CfD constrained allocation: Discussion Paper

Introduction

1. Allocation rounds will be used once a defined trigger level of the CfD budget has been met. Once the move to allocation rounds has been triggered, auctions ("constrained allocation") will be used to manage constraints on individual technologies, groups of technologies or the overall budget.

2. There are a number of detailed policy questions to be resolved on the trigger for auctions within allocation rounds and on the design of these auctions.

3. This section summarises:

   - The objectives of the paper;
   - The context for policy development; and
   - Government's previously announced policy positions on allocation rounds.

Objective

4. The objectives of this paper, and the associated workshop for stakeholders on 18 November are:

   - To improve understanding of the options being considered on CfD allocation rounds (in particular on auction design); and
   - To seek views and capture the key questions that will inform policy development in particular ahead of publication of the allocation framework and systems implementation.

5. This paper does not cover:

   - Emerging policy on minima/maxima; or
   - Trigger from first-come, first-served to rounds.

Context

6. We intend to publish a draft of the allocation framework early in 2014, with the final version in late Spring, at a similar time to laying the implementing regulations in Parliament. We are currently proposing that the allocation framework would contain the detailed process for constrained CfD allocation. We will be seeking views from stakeholders on the draft framework when it is published. Going forward, the presence of the allocation framework will, allow us if needed, to change some elements of CfD allocation system relatively quickly, if there is a risk of gaming or unintended consequence.

7. In early 2014, National Grid will begin development of the systems required for CfD allocation and testing these with industry. In order to minimise risks to EMR programme delivery, it is important that, ahead of systems development commencing, Government has a good degree of confidence that its preferred policy position will drive value for money while remaining investable.

Summary of previously announced policy positions

8. In the recent consultation on proposals for EMR implementation[1], Government set out the following policy positions:

- Unconstrained allocation rounds:
    - If all the bids within the round can be satisfied within the currently unallocated budget for a given delivery year (unconstrained) then all projects are allocated contracts.
    - The exceptions to this may be where a technology or group of technologies minima or maxima interact with the wider budget in particular ways.
- Constrained allocation rounds:
    - If there is insufficient budget to satisfy all bids or any maximum constraints for particular technologies are exceeded, then an auction (constrained allocation) will apply.
    - Primary rationing mechanism is by Strike Price bid, but subject to minima / maxima (if used).
    - Preference that the constrained allocation process will operate on a "pay-as-clear" basis for each technology or technology group, although Government is considering alternative auction formats, such as pay as bid.
    - The Strike Price paid to any generators with a CfD will in any case be no higher than the administrative strike price for the technology.

9. In addition, in the CfD allocation methodology for renewable generation (August 2013)[2], Government set out the following position:

- Under unconstrained allocation, sealed bids will not be opened by the Delivery Body but will be passed to DECC and may be used to inform future administrative strike prices.

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/255254/emr_consultation_implementation_proposals.pdf

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226976/Allocation_Methodology_-_MASTER_-_6_Aug_v_FINAL.pdf

Section 1: Understanding allocation over multiple years of commissioning

Summary

10. This section:

- Discusses the issues involved with allocating over multiple years of commissioning; and
- Highlights the implications for the basic features of any auction design, irrespective of the precise auction format chosen, including for phased offshore wind projects;

11. In summary, we believe the auction needs to have the following basic features:

- The auction will at the very least, need to distinguish between projects based on technology and year of commissioning.
    - For phased offshore wind projects, the current proposal is that these projects will, from the point of view of the allocation process, be treated the same as a single phase offshore wind project applying to commission in the same year as the first phase.
- There should be a single auction for all projects (irrespective of year of commissioning). We believe it is possible to do this without specifying rigid allocations for “Delivery Years”, as long as the auction recognises the budgetary constraints faced by projects commissioning in different years.
- We recognise there may be a case for allowing bidders the flexibility to nominate Strike Price bids to commission in different years.
- If necessary, it remains open to Government to use tools such as staged budget release to the Delivery Body (or possible minima/maxima) to ensure desired outcomes on the generation mix and year of delivery. However, policy in this regard is still under consideration.

12. The following paragraphs explain the rationale for this thinking in more detail. Annex A presents an outline auction algorithm consistent with these basic features and a worked example to illustrate the features further. We welcome views from stakeholders on the key points raised above.

Defining the "products"

13. The objective of the auction will be to select the projects with the lowest Strike Price bids, subject to the overall budget constraint and possible technology minima and maxima. Defining the range of "products" is an important first step to understanding the basic required features of auction design, as it allows us to be clear on the basis for which projects could be paid different Strike Prices.

- Given the stated policy that the auction would pay no project more than the administrative Strike Price for its technology, **the auction will at the very least, need to distinguish between projects based on technology and year of commissioning.**
- **For phased offshore wind projects, the current proposal is that these projects will, from the point of view of the allocation process, be treated the same as a single phase offshore wind project applying to commission in the same year as the first phase[3].** This is consistent with DECC's stated policy objective to ensure that, for all phases, phased projects receive the administrative Strike Price applying to the Delivery Year of the first phase.

Project valuation

14. An important part of understanding the constraints faced in CfD auctions is how the impact on annual spend of potential projects might be calculated. In theory, this is relatively straightforward[4]:

- Impact on budget = (Strike Price – Reference Price) * Generation
    - Where Generation = Capacity * Load factor * hours (per year)

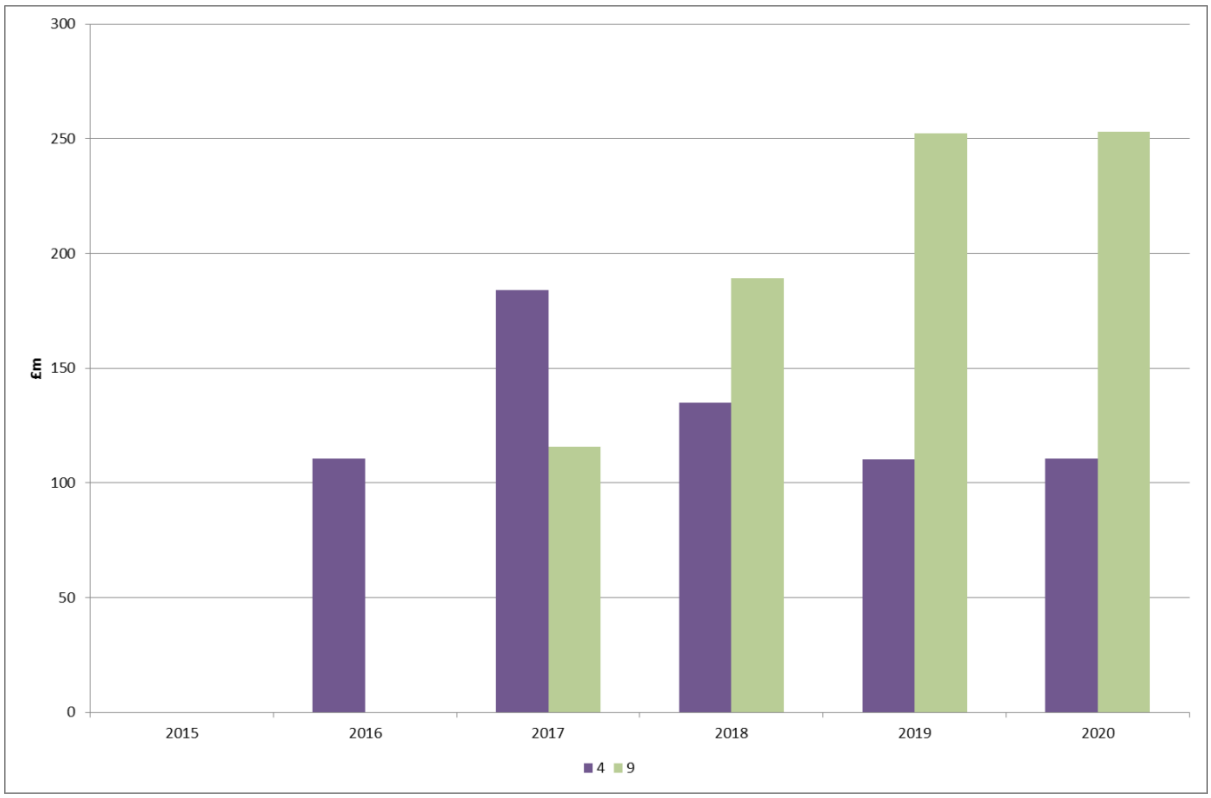
15. However, some of these variables may not be constant over time. **The auction will need to take into account of the potential for projected annual spend on a given project to vary over time.** For example:

- Projected fluctuations in wholesale electricity prices may cause the impact on annual spend of a given project to fluctuate over time (see example project 4 in Figure 1 below).
- Since the capacity of a phased project will increase in over time, so will its impact on annual spend (see example project 9 – a 3-phase project - in Figure 1 below).

[3] A simple example may help to explain the sorts of outcomes this might generate:
- Project A: Phased offshore wind farm commissioning in 3 phases of 300 MW each with first phase in 2017, Strike Price bid £130/MWh
- Project B: Single phase offshore wind farm, 400 MW, commissioning in 2017, Strike Price bid £132/MWh
- There is sufficient budget available to support one, but not both, projects.
- The auction would accept Project A since it has a lower Strike Price bid.

[4] The detailed CfD valuation methodology is under development.

Figure 1 Impact of sample projects on annual CfD spend



Source: DECC Calculations

Nature of constraints under the Levy Control Framework

16. The Levy Control Framework (LCF) specifies the maximum level of levy spend for electricity policies for each year. Under the LCF:

- DECC cannot "borrow" from future years to fund overspend in early years;
- DECC cannot roll forward any underspend in any one year to subsequent years; and
- Underspend in any one year does not result in an automatic reduction in the maximum level of spend available for subsequent years.

17. The last bullet above means that Government does have some flexibility within the LCF. It could, for example, choose not to spend the "incremental budget" in 15/16 on projects commissioning in 15/16, but instead spend more on projects commissioning in later years.

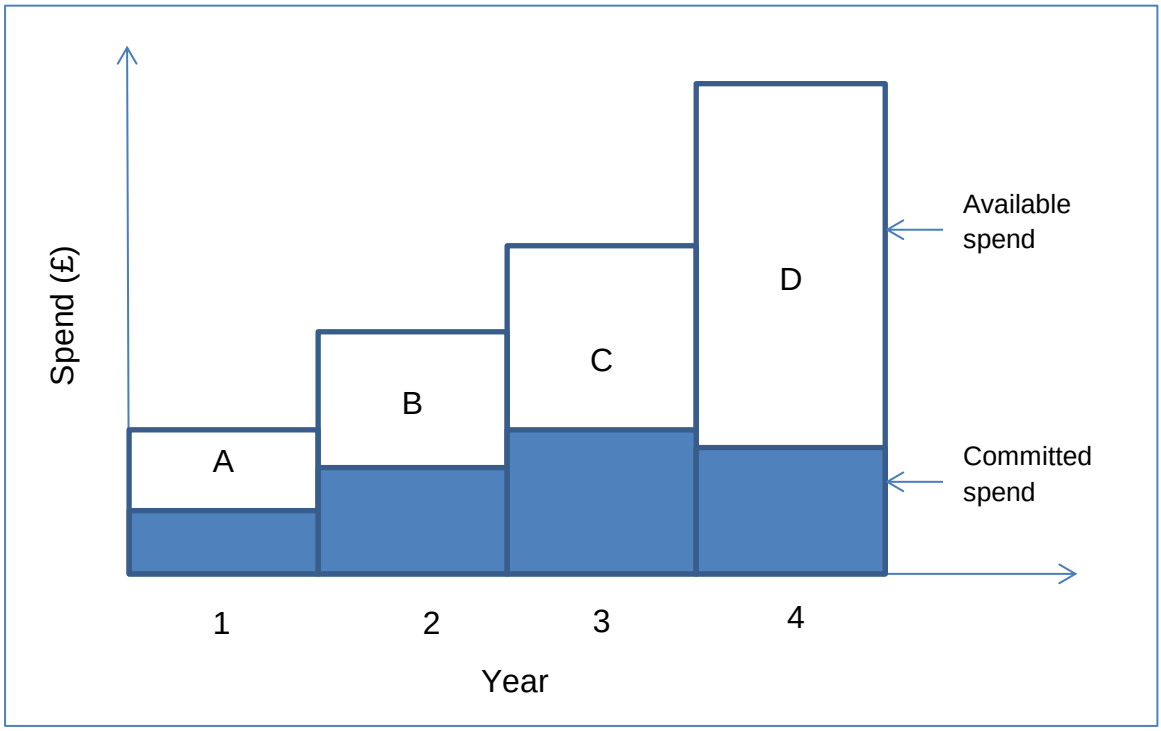
Implications for auction design

18. Our starting assumption is that, for the purposes of constrained CfD allocation, the Delivery Body will be given a series of annual spending limits for CfD allocation and allocation rules that reflect the flexibilities under the LCF. **We believe it is possible to have a single auction for all projects without specifying rigid allocations for "Delivery Years".**

19. Different budgetary constraints may still apply to projects commissioning in different years (which may result in different clearing prices for different delivery years). For example, in Figure 2 below, given a level of already "committed" spend (e.g. given a certain number of projects already accepted through an auction):

- In order to accept an additional project commissioning in Year 1 (or a phased project with its first phase in Year 1), the project will need to have an estimated impact on annual spend smaller than area A in Year 1, Area B in Year 2, Area C in Year 3 and Area D in Year 4.
- In order to accept an additional project commissioning in Year 2, the project will need to have an impact on annual spend smaller than Area B in Year 2, Area C in Year 3 and Area D in Year 4.
- Etc. for projects commissioning in Years 3 and 4.

Figure 2 Illustration of constraints faced by projects commissioning in different years



20. Some stakeholders have expressed a preference for separate, chronologically ordered (or "sequential") auctions for each Delivery Year. We do not believe this is necessary, and are concerned that this could result in a prioritisation of projects delivering early in the period that may not be justified.

- We believe the allocation rules should not create inherent barriers to selecting projects delivering later in the Delivery Plan period in favour of those delivering earlier in the period, where this might improve value for money.
- That said, it should still be open to Government to express preferences for early (or late) delivery of projects within the Delivery Plan period where this

might contribute to meeting Government's objectives. There might be different ways Government could express such preferences, including defining minima/ maxima by Delivery Years. Government policy in this regard is still under consideration.

21. In practice, the maximum level of allowed spend under the LCF increases year-on-year. We might expect this to be reflected in the CfD spend available for the Delivery Body to allocate. This means that projects commissioning in later years may (even for the same project size) face fewer restrictions on allocation.

22. This raises the potential issue that potentially cheaper projects commissioning earlier may be rejected in favour of more expensive projects commissioning later in the Delivery Plan period. As such, **we recognise there may be a case for allowing bidders the flexibility to nominate Strike Price bids to commission in different years.** Some stakeholders have expressed a preference for this (albeit in the context of justifying a preference for "sequential") auctions. Allowing bidder flexibility over commissioning in different years could:

- Spread competition across the Delivery Years;
- Enable DECC to keep to any funding constraints; and
- Reduce the risk bidders face, enabling them to bid closer to true costs.

23. As part of the collaborative development process, some stakeholders have asked whether there could be the possibility for bidder flexibility on capacity applied for. We can see some potential value for money and competition benefits from this, but are concerned about complexity[5] and risks to systems implementation, irrespective of the auction format chosen. We would welcome views from stakeholders on the relative importance they attach to this flexibility and whether and how it might be implemented. Such flexibility would appear to be beneficial only to the most expensive (i.e. marginal) projects in the auction.

[5] We note that there are potentially an infinite number of combinations of capacity/Strike Price bid combinations.

Section 2: Auction format and use of bids

24. We have indicated a preference for a sealed-bid, pay-as-clear auction for CfDs in which all successful suppliers are paid the last-accepted bid. However, we are still considering alternative options, in particular:

- Pay-as-bid (instead of pay-as-clear);
- Multi-round auction, including descending clock (instead of sealed-bid); and
- Last-accepted bid vs. first rejected bid.

25. In addition, we are considering the level of access Government should have to sealed bids under a descending clock auction.

26. On pay-as-bid vs. pay-as-clear:

- The few responses to the August Allocation Methodology on pay-as-bid versus pay-as-clear did not necessarily challenge the approach, but sought more clarity on why pay-as-clear was preferred. We subsequently discussed the issue with CfD Expert Group, who suggested we examine in more detail the precise reasons why some countries have chosen a pay-as-bid approach for auctioning renewable generation.
- A pay-as-bid approach may intuitively offer an opportunity for lower average Strike Prices paid than under a pay-as-clear approach. However, we consider that any potential for benefits to consumers will be limited and that there are risks that pay-as-bid could actually lead to higher prices, deter new entry, reduce incentives for innovation, and lead to higher-cost projects being selected in favour to cheaper ones (i.e. an inefficient allocation of society's resources).

27. On descending clock vs. sealed bid:

- Several stakeholders have expressed a preference for a descending clock auction on the basis of its increased transparency and efficiency and that it would help to avoid "winners curse". Some also believed it would be unreasonable to have generators determine the minimum Strike Price they were willing to accept. In addition, we have received a report by Dotecon commissioned by DONG Energy, EON, RWE Npower Renewables, Statkraft and Vestas.
- We consider the reasons on pure efficiency grounds to use a descending clock auction are not strong. In particular, common value uncertainty under the CfD is limited (which also suggests that it should be reasonable to expect generators to determine the minimum price they would be willing to accept). We consider that, irrespective of the auction format, delivery obligations in the contract can further mitigate the potential for winners' curse.

- We also believe that a sealed-bid approach inherently reduces the potential for signalling behaviour within an allocation round, limiting the potential for tacit collusion and predatory behaviour.

28. We understand that the impacts of a descending clock auction might depend crucially on design aspects, in particular around activity rules and transparency. For example, it is possible to limit transparency within a descending clock auction to mitigate the risk of collusion. This could limit the usefulness to bidders in terms of resolving common value uncertainty, and may not result in strategies or outcomes vastly different to a sealed-bid auction. In addition, we are not clear on exactly how flexibility to nominate commissioning in different years would operate under a descending clock auction. We welcome views from stakeholders on the exact form of descending clock auction they would propose in the CfD context.

29. On Last-accepted bid vs. first rejected bid:

- Setting the clearing price equal to the last accepted bid (as opposed to the first rejected bid) is likely to lead to at least some reduction in Strike Prices paid, which improves VFM and helps deliver more deployment from the available budget.

30. More detailed analysis in support of our conclusions on auction format is set out at Annex B. Hybrid auction designs (e.g. combining a 1st stage multi-round auction with a 2nd stage sealed bid auction) are possible. However, we have not considered them in detail in our analysis

31. On the use of sealed bids (under a sealed-bid auction):

- Some stakeholders believed that sealed bids should not be used to inform administrative Strike Price-setting, and questioned the usefulness of bid information. Others said that sealed bids should only be opened under constrained allocation.
- We understand the concerns bidders may have regarding use of sealed bids. We consider they may be partly mitigated by only asking that bids are submitted if constrained allocation is triggered. However, we consider there may be a significant desire for scrutiny of CfD auctions, and that it may be difficult to guarantee complete secrecy of bid data when auctions are run.

32. More detailed analysis of the options considered on use of sealed bids is at Annex C.

Section 3: Triggering auctions within allocation rounds

33. Where accepting all eligible projects applying in any given allocation round would breach none of the annual spending limits, we propose that auctions should only be run for groups exceeding a maximum limit (assuming that DECC sets one or more technology specific maxima).

34. Where annual spending limits are exceeded, we believe that auctions should in general be run across all projects. One possible exception might be for groups that have not exceeded minimum budgets/deployment. Options under consideration include:

- to simply allocate to these groups at the administrative Strike Price (i.e. on an "unconstrained" basis) and not subject them to auctions; or
- to also place these groups in the auction.

35. There may not be a substantive difference between the two options above under a descending clock auction (as it would simply start and stop at the administrative Strike Price for these groups). Under a sealed-bid process, in practice, groups subject to minima that they can anticipate are likely to be under-subscribed will have an incentive to bid up to the value of the administrative Strike Price. However, where developers do not have perfect information on their minimum allocation, placing these groups in an auction may give some ability for Government to gain value for money.

Section 4: other auction design issues

Incentives for contract signature

36. Following a constraint process, National Grid will issue a direction to the Counterparty Body to enter into a CfD with successful projects. There is a risk that successful projects will choose not to sign a CfD, for example, due to information received after the constraint process is run. This would result in unallocated budget (which may by default roll over to the next allocation round), which could have been allocated to projects in the constraint process just completed.

37. In general, we believe that the probability of successful projects making errors in their bids and/or choosing not to sign a CfD is low:

- Eligible bidders must have planning permission and grid connection offer, so will be somewhat serious about proceeding to develop a project;
- Bidders lose nothing from at least holding a contract until the date of Substantive Financial Commitment; and
- developers may not want to face the uncertainty of applying in future allocation rounds.

38. That said, we remain concerned about the risk materialising. Options under consideration include:

- Bid bonds: On entering the auction, bidders would post some collateral, which would be returned to them if either they were unsuccessful or if they signed the contract. Stakeholders have noted that, in selecting the level of the bid bond, we would need to have regard to the working capital implications, particularly for smaller generators[6].
- Preventing developers who fail to sign a contract from participating in future allocation rounds.

Tiebreaker Rules

39. There may be instances where it is not possible to ration between projects on the basis of their strike price bid alone. Tiebreaker rules may be needed in such instances.

40. Stakeholders have expressed some concern on the use of tiebreakers, in particular random allocation. One stakeholder commented that tiebreakers should be based on ability of projects to deliver.

41. We consider that, if bidders have bid as low as they possibly can, then tiebreakers are a suitable objective way of allocating CfDs as a last resort. We also consider that delivery obligations under the CfD should be the primary

[6] As a point of reference, under the capacity market, bid bonds for DSR are set at £4,420 per MW.

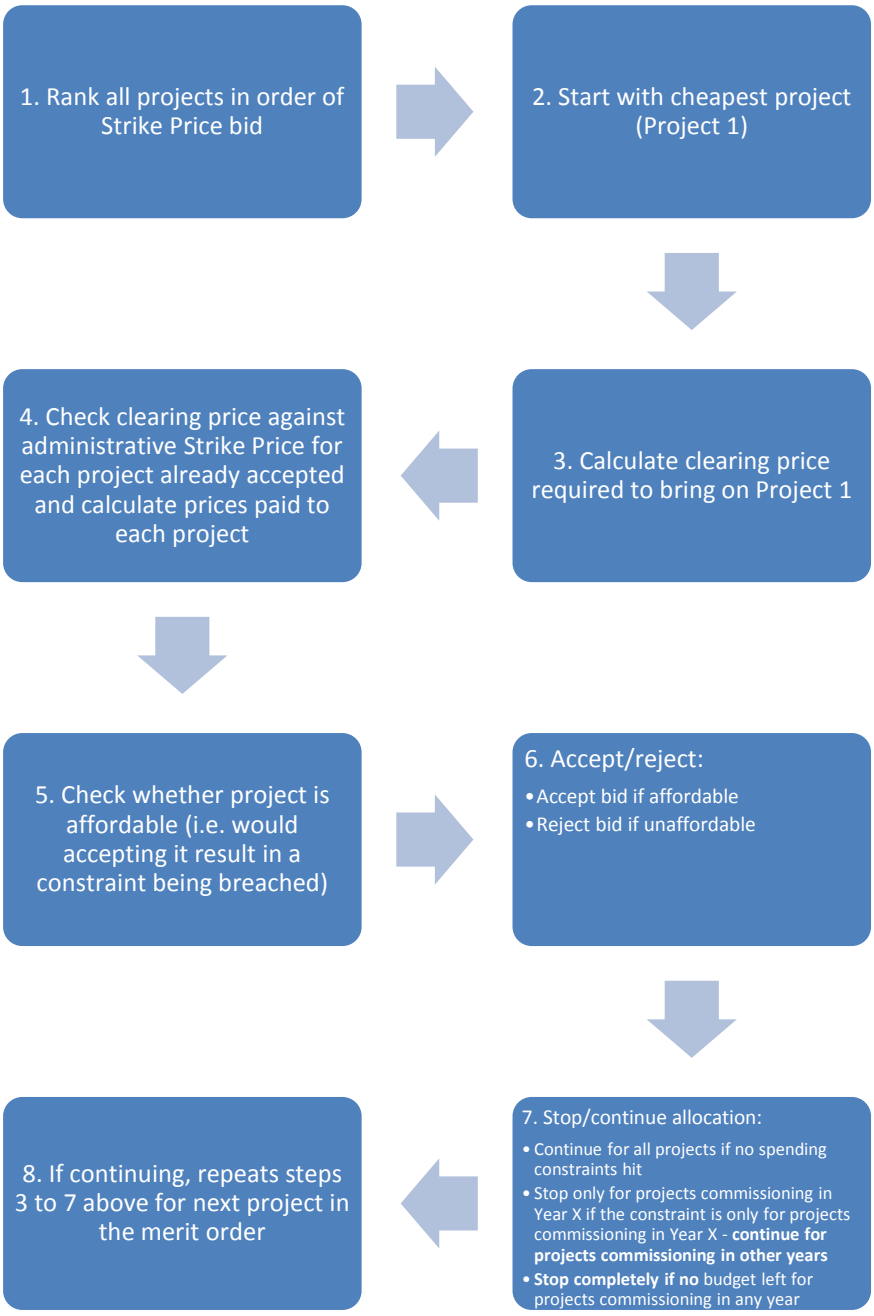
means of ensuring that projects selected in the auction are those best able to deliver.

42. We continue to propose the following tiebreaker rules:

- A first rule intended to minimise any slack in a binding constraint: select the (combination of) projects that most closely satisfies the constraint.
    - For example, if two projects have identical Strike Price bids and either can be the marginal bid to achieve a particular maximum constraint, then the project that is the largest that just fits beneath the budget limit would be selected.
- If, based on the first rule there is still a tie between more than one combination of projects, then we are considering whether we might Invite the remaining projects to further reduce their bids.
- We would still propose to use random allocation as a last resort.

Annex A: Outline auction algorithm and worked example

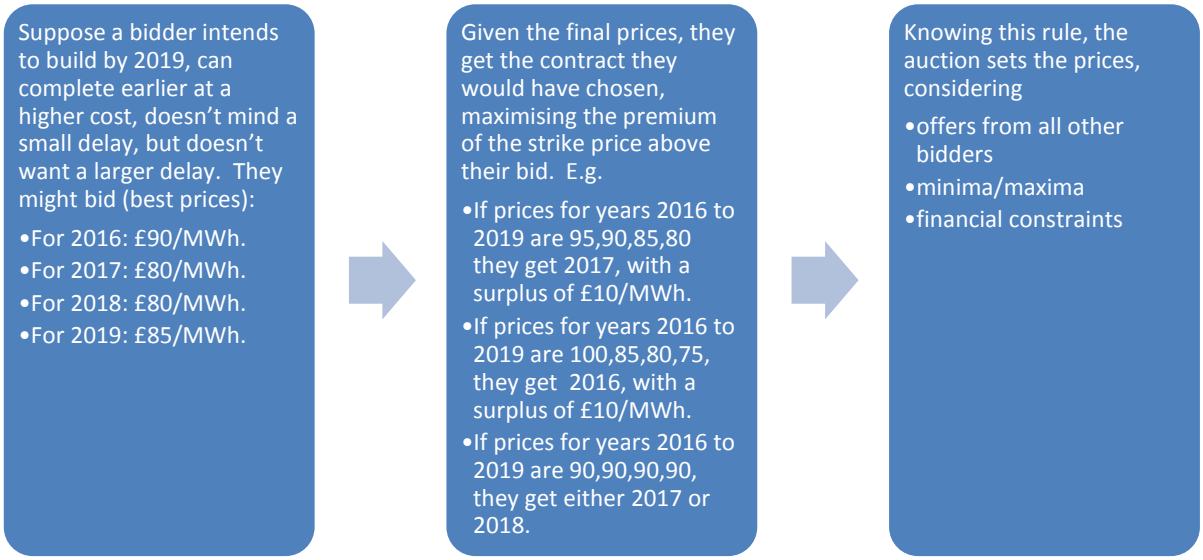
43. The following figure provides an outline of how we would expect the auction algorithm to work in a sealed-bid pay-as-clear auction, for the simple case with no minima or maxima and no bidder flexibility.



44. Bidder flexibility to nominate Strike Price bids to commission in different years will require a more complex algorithm for a sealed-bid auction[7]. Broadly, the algorithm under a sealed bid process would need to work as follows. The

[7] We have been advised that this flexibility may be easier to incorporate in a descending clock auction. However, we note that it may also need additional restrictions on bidders' ability to jump between Delivery Years ("activity rules").

algorithm will grow more complicated as the number of categories with minima / maxima increases.



Worked example

45. The following worked example illustrates how the algorithm above might work in practice, again for the simple case with no minima or maxima and no bidder flexibility.

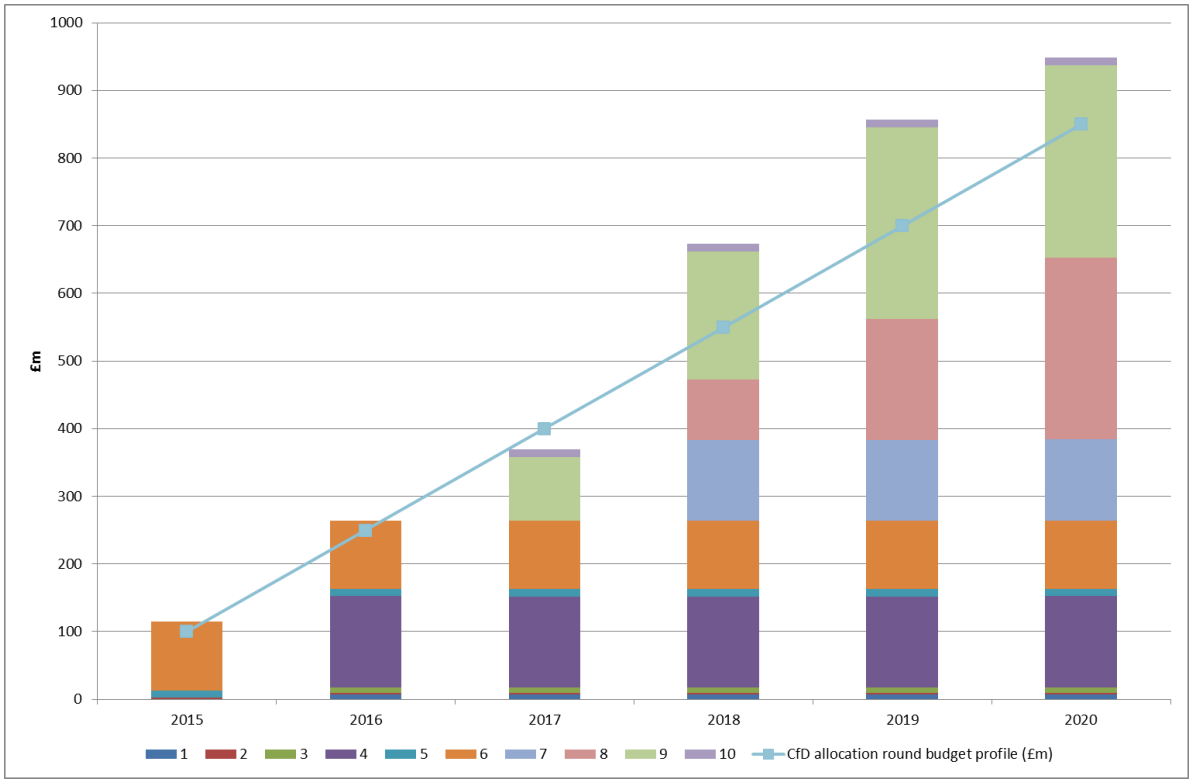
46. We consider the following set of hypothetical eligible projects applying in a given allocation round, ranked by Strike Price bid. We assume that the CfD budget increases in a straight line from £100m in 2015 to £850m in 2020 (2012 prices), and that the wholesale price is flat at £50/MWh. We assume the administrative Strike Prices set out in the draft Delivery Plan apply.

Project	Commissioning Year	Strike Price bid (£/MWh, 2012 prices)	Technology	Max capacity (MW)
1	2016	90	Onshore wind	50
2	2015	95	Onshore wind	20
3	2016	95	Onshore wind	60
4	2016	95	Biomass conversion	400
5	2015	99	Onshore wind	80
6	2015	100	Biomass conversion	300
7	2018	120	Offshore wind	400
8	2018	125	Offshore wind	900 (spread over 3 phases)
9	2017	130	Offshore wind	900 (spread over 3 phases)
10	2017	300	Marine	10

Triggering the auction

47. Given administrative Strike Prices as published in the draft Delivery Plan, National Grid's "initial valuation" against the assume budget profile would show an auction was needed, as the annual spending limits would be exceeded in ever year apart from 2017.

Figure 3 National Grid initial valuation of eligible projects

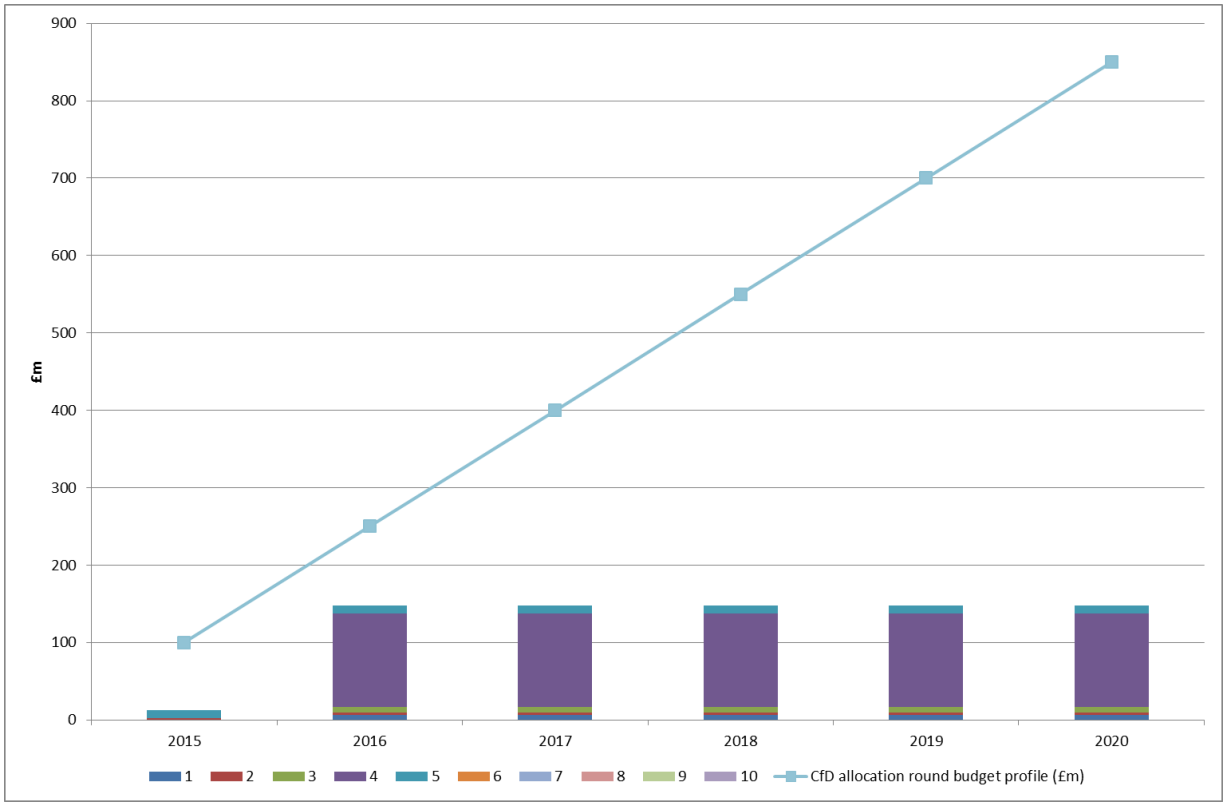


48. We cannot just run separate auctions for projects commissioning in the years when the budget is exceeded. For example, we can see from inspecting Figure 3 that, rather than rejecting project 8 (commissioning in 2018) to ensure we stay in budget for years 2018 to 2020, we would probably want to reject Project 9, which commissions in 2017 (a year in which the spending limit is not exceeded) and has a higher Strike Price bid.

Outline auction process

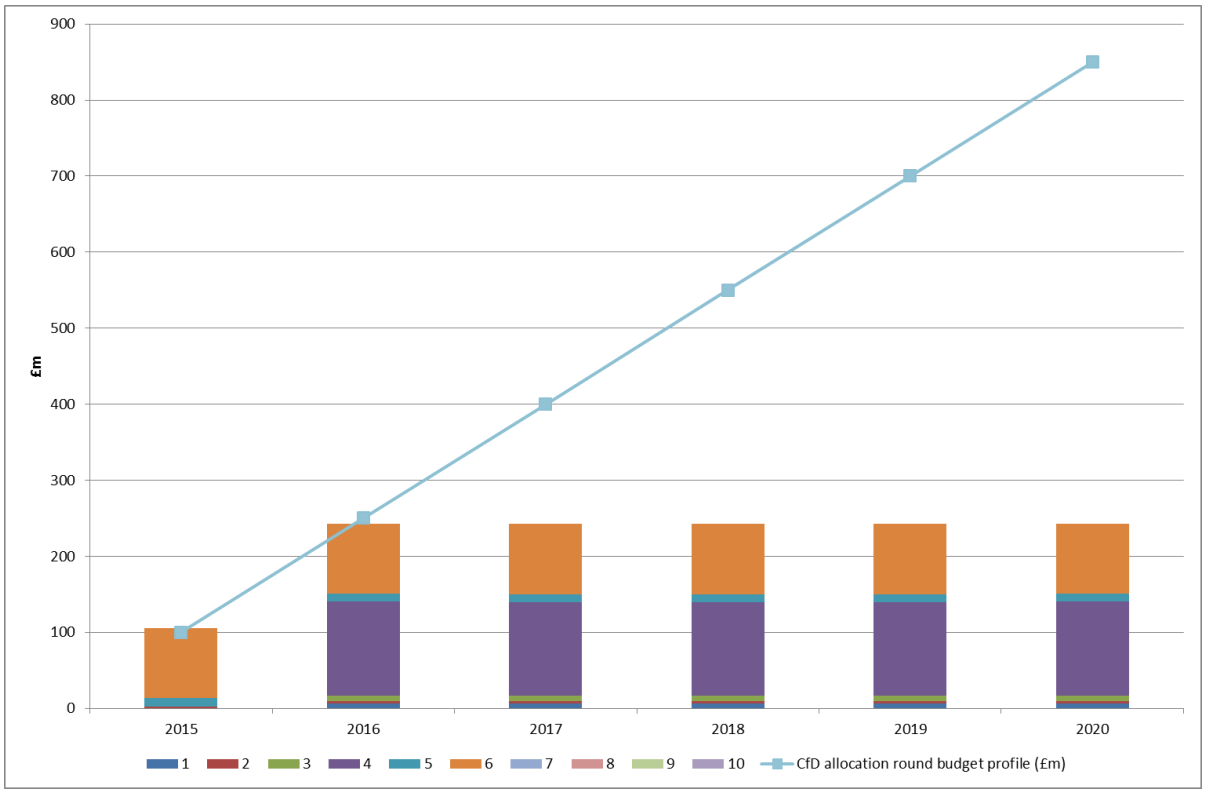
49. The auction would start by accepting the cheapest projects. Projects 1 to 5 can clearly be accepted (with a clearing price of £99/MWh across all Delivery Years) without exceeding any of the annual spending limits.

Figure 4 Accepting projects 1 to 5, still within budget



50. The auction would then proceed to try accepting the next most expensive bid (project 6). This would require a clearing price of £100/MWh for projects commissioning in all Delivery Years. However, this means the spending limit for 2015 would be exceeded.

Figure 5 Accepting projects 1 to 6, spending limit for 2015 exceeded



51. Hence we cannot allocate to project 6. Since the constraint was caused by a project delivering in 2015, we restrict the clearing price for all projects delivering in 2015 to £99/MWh so no more projects can come forward in that year.

52. However, we can continue increasing the clearing prices for projects commissioning in other years. At a clearing price of £130/MWh for projects delivering 2016 to 2020, we can accept projects 1 to 5, and 7 to 9.

Figure 6 Accepting projects 1 to 5, 7 to 9, still within budget

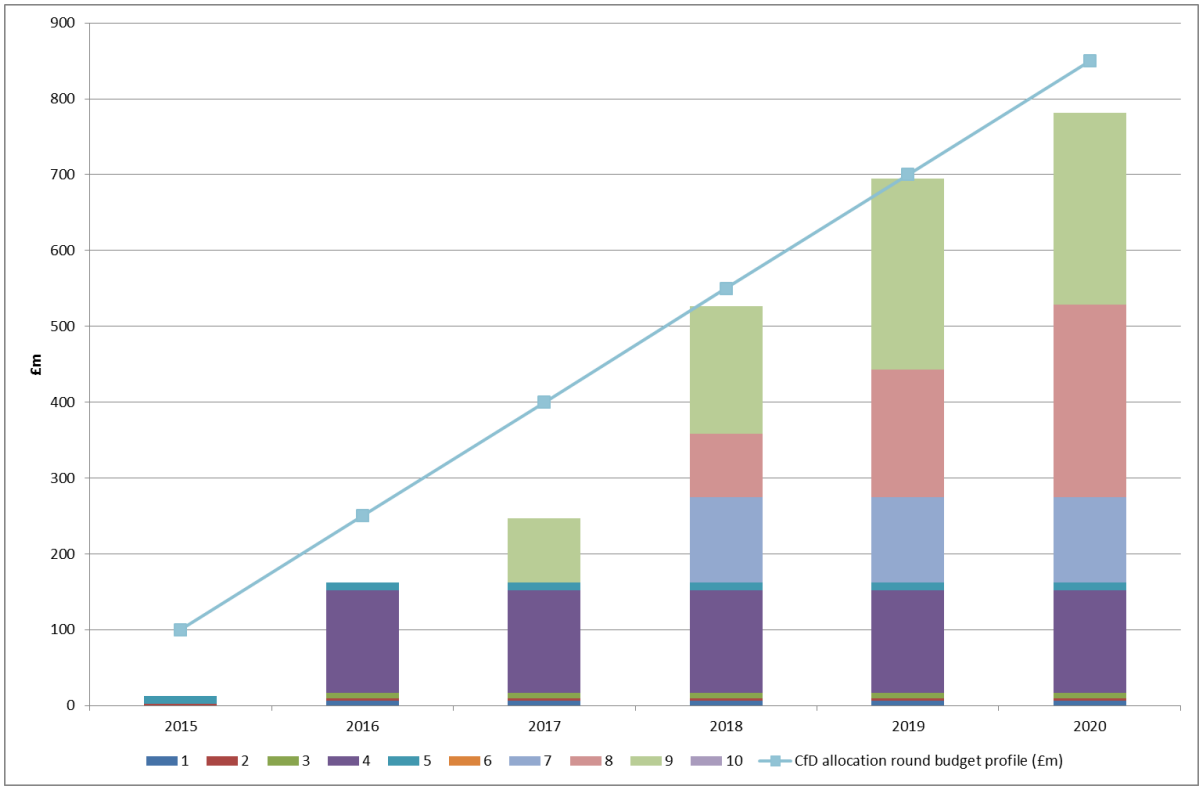


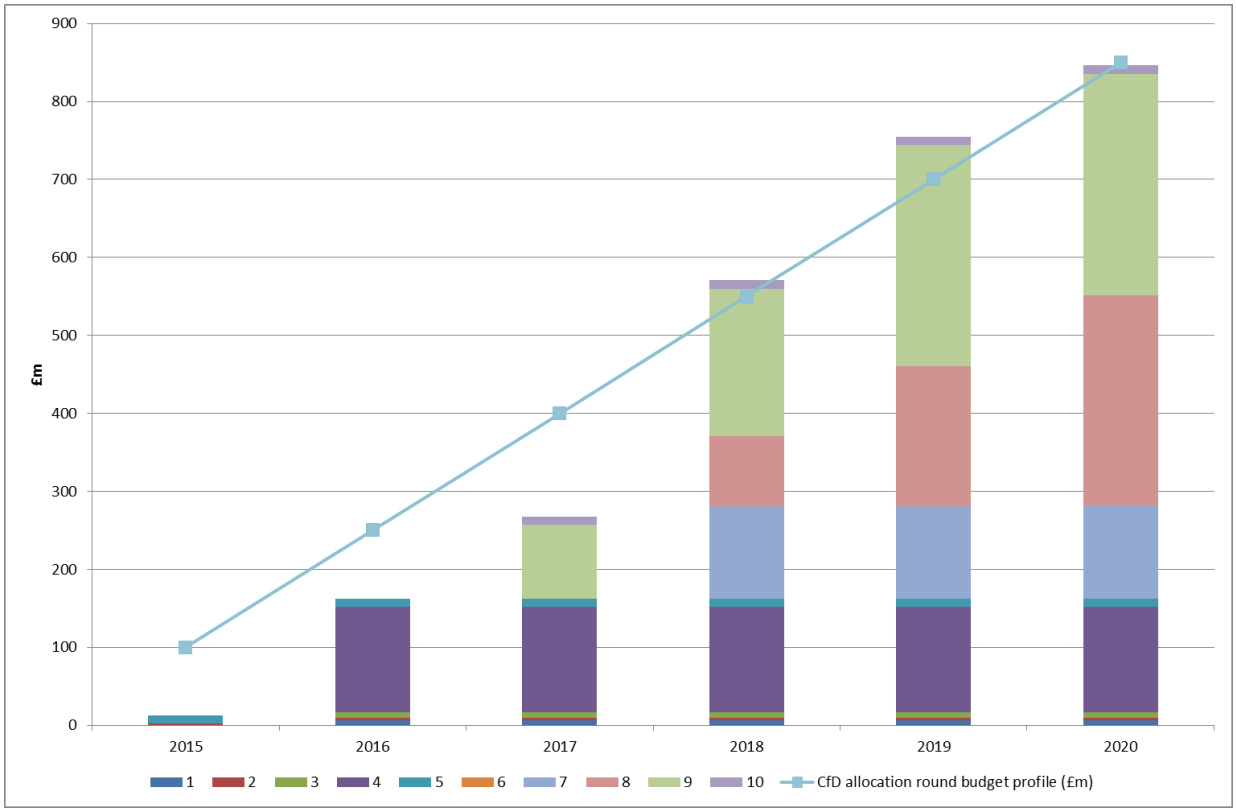
Table 1 Strike Prices paid when accepting projects 1 to 5 and 7 to 9

£/MWh	2015	2016	2017	2018	2019	2020
Clearing prices	99	130	130	130	130	130
Offshore wind	99	130	130	130	125	115
Onshore wind	99	100	95	90	90	90
Biomass conversion	99	105	105	105	105	105
Marine	N/A	N/A	N/A	N/A	N/A	N/A

53. The next most expensive project is Project 10 (marine), which would require a clearing price of £300/MWh to come on. However, this results in spending limits being exceeded in 2018 and 2019. This is because:

- We are supporting an extra project;
- The higher clearing price required to support the marine project leads to increased Strike Prices being paid to the offshore wind projects (although limited by the administrative Strike Price).

Figure 7 Accepting projects 1 to 5, 7 to 10, spending limits for 2018 and 2019 exceeded



54. Hence we cannot allocate to Project 10. The auction stops at accepting projects 1 to 5 and 7 to 9.

Annex B: Auction format

55. Our preferred auction format for CfDs is a sealed-bid, pay-as-clear auction in which all successful suppliers are paid the last-accepted bid. This Annex sets out the analysis that underpins these design choices and the alternative options considered:

- Pay-as-clear versus Pay-as-bid
- Descending clock versus Sealed-bid
- Last-accepted bid versus first-rejected bid

Pay-as-clear versus Pay-as-bid

56. In summary, we believe a pay-as-clear approach is most likely to deliver value for money:

- Pay-as-bid may have the potential for beneficial distributional impacts in the short-run (reducing the "producer surplus" and therefore the cost to consumer), especially given the imperative to win.
- However, it is not clear from both theory and from international experience that average prices would necessarily be lower under a pay-as-bid approach. In fact, some theory suggests the opposite would be true.
- In addition, a pay-as-bid approach risks:
    - increasing costs to society overall as a result of inefficient outcomes (i.e. an inefficient allocation of resources and potential drain on productivity);
    - reducing the gains from innovation/cost-reduction;
    - reducing auction contestability for new entrants; and
    - facilitating market power abuse and collusion, particularly in repeated auctions, by making it harder for authorities to detect excessively high bids.
- In any case, in the absence of minima or maxima, a pay-as-bid approach would probably only affect the bidding of the projects within the highest priced technology group (except where maxima skew that behaviour). For example, if onshore wind can never get paid more than the onshore wind Strike Price but was confident that offshore wind would be the marginal technology then every onshore project would simply bid the onshore wind Strike Price under a pay-as-bid approach.

57. The rest of this section:

- reviews some of the general arguments for and against pay-as-bid auctions;
- examines arguments for why the balance of risks might differ in the CfD context to the capacity market context; and
- reviews the Brazilian experience of pay-as-bid auctions.

General arguments

58. Under pay-as-clear (uniform pricing), all projects are paid the clearing price in their category. Projects in different categories may receive a different price, but only as the result of binding constraints, such as minimum spends intended to support emerging technologies. By contrast a pay-as-bid auction pays each successful bidder the price it bids. Pay-as-bid auctions are commonly referred to as discriminatory auctions because they pay successful bidders different prices based on their specific price bid.

59. Pay-as-bid auctions are sometimes promoted as a way to reduce the cost to suppliers, possibly resulting in lower prices paid by consumers, as described by Giulio and Rahman[8]. In addition, evidence from Brazil (see below) shows that pay-as-bid auctions can lead to price discrimination in procuring new generation capacity. So, while much of the academic literature notes that pay-as-bid auctions can result in distortions that have the potential to increase prices and costs in both the short- and long-run, we need to consider them carefully in the CfD context.

60. With pay-as-clear, project bids are closely aligned with the project cost. The bid reflects the minimum amount that the applicant needs to go forward with the project. Large bidders may have an incentive to bid somewhat above costs, but that incentive is limited by competitive forces. Small bidders, such as new entrants, can focus entirely on estimating costs and bidding those costs. In this way, uniform pricing is pro-competitive. It encourages entry first by making bidding easy for entrants and second any exercise of market power by large bidders makes room for smaller rivals. The fact that bids are more reflective of costs also supports efficient outcomes. The lowest-cost projects, subject to constraints, are the ones selected.

61. In a pay-as-bid auction, applicants are motivated to guess the clearing price and bid as close to it as possible rather than bid at a level that is primarily driven by their actual required return. From a bidder's point of view the spread between the clearing price and a winner's bid is money left on the table. A higher bid would still win and the bidder would be paid more. A bidder's costs are still relevant in the bidding, since the spread between the bid and the winner's cost is the potential prize that is lost in the event that the bidder bids too high. The trade-off is complex and uncertain.

62. Large participants tend to be better able to guess the clearing price and therefore can bid more aggressively (more toward the clearing price and further

[8] Federico, Giulio, and David Rahman. "Bidding in an electricity pay-as-bid auction." *Journal of Regulatory Economics* 24.2 (2003): 175-211. Available at: http://www.nuff.ox.ac.uk/economics/papers/2001/w5/federico-rahmansept2001.pdf

from costs) than small participants. In this way, pay-as-bid pricing systematically disadvantages new entrants and competition may be weakened as a result. On the other hand, successful bidders would still get a rate of return that they were happy with.

63. Auction outcomes may be less efficient under pay-as-bid pricing, since bidders may make mistakes in guessing clearing prices - a high-cost project may be selected in favour of a low-cost project. Even if average prices are lower than under a pay-as-clear approach, this would represent an inefficient allocation of resources and potential drain on the economy's productivity.

64. To the extent pay-as-bid is successful in reducing inframarginal rents, it may also disincentivise cost reduction through reducing the rewards available to cheaper projects within a given technology.

65. Much of the academic literature concludes that pay-as-bid is the auction design least open to collusion and market power abuse. However, there is also literature showing that, particularly under repeated auctions, this may not necessarily hold. While strategic capacity withholding in a given auction immediately leads to higher average prices for all suppliers under pay-as-clear, in pay-as-bid auctions bidders do not directly benefit from it but can generate extra-profits in the subsequent auction. Clearing prices cannot diverge arbitrarily far from their costs under a pay-as-clear framework. Since regulatory authorities should have at least a rough estimation of the cost levels, marginal suppliers would be confronted with the suspicion of market power abuse if their bids exceed a certain price limit. Under pay-as-bid auctions, bidders can more legitimately submit bids that deviate from cost, which makes it easier to sustain collusive higher prices, particularly where market concentration is high and demand is inelastic. Heim, Sven and Götz find some empirical evidence from this in Germany's market for reserve price[9].

What might make the CfD different to the capacity mechanism?

66. All the arguments above apply equally to the capacity mechanism, which will use a pay-as-clear auction. One potential reason why the Capacity Market and CfD differ is that, under the CfD, there would be an increased potential for price discrimination between projects (even of the same technology). This is since one auction will not necessarily provide participants with good information about clearing prices in future auctions:

- the same project would never bid in more than one auction; and
- low-carbon generators are much more heterogeneous in terms of cost than plant brought forward under the capacity mechanism, and projects brought

[9] Heim, Sven and Götz, Georg, "Do Pay-as-Bid Auctions Favor Collusion? Evidence from Germany's Market for Reserve Power" (2013). ZEW - Centre for European Economic Research Discussion Paper No. 35. Available at SSRN: http://ssrn.com/abstract=2278873 or http://dx.doi.org/10.2139/ssrn.2278873

forward in one auction would not necessarily be reflective of the mix of projects coming forward in subsequent auctions.

67. However, it is not clear how significant this argument is in the CfD context, where there is a good amount of project information. Given the pipeline information, participants should have a reasonable view of which projects might be applying, where they are located, information on solar radiation / wind speeds etc. which might allow them to form a view on the shape of the supply curve.

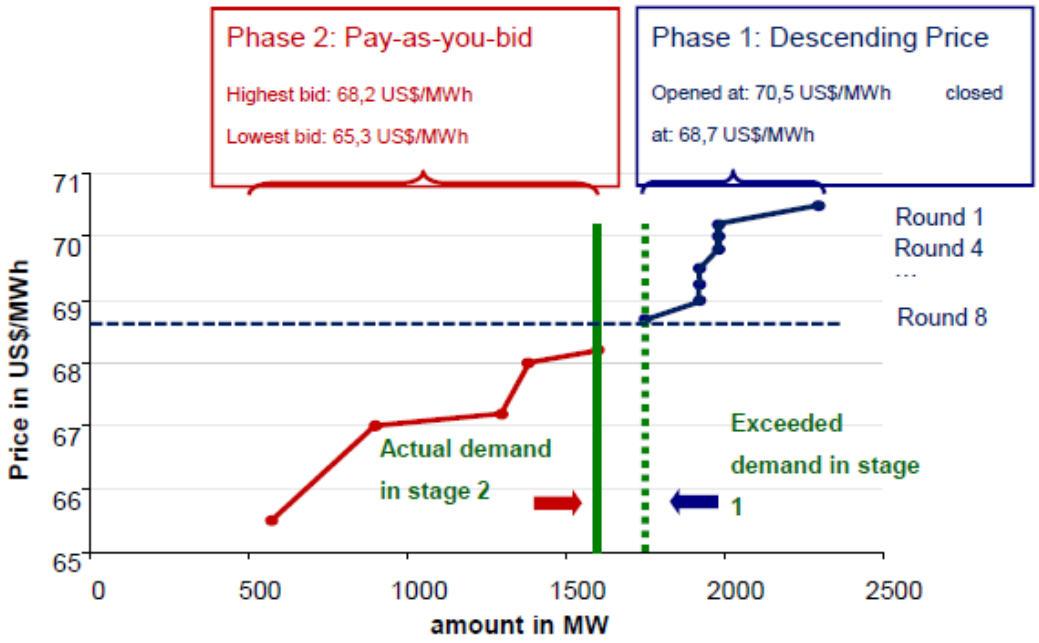
68. The auction system proposed for CfDs would include several technologies, and would cap the price given to any technology to the level of the administrative Strike Price. So, under either pay-as-bid or pay-as-clear, projects belonging to technology groups unlikely to be rationed (i.e. either cheaper technologies not subject to maxima or those subject to minima) were confident of never being rationed could rationally bid up to the level of their respective administrative Strike Price. In the absence of minima/maxima, the choice of pricing rule would probably only affect the bidding behaviour (and Strike Prices paid) to projects belonging to the marginal (i.e. most expensive) technology.

The Brazilian Experience of pay-as-bid auctions

69. The standard design for existing and new energy auctions (primarily hydro plant), which are carried out every year in Brazil[10], relies on a combination of two mechanisms: descending clock and pay-as-bid. The first phase of these auctions follows the design of a classical simultaneous descending clock auction, in which the auctioneer sets a purchasing price and bidders declare the quantity they are willing to sell at that price. As long as total supply is greater than demand by a percentage factor unknown to bidders - an essential point for promoting competition in the second phase of the auction - the price is further reduced. Once total supply reaches this threshold, the first phase ends and the second phase begins. In the second phase, bidders who have remained in the auction up to this point must submit their final offer price following a pay-as-bid design. At this point, the fact that total supply is still greater than demand provides an incentive for bidders to further reduce their bids with respect to the final price of the first phase[11]. The rationale for choosing a second-stage pay-as-bid design for the second phase is not clear, but may be to address collusion[12].

[10] South Africa and Peru also use pay-as-bid auctions for renewable energy.
[11] Maurer & Barroso. Electricity Auctions: An overview of efficient practices. A World Bank study. Box 2.2
[12] See, e.g. page 12 of IRENA (2013) “Renewable Energy Auctions in Developing Countries”

Figure 8 Brazil auction for 2012 delivery



70. Rego & Parente (2013) analyse the Brazilian experience[13]. They find that:

- On average, the final price is 3.06% lower than first stage price, and that this is statistically significant.
- The lowest price is, on average, 4.37% lower than first stage clearing price, which suggests that some degree of price discrimination is happening.

71. However, this should probably be interpreted as an upper bound to the gains from a pay-as-bid approach. The correct counterfactual is one where the 2nd stage auction takes a pay-as-clear approach. The first-stage clearing price is based on "excess demand": we would also expect the 2nd stage clearing price under a pay-as-clear approach to be lower than the first-stage clearing price.

Other considerations

72. Regardless of which pricing rule is adopted, it is essential to use the same approach across all categories. The reason is that the rationing should allow competition across categories at least in some circumstances and this cannot be done if bids are made incomparable as a result of inconsistent pricing rules.

Descending Clock versus Sealed Bid

73. The two options considered are:

[13] Energy Policy 55(2013)511–520

- Multi-round auctions, e.g. a Descending Clock auction, which involves the auctioneer announcing a high price at the beginning of the auction and providers indicating that they are willing to supply capacity at that price, and then repeated rounds at lower prices until the auction discovers the lowest price at which demand equals supply.
- A sealed bid auction, whereby providers each state the minimum price at which they are willing to provide capacity and the auctioneer identifies the marginal bid (i.e. the most expensive bid accepted) and sets that as the clearing price.

74. An important issue in auction design selection is "common value uncertainty". This describes situations where an object being auctioned is worth the same to all bidders, but bidders have different private information about its true value.

75. A descending clock approach reduces common value uncertainty, enabling bidders to bid more aggressively without fear of the winner's curse (winning at a price that is too low) because new entrants know they can withdraw their bid once they see a significant number of other bidders withdraw from the auction. This reduction of uncertainty can both increase revenues and improve efficiency[14].

76. However, our assessment is that common value uncertainty in the CfD context should be limited, and that bidders should largely be able to base their bid on estimates of their own private costs:

- CfDs are specifically designed to remove long-term electricity price risk; bidders mostly do not need to worry about their forecasts being out of line with others when making a Strike Price bid.
    - There may be some common value uncertainty associated with wholesale prices after the contract expires (i.e. beyond 15 years). However, this is likely to be heavily discounted in any case[15].
- For many bidders, load factors will be a significant factor in determining the project cost and bid. Load factors will vary across projects.
- For some technologies (e.g. biomass) there may still be common values issues with respect to long-term fuel costs, particularly where these are not subject to indexation in the contract and there is limited forward liquidity. Access to market forecasts may mitigate this, although there will still be some divergence of views. However, this risk will not be systematic across all bidders - not all projects will have the same fuel source.

[14] Milgrom, Paul and Robert J. Weber (1982), "A Theory of Auctions and Competitive Bidding," *Econometrica*, 50, 1089-1122.
[15] Assuming a 25 year project life, and a wholesale price in years 16-25 equal to the Strike Price, the first 15 years of operation would (assuming a 10% hurdle rate) still account for about 84% of discounted lifetime revenues.

- Bidders may have common value uncertainty regarding the performance of the technology being used, particularly where it is less proven (e.g. potentially in the case in offshore wind). However, at least for some technologies there are a variety of turbine designs and manufacturers, so it is not clear that this risk will be systematic across bidders.

77. In addition, each auction is one of a sequence, so demand in one auction is limited by the alternative of waiting for the next auction. Therefore, demand in one auction is affected by expectations about prices in subsequent auctions, which will be the same for all winners. However, it is not clear that we would want to actively encourage bidders to share expectations about prices in subsequent auctions, which might facilitate tacit collusion.

78. Finally, descending clock auctions may be more helpful for bidders bidding on many projects, where projects may be complements (e.g. different parts of the radio spectrum) or substitutes (e.g. projects in different delivery years, or different "packages" of projects affordable within a bidder's budget constraint). In a sealed-bid context, if the number of possible packages is very large, it becomes difficult for bidders to submit bids for every single combination. A multi-round auction may make it easier for bidders to narrow their focus on a few combinations as prices come down.

79. However, it is not clear how strong these arguments apply in the CfD context:

- Complements: Phased offshore wind projects will be treated as a single indivisible project from the point of view of the allocation system.
- Substitutes:
    - Budget constraints: Ensuring a project is eligible for CfD allocation entails a reasonable degree of commitment: the developer needs planning permission and a grid connection offer. So it seems likely that a bidder would potentially be willing and able to finance all of its eligible projects, subject to securing CfD allocation.
    - Nominating commissioning in different years: We have noted in Section 1 above that we see a case for allowing bidders to nominate Strike Price bids for commissioning in different years. We think this flexibility can be accommodated in a sealed bid auction.
    - Nominating different levels of capacity: We have noted in Section 1 above that some stakeholders have asked for this, but that we are concerned about complexity and how useful it might be in practice.

80. Sealed-bid auctions are the most robust against potential collusion and predatory behaviour

- Under descending clock, bidders may be able to infer individual bidder behaviour from the total demand (all eligible bidders will need to have

planning permission and TEC). This may allow "signalling" behaviour, facilitating tacit collusion.

- Descending clock auctions may deter entry: if strong bidders can see or infer entrants' bids, they can ensure they always beat them.

81. It is possible to run a less transparent clock auction, in order to mitigate collusion concerns. For example, after each round within the auction, we might only tell bidders "the market has / has not cleared" (an option suggested by Dotecon). However, this leaves bidders with much less information about the values of other bidders, as they will not be learning how the supply of projects varies with price. In essence, bidders may end up basing their bids on private values, with the effect that the strategy (and outcome) is effectively equivalent to a sealed bid process.

82. There is a risk under sealed bid of inefficient outcomes if bidders do not bid their true costs, if they are worried about revealing this information to Government. However, we are not clear how significant this effect is and it may be mitigated by the imperative to win (see Annex C).

Last-accepted bid versus first-rejected bid

83. A further significant policy decision is whether to set the clearing price at the price of the first rejected bid or the last accepted bid. The first rejected bid provides further incentives for parties that are aware that they are the marginal plant to bid in their true cost rather than to bid up to cost of the least-cost plant that will be rejected. However in practice it is likely that setting the price at the last accepted bid is likely to reduce costs for consumers – as there is likely to be some uncertainty around the price of the marginal plant and so it would be difficult for participants to game the auction by bidding up to the price of the lowest-cost plant to be rejected. This is the most common pricing rule in pay-as-clear auctions and is being used for the Capacity Mechanism.

Annex C: Use of Sealed bids

84. There are several options around DECC / Delivery Body's ability to access to bids:

    a) DECC and Delivery Body both have access to individual sealed bids under both constrained and unconstrained allocation rounds.
    b) DECC has access to individual bid information under constrained allocation only (but the Delivery Body does not). Bids are only invited if auctions are triggered.
    c) Bids are only invited if auctions are triggered. DECC has no access to individual bid information and only sees clearing prices and auction outcomes; individual sealed bids are held by the Delivery Body for a set period of time (e.g. in case of allocation appeals or competition investigation)
    d) DECC has no access to individual bid information and only sees clearing prices and auction outcomes. Sealed bids are destroyed immediately on conclusion of the auction (only allowing time for appeals).

85. Government wants firms to innovate and cut costs, so firms should expect some rents from doing so. Firms may prefer to keep such rents secret. The perception that Government may use bid information in a way that may reduce rents in future allocation rounds may create an incentive to distort bids. This may lead to inefficient outcomes, since efficient bidding in a pay-as-clear sealed bid auction is for bidders to honestly reveal their lowest acceptable subsidy.

86. Where it is extremely unlikely that the constraint process is run, bidders may view the bids solely as a way to influence the setting of parameters (i.e. administrative Strike Prices) in later rounds. The bid information may be thus be of limited use to Government under unconstrained allocation in particular.

87. However, the incentive might be weak under constrained allocation: it is in bidders' strong interests to bid low to maximise the chances of winning, although there is still a risk of inefficient outcomes (similar to issues under pay-as-bid auctions). This risk may be further limited if it is clear that constrained allocation would endure for future allocation rounds: it is not clear that bidders should worry about bids being used to inform future administrative Strike Prices in a world where administrative Strike Prices are unlikely to ever be paid.

88. To the extent it is judged the risk is material, we considered whether it might be possible to mitigate this problem by keeping the bids permanently secret, revealing only the auction outcome (Option (d) above). If this was preferred, given the size of bids and potential sensitivity of information, it would be preferable to have a technically verified method to completely delete the data.

89. In practice, under a sealed-bid auction, we acknowledge it is possible that there are situations in which scrutiny of the bid data might be desirable (e.g. audits or possible competition investigations). In addition, we would need to consider how

bid data would be covered by the Freedom of Information Act and/or Environmental Information Regulations.

Annex D - Summary of stakeholder feedback on August Allocation Methodology

Issue	Feedback raised
Budget management	• Clarity on budget management needed • Good information flows important
Min/Max	• Clarity required on min/max • Min required for less mature technologies (offshore wind) • Minima/maxima could be applied in different ways. For example: allocation round specific basis, a delivery year basis, or on a cumulative basis as set by a stated future date (e.g. 2020/21). Minima/Maxima metrics could be set either on the basis of energy, power, or budget usage
Allocation Rounds	• Seamless transition to competitive approach • Recommend more allocation rounds per year
Sealed-bid vs. Descending Clock	• Preference for descending clock – increased transparency and efficiency; avoids “winners curse”; unreasonable to have generators determine the minimum SP they are willing to accept • Sealed bids should not be used to inform administrative SP; question the usefulness of bid information • Sealed bids should only be opened under constrained allocation
Pay-as-bid vs. Pay-as-clear	• Welcome the commitment to principle of pay-as-clear, avoids “winner’s curse” • More detailed consideration of auction methods would be beneficial
Bidder flexibility	• Project should be allowed to bid for a later year in the same round
Sequential auctions	• Recommend DECC deploy chronologically-ordered, or sequential auctions
Tiebreakers	• Tiebreakers should be based on ability to deliver – would be more objective
Bid bond	• Need to consider amount for bid bond in light of fact that many generators will be small independents