D5.4, July 2021

Auction design and renewable energy financing

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Contents

Executive summary

This Auctions for Renewable Energy Support II (AURES II) report provides an overview of the impact of different renewable energy auction design elements on risk and the subsequent impact on the financing conditions of projects. Renewable energy investments are capital intensive but feature low operational costs. This means that the cost of capital has a large impact on the levelised cost of electricity (LCOE) and bid prices likely to be offered in an auction. Risk is a major factor in increasing the cost of capital for developers. While policymakers often only have an indirect influence on the exogenous drivers, e.g., capital market conditions or general country risk, they have a direct influence on many endogenous drivers, such as the auction and support design. Auction-specific risks such as qualification, allocation, non-compliance, and market exposure risk can be influenced and to some extent mitigated by careful auction design. In its empiric analysis, the AURES II project found that the presence of auctions in a competitive market environment not only did not increase the weighted average cost of capital (WACC) but rather the opposite: increasing experiences with auctions seem to reduce the WACC (Roth, et al., 2021). More broadly, renewable policies that mitigate market exposure risk, as well as learning effects in renewable energy deployment, can reduce the WACC, while the differences between countries can be explained by the presence of differing sovereign risks. The empirical analysis used data collected through 93 semi-structured interviews across the EU member states (and the United Kingdom) with bankers, project developers, investors, among other stakeholders.

General best practices for renewable energy auction design are sufficiently large auction volumes adjusted to the expected level of competition, high auction frequency and a long-term auction schedule. These allow for economies of scale and low allocation and qualification risk. Such clarity and long-term visibility are key, not only for mitigating risks for project developers but also for banks and finance providers. Technology-specific design elements allow for better tailoring of the auction to the technology and reduce the risk of one technology losing out entirely to a technology with a lower cost. The decision between a bidder or government-sited (site-specific) auction depends largely on the local land conditions. In countries with a high level of uncertainty surrounding land and grid connection approvals as well as for technologies with costly and risky site development, government-sited auctions can help reduce risk exposure and cost for bidders, otherwise, bidder-sited auctions are advisable.

Support design should aim at some form of revenue stabilisation across the support period. Both a symmetric sliding feed-in premium (FIP) (two-sided contract-for-difference [CfD]) or an asymmetric sliding FIP (one-sided CfD) can achieve this goal. Conversion of the support scheme for operational projects awarded a feed-in tariff (FIT) into a FIP upon the introduction of an electricity market, should be avoided. If this is not (politically) feasible, then the previous FIT level should be converted into the strike price of a symmetric sliding FIP and a reference (electricity market) price should be calculated over a short time interval (e.g., hourly) to minimize market exposure risk. Such changes to the support mechanism should be announced well before the auction takes place and the conversion mechanism (e.g., an assessment of electricity market readiness) needs to be clearly defined to avoid any uncertainty around it.

The auction procedure should be fixed before the auction and communicated transparently, as this helps developers and finance providers to better assess the potential consequences of such changes for their projects. Undisclosed ceiling prices can deter developers from participating in an auction. Similarly, previously unannounced decisions to reduce awarded volumes due to undersubscription puts developers off or may reduce participation in subsequent auctions.

Conditions for participation in the form of material pre-qualification requirements need to be fine-tuned carefully as to ensure a high project realisation rate but not put developers off on their participation in the auction. Bid bonds are rarely an issue for large and international players but can effectively lock small and medium developers out of an auction.

Deadlines should be consistent with the project development timelines of the respective technologies they apply to. Penalties should be clearly defined but gradual to allow for a penalty proportional to the extent of the commissioning delay, since this allows for controlling the impact on future cash flows in a more nuanced way than applying the full penalty would.

Good auction design also takes the local financing conditions of developers into account and tries to minimize unnecessary risks for developers. Good auction design does not need to shield developers from all risks, instead, it should help them correctly assess the risks involved in participating in an auction.

1 Introduction

1.1 Background of AURES project

The Auctions for Renewable Energy Support II (AURES II) project aims at ensuring the effective implementation of auctions for Renewable Energy Sources (RES) in EU member states. The main focus of the project is on the different auction design elements and policy design options. The principal objective is to provide support to EU member states and Energy Community parties in improving the effectiveness and cost-efficiency of financial support schemes for RES.

1.2 This report

This report provides auction design recommendations compatible with financing, drawing from the insights gained in AURES II project tasks 5.1 and 5.2 on financing conditions and risk for renewable energy projects.[1] In task 5.1, the report "Effects of auctions on financing conditions for renewable energy projects" by Đukan, et al. (2019) maps out hypotheses on the effects of auction designs on financing. In task 5.2, the report "Renewable energy financing conditions in Europe: survey and impact analysis" by Roth, et al. (2020) quantifies some of the effects using econometric analysis and cash-flow modelling. The analysis was performed with data on financing variables collected through a survey and in-depth interviews conducted between September 2019 and April 2020 in all the EU Members States and the United Kingdom. Besides this, members of the Finance Working Group of Wind Europe (a wind energy industry association) assessed auction-related risks and design recommendations during an online group discussion in May 2021.

Auction design compatible with financing aims at mitigating auction-specific risks, including market exposure risk, and increasing bidders' participation. Đukan, et al. (2019) analyse the exogenous and endogenous drivers of the cost of capital for project developers. While policymakers often only have an indirect influence on exogenous drivers, e.g., capital market conditions or general country risk, they have a direct influence on many endogenous drivers, such as the auction and support design. Roth, et al. (2020) showed that, as auctions become more persistent (i.e., more auctions where large volumes are implemented), the weighted average cost of capital (WACC) does not increase and may actually decrease. In addition, debt de-risking would achieve support costs savings that are on average almost two times greater than equity de-risking, which implies the importance of revenue stabilisation. While improving financing conditions through de-risking auction designs could decrease bid levels, its effect for mature EU markets is smaller than for less mature auction markets or comparatively higher risk countries.

The report is structured as follows. Section 2 provides an overview of the different types of risk that affect projects and their financing conditions, with a focus on auction-specific risk. Section 3 discusses the effect of certain auction designs on bidder's risk exposure and recommendations for auction design. Section 4 concludes the report.

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[1] An additional source used in this report is the 2021 paper by DTU researches Mak Dukan and Lena Kitzing titled "The impact of auctions on financing conditions and cost of capital for wind energy projects."

2 Risk types influencing the financing conditions

2.1 Financing of renewable energy investments and general risks

Renewable energy investments are capital intensive, usually with a large upfront investment and low operating costs. Therefore, their levelised cost of electricity (LCOE) is sensitive to changes in the cost of capital (Đukan, et al., 2019). The WACC calculation is a measure reflecting the costs of equity (a firm's capital), the cost of debt (a bank's or investors' capital), and the debt-to-equity ratio (the capital structure) of a project. WACC can be seen as the most significant cost indicator for renewable projects. Risk affects all components of the WACC and is its most significant important factor of influence. The more uncertain or risky an investment is judged to be, the more likely it is to receive financing at less favourable conditions from debt providers. For example, this could occur in the form of a higher interest rate or a lower debt capacity for a project, which subsequently increases the WACC. A similar argument can be made for equity, which comes at a certain opportunity cost of a forgone investment. The riskier an investment is, the more expensive a firm's equity is likely to be. A higher debt-to-equity ratio tends to reduce the WACC because debt tends to be cheaper than equity. As risk increases, the debt provider will not accept a high debt-to-equity ratio and thus the WACC is expected to increase. De-risking renewable energy investments can reduce the cost of capital and subsequently the LCOE (Đukan, et al., 2019; Roth, et al., 2020).

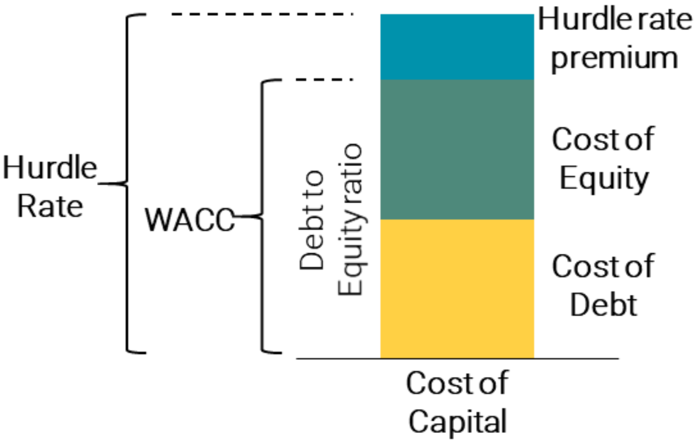

Figure 1. Conceptualisation of cost of capital, hurdle rate, and WACC

Source: Đukan, et al. (2019)

The risks influencing the cost of capital of a renewable project can be classified into macro-level, meso-level, and micro-level risks. Macro-level risks are often also referred to as country-level risks are usually outside of the scope of the influence of a developer but can be influenced by the policymaker. Box 1 provides a short overview of the different macro-level risk types.

Meso-level or sector-level risks included auction-specific risk, policy, and market risks, as well as actor experience. Auction and market risks stem from the auction design and the level of market exposure and will be discussed in detail in Section 2.2. Policy risk describes the risk of dependence on favourable policies, e.g., a support scheme and risk from sudden or retroactive changes to these policy conditions. This means, the more stable a certain policy framework around renewables is, the less risk is involved for renewable developers to invest in project development. Unexperienced actors are more likely to misjudge project developments, which can have financial repercussions. Micro-level or project-level risks refer to resource and technology risks, such as bad wind conditions or equipment failure, and should generally be controlled for in the risk mitigation practices of the project developer.

Empirical analysis by Roth et al. (2020) shows that not all risk types are equally relevant in practice. Some factors such as resource risks, actor experience, and political and socio-political risks seem to have a negligible impact on financing. Others such as economic or sovereign risk show a significant impact on the cost of capital. There is a strong positive correlation between national interest rates and the cost of debt. This relationship explains the declining cost of debt across many EU countries since 2014 when interest rates started falling due to the expansionary monetary policy of the European Central Bank. The results by Roth et al. (2020) suggest that the presence of and experience with an auction scheme in a country can reduce the WACC, while high market risk and low policy stability can increase the risk for projects and therefore the WACC. However, the study also finds that other effects, such as the expansionary monetary policy of the European Central Bank, could have played a significant role in the reduction of the WACC.

Box 1: Macro-level risk types for renewable energy projects

Economic risks	Political risks	Socio-political risks	Sovereign risks
Include general growth risks, commodity market price risks, contractual risks (non-compliance or bankruptcy of counterparties) and cost of insurance often directly influence project costs or cost of capital.	Include stability risks such as the rule of law and political regime stability. Political risks often translate into a higher cost of debt for financing projects.	Include risks from public opposition to renewable energy projects.	The risk of a country defaulting on its obligations.

2.2 Auction-specific risks

Renewable energy auctions introduce new and auction-specific risks to project development, which policymakers need to be aware of and should also be controlled for through tailored auction design. This meso-level risk can be deconstructed into four separate risk occurrences: Qualification and allocation risk, non-compliance risk, and revenue or market exposure risk. Figure 2 shows these risks and their occurrence during project development and the auction process. The upper section of the figure shows different project stages. Qualification and allocation risk occur earlier during project development while the risk of non-compliance is exclusive to the construction period and revenue or market exposure risk to the operations period.

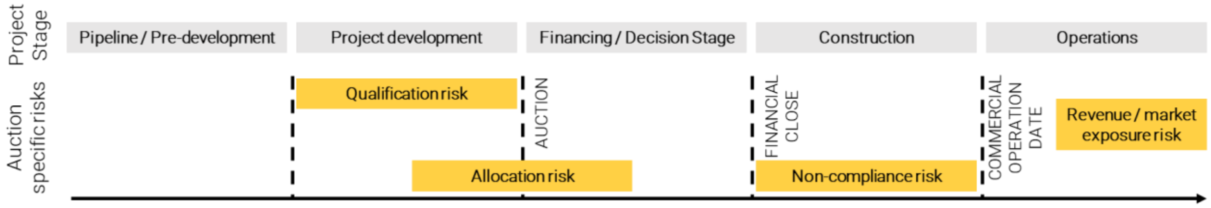

Figure 2 Auction-specific risks across the project lifetime

Source: Based on Đukan & Kitzing (2021)

Qualification risk is the risk that a bidder prepares but does not fully and timely meet an auction's pre-qualification requirements and is therefore disqualified from the auction. Bidders need to qualify to participate in an auction by fulfilling pre-qualification requirements. These pre-qualification requirements can be either: Financial in form of a bank guarantee (bid bond) or cash deposits in a designated account (financial prepayment), or material in form of project documentation such as detailed project description, proof of grid access, land tenure, and environmental assessments

Qualification risk tends to be lower in well-established auction schemes compared to the newly introduced schemes and is especially relevant for countries introducing a new auction scheme. This is reflected in the share of disqualified bids between two different types of auctions. For the long-running German onshore wind auction, disqualified bids hover around 5% for each of the 10 auctions in the period between 2017 to 2019 (Tiedemann, et al., 2019). For the first Albanian solar auction in Karavasta in early 2020, only one in five bids qualified (Koleka, 2020).[2]

Allocation risk describes the risk of not being awarded support after having participated in an auction. This risk can be assessed as a function of the cost of project predevelopment (for planning and permitting activities occurring before the auction) multiplied by the expected probability of the bid not being awarded. Allocation risk is more important in one-off auctions or auction schemes with irregular schedules, as developers don't know whether a project needs to be abandoned or if it can be submitted again. In schemes like the German EEG or the Dutch SDE+ or SDE++ with multi-year schedules, developers can simply submit an unsuccessful project in the next round with a reduced bid price to increase the chance of being awarded. In terms of outcome, both the qualification risk and the allocation risk are identical, as a project is not awarded and might not be pursued further, leading to sunk costs.

Non-compliance risk refers to the risk that a bidder does not meet contractually agreed deadlines or production obligations and thus must pay penalties. If developers take longer than the agreed time to construct the project, a penalty needs to be paid by executing the financial guarantee or reducing support payments. In the case of full-non-compliance, the award may be revoked, and the full penalty needs to be paid.

Revenue or market exposure risk, though not strictly speaking an auction-specific risk, is the risk resulting from the exposure of project revenue to price volatility on electricity markets. The higher the exposure of project revenue to market prices, the higher the share of unsecured revenues, which affects the project's ability to pay back investors. Without support payments or any form of revenue stabilisation (i.e., by signing a bilateral agreement), developers need to rely on the electricity market prices for their entire revenue and thus face full market exposure risk.

Depending on the stabilisation mechanism chosen, i.e., either a fixed premium, a symmetric, or an asymmetric sliding FIP, a developer will face different levels of market price risks, which increases uncertainty around future revenue. Premiums are calculated as the difference between a strike and a reference electricity price. The reference price is the electricity market price that serves as a benchmark for the revenue that a producer can receive on the electricity market. The reference price is usually linked to the day-ahead market price and it can be calculated based on hourly prices or averaged over a longer time horizon—typically monthly or yearly. If averaging periods are short (i.e., hourly), a sliding FIP behaves like a FIT regarding the risk profile faced by the producer. If averaging periods are longer (i.e., monthly or yearly), project operators face a higher exposure to market risks. Figure 3 provides an overview of the effect different support instruments have on the amount of secured revenue and following debt capacity. Payments are indicated in yellow, market revenue in turquoise, strike prices and support periods in red.

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[2] Additional circumstances such as the turbulence around the then just upcoming SARS COV2 Epidemic might be a mitigating circumstance here.

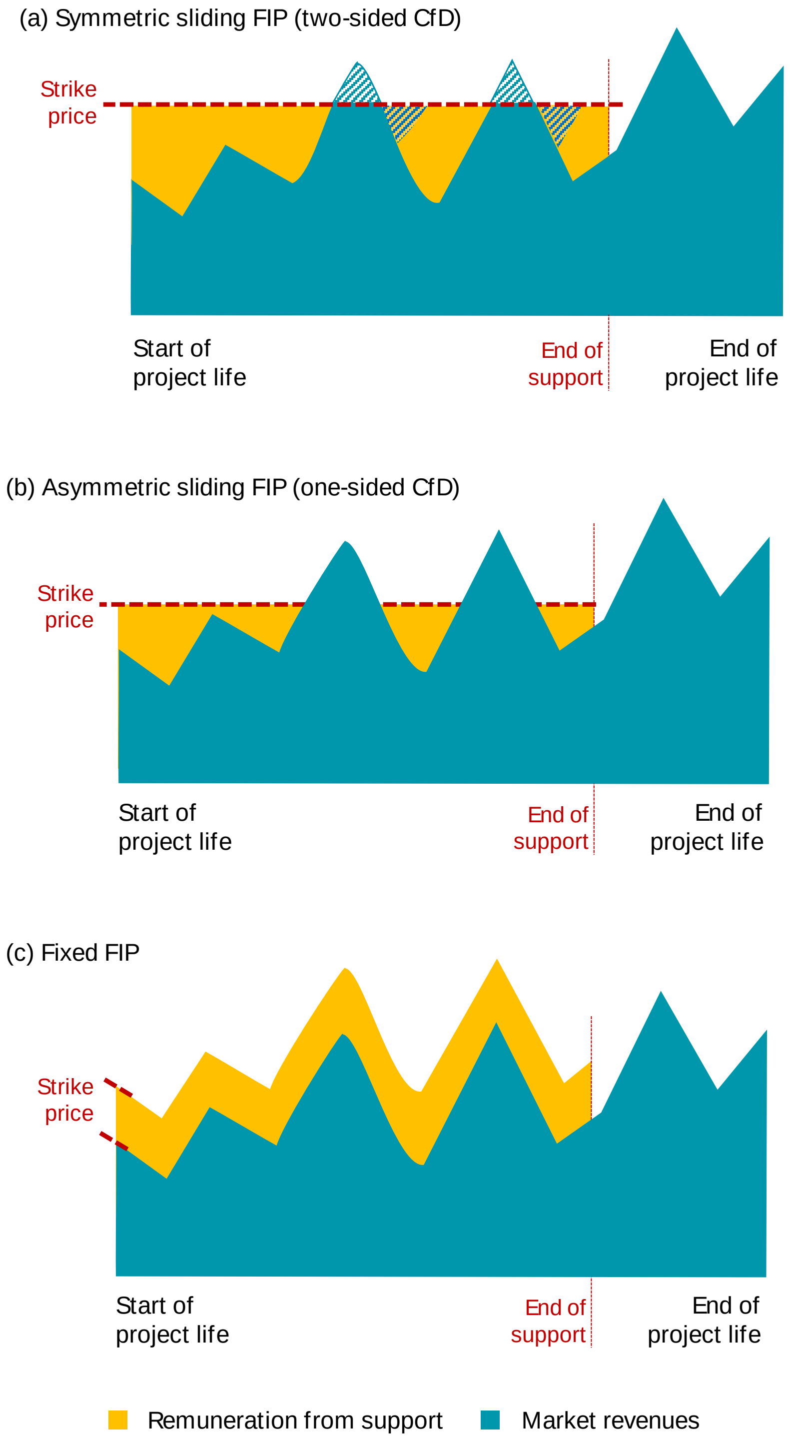

Figure 3 Strike prices, secured revenues and debt capacities under three different support designs

Source: Đukan, et al., (2019)

A symmetric sliding FIP (or two-sided CfD) provides the highest revenue security to a developer, as the support instrument shields her entirely from the market exposure risk. The developer has a guaranteed constant revenue stream throughout the support period, no matter the electricity price developments. This constant revenue stream results in lower risk and a higher debt capacity that lenders are willing to accept for such a project.

In an asymmetric sliding FIP (or one-sided CfD), bid prices secure a floor for project revenue but do not fully stabilise revenue like a symmetric sliding FIP. The developer has a minimum amount of revenue guaranteed throughout the support period but, depending on the electricity price development, has the chance of earning more than this base amount.

Under a fixed FIP, a producer sells at the market price and on top of that receives a fixed premium as a separate, guaranteed revenue stream. Therefore, a fixed FIP provides the lowest level of secured revenue and correspondingly the lowest debt capacity. Here, the developer faces the largest exposure to market price risks.

To shield themselves against market exposure and increase their debt capacity, developers can use private tools, such as power purchase agreements (PPAs).

Box 2: Private sector revenue stabilisation mechanisms

Corporate PPAs
A private sector mechanism for revenue stabilisation are PPAs. PPAs are agreements, often between large commercial and industrial power consumers (corporates) and developers to buy a set amount of electricity for a fixed price over a specified period. The corporate can market its usage of renewable electricity, while the developer has a secured revenue stream. The viability of corporate PPAs largely depends on member states' rules around guarantees of origin (GOs), which are needed by the corporate to certify its electricity to be green. The practice in the EU is diverse, some member states issue GOs to supported electricity (e.g., the Netherlands), while some member states do not. In France, Germany, and under the new Spanish support scheme, supported RES generation does not receive GOs. The GOs are retained by the state. Not giving GOs to supported generation can limit the growth of a market for corporate PPAs since the GOs would only be issued for the generation that is not receiving support.

3 Auction design options and their effects on financing

Reducing the perception of risk can contribute to spurring competition by increasing the number of participants in the auction (IRENA and CEM, 2015). Different auction design elements can mitigate different types of risk. Auction-specific risks affect different market actors differently: Large market players, with a portfolio of projects and access to capital, tend to be less vulnerable to qualification or allocation risk than a small market player with a single project. The relevance of certain risks also differs depending on the renewable energy technology and its associated project development process (solar, onshore, offshore) through the capital intensity of the technologies.

This section discusses the effect of certain auction designs on bidders' risk exposure and recommendations for auction design. Each design element is first briefly outlined, followed by a description of the potential impact on risk exposure. Evidence presented on the impact is based on findings from task 5.1, task 5.2, a critical discussion with members of the Finance Working Group of Wind Europe gathered by Wind Europe during an online workshop in May 2021, and practical insights by the authors from designing and introducing auctions in several countries in Europe and worldwide.

3.1 General auction design

Auction volume

Auctioneers usually limit the capacity on offer in an auction to spur competition and attract lower bid levels. Size restrictions can apply to the total volume offered in an auction as well as to the bid size that can be submitted.

Impact: While smaller total volumes lead to higher scarcity and enhance competition, too small auction volumes can significantly increase the allocation risk for participating bidders. That is because lower auction volumes will increase an individual bidder's probability of not being awarded while the predevelopment cost remains the same—all other things being equal. Too small volumes in a year are likely interpreted by bidders as low market deployment and can lead them to walk away from an auction.[3]

Regarding bid sizes, while lower maximum bid size limits can increase an individual bidder's probability of being awarded (as more projects will be required to achieve the same overall targeted capacity), they also prevent cost reductions that could be achieved from economies of scale in larger projects. From a bank's point of view, smaller bid sizes reduce the attractiveness of financing as small projects require the same amount of due diligence (fixed cost) to be invested as larger projects. Thus, with smaller bid sizes, the total fixed cost will be higher for the same amount of liquidity than with larger projects.

Technology-specific considerations: The impact of low bid size limits can differ by technology. Achieving economies of scale through larger projects can be particularly important for technologies with a high capital intensity such as onshore and offshore wind. For mature technologies with a high level of modularity, such as solar PV, this impact is less pronounced in bidder-sited (or non-site-specific) auctions where smaller projects can still place competitive bids.

Evidence: Econometric evidence by Roth et al. (2021) for the European context suggests that, as auctions become more established (i.e., more auction rounds, larger volumes, and more time passed since the introduction of auctions in a country), the WACC for solar PV and wind projects in a country does not increase but can decrease. Moreover, respondents to a survey among experts in wind energy project development and finance confirm that well-defined auction volumes may improve financing conditions and help banks estimate the risk of corporate lending for project pipeline development (Đukan & Kitzing, 2021).

Recommendation: Overall auction volume should be sufficiently high to ensure the participation of a high number of bidders but at the same time maintain competition. This requires adjusting volumes to the size of

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[3] Bidders may decide not to participate in an auction because they perceive its design as unfavourable or with an inadequate risk-return profile.

the actual project pipeline to avoid too large auction volumes and high bid prices being awarded. High maximum bid sizes enable economies of scale for more capital-intensive technologies such as wind energy.

Auction schedule and frequency

Auctions for renewable energy can be held as a one-time event or take the form of a multi-year auction scheme with one or more auctions scheduled each year.

Impact: One-off or low frequency auctions can also lead bidders to not bid in an auction. The lack of a pipeline of future auction rounds where non-awarded projects can reapply with their projects may cause companies to decide not to enter a market. One-off auctions increase the allocation risk for developers participating especially if a support scheme was suspended or is being reformed and a large pipeline of predeveloped projects is accumulated. The lack of a long-term schedule can also lead to deteriorating project pipelines as updating them may not be considered worthwhile by developers in absence of long-term market signals.

The impact of low frequency auctions on financing conditions is more pronounced for project-financed projects than for balance-sheet financed ones because it reduces the project pipeline of a developer in a country. This may cause banks to be more hesitant to provide financing given the low visibility of future cash flows. For banks, a low auction frequency increases the pressure on individual financing deals to be successful in an auction.

Technology-specific considerations: Technologies with longer predevelopment phases such as onshore and offshore wind can especially benefit from long-term auction schedules. Coordination and exchange on tender and commissioning dates between countries can help create a more stable regional market, especially for offshore wind in markets such as the EU with multiple different policy regimes.

Evidence: Roth et al. (2021) observe that a combination of higher auction frequency, larger volumes, and long existence of the scheme is not associated with higher WACC rates. A higher auction frequency can result in lower WACC. Well-defined auction frequencies are also considered to generally improve the long-term planning among project developers (Đukan & Kitzing, 2021; IRENA and CEM, 2015). This was also confirmed by a workshop participant that stated developers are interested in stable policy frameworks and long-term perspectives.

Recommendation: Disclosing a long-term auction schedule with a regular frequency can mitigate some allocation risk and improve financing conditions. A long-term schedule can encourage market entry and enhance competition. Higher levels of competition can, in return, lead project sponsors to pressure banks to offer better terms. Banks are responsive to this strategy because of increasing competition in the banking industry for the provision of financing for the energy transition. Auction schedules should provide an adequate level of flexibility allowing policymakers to adjust volumes per the supply of projects to avoid strong price fluctuations (e.g., German onshore wind auctions between 2017 and 2018, Tiedemann, et al. [2019]).

Technology coverage

Auctions may be organized such that only one renewable technology (technology-specific auction) or multiple renewable technologies (multi-technology auction) compete for the same auction volume. A more detailed discussion on the impacts of changes in auction design on technology bias in multi-technology auctions can be found in the 2020 report "Technology bias in technology-neutral renewable energy auctions" by the AURES II consortium (Diallo & Kitzing, 2020).

Impact: Depending on the design (e.g., no technology-specific ceiling prices), a multi-technology auction might lead to the award of the technologies with the lowest generation costs, and thus bid prices. This would increase the allocation risk for other technologies that are still facing higher costs. For technologies that are less mature and face less favourable geographic or regulatory (e.g., onshore wind through minimum distance rules) conditions, this can deter developers, that may decide to participate in technology-specific auctions in other countries instead.

Evidence: The impact of multi-technology auction design on financing is not assessed in work package five

(WP5). However, experiences from workshop participants support the hypothesis that in most countries there will be a lowest-cost technology in multi-technology auctions. For example, early rounds of the Dutch SDE+ scheme showed the dominance of one technology in a technology-neutral tender. More broadly, Diallo & Kitzing (2020) argue that making the same rule for all technologies is not equal to creating a level playing field. Instead, acknowledging technological differences and accounting for them in design would be more equitable.

Recommendation: Multi-technology auctions are sometimes implemented to comply with EU state aid guidelines or take advantage of converging generation costs between solar and onshore wind. In such cases, including technology-specific design elements that account for technology differences can help mitigate the allocation risk for technologies that have a lower chance of being awarded. Examples of design elements to achieve this include technology-specific ceiling prices (e.g., the Netherlands), minimum quotas for solar or wind (e.g., Spain), or pots with specific feed-in profiles. Auctioning-specific technologies can help align renewable energy development with grid expansion as well as overall generation and demand patterns while at the same time achieve a greater diversity of renewable technologies (Lotz, Wigand, & Amazo, 2020).

Responsibility for site development

The responsibility for site development can be on the bidder (bidder-sited) or the government (government-sited auctions). In a bidder-sited auction, the auctioneer sets a target volume and bidders compete with projects they have predeveloped at their chosen sites. In government-sited auctions, the project site is selected by the authorities and predeveloped to a certain degree (e.g., permitting and resource assessment). Bidders then compete for the right to construct a facility at the specific site.

Impact: Under certain conditions, site development by the bidder might entail a high qualification risk. This can be the case in countries or regions where land and grid connection approvals are highly uncertain and for technologies where site development is costly and risky (e.g., offshore wind). For bidders participating in an auction, these circumstances may additionally lead to a higher risk of non-compliance if they are unable to correctly assess the time and resources needed to fulfil the contractually agreed-upon obligations before the auction.

Evidence: The impact of the responsibility for site development on financing is not assessed in WP5. However, country experiences in Europe (e.g., Albania for solar PV, Germany, and the Netherlands for offshore wind) and abroad indicate that countries may opt for government-sited (site-specific) auctions when better positioned than the bidders to select and (to some extent) predevelop sites. These sites must have sufficient land that complies with zoning and environmental regulations and have sufficient grid capacity to evacuate the injected electricity.

Recommendation: In general, both bidder-sited and government-sited auctions can work well. In countries with a high level of uncertainty surrounding land and grid connection approvals or for technologies with costly and risky site development, government-sited auctions can help reduce risk exposure and cost for bidders. Mitigated risk exposure happens because in those auctions a higher share of the development and cost burden is assumed by the authorities. In bidder-sited auctions, intermediary steps can be taken by the government to reduce site-selection related risks for bidders such as zoning potential sites according to their environmental sensitivity (e.g., Spain).

3.2 Support design

Fixed FIP versus sliding FIP - symmetric sliding FIP and asymmetric sliding FIP

With a FIP, bidders receive a certain payment, a premium, on top of the market price. In the case of a fixed FIP, bidders are given a fixed-amount premium payment. Under a sliding FIP (equivalent to a floating CfD), the premium is calculated as the difference between market prices—usually technology-specific averages over a certain period, e.g., one month—and the auction (strike) price. Sliding FIPs can be symmetric (two-sided CfD), or asymmetric (one-sided CfD).

Impact: The choice of the support design directly impacts the future cash flows of a project. Remuneration schemes with higher market price risk exposure increase the uncertainty surrounding future revenue from the project. This can in turn have a negative impact on the financing conditions of a project. Under a fixed FIP, premium projects are fully exposed to market price risk. Symmetric sliding FIPs stabilise revenue and can attract better financing conditions than a fixed FIP. Compared to a symmetric FIP, an asymmetric FIP leads to lower levels of secured revenue. While for facilities performing above or at market average the market price risk is low, such performance can lead to insufficient revenue for facilities performing below average.

Evidence: Roth et al. (2021) observe that, on the one hand, support schemes that reduce market price risk exposure enhance the effect of auctions becoming more present (i.e., more auctions and large volumes) and lower the WACC. However, the study also finds that financing costs and costs of capital do not depend only on support policies, but on many other external factors, for instance, the country risk.

Recommendation: Remuneration scheme designs that shield developers from volatile market prices, as sliding FIPs, reduce the uncertainty around future cash flows and can therefore improve financing conditions. Symmetric sliding FIPs stabilise revenue and can therefore attract better financing conditions than a fixed FIP. Compared to a symmetric FIP, an asymmetric FIP leads to lower levels of secured revenues, which potentially increases risk and a project's cost of capital. However, both options can work well, and policymakers should consider that risk depends on variables other than the support design such as differences in country risks, market electricity prices, and capacity factors.

Conversion from FIT to FIP during the operation stage

Some Western Balkan and Eastern European countries in the Energy Community without electricity markets consider converting FITs awarded in an auction into FIPs once an electricity market has been established. In such cases, the potential conversion is part of the auction design such that bidders know in advance that the fixed tariff will be converted to a premium during the support period. Therefore, this should not be considered a retroactive change. A discussion of the issue can also be found in the 2020 report "Renewables cross-border cooperation in the Energy Community" by the AURES II consortium and the Energy Community Secretariat (Kerres, et al., 2020).

Impact: If operational projects awarded a FIT in an auction are converted into a FIP upon the introduction of an electricity market, project owners are confronted with market price volatility and, if this was not the case before, balancing responsibility. Although bidders are informed of the conversion upfront, the uncertainty around the conversion event itself (e.g., timing, market access conditions, market prices, and the potential cost of balancing) can be heavily discounted by bidders and investors, resulting in higher financing costs and thus bid prices offered.

Evidence: The impact on financing conditions of a conversion from a FIT to a FIP during the operation stage was not assessed in WP5 since this is a recent development in Europe. The concept is being tested in Albania's solar PV and planned wind auction.

Recommendation: Conversion of remuneration schemes during a project's lifetime should generally be avoided due to the uncertainty of the market price development at the time of bidding. Yet, if necessary, the negative impacts of a future conversion event on bidders' financing conditions can be attenuated if the conditions triggering the conversion event (e.g., a market readiness assessment by the regulator after the electricity market is introduced) are defined clearly. Moreover, the FIP itself should be designed by converting the previous FIT level into the strike price of a symmetric sliding FIP and by using a reference price with a shorter time horizon (e.g., hourly day-ahead market prices). Assuming producers can sell their power at the level of the reference price, exposure to market price risk is lessened and the revenue risk for existing projects is reduced. Moreover, until a liquid intra-day market exists, creating certainty on imbalance costs, e.g., by defining a balancing charge cap for the support duration, can mitigate risks for producers.

3.3 Auction procedures

Ceiling prices

Auctions can impose an upper limit (ceiling price) on the price bidders can submit. Any bid above the ceiling will automatically be disqualified, even if the auction volume is not yet exhausted. If the total volume of bids below the price ceiling exceeds the auction volume, the most expensive bids within the price range will be discarded until the desired capacity has been reached.

Impact: For bidders participating in an auction, the existence of ceiling prices not only increases competitive pressure but also narrows possible auction outcomes and helps bidders to decide whether to enter an auction or not. Disclosing ceiling prices in advance can therefore reduce allocation risk. If ceiling prices are not disclosed, this can in turn increase the allocation risk for participating bidders, even for those submitting reasonably low bids that are only slightly above the ceiling price. Moreover, unreasonably low ceiling prices can cause bidders to choose not to participate in an auction if they expect their costs to be too high to compete.

Evidence: The effect of ceiling prices on financing conditions was not assessed in WP5. However, country experience shows that most auctions in Europe (e.g., Denmark, Germany, Spain, Italy, Netherlands, Portugal, UK) have implemented ceiling prices. Workshop participants reported that undisclosed ceiling prices can lead to a walk away effect due to a perceived additional allocation risk for bidders. They further highlighted that there could be a rush to the bottom as bidders may submit speculative and low bids.

Recommendation: Disclosing the ceiling price before an auction increases the planning certainty for bidders because it reduces the risk of being disqualified for bidders that are offering prices slightly above the ceiling price. However, in situations of low competition, disclosing ceiling prices can pave the way for windfall profits for projects with actual costs are far below the ceiling price. Low competition can be prevented by adjusting the auction volume to the project pipeline over several auction rounds.

Endogenous rationing

If the supply of bids does not exceed the auction volume (or only slightly exceeds it), the auctioneer may choose to adapt the auction volume to the observed supply according to prespecified rules. As a result, only a certain fraction of the supply gets awarded. By preventing that all bidders win even if the sum of all bids is below the capacity initially offered, this measure artificially generates competition in the short term and lowers bid prices.

Impact: Awarding a fraction of the volume auction (i.e., applying endogenous rationing) lowers the chances of being successful for participating bidders, particularly for expensive projects, and thus increases their allocation risk. The possibility of endogenous volume reductions and the associated risks for bidders can represent a source of uncertainty for finance providers. Moreover, it may result in a downward spiral of supply of bids if bidders with the most expensive projects decide not to participate in the auction because their award chances abruptly drop to zero.

Evidence: While policymakers could respond to changing market conditions through endogenously adjusting auction volumes, this could damage the reliability and trustworthiness of the auctioneer and decrease competition further (Hanke & Tiedemann, 2020). Onshore developers and bankers interviewed by Đukan & Kitzing (2021) stated that endogenous rationing, among other factors, increases planning risk and can affect the corporate financing of project pipelines.

Recommendation: In general, endogenous rationing should be avoided. Undersubscribed auctions can be a signal of volumes that are set too high. If endogenous rationing is nevertheless applied, the conditions and size of the volume adjusted should be clearly stated before the auction (e.g., based on past auction results). Volume reductions should be moderate to strike a balance between achieving cost reductions and keeping risks for developers manageable. A reduction of the volume awarded that depends on the participation in the same auction round should be avoided.

3.4 Conditions for participation

Material pre-qualification requirements (for the project or the bidder)

Material pre-qualification requirements refer to the project documentation required for bidders to participate in an auction. This typically includes a combination of the following: a detailed project description, grid access guarantee, land tenure, and environmental assessments. Such requirements can help bidders submit more realistic prices as they gain more information on site conditions and costs. They also ensure a higher likelihood that awarded projects are realised.

Impact: A potential effect of overly strict and onerous material pre-qualification requirements can be that bidders decide not to participate in an auction (e.g., the walk away effect). For bidders participating in the auction, too high requirements can substantially increase qualification risk—especially in combination with tight auction timelines. However, pre-qualification requirements also help to ensure that bidders submit cost-covering bids with a high probability of timely commissioning as projects awarded are already further developed, thereby reducing the risk of non-compliance.

Evidence: Đukan & Kitzing (2021) investigate the hypothesis of whether material pre-qualification requirements lead to an upward adjustment of hurdle rates among wind energy developers. In their interviews, they find no supporting evidence for this hypothesis. This could indicate that potential bidders simply decide not to—or are not able to—participate in an auction when faced with excessively high pre-qualification requirements. Furthermore, Roth et al. (2021) show that the effects of lowering the costs of equity by, for example, de-risking the preauction project development stage through lower material pre-qualifications, would not create significant additional benefits in terms of decreasing bid levels. On the contrary, relaxing these requirements could create unwanted effects, such as potentially lowering project realisation rates in an auction.

Recommendation: Pre-qualification requirements should generally be set carefully at a level that is necessary to ensure a high probability of project realisation and helps serious bidders gain relevant insights on project site conditions, costs, and local regulations. These requirements should be realistic to encourage a high competition level.

Bid bonds

An interested bidder has to prequalify for an auction either by delivering a bank guarantee (bid bond) or by placing cash in a designated account (financial pre-payment). Bid bonds and financial pre-payments are set to guarantee the potential payment of a penalty. If the bidder is awarded, but the contracted project is delayed or not completed, the money will not be returned to the winning bidder.

Impact: Bid bonds help ensure that a winning bidder will meet contractual obligations. Too high bid bonds increase the qualification risk for small bidders that may not be able to pay or secure finance for the bid bond. These bidders may then decide not to participate in the auction. For participating bidders, high bid bonds could also increase hurdle rates for projects if bidders see the need to bid higher to reflect the additional cost—or decrease costs if bidders decide to reduce the expected return on equity.

Evidence: Đukan & Kitzing (2021) find the impact of bid bonds to differ with technology and the type of market actor. High bid bonds can disincentivise smaller onshore players from entering an auction, while large offshore wind projects do not see the payment of sizeable bid bonds as an obstacle. No evidence was found regarding the potential adjustments of the cost of equity or that of hurdle rates, which remained unmentioned by interviewees. A workshop participant commented that in his experience, even if there are high bid bonds, banks may still be willing to invest if the project itself is interesting enough. Lastly, and similar to the effect of relaxing material pre-qualifications, Roth et al. (2021) find that reducing bid bonds would not yield a large support cost reduction.

Recommendation: When deciding on the level of bid bonds, policymakers should seek to strike a balance between two desired outcomes. Bid bonds should be set carefully to ensure the seriousness of bidders. At the same time, they need to be balanced with other, material pre-qualification requirements to ensure that smaller bidders will also be able to participate.

3.5 Project realisation deadline and penalties

Project realisation deadline

Impact: If deadlines for project completion are too tight, it increases the risk of non-compliance as developers may not have sufficient time to realise the project. Consequently, they may be required to pay penalties for non-completion, which increases the overall cost of the project. The risk accruing from short deadlines can have consequences on the availability of finance. As reported by a workshop participant, when evaluating the bankability of a project, banks may consider the potential consequences of tight deadlines. As a consequence, banks can judge projects as not being bankable and refuse to provide finance.

Evidence: The effect of project realisation deadline on financing conditions was not explicitly assessed in WP5. However, country experience shows that auctions with unrealistic realisation deadlines will likely not attract competition due to the higher risk of having to pay a penalty or lose the support awarded. Workshop participants affirmed that, in their experience, tight project timelines substantially increase the risk of non-compliance. Moreover, workshop participants argued that banks can be reluctant to provide finance if there are too short realisation deadlines.

Recommendation: Project realisation deadlines should, in general, be consistent with the project development timelines of the respective technologies they apply to. For example, due to higher modularity, construction time for solar PV projects is usually shorter than for onshore wind plants and much shorter than for offshore wind farms. When setting timelines, policymakers should also consider the project development stage at which projects were auctioned. Projects auctioned at an earlier stage need a longer deadline as compared to projects that were in a later stage of development when the auction took place.

Penalties

To ensure timely commissioning of projects, the auctioneer can apply penalties by executing parts of the submitted bid bond/completion guarantee, reducing the support level or duration, terminating the support contract, or excluding bidders from future rounds. Similar to pre-qualification requirements, penalties can increase the seriousness of bids submitted and reduce the risk of non-compliance.

Impact: Penalties that are implemented by retaining parts of the bid bond might, in theory, increase hurdle rates, if the additional costs nudge the bidder to bid higher, or decrease them if the bidder reduces the expected return on equity. On the other hand, penalties that result in a shortened support duration could negatively affect the ability to pay back loans and ultimately reduce the debt capacity of a project (Đukan & Kitzing, 2021).

Technology-specific considerations: The effect of penalties on bidder participation in an auction can differ between technologies depending on their regulatory and business environment. An example is the case of onshore wind in Germany. Bidders might be deterred from participating in an auction altogether if they perceive that the increasing number of environmental lawsuits could threaten timely project realisation and thus increase the probability of having to pay the penalty (Đukan & Kitzing, 2021).

Evidence: When applied gradually, penalties have nearly no effect on the financing conditions of either onshore or offshore wind projects. For offshore wind, penalties could only have a deteriorating effect on financing conditions (e.g., reducing project bankability) if missing the initial commissioning deadline is penalised with the cancelation of the support contract (Đukan & Kitzing, 2021). Lastly, and similar to the effect of relaxing material pre-qualifications, Roth et al. (2021) find that lowering penalties to de-risk auction design would not yield a large support cost reduction. Doing so may, instead, create unwanted effects, such as potentially lowering project realisation rates in an auction.

Workshop participants agreed that penalties are an important and needed incentive for completing projects on time and thus should increase gradually up to the complete loss of the support. However, participants also highlighted the need for a clearly defined scope of the penalties. Delay causes must be identified as from either project failure or from force majeure, i.e., pre-defined causes that lie outside the developer's force such as natural disasters.

Recommendation: Policymakers should consider applying gradual penalties that are proportional to the extent of the commissioning delay because this allows for controlling the impact on future cash flows in a more nuanced way than applying the full penalty.

4 Conclusions

Good auction design can not only mitigate unnecessary risks for renewable energy project developers but also help assess the potential risks of participating in an auction. To enable policymakers to design better auctions, this report condensed evidence on the impact of several auction design elements on projects' financing conditions from previous AURES II work packages. It also outlined recommendations for implementing auction design that mitigates auction-specific risks including market exposure risk and increasing bidders' participation.

First, financing conditions can be improved through long-term visibility and certainty. Sufficiently large auction volumes adjusted to the expected level of competition, high and regular frequencies, and long-term schedules can offer several advantages. They can enable economies of scale and significantly reduce allocation and qualification risk through recurrence and long-term visibility. While bidder-sited auctions are generally advisable, if there is high uncertainty regarding land and grid connection approvals or for technologies with costly and risky site development, governments may choose to implement government-sited auctions to reduce bidder risk and cost exposure.

A second key factor is stability and clarity. Regarding remuneration, both a symmetric sliding FIP (two-sided CfD) and an asymmetric sliding FIP (one-sided CfD) can work well as they stabilise revenue across the remuneration period. Yet, conversion of one remuneration type to another during the lifetime of a project should be avoided. Moreover, the auction procedures including ceiling prices and endogenous rationing, as well as potential tariff conversions, if necessary, should be clearly defined before the auction and communicated transparently. This allows developers and finance providers to better assess the potential consequences of such changes beforehand. Unannounced changes to auction design should generally be avoided.

Finally, proportionality and context-sensitivity are instrumental. While financial and material pre-qualification requirements are important for assuring project completion and seriousness of bids, they should be realistic and balanced. To reduce non-compliance risk, deadlines should be consistent with project development timelines and penalties applied gradually and proportionately. Furthermore, implementing technology-specific design elements allow for better reflecting differences between technologies and avoiding allocation being biased in favour of the lowest-cost technology.

Limitations apply as the evidence discussed from WP5 of the AURES II project relies on a limited number of interviews and a dataset with approximately 220 inputs on financing conditions for the entire EU. Moreover, access to reliable WACC values was challenging for researchers because the WACC is considered to be a trade secret and is highly confidential. Therefore, the statements made in this paper should not be generalised across EU countries or abroad.

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

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