Agenda

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CfD auctions, bidding strategies, and insights from auction theory

The aim of electricity market reform (EMR) in Great Britain is to bring forward investment in low-carbon generation, through the use of long-term contracts for differences (CfDs). These CfDs will be allocated to generators via 'auctions', with the process beginning in December 2014. What are the features of the planned auctions, and what can auction theory tell us about their potential challenges and opportunities?

The EMR's CfDs establish two-way payments between low-carbon generators and the CfD that are equal to the difference between the contract 'strike price' and a reference electricity price.[1] Throughout 2014, the Department of Energy & Climate Change (DECC) has been finalising the details of its allocation of CfDs to eligible generators, which will take place via an application process involving an auction, where bidders will compete on the basis of the strike prices offered for specific projects. Indeed, the timing for the first CfD allocation round is rapidly approaching, and the closing date for bids to the first prospective CfD auction is expected in December 2014. This article summarises the key features of the CfD auctions and considers the potential challenges and opportunities for auction participants and policymakers based on insights from auction theory.

Overview of the CfD auction process

The starting point for any CfD allocation round is DECC's budget, which is provided in advance to National Grid as the EMR Delivery Body.[2] The budget sets the overall funding cap and may include various 'maxima' and 'minima' capacity thresholds or other budget constraints for particular low-carbon generation technologies targeted by DECC. Eligible generators may then submit multiple applications for various projects to the Delivery Body, and an auction will be called if the applications collectively exceed the budget in any delivery year, or if any minima or maxima thresholds are breached.[3]

The task of the Delivery Body is then to allocate projects to generators according to the results of the auction. The aim is to allocate CfDs to those projects with the lowest cost, and in a manner that is broadly technology-neutral (subject to the capacity thresholds and other technology-specific budgets mentioned above). In the

absence of a competitive allocation (i.e. when the total value of applications does not exceed the available budget), all accepted projects will receive the technology-specific strike price set by DECC.

From the perspective of auction participants and their potential bidding strategies, the relevant features of the CfD auction process are as follows:

- eligible generators submit a sealed bid for each application (including a number of 'flexibility bids', as discussed below), which are then ranked from lowest to highest strike price;

- bids are accepted sequentially, starting with the bids with the lowest strike price, and subject to the budget constraint and any minima and maxima;

- projects are approved in this way until the next bid under consideration causes that delivery year's budget to be exceeded, or if some other capacity threshold is met;

- when a CfD auction is closed, all projects within that delivery year are awarded a final clearing price equal to the strike price of the last approved project, indicating that it is 'pay as clear'. This is also referred to as a 'uniform price' auction.

Where any minima technology thresholds are binding, a separate auction is run before the general CfD auction. This is where an auction with bids from only the relevant technology is run, and the cheapest bids are accepted until the minima capacity threshold is reached. The projects that are not accepted in the minima auction still take part in the general auction that follows.

Flexibility bids allow the generators to make multiple bids pertaining to the same project by varying the strike price to account for alternative (lower) capacity levels or (later) delivery years. If a bid exceeds the budget in any given delivery year, and the next highest bid is a flexibility bid from the same application, the flexibility bid is accepted if it prevents the budget being breached. If the budget is still breached then this process continues until all flexibility bids are exhausted and the auction for a given delivery year is closed. As soon as one of a group of flexible bids is accepted, all the other bids of the group are removed from the auction process.

After the auction, but before contracts are issued, the results are audited to ensure that there were no errors in the calculations and that the relevant auction rules were followed. A decision will then be made about whether to accept the results of the auction, recalculate the results, or cancel the auction round.

Following an auction, measures will be adopted to adjust target commissioning dates for winning bidders should there be delays to the auction process. However, if winning applicants fail to achieve milestone requirements, or drop out early, they may be prevented from participating in future auctions on that generating site.

Insights from auction theory

Since the 1960s, the development of auction theory has been characterised by increasingly sophisticated analysis of an ever-widening variety of auction models, and the assumptions underpinning the standard models have been progressively relaxed.[4] Alongside the growth in the academic literature in this area, auctions in some form are increasingly common in public contract procurement processes, and there is now considerable scope for the insights from theoretical models to be tested empirically. A review of the academic literature on auction theory, supplemented by real-world case studies, is therefore a natural starting point for the assessment of new auction formats such as the one for CfDs.

Multi-unit, uniform price auctions

As already noted, the key features of the CfD auction are that it is a multi-unit, sealed bid, uniform price auction.[5] Also, bidders in the CfD auction would be expected to have different—but related—valuations of the strike prices for the projects they are putting forward. This is because the costs and risks of alternative technologies vary greatly, and because there are also likely to be variations due to the precise location of a project, even if the generation technology is the same. Bidders' hurdle rates would be expected to vary according to factors such as their business models and risk appetites, something that is particularly relevant to the GB electricity market, given the uncertainty over the future generation mix.[6]

These features of the CfD auction mean that the optimal bidding strategy (in the sense of it being a 'dominant' and/or 'equilibrium' strategy) is not necessarily to simply bid on the basis of a bidder's own true valuation.[7] Moreover, the outcome of the auction is not necessarily that the bidders with the highest valuations or lowest costs win, and nor will the revenues collected from bidders be independent of the specific auction rules.[8]

This is in stark contrast to the findings from auction theory applied in simpler settings where bidders do not have the incentive to bid strategically, and where the bidder with the highest valuation always wins—which would be the case with a (Vickrey) auction for a single good, and independent, private valuations.[9]

For example, Ausubel and Cramton (2002) have shown that, in a multi-unit case, the dominant strategy of bidders may not be to bid in accordance with their true valuations, even when the auction is uniform price.[10] In particular, larger bidders have the incentive to bid less aggressively than their own valuations would suggest, in order to increase the pay-off from winning—albeit this also marginally reduces their probability of winning. Importantly, the incentive to engage in such 'bid-shading' depends on the number of units demanded. The implication could be that some firms participating in the CfD auction may adopt a strategy of marginally increasing their strike prices relative to their own valuations.

Similarly, the results of analysis by Engelbrecht-Wiggans and Kahn (1998) show that, in a multi-unit auction, the winners will not necessarily be those bidders with the highest valuations.[11] This is because larger bidders, in an attempt to lower the clearing price, may 'shade' their bids to the extent that bidders with lower valuations actually end up winning some of the items being auctioned. Indeed, in multi-unit, uniform price auctions bidders may, depending on the number of bidders, be incentivised to bid zero. In the CfD auctions, this could imply that some bidders may find a strategy of submitting strike prices that are close to the administered strike price to be optimal.

These examples highlight how CfD auction participants may see a value in exploring different bidding scenarios in order to identify how they can maximise their pay-offs. Such bidding scenarios would typically be used to assess the benefits of a variety of strategies, assuming that a number of other bidders follow different strategies in the context of the specific auction rules. It would also be possible to extend the analysis of bidding strategies by constructing an auction simulation, with the aim of testing for the existence of optimal strategies in the presence of different bidder configurations, valuation uncertainty, and learning (in cases where there are multiple allocation rounds).

Strategic bidding

As well as considering the auction setting when devising a bidding strategy, bidders must determine the extent to which the actions of other bidders will affect how they value a CfD.

In some cases, bidders can be assumed to have independent private valuations, where each buyer knows how they themselves value an item, but not how others value it. Here, the bidder's own value is not dependent on others' values.

At the other extreme, the auctioned item has the same value for all bidders, although they may also have some private information about what that value actually is. In this case, a bidder would change their own valuation if they knew a rival's bid.

In reality, the items being auctioned, probably including CfDs, are likely to have values that are neither purely private nor entirely common (i.e. they are likely to be more generally interrelated and interdependent). To the extent that CfDs have interdependent values and these are subject to uncertainty, a sealed bid auction will be less effective in facilitating information aggregation and price discovery, as rivals' bids will not be publicly available. Therefore, in multi-unit, sealed-bid, uniform price auctions, the incentives on larger bidders to engage in strategic bidding (e.g. bid-shading) are likely to be even greater.

Given the potential sensitivity of auction outcomes (and, therefore, a bidder's optimal strategy) to the valuation assumption and the difficulties of assessing the subjective elements that enter into other bidders' valuations, this would be a key sensitivity to test in any scenario or simulation analysis.

A potential concern with some bidding strategies is that they could be perceived as being in breach of competition law or market abuse regulations, or that they are otherwise 'unfair'.[12] In particular, larger bidders that are able to bid for more than one CfD may be viewed as being able to influence the clearing strike price.

The winner's curse

The 'winner's curse' refers to the regret sometimes experienced by successful bidders when they believe that the very fact they have won implies that they 'overbid' (in terms of either price or quantity). In other words, bidders may consider their success in the auction to be 'bad news', since it signals that they may have bid naively. The winner's curse can arise whenever bidders have interdependent (but not purely private) valuations—that is, where one bidder's estimate of the auctioned item's value (e.g. the strike price) would be useful to another bidder when formulating their own valuation estimate.

In general, the potential for a bidder to experience the winner's curse is greater in sealed-bid auctions with common values, especially where there is significant uncertainty over these valuations. Indeed, the desire to avoid the winner's curse may provide a further motivation for bid-shading.

While there is no common term for the equivalent of the winner's curse for the auctioneer, it is also possible for them to experience disappointment at certain outcomes. For example, policymakers may be concerned if CfD auctions fail to attract a sufficiently large or diverse set of participants, or if clearing strike prices are not materially lower than administered strike prices.

Similarly, granting CfDs that are later perceived as having excessively high strike prices compared with those achieved in future allocation rounds may undermine the UK's ability to meet its renewable energy commitments, and/or increase the probability that the budget limits established by the Levy Control Framework will be breached.[13] In turn, this may increase pressure on the government to review the trajectory of the Carbon Price Floor, something that could have wider macroeconomic consequences (e.g. for consumers and energy-intensive users). Yet another possibility is that CfD auctions will be perceived as either 'inefficient' or 'unfair' by some (perhaps unsuccessful) bidders.

It is worth noting that such outcomes are generally more likely in sealed-bid auctions (than in multi-round, open-bid mechanisms), since this makes price discovery more difficult. A countervailing feature of sealed-bid auctions is that they make it harder for bidders to engage in collusion, since they would find it more difficult to react to each other's bids than te designed in this way at least in part in order to make collusion less likely.

Summary

As in many other European member states, concern in Great Britain about the costs of the large-scale transition to renewable and low-carbon generation technologies has motivated the search for more efficient approaches to allocating the necessary support payments.[14] As part of the GB EMR programme, policymakers have developed a competitive CfD allocation process based around a multi-unit, sealed-bid, uniform price auction.

Unlike in simpler auction formats, the insights from auction theory highlight that the resulting CfD auctions are not guaranteed to arrive at the most efficient allocation. In particular, bidders may be expected to still have an incentive to bid strategically, and they may still experience a winner's curse.

[1] Under a CfD, if the reference electricity price is below the strike price then the contract will provide a 'top-up' support payment to ensure that the total revenue (i.e. the electricity price plus a support payment) is equal to the agreed strike price. See Oxera (2012), 'The Energy Bill: a recipe for risk reduction?', *Agenda*, December.

[2] For further information on the detailed design of the CfD auctions, see National Grid (2014), 'Contracts for difference: Implementation coordination', 11 September.

[3] All applications must meet certain eligibility requirements, including having an approval certificate issued by the Secretary of State; having planning consent; and having a connection agreement. If the Delivery Body determines that an application does not meet one or more of these requirements, the applicant can appeal.

[4] An important early milestone in the development of auction theory was the work of William Vickrey. See Vickrey, W. (1961), 'Counterspeculation, auctions, and competitive sealed tenders', *The Journal of Finance*, **16**:1, pp. 8–37.

[5] 'Multi-unit' means that multiple contracts are to be awarded subject to a budget constraint, and each bidder is able to bid for more than one contract in each competitive allocation round.

[6] See Oxera (2013), 'EU electricity markets: one of a kind?', *Agenda*, January; and Oxera (2012), 'The Energy Bill: a recipe for risk reduction?', *Agenda*, December.

[7] A strategy is dominant if, regardless of what any other players do, the strategy earns a larger pay-off than any other strategy. A Nash Equilibrium is achieved when all players give a best response to each other's strategies (i.e. where each player's strategy is optimal in light of the others' anticipated behaviour). If each player has a dominant strategy then this would constitute an equilibrium. However, an equilibrium may also be found even if players have no dominant strategies.

[8] With independently and symmetrically distributed private valuations for a single item, if bidders are risk-neutral (i.e. if they evaluate risky pay-offs according to their expected valuations), the Revenue Equivalence Theorem implies that the form of the auction does not affect how much money the seller makes. While this has been shown to hold in theory, it often does not hold in practice, and it certainly does not apply in a multi-unit environment with potentially asymmetric and risk-averse bidders.

[9] Ausubel, L.M. and Milgrom, P. (2004), 'The Lovely but Lonely Vickrey Auction'.

[10] Ausubel, L.M. and Cramton, P. (2002), 'Demand Reduction and Inefficiency in Multi-Unit Auctions', Digital Repository at the University of Maryland, July.

[11] Engelbrecht-Wiggans, R. and Kahn, C.M. (1998), 'Multi-unit auctions with uniform prices', *Economic Theory*, **12**, pp. 227–58.

[12] For example, strategies based on collusion or coordination between auction participants would be expected to be in breach of European and UK competition law and/or other market abuse regulations.

[13] See Oxera (2012), 'The Energy Bill: a recipe for risk reduction?', *Agenda*, December.

[14] See Oxera (2014), 'Almost a reform: the new German support scheme for renewable electricity', *Agenda*, August.