Policy Memo 4, October 2016

# The effect of competition levels on auction outcomes

HORIZON 2020

**Short about the project**

**Auctions for Renewable Energy Support: Effective use and efficient implementation options (AURES)**

This project helps assessing the applicability of different auction types to renewable support under different market conditions. It also explores which auction types and design specifications meet particular requirements and policy goals in European countries. By establishing best practices and a knowledge sharing network, we contribute to informed policy decision-making and to the success of auction implementations across Europe.

**Target-oriented analysis:** Through analysis of empirical experiences, experiments and simulation, we will create a flexible policy support tool that supports policy makers in deciding on the applicability of auction types and certain design specifications for their specific situation.

**Capacity building activities:** We undertake specific implementation cases to derive best practices and trigger knowledge sharing amongst Member States. We strive to create a strong network with workshops, webinars, bilateral meetings, newsletters, a website that will serve as capacity building platform for both policy makers and market participants (including project developers, auctioneers,etc.). Wherever required, we can set up specific bilateral and multilateral meetings on specific auction issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals issues and facilitate cooperation and knowledge sharing. Additionally, we offer sparring on specific implementation options, drawing from insights gained during the first phases of the project (empirical analysis of previous auctions in Europe and the world), conceptual and theoretical analysis on the applicability of specific designs in certain market conditions and for certain policy goals.

**Project consortium:** eight renowned public institutions and private firms from five European countries and combines some of the leading energy policy experts in Europe, with an impressive track record of successful research and coordination projects.

This report deals with possible effects of competition on the auction outcome and how different measures affect the competition level. It is one in a series of four Policy Memos published by the AURES project:

Policy Memo 1: Secondary objectives in auctions

Policy Memo 2: Pre-qualifications and penalties

Policy Memo 3: The effect of award types on auction outcomes

Policy Memo 4: The effect of competition levels on auction outcomes

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# 1. Definition of competition level in auctions for RES-E

The structure of this memo is as follows. At first, this section describes what competition level actually means. The definition of this term in the context of auctions for the support of electricity generation from renewable energies (RES-E) is far from obvious. Therefore, a structured and precise explanation is necessary. The next section analyses the effect different levels of competition have on the auction outcome. The third section states which measures have an influence on the competition level and how this affects the overall result. Section 4 concludes this memo.

Sufficient competition is a necessary condition for the success of any auction. This has been proven by various results in practice, especially in the context of spectrum auctions (Klemperer, 2002). However, it is difficult to quantify what competition level means. On the one hand, competition increases if more bidders participate in the auction. On the other hand, it increases as well if weaker bidders are replaced by stronger[1] ones (Haufe & Ehrhart, 2015). So, it is crucial to know which and how many bidders will probably submit a bid.

It is especially difficult to determine which auction has most competition if several variables change. Another challenge arises if there is a multi-unit auction with multi-project bidders. A simple example illustrates this: Assume a multi-unit auction in which ten projects are auctioned off. In the first case there are 15 bidders with a single project each. In the second case there are just two bidders but both have ten projects. Without further knowledge it is impossible to decide which auction has a higher level of competition. In the first case there are more bidders, in the second case there are more projects available.

For that reason, we will in the following start our analysis by assuming single-unit auctions and bidders with just one project. Furthermore, we assume that project costs are private knowledge of every bidder and these costs are independently and identically distributed and the distribution is common knowledge among all bidders (IPV) (Krishna, 2002). With this assumption as starting point, we will allow for some deviations depending on the field of investigation. The next section will outline positive and negative effects that occur through a high level of competition in an auction. Furthermore, it will analyse what problems occur if the level of competition is low.

# 2. Effect of competition level on the auction outcome

The most general result is that a high level of competition has a positive influence on the **support level** and hence the auction outcome from an auctioneer's perspective. This holds for single and multi-unit auctions as well as for uniform-price and pay-as-bid auctions. It is furthermore not important whether there are more or only stronger bidders. The reason is as follows. In a multiple-item auction with a high level of competition, the bidders bid more aggressively compared to the same auction with less competition, assuming a pay-as-bid pricing rule. Due to the high competition the bidders exaggerate their costs less. In a uniform-price auction the expected clearing price is lower with a higher level of competition. Independent of the competition, it is a weakly dominant strategy for single-project bidders to truthfully bid their costs. As a result, if more or stronger

[1] Stronger means a bidder with lower costs in this context.

bidders participate, the expectation value of the price determining bid decreases and hence the support level (Krishna, 2002).

**Multi-project bidders** are only an issue in multi-unit auctions under a uniform-pricing rule, as here it is no weakly dominant strategy for multi-project bidders to truthfully bid their costs. For the second lowest and the following bids in a multi-unit auction, it is optimal to overbid as there is a positive probability that this bid is price determining. Hence, it would also determine the support level for all projects the bidder would receive because of his lower bids. If competition increases, the probability to determine the price and also the probability to be awarded decreases. Thus, the incentive to overbid decreases as well (Engelbrecht-Wiggans & Kahn, 1998). The risk of strategic supply reduction is also affected by the competition level. A multi-project bidder might withhold some of his projects to gain a higher price for the remaining ones. The incentive for this behaviour decreases with higher competition as the impact of the supply reduction is lower the more other bids are submitted (Asubel, et al., 2014).

In general, all auctions can be affected by **collusive behaviour**. Nevertheless, multi-unit auctions are more vulnerable because several bidders are awarded and can thus benefit from such behaviour. The degree of vulnerability of a multi-unit auction depends on several aspects. There are differences between uniform price and discriminatory auctions (Back & Zender, 1993) and between static and dynamic auctions (Cramton, 1998). However, the effect of the competition level is ambiguous. A higher number of bidders makes the necessary coordination for collusion more difficult and hence collusion less likely (Comanor & Schankerman, 1976). The result might not be the same with stronger bidders. An important driver of collusion is the transparency of bidders, i.e. how well bidders know each other. Therefore, collusion is more likely among strong bidders who potentially compete repeatedly against each other (Klemperer, 2002).

**Asymmetry of bidders** is a special case. Until now, we only considered cost levels that were independently and identically distributed. This means, before the auction the expected costs of each bidder were the same. Furthermore, the probability to be below a certain cost level is ex ante identical. With asymmetric bidders there are two or more different cost distributions and hence groups of bidders that can be distinguished prior to the auction. One group of asymmetric bidders can have lower expected costs than the other. To define what an asymmetric group of bidders is and what is not is difficult. In the context of renewable energy support for example projects using different technologies and competing in the same auction could be deemed asymmetric but also onshore wind turbines located at the coast and in the interior of a country could be defined as asymmetric (as long as there is no adjustment mechanism). The granularity depends on which cost drivers prevail and whether they can be distinguished. The effect of the level of competition on an auction with asymmetric bidders is different in a single-unit or multi-unit auction. In the first case, the winning bidder is most likely a bidder from the strongest group of bidders. As a result, the stronger bidders bid less aggressively and the level of competition is essentially determined by the number of stronger bidders only and hence the overall number of bidders is of limited meaningfulness (Maskin & Riley, 2000). In the case of a multi-unit auction, the level of competition is determined by the group of bidders containing the last awarded bidder.

Thus, the support level can either increase or decrease through asymmetric bidders in a multi-unit auction depending on the composition of the bidders and the number of awarded bidders.

Example: Asymmetric bidders in a wind onshore auction

We assume a multi-unit onshore wind auction with two different groups of bidders where each bidder participates with a single project in the auction. One group, in the following called Group 1, has projects located near the coast in windy locations, whereas the other group, Group 2, plans to build the wind turbines in the less windy interior of the same country. Hence, bidders from Group 1 have a revenue advantage and thus lower expected levelised costs than bidders from Group 2.

Consider now that each group contains five bidders and that even the bidder with highest costs from Group 1 has lower costs than the strongest bidder from Group 2. If the auction awards three bidders, the competition is essentially among the five bidders from Group 1 and the bidders of Group 2 are not relevant for determining the level of competition. However, if there are for example seven awarded projects, bidders from Group 1 know that they will most probably be awarded (leading to less aggressive bidding) and hence the competition is essentially among the remaining bidders from Group 2.

To include both groups in the competition, the auctioneer might consider an equalising mechanism that improves the competiveness of the bidders from Group 2 through a bonus. Those bidders are then stronger and might be a threat to the bidders from Group 1 who, as a result, have to bid more aggressively. In this case, all ten bidders contribute to the level of competition.

The effect of competition levels on the **incentive for innovation** is twofold. On the one hand, a high level of competition means that innovation leads to a large increase in competiveness for the innovative bidder. Due to the high competition, the probability of winning is low before an innovation. Afterwards, the innovative bidder has a competitive advantage and hence an increased winning probability. On the other hand, innovations are usually equivalent to preliminary payments and thus, in the case of not winning in the auction, sunk costs (McAfee & McMillan, 1987). A high competition level leads to a low probability of winning and hence it is less likely that the bidder will recover sunk costs. The essential question regarding the incentive for innovation is therefore which effect is more dominant. Is it preferable for bidders to increase their competiveness through innovation or are the potential sunk costs higher than the expected additional profit? To summarise, it depends on the specific environment whether competition has a positive or negative effect on innovation.

Finally, the risk of the so-called **winner's curse** is affected by competition level. To analyse this effect, we have to deviate the initial model in the sense that the bidders no longer know their respective costs exactly prior to the auction. The costs are partly or completely unknown and only the probability distribution of the costs is common knowledge. Usually this unknown cost component is common to all bidders. In the context of renewable energy support, an example might be future PV module prices. The bidders do not know these costs exactly but they make an estimate. Furthermore, all bidders need modules, so this cost component affects them all. The risk of the winner's curse is now the risk that the winning bidder wins the auction because he has the lowest estimate for the unknown costs and hence the lowest bid. This estimation is most probably below the actual costs (as it is the lowest estimation) and hence the winning bidder may make a loss. Theoretically, rational bidders include this risk in their bid and hence the winner's curse does not occur. In practice however, it does occur. Assuming that the bidders do not sufficiently include the risk of the winner's curse in their bid, the probability that the winner's curse occurs is directly negatively correlated to the support

level. The lower the support level, the higher the probability of the winner's curse under the assumption that the same bidder wins the auction. The explanation is simple. If the other conditions do not change (cost parameters, uncertainty level etc.) and due to the high competition the award price decreases, then the probability that the costs are higher than the award price increases (Krishna, 2002).

This result immediately leads to an implication on the **non-realisation risk**. If the probability increases that the costs are higher than the revenue of the project, the risk of non-realisation increases as well (Waehrer, 1995). To prevent this implication, the auctioneer could establish a financial prequalification or penalties but this again could have an impact on the competition level, as shown in Section 3 and in Policy Memo 2: "Pre-qualifications and penalties".

*Table 1 – Analyses of the effect of competition level on different conditions and objectives*

| Object of investigation | Effect |
|---|---|
| **Support level** | • Higher competition level leads to lower support level. |
| **Multi-project bidders** | • Probability to be price determining decreases with higher competition level.<br>• Incentive for overbidding in uniform price auction decreases and hence also the incentive for strategic supply reduction. |
| **Collusion** | • Collusive behaviour is more difficult to implement in auctions with high competition level due to a high number of bidders. Less so if high competition level is due to stronger bidders. |
| **Asymmetric bidders** | • The group of bidders that includes the last awarded bidder in the auctions has an essential influence on the competition level.<br>• Competition can be increased by equalising different groups for example through a bonus / malus system. |
| **Incentives for innovation** | • The effect of a high competition level on the incentive for innovations is ambiguous.<br>• An innovative bidder has a competitive advantage.<br>• Innovations are accompanied by sunk costs. |
| **Winner's curse** | • High competition level under cost uncertainties increases the risk of the winner's curse. |
| **Non-realization risk** | • High competition level and cost uncertainties increase the non-realisation risk. |

# 3. Auction design and its effect on competition

## Auction Format

In RES-E auctions the predominant auction scheme are static auctions with either a pay-as-bid or a uniform pricing rule (Wigand, et al., 2016). These two rules can have different effects on the competition level (Klemperer, 2002). Nevertheless, the effect of the auction format on the level of competition is only minor especially in comparison to the other auction design elements explained hereafter.

## Material prequalification measures

Prior to the auction the auctioneer might require the bidders to satisfy certain criteria, for example having a land-use plan or a building permit. The bidders would have to fulfil these criteria in any case if they want to construct a RES-E project. Nevertheless, physical prequalification measures cause costs for the bidders prior to the auction. These costs are sunk if the bidder is not awarded in the auction.

As a result, only bidders participate in the auction who have a positive expected profit. Only strong bidders (with a low cost signal) expect a positive profit even with potential sunk costs. Therefore, the number of participating bidders decreases but the ones who participate are stronger (McAfee & McMillan, 1987).

There could be also other material prequalification rules that do not relate to the specific project itself but to the participating bidders. In order to implement secondary objectives (see Policy Memo 1: “Secondary objectives in auctions”) such as the development of the domestic industry or system integration, the auctioneer may restrict the participating bidders. Also, e.g. requirements regarding previous experience with building and operating certain technologies can be used to increase the realisation probability of winning projects.

But whatever reason such a restriction has, it decreases the number of bidders. However, it can also prevent unfair competition (e.g. dumping or market concentration) and hence could increase the competition among the remaining bidders.

## Auction volume

Given that all other parameters stay the same, the auction volume influences the level of competition greatly. It has the opposite effect as the number of bidders. The higher the auction volume the lower the level of competition and vice versa. It is intuitively understandable that there is less competition if the same number of bidders compete for more goods.

Nevertheless, a higher auction volume and hence a higher winning probability might be an incentive for more bidders to participate in the auction (see “Material prequalification measures”).

## Frequency of repeated auctions

To evaluate the effect of a change in the frequency of auctions on the level of competition we have to distinguish two cases. In the first case the auction volume per time unit (e.g. per year) stays the same. In the other case, the volume per auction stays the same.

The latter case means that the overall auction volume changes and thus the same implications hold (see “Auction volume”). The effect of the first case is more difficult. If for example more auctions with a lower volume per auction are held, several implications are possible depending on the other framework conditions.

There is less risk that there is an involuntary disruption of project development because the bidder has to wait for the next auction, meaning less (sunk) costs. Additionally, the bidders can participate in more auction rounds before a permit or the financing expires. By tendency, this increases competition but also means that bidders might bid strategically. Furthermore, an increased frequency also increases the fluctuation of the competition level between the individual auction rounds. This in turn increases the bidders’ uncertainties regarding the competition level of each auction round.

## Maximum prices

A maximum price restricts bidders in the auction to bid lower or equal to this price. Thus, bidders with higher costs than the maximum price will never participate in such an auction. As a result, the number of bidders decreases. However, the non-participating bidders are the weakest ones. Hence, the remaining bidders are stronger on average. Depending on the choice of the maximum price, this will ideally lead to a lower support level. However, in a worst-case scenario, if no bidder has lower costs than the maximum price, it will lead to a complete disappearance of competition (Krishna, 2002). However, even if the maximum price does not eliminate all competition, a lower number of bidders can still have negative effects on the auction outcome, similar to a lower competition level, e.g. collusive behaviour and overbidding by multi-project bidders.

Furthermore, a maximum price can have the effect of a focal point. The bidders orient their bids towards the ceiling price. Although this effect has practical evidence (Knittel & Stango, 2003) the immediate influencing factors are not clear yet (Engelmann & Müller, 2011). Nevertheless, a high level of competition complicates also this collusive behaviour.

## Financial prequalifications (securities) and penalties

In case the bidders face uncertainties regarding project costs as described in the first section, there is always the possibility that an awarded bidder will not realise a project after learning the true project costs. As a result, the auctioneer might require the depositing of a security prior to the auction that is held as penalty in case of default. Alternatively, there might be a penalty applied after the auction in case of non-realisation.

The depositing of a security causes financing costs for the bidders. Consequently, these are also potentially sunk costs and the effect on the level of competition is the same as with material prequalifications. Furthermore, securities and penalties might discourage bidders from participating if they cannot definitely predict the project’s feasibility, especially in combination with maximum prices.

Whereas securities cause sunk costs, penalties can lead to inefficiencies and asymmetries. Small project companies might not calculate with paying a penalty in the non-realisation case as this would be more expensive than declaring bankruptcy. Thus, they face a smaller risk and bid more aggressively than bigger companies or companies where the owner is personally liable. If the discrepancy is high enough only project companies are competitive and the level of competition decreases (Burguet, et al., 2012).

Although the effect on the competition level is mainly negative, penalties, securities and other prequalification measures also have positive effects on the auction outcome, see therefore Policy Memo 2: “Pre-qualifications and penalties”.

### Contingents (local, technological)

Contingents (or quotas) are a possible design element for multi-unit auctions. There are two different possibilities to implement contingents in RES-E auctions. Either there is a maximum restriction for RES-E from a specific technology or region or there is a minimum requirement. As with the maximum price the right design of the contingents can have a positive effect on the competition level.

If there is a maximum contingent, there is a higher competition level among the bidders in this group. In the case of a minimum contingent, the level of competition among those bidders not in this group increases. However, the overall result depends on the market framework and the specific design of the contingents.

# 4. Conclusions

Sufficient competition is a necessary requirement for the successful conduction of an auction for RES-E. Without it, an auction cannot fulfil its basic functions which are generation of information and ensuring an efficient outcome. There is virtually no such thing as too much competition. A high level of competition reduces the support level and complicates collusive behaviour. Nevertheless, there are some downsides of an increased competition, in particular the risk of the winner’s curse and the non-realisation risk. Section 2 of this Memo covers the direct effects the competition level has on the auction outcome.

The most important influencing factors for the level of competition are the market framework conditions. But there are other measures that can affect the level of competition. In careful wording, a more restrictive auction decreases the competition level. Such restrictions could be a maximum price, prequalification measures or contingents. But most commonly the implications are ambiguous. Section 3 outlines the different effects these measures have on the auction outcome.

Moreover, most of these measures have implications beyond the level of competition. The other policy memos in this series explain why those measures might be meaningful even though they decrease the competition.

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AURES is a European coordination and support action on auction designs for renewable energy support (RES) in the EU MS.

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

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