DEALING WITH UNCERTAINTY WHILE DEVELOPING BID STRATEGY FOR CFD AUCTIONS.

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Overview

The Contract for Difference (CfD) is the UK government's primary policy mechanism for subsidising renewable energy generation, which includes offshore wind. For many renewable developers, winning a CfD contract through the auction is considered the most viable route to market. This is because it reduces revenue risk by protecting developers from volatile wholesale prices, and therefore reduces the cost of raising debt. Developers who bid too high and fail to win a contract, are likely to incur project delays as they wait for the next allocation round. On the contrary, a contract-winning developer who does not quantify its costs properly may bid too low and experience winners' curse, potentially leading to the non-realisation of projects [1]. Therefore, preparing an optimum bid for a project in these increasingly competitive auctions from a renewable developers' perspective is challenging. This is attributed largely to the amounts of uncertainty associated with one’s costs, those of the competition, future wholesale electricity prices, and future grid charges. This uncertainty whilst bidding at auction can also lead to allocation inefficiencies and allow intrinsically worse sites to be awarded subsidies [2].

To better characterise this uncertainty, strategic analysis in the form of simulation allows for better bid preparation. The proposed paper presents a stochastic, agent-based modelling approach, which utilises game-theoretic principles to generate optimum bid strategies for generators attempting to win a CfD contract. The model has use cases and potential implications for policy-makers and renewable generators alike and has been developed in partnership with industrial partners with active participation in CfD auctions. The model can also be readily adapted to renewable subsidy auctions in other countries. In this paper, a sensitivity analysis is demonstrated through replicating the Allocation Round 3 (AR3) which was held in 2019 as a base case. Empirically derived stochastic data obtained from a previously validated proprietary cost modelling tool [3] is used to map each agent to a real-life project that participated in AR3. A sensitivity analysis shows which cost and revenue streams are most important for bid preparation, and thus highlights, where resources to reduce uncertainty should be focused by auction participants. Further analysis shows the effect that the geographical location of the wind farm and differing outlooks on future wholesale electricity prices has on bid preparation. This paper then highlights recommendations, evidenced by simulation, of how uncertainty can be mitigated against by policy-makers to ensure value for money by electricity consumers.

Methods

The numerical framework recreates the CfD allocation mechanism as specified by the CfD allocation framework produced by BEIS [4], through the utilisation of the Python framework for agent-based modelling, Mesa [5]. The present framework considers stochastic inputs for one complete simulation, therefore, each complete simulation typically contains over 20,000 auction runs to average over stochastic inputs. One auction run contains two main stages defined as *Bid Preparation* and *Allocation Mechanism*.

The *bid preparation* stage involves the conversion of the input project data into a CfD bid for each project. To do this the cost and revenue streams of every power project are assessed for each auction simulation round. The cost streams include capital, operational, decommissioning, development, rent, interest payment, tax, and grid charges. Revenue streams consist of CfD payments, contracted power, and market wholesale revenues. The discount equity cash flow is then calculated to derive a CfD bid for each agent. The *allocation mechanism* follows the bid preparation stage and assesses each bid. In this part, the model ranks bids before accepting the required amount of capacity according to its budget. The outputs from one auction run of the model are as follows: Clearing price, winning projects, all project bids, and total capacity procured. From this, it is possible to draw out significant amounts of insights from all the auction runs

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The main cost streams are assessed (e.g. capital expenditure, operational expenditure, development expenditure) to ascertain the largest cost-related sensitivity. Once this is identified, a granular look at the composition of these cost streams is examined to highlight the exact cost components influencing cost and uncertainty in bid preparation for CfD auctions. Scenarios based on the AR3 auction are then run, to demonstrate how uncertainty could have influenced past auctions and to generate policy recommendations.

Results

The input parameters are ranked in order of their effect on model outputs and are demonstrated through a Tornado Chart. During this factor prioritisation, the results show that variation in a subset of input parameters has a very small impact on outputs and that uncertainty in these parameters can be safely ignored, known as factor fixing [6]. This allows for strategy teams preparing CfD bids to reduce model complexity and focus resources on the most significant inputs. The most sensitive inputs for bid preparation are capital expenditure and capacity factor. A more granular look into these inputs demonstrates that uncertainty associated with estimated mean wind speed, steel costs, and wind turbine unit costs have the largest impact on CfD bids. Inputs which have little effect on CfD bid is development and decommissioning expenditure. Further results show the influence of future wholesale electricity prices, and forecasted grid charges on CfD bid preparation. Results show that without grid improvement to reduce transmission charges, decarbonisation can be hindered in some geographical areas. Potential policy recommendations such as increasing CfD contract length to reduce uncertainty have been investigated. A trade-off is presented between reducing uncertainty for developers and increasing the net present value (NPV) of support payments to generators.

Conclusions

Winning a CfD contract is important for renewable developers to secure the financing required to realise consented projects. However, uncertainty associated with bidding at auction makes winning a contract challenging. This paper has presented a numerical framework for studying the CfD auction, which can be used to provide insights into the auction mechanisms and for optimum bid preparation. Using a proprietary stochastic cost modelling tool, the AR3 auction has been replicated. Using this as a base case, a sensitivity analysis has been conducted. This has shown the most important inputs for bid preparation, and where significant resources should be focused by developers to reduce uncertainty to develop optimum bid strategies. It is shown from running scenarios, that there are potential solutions such as increasing CfD contract length, which reduce uncertainty for developers by policy-makers, and should, therefore, be taken into consideration to reduce energy prices for consumers.

References

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