Russian fossil fuels, the Commission recommended raising the target to 45%. In the process of negotiating the final legislation, European policymakers ultimately agreed on a binding target of 42.5% at the EU level, with aspirations to achieve 45%. The revised RED also introduced several sub-targets, including an indicative target of 5% for innovative renewable energy technology, as well as sector-specific targets aimed at accelerating renewable energy adoption in the heating and cooling (H&C), transport, industry, and the buildings sectors.

Member States are required to transpose the revised Directive by 21 May 2025, with specific provisions related to permit granting procedures by 1 July 2024. Each Member State's contribution will be outlined in their updated national energy and climate plans (NECPs). A review of the initial drafts of the updated plans revealed that they are insufficient to meet the overall EU target, reaching only approximately 39%. The final NECPs are expected to be submitted by June 2024.[12]

The revised RED[13] includes provisions aimed at accelerating the deployment of RES, particularly by streamlining the permit-granting processes. Member States are required to identify 'renewables acceleration areas' where RES projects can be implemented without significant environmental impact. Projects located on these areas will benefit from simplified permitting procedures. Moreover, special infrastructure areas will be designated for the deployment of grid and storage projects, facilitating the integration of renewable sources into the electricity system. Public objections against renewable installations will be limited presuming RES deployment to be of 'overriding public interest'.

To facilitate faster permit granting, Member States must adhere to strict deadlines. In renewables acceleration areas, permits must be issued within a maximum of 12 months (or 24 months for offshore wind projects). Outside of these areas, the permit-granting period for RES power installations should not exceed 2 years (or 3 years for offshore wind projects). Extensions may only be granted for up to six months in exceptional circumstances. Additionally, it urges Member States to remove barriers hindering the deployment of cross-border renewable energy agreements and long-term renewable energy power purchase agreements.

Another significant change is expected in the reform of the electricity market design following a political agreement in December 2023. Under the proposal, Member States will be mandated to implement support schemes providing two-sided contracts for difference (CfD) for new renewable generation facilities in order to make the market less susceptible to price volatility[14].

2.2.2 Evolution of prices and oversubscription

After outlining the regulatory changes, this report focuses on the recent auction trends. The key argument in favour of auctions is to achieve large-scale renewable energy deployments in a competitive and therefore cost-effective manner. The analysis of this sub-chapter pertains to competition and price levels.

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[12] COM/2023/796 final

[13] together with Council Regulation (EU) 2022/2577 (amended by (EU) 2024/223)

[14] https://www.consilium.europa.eu/en/policies/electricity-market-reform/

The price evolution is a meaningful tool for evaluating a country's progress and development with auctions but is not suitable for cross-country comparisons due to the heterogeneity of support schemes and associated costs. Data from the most recent auction results is used, however, in cases where there was a significant number of auctions within a given year, the dominant trend is emphasized instead. The prices apply to the largest size category and the most recent auction of the period[15]. In the case of multiple rounds, the average price was used. All prices are adjusted for EU inflation to show real 2020 EURs. This analysis covers solar PV and onshore wind auctions since they are the most mature technologies.

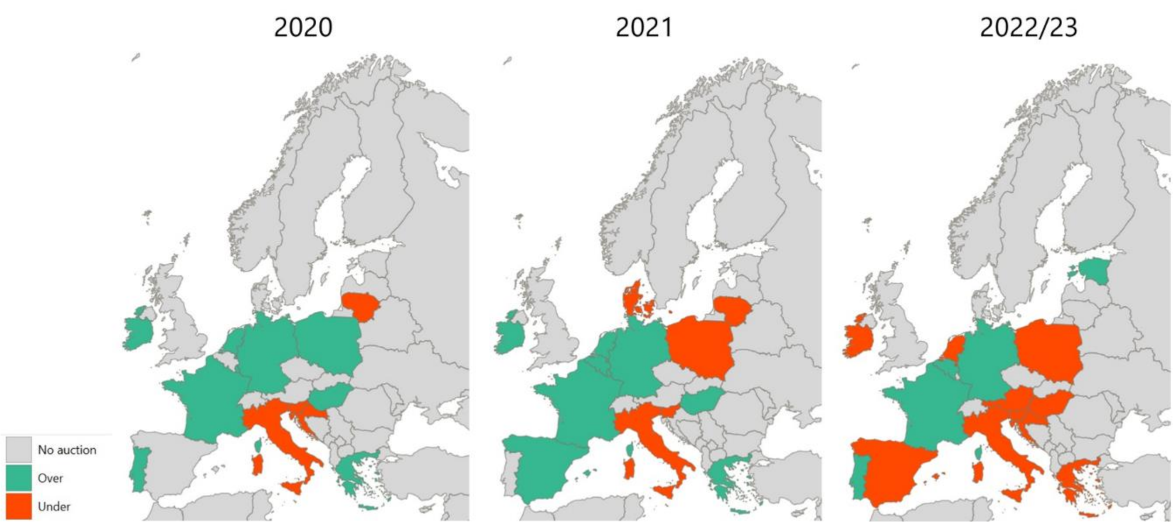
Level of competition

The competitiveness of auctions since 2020 is illustrated in Figure 5 andFigure 6. Level of competition - Onshore wind auctionsFigure 6. The green countries were oversubscribed, attracting more bids than the announced volumes, and the red countries were undersubscribed, attracting less bids than the announced volumes. It shows that European auctions have been more undersubscribed in the last few years, both for solar PV and onshore wind auctions. While the individual case for each country is beyond the scope of this report, it can be observed that the situation was mixed in 2020 and overall auctions have become less competitive since.

The reasoning behind this trend will be analysed in more detail in Section 2.2.3 (including the popularity of alternative revenue streams like PPAs), but the short timeframe makes it difficult to extrapolate over a longer timeline. Low subscription rates can also result from the uncertain economic environment, elevating the associated financing and implementation costs, and thereby compelling investors to postpone their projects.

In some cases, however, this can be attributed to unfavourable auction design. For example, if consistently higher volumes are targeted beyond the investor appetite (Italy) or ceiling prices are set too low (Spain). While this does not fundamentally explain the trends, downward adjusted auction volumes in response to economic uncertainty could have maintained a higher level of competition even in these years.

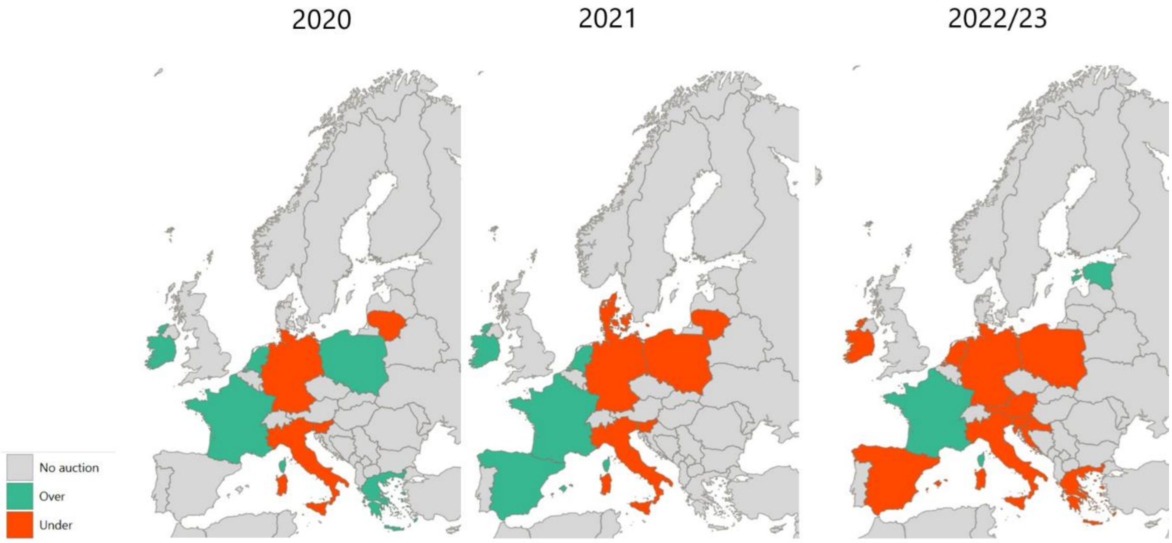
FIGURE 5: LEVEL OF COMPETITION – PV AUCTIONS



[15] Until November 2023

Source: AURES II database and REKK data collection

FIGURE 6. LEVEL OF COMPETITION - ONSHORE WIND AUCTIONS



Source: AURESII database and REKK data collection

Evolution of prices

Based on past experience, a gradual decline in costs, and thus in auction prices, are expected over time. In observing the European auction outcomes, nominal price changes generally increased between 2020 and 2023. However, if prices are adjusted for inflation, the picture becomes more varied. Table 2 includes the inflation adjusted average prices in EUR for 2020.

Achieving a uniform technology comparison within countries is challenging. For example, Hungary imposed a storage obligation, while Portugal conducted auctions specifically for floating PV rather than traditional PV installations in the latest rounds organised.

TABLE 2. EVOLUTION OF INFLATION CORRECTED AVERAGE PRICES (EUR 2020)

PV

EUR/MWh	2020	2022/2023	
Austria	No auction	65.3	New auction
Belgium	No auction	3.0	New auction
Croatia	No auction	58.7	New auction
Estonia	No auction	21.9	New auction
France	56.3	73.3	Increased
Germany	50.3	65.7	Increased
Greece	50.0	40.0	Decreased
Hungary	51.2	59.4	Increased
Ireland	72.9	89.4	Increased
Italy	64.6	56.7	Decreased
Malta	123.0	115.5	Decreased
Netherlands	39.3	33.9	Decreased
Poland	50.0	54.2	Increased
Portugal	11.14 (-24.69)	9 (-23.5)	Stagnated
Slovenia	69.9	81.6	Increased

Onshore wind

EUR/MWh	2020	2022/2023	
Austria	No auction	73.2	New auction
Croatia	No auction	53.7	New auction
Estonia	No auction	24.5	New auction
France	62.2	75.9	Increased
Germany	62	65.3	Stagnated
Greece	55	51.3	Decreased
Ireland	74.1	89.4	Increased
Italy	65.2	56.7	Decreased
Netherlands	21.1	23.2	Stagnated
Poland	50	54.2	Increased
Spain	30.8	38.1	Increased

Source: AURES II database and REKK data collection[16]

Factors working against the steady decline in technology costs have been strongly evident in recent years. First and foremost, the inflation levels observed across Europe in the last few years naturally influenced renewable investments and auction prices. High inflation has led to nominal strike prices increasing in almost all countries between 2020 and 2022. However, adjusting for inflation helps mitigate the price effect to some extent. Overall, the turbulent events of the last few years resulted in a growth of real LCOE (mainly through increased real interest rates), making higher prices in the auction outcomes unavoidable.

The performance of auctions, as indicated by subscription rates and resulting prices, appears to be notably poorer in recent years, with a higher number of undersubscribed rounds and higher prices. These negative trends may be temporary as investors await more favourable economic conditions. There are some indications that towards the end of 2023 and into 2024 lowering electricity prices are feeding through to better performing auctions, such as the notably competitive German PV auction[17], however it is too early to tell if this is indicative.

2.2.3 New trends in EU auction

From 2021, wholesale electricity prices were significantly higher than in the previous years. Until 2020 almost 90% of the awarded EU auction capacities went to solar PV and onshore wind technologies[18]. The elevated price environment, however, allowed provided opportunities for other technologies to participate in tenders, resulting in more diverse composition.

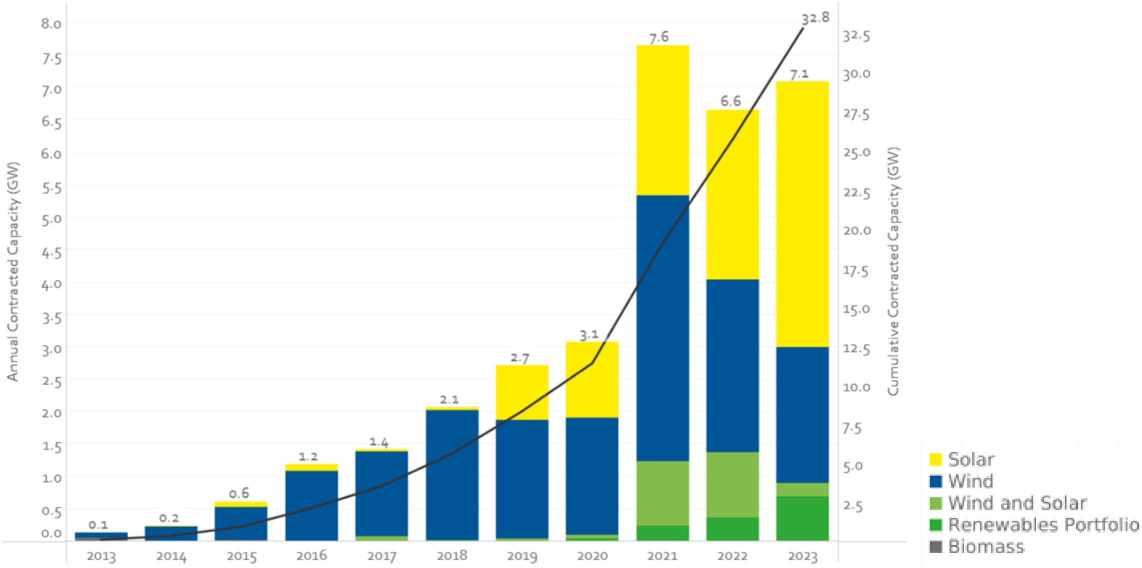
[16] In the case of onshore wind prices in Spain, 2021 data was used since there were no auctions in 2020.
[17] https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/EN/2024/20240131_solar1-23-3.html
[18] http://aures2project.eu/auction-database/

Portugal has executed two rounds of floating solar PV auctions[19], while Luxembourg organized separate tenders for agrivoltaic[20] PV and PV for industrial self-consumers[21]. Estonia[22] has experimented with tenders for hybrid RES installations. In addition, several countries implemented combined PV and storge tenders which will be discussed in more detail in section 3.3.

The high electricity prices have positive impact on the marketability of more mature technologies like offshore and onshore wind and solar PV as well. Recent offshore wind auctions have been mostly successful, meaning projects do not need further support. As a result, some countries initiated negative bid offshore auctions whereby the producers pay for the opportunity to complete the project. This new auction type is analysed in more detail in section 3.2.

The situation surrounding onshore wind and solar PV is more complex. Similar to offshore wind, it appeared that these technologies could survive and even thrive without governmental support, sending investors ins search of market-oriented alternatives. One of the most common solutions was the private power purchase contract (PPAs), which is a long term (minimum 10 years) supply contract between the RES investor and a private company. Figure 7 summarizes the evolution of contracted PPA capacities since 2013. As shown in Figure 7, the contracted volume drastically increased in 2021 and has sustained this higher threshold.

FIGURE 7: TOTAL CONTRACTED PPA CAPACITIES FOR NEW POWER PLANTS IN EUROPE, 2013-2023



Source: RE-Source platform[23]

For now, it is not clear what kind of effects the emergence of PPAs will have on renewable auctions. The experience over the last couple of years suggests that at least in the short-run, PPAs and auctions are in competition; while contracted PPA capacities have increased in many countries, undersubscribed tenders have become more commonplace in parallel (see 2.2.2 for

[19] https://www.pv-magazine.com/2023/05/29/portugal-launches-floating-solar-tender/
[20] https://www.pv-magazine.com/2023/10/05/luxembourg-allocates-52-7-mw-in-agrivoltaic-tender/
[21] https://taiyangnews.info/luxembourg-awards-85-solar-projects/
[22] https://elering.ee/en/ministry-reverse-auction-resulted-market-receiving-540-gwh-renewable-energy-near-future
[23] https://resource-platform.eu/buyers-toolkit2/ppa-deal-tracker/

details). Thus, some countries will or already have phased out financial support for new PV and wind installations. In Denmark outside of offshore wind, RES auctions are no longer implemented[24]. Similarly, the Netherlands is planning to phase out solar PV and onshore wind from SDE++ beginning in 2025[25]. Greece also plans to cease tenders for PV and wind in 2024[26].

It is important to highlight that declining energy prices in 2023 boosted participation in governmental auctions in the latter half of the year compared to the preceding years. This indicates that wholesale prices play an important role in determining the popularity of auctions and, in the long run, that PPAs and governmental auctions can be complimentary rather than rivals. However more time will be needed to collect data and draw more definite conclusions.

[24] https://commission.europa.eu/document/download/31895e48-37c3-46fe-8a8f-8f61fbff6724_en?filename=EN_DENMARK%20DRAFT%20UPDATED%20NECP.pdf

[25] https://commission.europa.eu/document/download/0fe725be-1783-4c33-a9b1-d42b428ea903_en?filename=EN_NETHERLANDS%20DRAFT%20UPDATED%20NECP.pdf

[26] https://balkangreenenergynews.com/greece-announces-timetable-prices-for-renewable-energy-auctions/

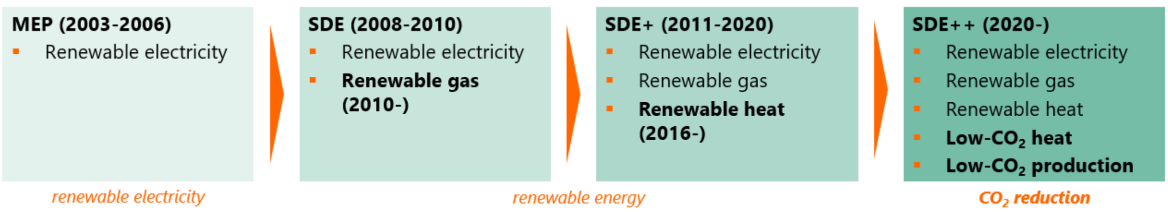
3 Innovative solutions for limiting environmental impact and enhancing grid integration

Adapting to changing market environments has led to a greater emphasis on non-price elements of auctions, such as environmental impact or grid integration. This section aims to gather and evaluate practices from Europe (and in some instances outside Europe) that offer innovative solutions to address these non-price dimensions.

3.1 Targeting GHG reduction – The Dutch SDE++ scheme

While renewable deployment is a long-term goal in the European Union, over the last decade the policy focus has expanded to include GHG emissions reductions in RES auction schemes. For example, France requires RES producers to remain below a certain threshold of lifecycle GHG emissions as a prequalification criterion. The best is in the Netherlands, where the SDE++ scheme takes an innovative approach of targeting CO_2 emission reductions rather than renewable capacity levels. This feature, however, was developed in an organic process from a technology inclusive renewable electricity support scheme (MEP), with a step-by-step expansion of the eligible technologies. As Figure 8 depicts, the SDE system operated as a renewable energy support scheme between 2010 and 2020, where project promoters of renewable electricity, renewable gas, and renewable heat (since 2016) competed in one system for the same support budget. This allocation mechanism was then expanded (SDE++) to cover low-CO_2 heat and low-CO_2 production technologies[27], with the aim of facilitating the decarbonization of the industry and building sectors under the same support scheme.[28]

FIGURE 8: DEVELOPMENT OF THE DUTCH RENEWABLE ENERGY SUPPORT SCHEMES



As SDE++ also covers carbon capture technologies, the auctioneer must overcome the practical issue of a standard metric to make these technologies comparable. It goes even further by comparing the ability of different renewable energy technologies to reduce greenhouse gas emissions. Thus, the allocation of support is based on the subsidy intensity of CO_2 reduction.

[27] The full list of technologies is presented in **Hiba! A hivatkozási forrás nem található.**.
[28] https://english.rvo.nl/subsidies-financing/sde/features
https://english.rvo.nl/subsidies-financing/sde/apply

FIGURE 9: ELIGIBLE TECHNOLOGIES IN THE SDE++ SCHEME

Main category	Technology
Renewable electricity	Osmose Hydropower Wind Solar PV
Renewable gas	Biomass fermentation Biomass gasification
Renewable heat	Biomass fermentation Biomass gasification Composting Solar thermal energy Geothermal energy
Low carbon heat	Aquathermal energy Air-water heat pump Daylight greenhouses Solar PVT panels with heat pump Electric boilers Geothermal energy with heat pump Waste heat utilisation Industrial heat pump
Low-carbon production	Electrolytic hydrogen production Carbon capture and storage (CCS) Carbon capture and use in greenhouse horticulture (CCU) Advanced renewable fuels

Source: https://english.rvo.nl/sites/default/files/2023-09/BrochureSDE2023English.pdf

From a methodological point of view, the process requires only one significant change: an emission factor must be determined for each technology, showing how much CO_2 is avoided by generating one unit of energy/output with the given technology. Since this depends on the demand and supply conditions at the time of production, the average emission factor will differ across renewable electricity technologies. For example, wind has a slightly higher emission reduction factor than PV, acknowledging that the production profile of wind is more suitable for replacing fossil power plants.[29]

The subsidy intensity is calculated as the ratio of the support requirement (the difference of the bid price and the forecasted long-term price) and the emission factor. The bids must still be submitted in EUR/kWh (for energy-related services) so there is no change from the project promoter's perspective, allowing the auctioneer to transform the bids according to subsidy intensity based on its own technology specific calculation using the long-term price and emission factors.[30]

The benefits of this approach can be summarised as follows:

- The main concept of this technology inclusive scheme is that it can lead to a high level of participation, where competition amongst the different technologies ensures that the most efficient technologies and projects will be awarded, minimizing support.
- The second important advantage of this approach is that it allows decision makers to focus on higher level goals (decarbonization) instead of sub-goals (PV penetration). This also means that technologies which are more efficient in reducing GHG emissions

[29] https://english.rvo.nl/sites/default/files/2023-09/BrochureSDE2023English.pdf

[30] The technology specific long-term prices and emission factors are published in the call for proposals, so project promoters can also calculate their own subsidy intensity based on the equation:
subsidy intensity = (bid price- long-term price) / emission factor.

will have an implicit advantage in the allocation procedure, so the above-mentioned cost-efficiency will be ensured according to the overarching goal of decarbonization.

- The third main benefit of a technology inclusive system is that it simplifies the institutional framework. The expansion of an established and successful support system increases its transparency and predictability relative to schemes operated for a single technology.

The implementation of such a support also has disadvantages:

- Fully neutral schemes may lead to undesired outcomes, such as the dominance of one technology at the expense of less mature technologies. In other words, the scheme ensures only the short-term efficiency (selection) but not the long-term efficiency (technological development).
- Solving these problems requires a more complex subsidy scheme. For this reason, the Netherlands sets technology-specific ceiling prices. However, some areas and technologies may require even more special treatment such as domain fencing, which is a budget reserve for specific technology categories. The Netherlands recently introduced this in 2023.
- The inclusion of non-energy technologies requires the use of emission factors and monitoring of production (Low-CO_2 production) which creates new complexities, and the methodological difficulties can lead to distortions in the support allocation.

From the perspective of the Energy Community countries, two main conclusions should be highlighted. First, multi-technology auctions are optimal because they reduce subsidy expenditures, but a step-by-step approach is recommended, beginning with PV and wind technologies competing against each other. Second, it is important to establish a transparent and predictable support scheme with regular auction rounds and ensuring this system operates well. This will build up trust in the system and attract more participants. Later on, the system can be further expanded and developed, making it favourable compared to the operation of multiple schemes or ad hoc subsidy programs that are discontinued.

3.2 Negative bid auctions – The case of Portugal and offshore wind tenders

From the second half of 2021, wholesale electricity prices rose drastically from their previous levels. The high price environment paired with the long-term trend of declining levelized cost of energy (LCOE) for renewables[31] left many RES investors thinking their projects would be viable without any governmental support. As a result, the magnitude of private PPA contracts signed increased dramatically, with some countries introducing negative bid auctions, mostly in the case of offshore wind.

In negative bid auctions the objective is no longer the efficient allocation of support. As technologies become mature, investors are willing to pay for the auctioneer to complete their projects, so they compete for the "possibility to build".

[31] https://mc-cd8320d4-36a1-40ac-83cc-3389-cdn-endpoint.azureedge.net/-/media/Files/IRENA/Agency/Publication/2023/Aug/IRENA_Renewable_power_generation_costs_in_2022.pdf?rev=cccb713bf8294cc5bec3f870e1fa15c2

Thus, there are several conditions required for the organisation of successful negative bid tenders. First, the remuneration scheme shouldn't be based on CfD. In a CfD scheme, it is possible to bid below the future expected market price, which de facto means a stable payment towards a system. Second, there should not be a viable market-based alternative for investors. In negative bid schemes investor must pay an additional fee, and if they can fully avoid the government scheme, it would be financially beneficial to complete the project without additional payments.

Because of these two factors, negative bid auctions in EU Member States are more common for offshore wind tenders, for which it is generally not possible or extremely difficult to conclude a PPA agreement since connection points are usually scarce and direct governmental investments are needed for the grid integration of the power plant.

In recent years, several negative bid offshore tenders were concluded. In Germany, 7 GW capacity was awarded in mid-2023[32]. The winners contributed 12.6 billion EUR to the state which will go towards funding the grid connection (90%), maritime biodiversity protection (5%) and support of environmentally friendly fishing (5%). The Netherlands also conducted several negative bid auctions in 2021, 2022, and 2023, the latest of which was a multi-criteria tender under which 756 MW of capacity was awarded and the winner paid 63.5 million EUR into the system[33]. Lithuania also organised a negative bid auction in mid-2023, under which 700 MW of capacity was awarded and the winner contributed 20 million EUR.

Portugal is the only country which applies negative bidding for solar PV tenders. The first, organised in 2019, was a site-specific multi-unit auction[34]. In the first auction round participants could choose between participating in a CfD scheme or offering contribution to the system[35]. The next auction in 2020 extended the technology scope to PV + battery storage installations before adding floating PVs in subsequent rounds in 2022 and 2023 All auctions were oversubscribed.

Even in the first round, organised before the spike in electricity prices, many investors chose to participate in the contributing scheme (25% of the awarded capacities), and this share increased significantly in the following rounds.

Negative bid auctions have some significant advantages. The most important is that it can provide revenue for the state to develop the grid network and enhance renewable integration. Additionally, it dampens over-subsidisation and excessive profits of mature RES projects in a high price environment.

On the other hand, it leads to other suboptimal outcomes. Firstly, if reasonable alternatives are present, the government auction may become undersubscribed as producers seek to avoid payments. Secondly, negative bid tenders usually require a large payment in the development phase, which only larger, financially well-positioned companies can afford. And finally, if market

[32] https://windeurope.org/newsroom/press-releases/german-offshore-auctions-award-7-gw-of-new-wind-future-auctions-must-avoid-negative-bidding/

[33] https://windeurope.org/newsroom/news/the-netherlands-run-another-successful-auction-based-on-non-price-criteria/

[34] http://aures2project.eu/wp-content/uploads/2020/02/AURES_II_case_study_Portugal.pdf

[35] The contribution in the 2019 auction round was in a form of negative fix premium, which was changed from the 2020 round to capacity-based payment.

prices are not sufficiently high, negative payment auctions can decrease the profitability of the projects leading to lower participation in the auctions.

Whether EU countries will continue to organize negative bid auctions is uncertain. Currently Portugal has no plans to change its system while Germany is planning negative bid tenders in the near future[36]. Lithuania, meanwhile, changed to a CfD system after the first auction round[37].

3.3 Renewable + storage auctions

The falling price of energy storage technology and the imperative to integrate higher amounts of variable capacity to the grid has prompted governments worldwide to design auctions for sourcing standalone and co-located storage capacity.[38] This section focuses on auctions aimed at providing support for installations that combine renewable plants and storage facilities, also known as hybrid auctions. It examines four examples within the EU: Germany's innovation auctions since 2020, Hungary's renewable energy auction in March 2022, Portugal's auction for grid injection capacity in 2020, and Spain's REER auctions in 2021-2022[39] and PERTE tender in 2023[40]. A comparison of these schemes shows that RES + storage auctions differ from country to country in many areas which are analysed in more detail.

Combining renewable generation and storage assets offers numerous advantages. They can provide capacity and ancillary services, support grid operation, limit congestion in the power system and enable electricity system operators to defer or reduce the costs of necessary investments in grid reinforcement. Additionally, they can help renewable plant operators in avoiding curtailments and shifting grid injections to higher price periods. Depending on the rules of the auction, supported installations may also participate in other markets and services and capitalize on the business opportunities provided by the storage system, such as ancillary services markets and wholesale electricity market arbitrage.[41]

The primary objective of supporting RES-E plus storage projects in the above-mentioned EU countries was to facilitate network integration, enhance system flexibility, and ensure the operational security of the electricity system. Other, specific goals were also pursued in some of the countries. For instance, Germany's innovative auctions aimed to address recurring negative

[36] https://www.rechargenews.com/wind/germany-sticks-to-negative-bidding-at-kick-off-of-next-2-5gw-offshore-wind-auction/2-1-1590234

[37] https://renewablesnow.com/news/lithuania-puts-off-second-offshore-wind-tender-for-2024-836471/

[38] USAID, https://pdf.usaid.gov/pdf_docs/PA00X4KB.pdf, accessed: 1/15/2024.

[39] Del Rio (2021) An assessment of the design of the new renewable electricity auctions in Spain under an international perspective, *https://www.funcas.es/wp-content/uploads/2021/06/Papeles-de-energ%C3%ADa-13.pdf, accessed:* 1/15/2024.

[40] The PERTE tender was announced within the framework of Recovery and Resilience Facility of the EU, *https://www.boe.es/boe/dias/2022/12/28/pdfs/BOE-B-2022-40803.pdf /, accessed:* 1/15/2024

[41] Chadwick (2022) Co-location, co-location, co-location, https://www.cornwall-insight.com/wp-content/uploads/2022/12/Weightmans-Colocation-Insight-Paper-final.pdf, accessed: 1/13/2024.

market prices[42], while Portugal aimed to efficiently allocate scarce injection capacity, capitalizing on the declining costs of renewable technologies.[43]

Table 3 summarizes the storage-system related rules of the assessed auction schemes. Regarding the incorporation of storage, Germany has a special auction for dispatchable RES-E combinations including RES-E+ storage, while Hungary added an obligation to install storage under its regular scheme. The German auction transitioned from a fixed premium to a one-sided sliding premium, while Hungary applies a two-sided CfD. The auctions in Spain and Portugal apply special remuneration formulas elaborated for RES-E+ storage installations. Portugal offered a special 'premium' scheme for the dual installations, which is a mix of fixed capacity-based payment (that could be even negative), and CfD. The Spanish scheme also provided a special remuneration formula above the standalone RES-E facilities to encourage promoters to adapt dispatchable technologies to market conditions, exposing them partially to market prices.[44] The Spanish PERTE auction executed a separate round for RES-E storage combinations, however, the projects were awarded separately from the regular auctions, providing an investment subsidy based on a special multi-criteria evaluation.[45]

RES-E+ storage auctions in EU countries incorporate storage systems in various ways. Normally, there is an option to participate with RES-E+ storage installations in regular auctions, whether explicitly mentioned or not. However, due to the relatively high cost of batteries[46], some countries conduct special auctions for RES-E+ storage combinations, like in Germany, or establish special rules within their general auctions, like Portugal or Spain. In other cases, bidders are mandated to install storage together with their renewable installations, which was the case in Hungary's 2022 auction and planned for the upcoming RES-E auctions in Greece.[47] Alternatively, auctions can be organised with storage support as the primary objective, with separate calls for RES-E+ storage installations, similar to the PERTE auctions in Spain.[48]

The auctions typically establish rules related to the location of the storage system that are aligned with the overarching objective. When the primary goal is to enhance a network's capacity to accommodate new RES-E generation, as is mostly the case, the storage system is required to be co-located with the renewable plant, sharing the same grid connection. This was the case in the assessed German, Spanish and Portuguese auctions. In Hungary, alternatively, the primary aim of incorporating storage systems was to contribute to the operational

[42] Renewable Energy Act (EEG), Innovation Tenders Auctions (InnAusV), *https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/Ausschreibungen/Innovation/BeendeteAusschreibungen/start.html,* accessed: 1/10/2024.

[43] https://afry.com/sites/default/files/2020-10/Portuguese%20Auction%202020%20Review%20v100.pdf, accessed: 1/10/2024.

[44] Del Rio (2021) An assessment of the design of the new renewable electricity auctions in Spain under an international perspective, *https://www.funcas.es/wp-content/uploads/2021/06/Papeles-de-energ%C3%ADa-13.pdf,* accessed: 1/15/2024.

[45] https://www.energy-storage.news/spain-awards-contracts-to-1-9gwh-energy-storage-in-first-perte-tender/, accessed: 1/8/2024.

[46] Lazard (2023) estimated the levelised cost of Utility-Scale PV (100 MW PV) + front of the meter Storage (50 MW, 4 hour) to fall between USD 110-131/MWh, https://www.lazard.com/research-insights/2023-levelized-cost-of-energyplus/, accessed: 2/20/2024

[47] https://balkangreenenergynews.com/11-projects-selected-in-greeces-second-energy-storage-auction/, accessed: 2/27/2024.

[48] https://www.boe.es/boe/dias/2022/12/28/pdfs/BOE-B-2022-40803.pdf /, accessed: 1/15/2024

security of the electricity system, and therefore the storage may be located anywhere within the territory of the country.[49]

The auction announcement may also contain specific rules regarding the operation of the supported storage system. In certain cases, it may be restricted to storing the electricity generated by the co-located plant and prohibited from taking advantage of the arbitrage opportunities associated with the grid. Furthermore, revenue stacking - which involves maximising revenues by participating in multiple markets such as grid flexibility, balancing, capacity, and others – can also be prohibited. Such restrictions are included, for example, in the German innovation auction scheme. The rationale is to prevent supported installations from competing in electricity markets with non-supported capacities while utilizing the partially fossil-based electricity from the network.[50] In other cases, RES-E+ storage installations are granted permission to exploit all of these business opportunities, which is the case in Portugal and Hungary. Allowing developers to maximise their potential revenues can lead to more effective utilisation of the installations, thus reducing support costs (as in Hungary) or increasing revenues for the system (as in Portugal).

TABLE 3: SUMMARY OF THE MAIN FEATURES OF THE ANALYSED AUCTIONS

	GERMANY	HUNGARY	PORTUGAL	SPAIN
Form of incorporating storage	special auction for innovative solutions	same scheme, mandating bidders to incorporate BESS	same scheme, special rules for RES-E plus BESS	option to participate in regular auctions (REER) & special BESS capacity tenders (PERTE)
Rule for location	must be co-located with RES-E installation	can be located anywhere in the system of HU	integrated with the RES-E plant (co-located)	integrated with the RES-E plant (co-located)
Restrictions related to operation	participation on ancillary services markets not allowed	certain BESS capacity has to be available for aFRR	no restrictions	can store only the electricity from the co-located RES-E plant
Technical specifications	Power capacity: at least 25% of the total installed capacity Storage capacity: 2 MWh/MW	Power capacity: at least 10% of the total installed capacity Storage capacity: 1 MWh/MW .	Power capacity: at least 20% of the total installed capacity Storage capacity: 1 MWh/MW	Power capacity: min 1 MW per MW of RES-E plant in PERTE, 2 MWh of storage for each MW of RES-E in REER auction Storage capacity: 2 MWh/MW in both auctions

As evidenced by the case studies, combining hybrid and non-hybrid installations in the same auction may require special remuneration rules, inviting greater complexities into the scheme. While ensuring fair competition in the electricity and ancillary markets may warrant restrictions

[49] https://www.mekh.hu/download/f/60/11000/2022_I_METAR_Kiirasi_dokumentacio_v11.pdf.

[50] https://blog.fluenceenergy.com/germany-innovation-tender-full-potential-renewable-storage-co-location,

on operation and participation in some of the markets, it may also lead to higher prices and less efficient utilization of the storage systems.[51]

In countries with underdeveloped flexibility markets, such as Energy Community Contracting Parties, support for hybrid installations can enhance flexibility and dispatchability. Additionally, the state of the grid and local bottlenecks might necessitate co-located storage to facilitate the connection of new RES-E capacities. However, instead of a blanket mandate for the instalment of co-located storage with renewable plants, it is crucial to tailor the support to the specific needs of the system by adopting a holistic planning approach. This must take into account demand and supply patterns, the regulatory environment, and expectations for the specific energy market. Within this planning, it is essential to assess the cost-effectiveness of other available sources of flexibility, such as dispatchable RES like hydro or biogas, RES-E curtailment, cross-border trade, other types of storage, demand response, etc.[52]

3.4 Innovative elements to enhance renewable grid integration

The integration of renewable installations into the electricity grid carries various challenges. If the existing network can no longer cope with the intermittency of weather dependent capacities, situations may arise leading to the forced curtailment of RES production to avoid oversupply. In the short-term, this reduces the profitability of RES facilities and increases ancillary service costs. In the long run, such occurrences have a dampening effect on RES investments and auction volumes, making it difficult to achieve strategic goals for expanding renewable energy capacity.

Addressing these challenges requires careful planning, investment in grid infrastructure, and the development of flexibility policies to ensure the smooth integration and efficient operation of RES facilities within the electricity system. Grid development is outside the scope of auction schemes, which themselves are not responsible for grid problems nor a panacea for them. Yet some specific design elements can support a smoother integrability of new installations into the already existing network in the following ways:

1. Grid connection related administrative requirements or pre-qualification criteria: The best and most common example is a requirement for grid connection permitting as part of the material pre-qualification criteria. The ability of developer to meet this requirement varies from country to country.
2. Location restrictions: Ex-ante intervention auction volumes are location specific to areas where new production capacities are allowed to be built. This can lead to the necessary utilization of suboptimal areas for RES development.
3. Bid price adjustments based on location: Ex-post modification of submitted bids for RES projects fitting the supply-demand dynamics in terms of location are preferred.

51 https://blog.fluenceenergy.com/germany-innovation-tender-full-potential-renewable-storage-co-location, 1/8/2024.

52 Lawson, Wigand (2022) USAID SURE webinar on Dispatchable Renewable Auctions, October 12 2022, *https://www.youtube.com/watch?v=tV_w3GsTSmk*, accessed: 1/20/2024.

This type of intervention also encourages investors to plan projects which not necessarily have the highest yield potential in the country.

4. Smaller new RES capacities and smaller installations: Smaller projects or lower aggregate volumes are easier to integrate into the grid, but of course slows RES expansion.,
5. Pass-through of grid development costs to the project investor is a simple way to generate resources that can be used for network development, but it worsens the profitability of projects.

Since each intervention should be evaluated in the context of the domestic market environment, a few coping strategies are presented in this subchapter. Grid related auction solutions seem to be more prevalent outside Europe, and therefore most examples will come from non-EU countries. Colombia experimented with qualitative conditions (multi-criteria auctions) before switching to a supply-demand matching approach. Argentina used different location specific criteria and subsequently reduced auction volumes and eligible project sizes. Germany used location-based restrictions supplemented with forced utilization in areas with strong but not the highest yield potential. Mexico's simultaneously introduced region and supply-demand balance adjusted schemes. There is no one perfect solution for integrating RES into the grid, and the success of these tools is context dependent.

3.4.1 Colombia

The first auction round took place in February 2019 using very sophisticated rules to incentivize the desired actors and projects to participate. The main goal was to attract projects supplementing the electricity mix of the country which consists of high level of hydro capacities. As part of the pre-qualification criteria, each bid needed at least 50 of 100 points from he following criteria:[53]

- Resilience (25 points): Contribution to the enhancement of the resilience and adaptability of the energy system to face variability and climate change events through the diversification.
- Complementarity (25 points): Complementarity of the project's seasonal profiles with hydro resources, both in terms of location and time.
- Emissions reductions (25 points): Contribution of the project to the reduction of CO_2 emissions in accordance with Colombia's commitments to the Paris Agreement.
- Regional energy security (25 points) Impact on the supply-demand balance and reduction of operational restrictions to promote sustainable economic development and strengthen regional energy security.

This round did not result in any contracts because competition criteria[54] applied as part of the decision-making process to lessen market concentration could not be met by an of the applied projects.

The next auction in October 2019 took stakeholder feedback into account and disposed of the qualification and most of the competition criteria. In their place, three daily time slots were

[53] IRENA (2021) Renewable energy auctions in Colombia: Context, design and results https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/March/IRENA_auctions_in_Colombia_2021.pdf assessed: 15.11.2023.

[54] It was limited, that one investor can only win a certain percentage of the offered capacity.

introduced (0-7, 7-17, 17-24) when producers could submit one or more bids, indicating whether their bids were mutually inclusive, exclusive, or simultaneous. If there was any difference between produced electricity and the offered quantity in the specified time slot, the difference was sold or added to the spot market. This round awarded almost 1.3 GW of solar and wind installation at a weighted average price of 25 EUR/MWh.

The Colombia case suggests that the auctioneer's willingness to take stakeholder feedback into consideration was the key factor of its eventual success. The only drawback to this design was that the 10-hour timeslot raises the risk profile for PV developers since actual production differs substantially in the beginning and middle of the daytime period and yet they are required to provide the same offered quantities in every hour within the time slot. This likely explains why only 3 PV projects were awarded despite the country's excellent solar potential.

3.4.2 Argentina[55] [56]

The RenovAr auction scheme included three and a half rounds, with the fourth round being announced but not launched, between 2017 and 2019. Following the first round, design adjustments were necessary to address insufficient transmission infrastructure.

The third round introduced region-specific caps on capacity per interconnection point, limiting contracted capacity to 20 MW per province, except for Buenos Aires, which had a ceiling of 60 MW. Additionally, new projects were required to connect to existing medium voltage grid capacities, with a size limit of 10 MW. The fourth round was preparing to link private investments with grid infrastructure.

TABLE 4. CHANGES TO THE AUCTION DESIGN OF THE RENOVAR SCHEME, ARGENTINA

	Round 1-1.5	Round 2	Round 3
Announced volume	1000 MW, 600 MW	1200 MW	400 MW
Wind and PV	1-100 MW	same	generally reduced to 0.5-10 MW
Biomass	1-65 MW	reduced to 0.5-50 MW	
Biogas	0-15 MW	reduced to 0.5-10 MW	
Mini hydro	0.5-20 MW	same	

Source: Auctions for the support of renewable energy in Argentina (AURES report, 2019)

[55] Before the country launched its first auction, studies estimated that the existing grid could accommodate approximately 5,000 MW of new capacity, but this came with specific limitations imposed on each relevant transformation node and/or transmission line corridor.

[56] : C. Menzies-M. Marquardt-N. Spieler (2019:: Auctions for the support of renewable energy in Argentina, https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5ccaf543e&appId=PPGMS assessed: 15.12.2023.

After a four-year pause, the first round of Renewable Energy Market Diversification Initiative (RenMDI)[57] was effectively implemented in 2023, carrying two primary objectives:

- Replacement of thermal generation in six predetermined regions with a targeted capacity of 500 MW (for PV and wind, with or without storage)
- General diversification of the power mix with an allocation of 120 MW (biogas, biomass, small hydro).

Through these targeted allocations and technology specifications, RenMDI aimed to advance RES deployment while fostering diversification.

The main takeaway from the Argentinian case is that a location-specific approach can be advantageous for efficiently utilizing existing network infrastructure in the short term. However, this strategy may encounter limitations over time as available connection points become saturated, hindering further expansion of renewables.

3.4.3 Germany[58] [59]

Germany has tried several ways to address the huge geographical imbalance between the electricity consumption centre of the south and electricity production centre of the north. Firstly, regional capacity limits for Northern states were set at 902 MW/year until 2021. Second, awarded projects are limited to areas where grids are overstressed (so-called grid expansion areas or Netzausbaugebiete). Once this cap is reached, bids for the grid expansion area are no longer accepted, even if their bid prices are lower than those from outside this area. This intervention was recently modified so that at least 15% - and 20% from 2024 - of supported projects must be located in the Southern areas where demand exceeds local production.

Two technology-based adjustments were implemented to better utilize lower potential locations that still exhibit sufficient yield potential.

For onshore wind auctions, the bid price was adjusted by the reference yield model (Referenzertragsmodell), which operates as a bonus for projects selecting locations with lower wind resource yields and as a malus for projects located on optimal sites.

Based on the observed results, the location specific incentives had only a marginally positive effect on the German auction outcome, but did not drastically change the results, nor resolve the underlying grid issue.

3.4.4 Mexico[60]

The Mexican auction included three rounds with adjustment factors to support grid integration. The application of a regional clause served to reward or penalize zones based on

[57] Djunisic (2023): Argentina crowns 633.7 MW of projects in RenMDI renewables tender, Renewablesnow.com https://renewablesnow.com/news/argentina-crowns-6337-mw-of-projects-in-renmdi-renewables-tender-828980/ assessed 20.11.2023

[58] T. Sach - B. Lotz- F. von Blücher (2019:: Auctions for the support of renewable energy in Germany, http://aures2project.eu/wp-content/uploads/2020/04/AURES_II_case_study_Germany_v3.pdf assessed: 15.12.2023.

[59] M. Kröger,- K. Neuhoff- J. C. Richstein (2022): Discriminatory Auction Design for Renewable Energy https://www.diw.de/documents/publikationen/73/diw_01.c.848765.de/dp2013.pdf assessed : 11.12.2023

[60] P. del Rio (2019): Auctions for the support of renewable energy in Mexico, https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5ccaf543e&appId=PPGMS

whether new capacity was needed, or production overcapacity existed, rewarding projects in nodes with higher generation costs. The adjusted price served as the basis for the award decision in the auction, but the support for winning projects was calculated using the original bid price. The significance of this factor was reduced after the first round.

An hourly adjustment feature provided more support for electricity generated at times of higher demand and less in times of lower demand. In this case, support was calculated using the adjusted price.

Competition turned out to be very strong in all the three rounds despite criticism from market players over the complexity of the scheme.

4 Current state of auctions in the Energy Community contracting parties

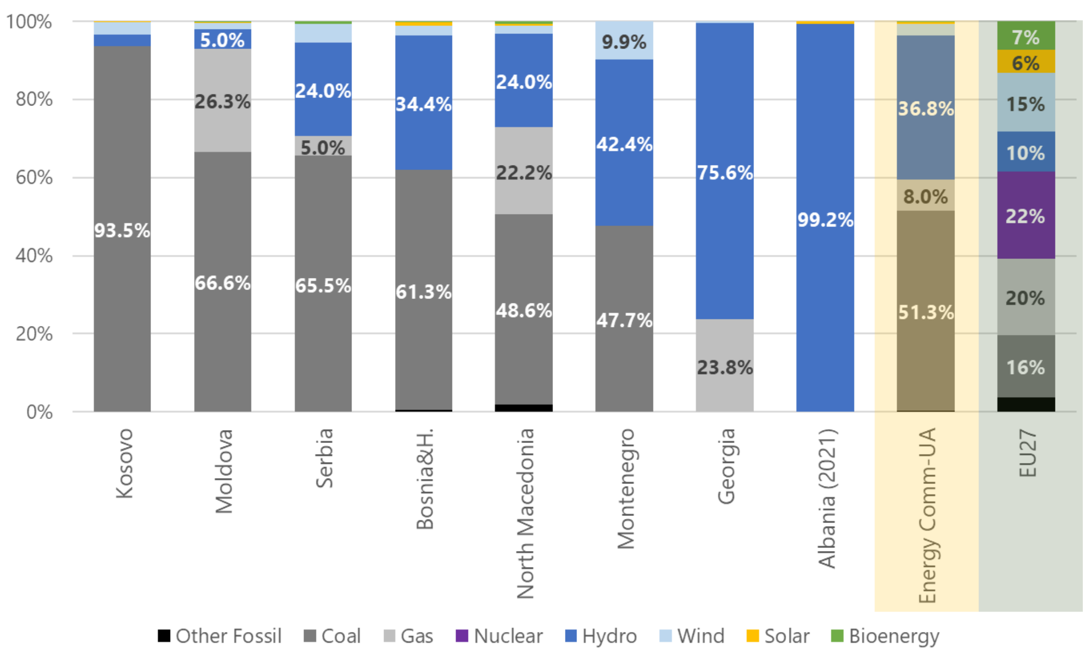
The section analyses the current status of RES auction procedures in the ENC contracting parties[61] and identifies the main similarities and differences between ENC and EU member state auctions. It begins with a brief overview of the regional electricity sector, before summarizing the characteristics and results of the completed RES auctions, and lastly evaluating them against EU practices and experiences.

4.1 Overview of the region

The electricity mix of the eight assessed countries is vastly different from the EU with a much higher share of coal (51% vs. 16%), less natural gas (8% vs. 20%), and no nuclear power. Although the aggregate RES share is nearly identical (~40%), the composition differs considerably, with the majority coming from hydro compared to a more balanced portfolio of wind, hydro, solar PV and bioenergy in the EU. (Figure 10)

Within the region there is a high degree of heterogeneity, especially in relation to the share of coal and hydro, and the utilization of natural gas. What can be said is that wind, PV and bioenergy have very limited roles in these countries (except Montenegro where the share of wind is already close to 10%), which are the technologies usually promoted through RES auctions.

FIGURE 10: ELECTRICITY MIX IN THE ENERGY COMMUNITY COMPARED TO THE EU (2022)



Source: REKK figure based on EMBER bata[62]

[61]The analysis does not cover Ukraine due to the high uncertainty in relation to the current state of the country's energy system and the future energy policy of the country bowing to Russia's invasion.

[62] https://ember-climate.org/app/uploads/2022/07/yearly_full_release_long_format.csv

Removing hydro from the equation, the average RES-E share was only 3.7% in 2022. Wind installations did pick up around 2018/2019 while investment in PV only began in 2020/2021.

4.2 Applied auction designs

Four out of the eight analysed countries have completed at least one auction round - Albania, Georgia, North Macedonia, and Serbia - while Kosovo's first auction procedure is underway still in the beginning of 2024. North Macedonia was a pioneer in 2019, organising three auction rounds altogether, all targeting solar PV. Albania followed suit in 2020 by organising the first wind auction in the region. Serbia and Georgia were next in 2023, launching both PV and wind auctions, with Georgia adding a hydro and „other RES" auction. To date the four countries have completed eight auction rounds, which in some cases included different procedures for specified technologies within the round, resulting in twelve total auctions covering 1,232 MW. Table 5 presents a summary of these auctions.

TABLE 5: COMPLETED AUCTIONS IN THE ENERGY COMMUNITY

	Year of first auction	Nr. of rounds	Auctioned capacities (MW)			
			PV	Wind	Other	Total
Albania	2020	3	240	100	-	340
Georgia	2023	1	70	70	160	300
North Macedonia	2019	3	142	-	-	142
Serbia	2023	1	50	400	-	450
Total		8	502	570	160	1232

Source: REKK data collection based on national sources

The status in the other four countries can be summarized as follows:

- Kosovo launched a 100 MW PV auction in 2023 which will be completed in early 2024.[63]
- Bosnia and Herzegovina has a regulation establishing a FiT scheme for small-scale projects and a fixed FiP for large-scale projects but the call has not been published yet.
- Moldova has a regulation establishing a FiT scheme and a call is expected to be published in 2024 for 60 MW PV, 105 MW wind and 65 MW biogas/biomass.
- Montenegro is the only country in the region where the regulation has not yet been implemented, but the intention to introduce auctions was declared in 2022.

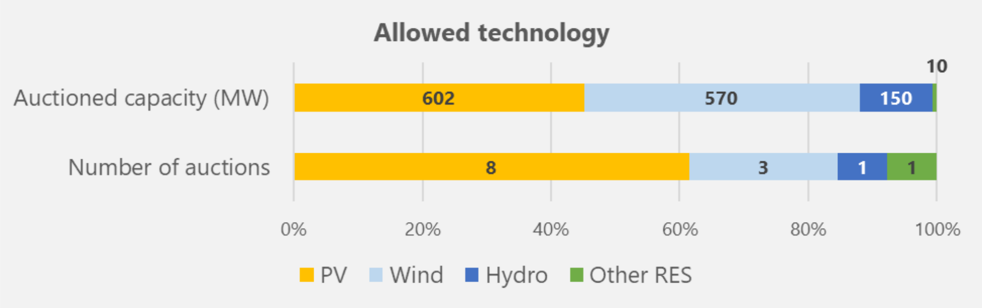
The following subsections present the specific design elements of the 13 auctions (12 completed + 1 in progress).

[63] The list of valid submissions was already published.

4.2.1 Auction demand

Each of the 13 auctions were capacity-based and technology specific, in contrast with the EU, where the picture is more diverse (electricity, budget-based, and technology neutral auctions are common). The majority of the auctions (8) focused on PV, but in terms of auctioned capacities, they are more balanced, since wind auctions (especially in Serbia) are on average larger. (Figure 11)

FIGURE 11: TECHNOLOGIES IN THE ENC RES AUCTIONS



Source: REKK data collection based on national sources

Most of the auctions were multi-item, meaning that participants introduce their own projects comprised of different sizes and locations, and more participants are selected for the support. Thus, auctions are similarly organized in the EU, but there were also examples of site-specific single item auctions in which the auctioneer essentially designs the project for a specific territory, that is generally state-owned, and one contractor is selected in the auction. There is also an example of a hybrid solution (site-specific multi-item auction) in North Macedonia, where more projects were awarded to be accomplished in a specific state-owned territory.

4.2.2 Prequalification

The auctions in the ENC countries apply material and financial prequalification procedures similar to EU Member States. While the level required financial prequalification (bid bonds) are very much in line with the EU average, some requirements in relation to technical expertise or financial capabilities are somewhat more demanding compared to the EU. Those that especially stand out are the following:

- Bid security of 750 000 EUR (KO)
- Balance sheet and income criteria (MK)
- At least 5-year experience with wind power plant development (AL)
- Plans regarding associated infrastructure, e.g. roads (GE)

These criteria can significantly restrict the auction participation rate, leading to lower competition and higher support needs.

4.2.3 Selection procedure

In all 13 auctions the selection of winning projects was based only on the price, while the other criteria were covered by prequalification requirements. There are differences, however, depending on whether these two selection criteria are considered in a one-round or a two-round procedure.

In one-round procedures, the participants submit their prequalification documents and financial bid together and only those bids of qualifying participants are opened. In two-round procedures, the first round is used to check the prequalification criteria, and only qualified participants may submit a bid in the second round. There are examples of both in the ENC, but in the EU the one-round procedure is the dominant practice. The two-round procedure carries the downside of allowing bidders to know when there are only a limited number of investors participating, which can lead to elevated financial offers.

The price competition mechanism can be either static or dynamic. Static procedures are common both in the EU and in the ENC, whereby the participants submit one bid that cannot be altered in the procedure. But there are also examples (MK, KO) of dynamic bidding under which electronic reverse auctions are applied in a subsequent round. In these cases, the price automatically drops from the first round, and the participants must decide at which price level they would withdraw without knowledge of the decisions of the other participants.

4.2.4 Remuneration scheme

The most commonly applied remuneration scheme was the contract-for-difference (CfD), featured in in 7 schemes: four in Georgia, two in Serbia, auctions and one in Albania. The three North Macedonian auctions were fixed premium schemes, while the Albanian and Kosovo PV auctions (the single items in the auction) used hybrid schemes:

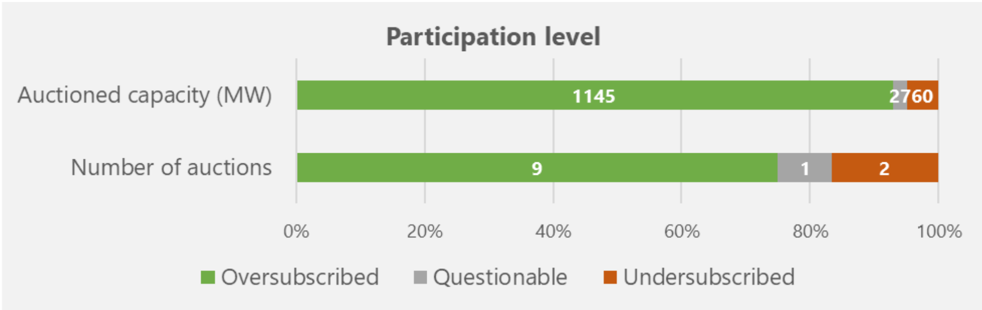
- In the case of the first Albanian auction, the project owner can sell 50% of the generated electricity at the strike price (feed-in tariff) with the other half sold on the market. In the second auction, only 30% of the generation can be sold at the strike price and 70% must be sold on the market.
- In the Kosovo auction, the strike price is used as a feed-in tariff in the early stage, later converting to a CfD scheme once the Energy Regulatory Office (ERO) confirms that a liquid functional day-ahead market has been established in Kosovo.

4.3 Evaluation of auction outcomes

To summarize, ENC RES auctions were successful in terms of participation level and contracted capacities. Out of the twelve completed auctions, nine were oversubscribed, with only two undersubscribed (the Serbian PV auction and the Georgian "Other RES" auction), and one undetermined in this regard (the second North Macedonian auction[64]). (Figure 12)

[64] The total bids exceeded the winning bids, but there is no information about the number of valid bids, and less than 80% of the auctioned capacity were contracted.

FIGURE 12: PARTICIPATION LEVEL IN THE COMPLETED ENC RES AUCTIONS



Source: REKK data collection

It is worth highlighting that the Albanian wind auction (2021), which accepted all qualified bids, led to a higher average price but also significantly higher contracted capacities (222.5 MW compared to the auctioned 100 MW). There was no competition in the procedure because the auctioneer accepted every bid below the ceiling price and contracted far greater capacities than planned. This strategy is suitable for increasing renewable capacities but comes at the expense of higher prices. Moreover, if project owners learn from this auction that all bids below the ceiling price will be accepted, it may discourage them from submitting competitive prices in future auctions.

The impact on prices is difficult to assess because of the different remuneration schemes and the wide range of prices in the EU. In general, ENC prices were within the EU price range for all auctions (in some instances even lower) that were oversubscribed, and the strike price was notably high in the undersubscribed Serbian PV auction.[65]

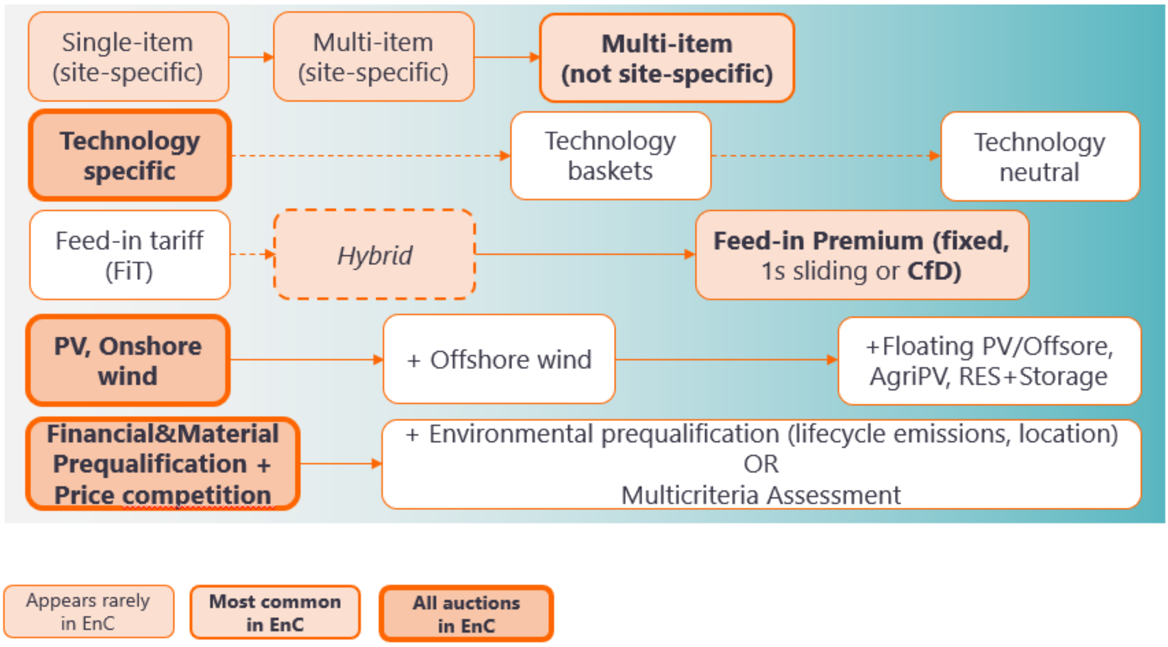
4.4 Evaluation of ENC auctions

The evolution of EU renewable energy support schemes over the past decade depict a learning curve. Most countries began with administrative feed-in tariff schemes, under which the electricity was purchased by a state-owned entity at a predefined price, and project promoters did not face competition within the scheme or on the market. In the next stage, countries began to organize auctions to enhance the efficiency of the support scheme and to minimise public expenditure, in parallel with the related regulatory changes. Auctions also evolved over time, covering more technologies and enabling competition between them. The support is now rather a premium on the top of the market revenues, instead of a fixed, guaranteed revenue stream. Next new requirements were added address grid integration issues and environmental footprints.

The recent ENC auctions share many characteristics of those early EU auctions; they are technology specific, targeting PV and wind, with financial and material prequalification, and price competition. On the other hand, these auctions can be considered more advanced in terms of the remuneration schemes since, in line with the EU regulation, fixed premiums and CfDs are common and feed-in tariffs appear only provisionally (in Kosovo) or in hybrid systems (in Albania). (Figure 13)

[65] In the case of the other undersubscribed auction (Georgian „Other RES"), capacities were not contracted.

FIGURE 13: ENC RES AUCTIONS ON THE LEARNING CURVE OF RES AUCTION SCHEMES



Source: REKK data collection

An important challenge facing ENC countries is the absence of liquid wholesale markets, which would be a prerequisite for advancing from feed-in tariff schemes to market-based feed-in premium schemes. This has the potential to create problems on two fronts. First, for a well-operating FiP scheme, a liquid short-term market is required for producers to sell their electricity. Second, a reference price is required for sliding premium schemes to calculate support payments.

Nevertheless, the auctioneers exhibit a high risk-aversion which is reflected in the design elements: simple design (technology-specific, capacity-based, static, single-item and site-specific in some cases) and strong prequalification criteria (targeting large investors and high realisation rates). This leads to lower effective competition and higher prices. Furthermore, only prequalified participants can submit bids under a tightly controlled process, reinforcing these trends.

5 Auction design recommendations for ENC contracting parties

This section summarizes the recommendations for the optimal auction design for ENC contracting parties. It is important to note that the recommendations cover the main design elements which are common across the countries of interest, but do not consider country-specific barriers and characteristics. Therefore, while the recommendations serve as a starting point for implementing/enhancing auction design within the region, a more in-depth country level analysis is required to incorporate national specifications.

The main goal of the recommendations is to provide an auction framework which leads to lower support costs, which is the key function of a well operating auction design to ultimately achieve cost efficiency. Other important objectives are also considered related to the project realisation rates, the environment, and the participation of smaller players. It is important to highlight that these goals do often contradict each other - for example higher participation usually leads to lower realisation because less serious bidders can place a bid - but the aim is to strike a balance between these different areas.

The recommendations are grouped into four categories: 1) general design; 2) pricing and allocation; 3) technical elements; and 4) procedural elements, which are covered in the upcoming subsections. In each sub-section a summary table provides the most important recommendations, followed by a written analysis of some highlighted elements, which are uncommon within the ENC countries or less evident compared with European auctions. Therefore, it must be noted that not all suggested design elements are discussed in detail in the written section under the tables.

Finally, it is also important to note that the recommendations are mainly intended for countries which have either just started or are in the process of implementing auctions. Therefore, more complex auction designs (like combined RES+storage) are not included in the recommendations as auction procedure and markets are not mature enough to implement such measures. For more about innovative auction designs, see those highlighted examples in Section 3.

5.1 General auction design

TABLE 6: AUCTION RECOMMENDATIONS FOR ENC CONTRACTING PARTIES – GENERAL DESIGN

Auction Design Features	Explanation
Auction Volume: Capacity (MW)	• This system is now already applied in ENC countries with no reason to change it.
Frequency & Size: 1-3 smaller sized auctions within a year (scheduled at least a year before or based on a long-term auction calendar), in line with the governmental capacity targets.	• Frequent, pre-scheduled auctions can largely increase predictability of the support scheme. • A lower auctioned volume would lead to better competition resulting in lower prices. • Frequent auctions would allow better adaptation to changing market trends.

A general aim to keep the over-subscription rate for all auctions at a minimum above 1, and ideally above 1.5, meaning that auctioned volumes should be adjusted based on competition intensity in the consecutive rounds the[66].	• The adjustment for offered capacity would help to avoid long-term undersubscription, which significantly increase support costs.
Type: Multi-unit[67], without pre-determined location (except for offshore wind if applicable) Second-best: In the case of very limited available grid connection capacity, fixed location auction is a short-term solution Optional: Zonal price incentive might facilitate better deployment of renewables, however, it does not solve long-term grid integration problems	• Not restricting the location to a specific connection point will provide project promoters greater flexibility and therefore attract more bidders. • Site diversity improves system stability and reduces volatility in generation patterns. • Multi-unit auctions allow smaller power plants to participate, enhancing competition and facilitating decentralized power generation instead of large, concentrated power plants. This also helps reduce volatility in intermittent production. On the other hand, it imposes more legal responsibilities under the government and regulator to ensure that connection rules are clear and transparent (e.g., pre-announcing where available connection capacities are). • Pre-determined locations can decrease the burden on investors, but the European experience demonstrates that it can result in outcomes where certain locations are not attractive for bidders. • Literature suggests that location-specific price incentives can enhance the optimal deployment of renewables[68]. However, EU experience shows that it is not a long-term solution for grid integration and only small benefits are achievable.
Technology Specificity: Multi-technology auctions or technology baskets (different auction for more costly or less mature technologies) Solar PV and onshore wind should be allowed to compete against each other.	• Multi-technology auctions lead to more competition and price efficiency since the most cost-effective projects will be connected to the grid. • PV and onshore wind LCOE converge, meaning that in most of the cases they are true competitors. • The EU experience shows that the other technologies (aside from PV and wind) are generally not competitive in multi-technology tenders. Thus, if the aim is to integrate

[66] Never adjust the volume during the ongoing auction round. If the auction is undersubscribed, reduce the capacity for the next tender.
[67] Multi-unit means that the winner of the auction is not a single project but can be several projects until reaching the capacity limit.
[68] https://www.sciencedirect.com/science/article/pii/S0957178723001327

Optional: Introducing quota for underperforming technologies In the long-run, new innovative technologies should be incorporated within the auction scheme	multiple technologies in the auction scheme, separate technology basket should be created. (The technologies can still compete against each other within the separate basket/baskets) • If one technology is dominant within a competitive PV & wind auction, a quota for the worse performing technology could be introduced.

With respect to general auction design, one debatable point needs to be highlighted. Regarding technology specificity, this report argues in favour of a multi-technology scheme under which (at least) solar PV and onshore wind compete against each other. This suggestion contradicts the current practice of all ENC countries, which apply technology-specific tenders.

Competition across technologies might be more technically difficult to implement but brings several advantages. First, it broadly increases the competition in the auction, leading to lower support requirements. Second, it enhances technological development, with onshore wind and solar PV LCOE converging. This is because in a multi-technology scheme, the slightly more costly technology is strongly incentivised to reduce costs in order to remain competitive in the tenders.

The most important arguments against multi-technology auctions are that governments lose control over which technology is deployed and to what extent. Furthermore, one technology can dominate the other if cost differences are too large. However, this is only partially true, since in this case quota can be implemented for the underperforming technology, like Spain[69]. Additionally, in most European countries applying multi-technology schemes, did not resulted in one dominating technology.

5.2 Allocation and pricing

TABLE 7: AUCTION RECOMMENDATIONS FOR ENC CONTRACTING PARTIES – ALLOCATION & PRICING

Auction Design Features	Explanation
Type: Static, sealed bid [70] Alternatively: Non-complex dynamic (multi-round) auctions can also lead optimal allocation of support	• Static is the simplest form of auction both for participants and the auctioneer and does not carry significant disadvantages. • Economic theory indicates that some forms of dynamic auctions can lead to better allocation of support than a static auctions.[71] • Applying dynamic systems have additional risk. First, they may be too complex for many entrants. Second, when

[69] In the Spanish auctions there is a minimum capacity limit for both solar PV and onshore wind technologies.
[70] Sealed-bid means that neither the auctioneers nor the competitors are aware of the bids submitted until the submission process is over. In case of static auctions, always sealed bid type of tenders is applied in MSs.
[71] http://aures2project.eu/glossary-terms/dynamic-auction/

	competition is low, market players can better coorinate, resulting in higher support costs.
Pricing Rule: Pay-as-bid	• The dominant pricing method in Europe, which leads to lower support costs than the pay-as-clear auctions.
Award Criteria: Price only	• Including additional criteria into the evaluation rules may drastically distort the price efficiency of the auction. • Additional considerations such as the life cycle GHG emission of the power plant should be included in the prequalification criteria.
Remuneration scheme: Contract-for-Differences (CfD) scheme The reference period should be at least one month long, with technology agnostic reference prices (for example average monthly exchange price). Optionally: CfD scheme with cap & floor: Close to the strike price (slightly below or above), producers receive market price, support is only received below a threshold, pay-back is only required above a threshold. CfD can only operate if there is a reference market to serve as a basis for calculating payments and for market participants to sell their products. If this market is unavailable: • Use the nearest liquid power exchange within the region as the basis for the reference price calculation.	• The new EMD reform proposal assumes that only CfD will be the allowed remuneration scheme for RES auctions. • The main advantage of CfD (and all premium schemes) is that it requires market participation, meaning that producers have to sell their product, and in parallel, a stable cash-flows can be achieved. • Shall be implemented with measures ensuring the liquidity of the wholesale electricity market to generate meaningful price signals and allow new RES producers to sell their products in DAM. • It is advised to implement CfD even in the absence of a liquid wholesale market present in the country. In this case, try to link the national electricity market with other liquid markets nearby, using their prices of as the reference price. • In general, CfD does not incentivize producers to make short-term adjustments in response to market signals. Introducing a cap & floor and applying a longer reference period, or technology neutral reference price, can incentivize market-oriented behaviour.
Balancing: Renewable power plants should have full balancing responsibility. Alternative: In the absence of a balancing market, scheduling should be mandatory for all power plants. Imbalance payment	• In line with the EU norms, the RES market integration should be a key target and, therefore, energy producers should be responsible for scheduling and balancing. • Even if the absence of a balancing market, scheduling is a critical for RES production. Therefore, in order to incentivize accurate generation forecasts, deviations should become more costly for producers.

should be based on administratively set costs.	

A major challenge for some ENC countries is the absence of liquid wholesale electricity markets, which are critical for calculating a reference price and enabling producers to sell their product in the domestic market.

Theoretically, there are two options to address this issue. The first is to introduce an administrative feed-in tariff (FIT) (or administrative reference CfD price) that transitions to a CfD when the market is mature enough. However, this does carry some disadvantages. Producers may lack the incentive to sell electricity initially, keeping a significant amount of supply out of the competitive market. Also, it is not evident, when or whether the transformation of the market will occur.

Thus, a second, recommended alternative to enhance the market integration of renewables would be, to use a neighbouring or close power exchange for the reference price[72]. This would allow producers to sell their electricity in the short-term market linked to a credible reference price as a benchmark for payments. This will lead to some distortions but ultimately serve the effective market integration of renewables while minimizing administrative-based interventions.

Market integration is only possible if producers fully cover their imbalances, but in several ENC countries the electricity market is not mature enough to establish a well-functioning balancing market. In such cases, scheduling of RES power plants becomes even more important, and administrative penalties could be introduced for power producers.

5.3 Technical elements

TABLE 8: AUCTION RECOMMENDATIONS FOR ENC CONTRACTING PARTIES – TECHNICAL ELEMENTS

Auction Design Features	Explanation
Support period: 15 years (can be shortened with more mature technologies) It is important that participating power plants are obligated to enter the payment scheme when the power plant is completed.	• This length is in line with the current European norms. • In some European countries (e.g. Italy, Hungary) it is possible to delay the entrance to the payment scheme, e.g. operating on a market basis during the first year after commissioning. This is, however, suboptimal, as it can allow producers to avoid CfD pay-back obligations when prices are high.
Size limitations: Limiting the maximum capacity of power plants participating in the	• Limiting the maximum capacity prevents 1 or 2 large-sized projects from dominating the auction and allows for a more distributed placement of generation.

[72] Reference price should be adjusted with cross-border transmission costs if present.

auction to 10-20 MWs, depending on the preferences of countries. Optional: Creation of two size categories Category I: Power plants with capacity of at least 0.1-0.5 MW but less than 1 MW (lower boundary depending on the countries' self-consumption regulation and preference) Category II: Power plants with capacity of more than 1 MW	• Creating size categories allows for the successful participation of small power plants, which is not common in the EU without size categories. • The size is based on European best practice, however, the lower boundary depends on several factors, such as whether there is an overlap with the upper capacity limit of self-consumption and whether the country aims to provide FiP for projects with a capacity of less than 0.5 MW (which typical for several EU Member States). • Please note that a separate auction for a small category may result in 5-40 EUR/MWh price bonus based on European experience.
Allowed Realization Time: Technology specific realization times: Solar: 24 months Wind: 36 months All other technologies: 48 months	• Because different technologies require different durations separate realization times are necessary for multi-technology auctions. • The proposed realization times align with the currently applied European best practices. • Longer realisation time can incentives market players to pursue strategic bidding or abandon the projects if the market environment drastically changes.
Ceiling price: Technology neutral ceiling price (within baskets) Ceiling price should differ across different auction baskets	• The ceiling price is a more transparent measure for producers than post validation of the winning price, which is a theoretic alternative. • The ceiling price should be adjusted in the next auctions accordingly (e.g. max winning price +20%). • Technology-specific ceiling prices can completely price out a single technology. A more balanced energy mix is better achieved through capacity quotas. Thus, technology specific ceiling prices are not recommended for competing technologies within the same auction round. • It is recommended to set different ceiling prices across baskets (based on size or technology) since larger power plants are generally cheaper and non-mature technologies more expensive.

Most of the technical recommendations align with general best practices in Europe. However, limiting the options of the producers after project completion is a point to highlight. In some European countries it is allowed to delay the entry into the payment system, after the completion of the project. In Hungary, for example, after the support period begins, it is allowed for the power plant to earn revenues outside the scheme (through short-term PPAs), thereby avoiding payback. In Italy, it is possible to delay entry into the scheme for 18 month and generate revenues under market conditions.

In our view, these procedures contradict the essence of CfD: when prices are low, taxpayers finance the support costs, and when they are high the power plants must make up the difference. Allowing late entry into the system enables producers to avoid payback when market prices are high while still benefiting from the scheme during periods of low prices. Therefore, the payment scheme should start in parallel with the completion of the power plant and penalties for early exit should be introduced.

5.4 Procedure, prequalification and penalties

TABLE 9: AUCTION RECOMMENDATIONS FOR ENC CONTRACTING PARTIES – PROCEDURE, PREQUALIFICATION & PENALTIES

Auction Design Features	Explanation
Prequalification requirement (financial): • Bid Bond (approximately 1-2% of investment cost) • Performance bond/2nd stage bid bond (approximately 5-10% of investment cost) Second-best: One-stage bid bond (approximately 5-10% of investment cost)	• Bond systems are commonly applied solutions in EU MS auctions, improving project realization rates. • The bid bond ensures bidders intend to complete their projects instead of pricing out competitors or participating for speculative reasons. • Performance bonds (2nd stage bid bond) make the non-completion of the project costly for project promoters. • High bonds are associated with lower participation in auctions. Thus, to maximize competition, a lower/moderate level of bid bond is recommended.
Prequalification requirement (material): Prequalification should be only a technical check of required documents, no actual "human" decision-making involved in the process. Therefore, organizing a separate prequalification round is not advised. Suggested potential prequalification requirements: • Information about the financial situation of the firm • Schematic plans of the power plant • Proof of access to the planned site	• Pre-selection of bidders in a separate round is not advised because it results in a less transparent and competitive process (although potentially higher realization rate). • Strict material requirements allow project participation in the early stage of development, which may reduce the completion rate, but enhances competition. It also incentivizes new entrants to participate in the auctions. • It is not advised to implement strict prequalification criteria since it can considerably hinder the participation of smaller investors and well performing new entrants. • "Human decision" should be eliminated from the prequalification as much as possible, which will increase investors trust and transparency of the process. This requires only a technical check after submission.

• Generation authorization (if applicable) • Grid connection agreement (if applicable) • Environmental impact assessment (optional)	
Penalties: Non-completion in time: Loss of bond, reduction of support (gradually after deadline), reducing awarded CfD contract price in the case of delay. Suggested 1 EUR/MWh reduction per quarter year. Non-completion on time + 1 year: Loss of support	• A stepwise penalty system penalizes deters non-completion and allows a reasonable time for completion.
Post auction negotiation/agreements: Post-auction negotiations with the winning promoters is not advised since conditions (such as grid-connection costs) should be stated before the auction process starts, without the possibility of changing the contract once the winners are awarded.	• Post auction contract negotiations can significantly impact transparency and may discourage new investors from participating in the auction.

With all of the recommendations it is crucial to minimize „human decision" to the greatest extent possible. These mainly occur in the pre-qualification stage of the auctions and post-auction negotiation with the winners.

In the prequalification stage, the auction council or the auctioneer should not evaluate the eligibility of projects to participate in the tenders based on "soft" criteria, such as whether the project promoter company is financially stable enough to carry out the project or whether the plans of the projects seem feasible. If they should be checked to facilitate transparency, "hard" criteria, such as determined years of experience, or a specified amount of turnover, should be established.

However, material criteria focusing on the characteristics of the promoter's company is also not recommended. This encourages the participation of large, experienced investors in the tenders, which may hinder competition. A better alternative is to set criteria linked to the implementation procedure (such as a grid connection agreement or licence) which provides the safeguard that the project will be implemented, while also allowing for the participation of smaller, less experienced, but competent investors.

Additionally, if a static auction procedure is applied a prequalification round might not be necessary. At this point promoters can simultaneously hand in their bid and prequalification documents, and only those bids fulfilling the prequalification criteria are considered.

As a second point, it is recommended to avoid post-auction negotiations with the winning project promoters. In an optimal system all conditions will be set before the auction procedure is initiated so that participants have full knowledge of the implementation and operation ex-ante.