Offshore wind: All at sea?

How old Treasury rules threaten the UK’s booming offshore wind industry

August 2023
**EXECUTIVE SUMMARY**

The turbines churning off the coast have made Britain a world leader in wind power generation. The UK had the world’s largest fleet of offshore turbines until 2021, and is now second only to China. Wind supplies more than a quarter of the UK’s electricity needs.

In 2022, 90% of new global offshore wind was built in China and the UK, with these two countries expected to be ahead until at least 2030.

Up until now, the Government’s Contracts for Difference (CfD) scheme has been vital in helping British wind power drive down costs. The contracts provide generators with the certainty of a pre-agreed ‘strike price’ for their electricity so reducing the cost of financing and shielding bill payers from the volatility of the wholesale electricity market which has seen prices soar during the gas crisis.

The policy has been very effective, cutting costs over the last decade by 75-80%, so much so that the Government last year chose to increase the frequency of the CfD auctions to be annual. During the worst of the gas price crisis caused by Russia’s war on Ukraine, low-cost renewable power and high energy prices meant CfD windfarms were paying back. Over the course of 18 months, during the worst of the gas price crisis from October 2021 to April 2023, CfD windfarms were expected to pay back £660 million, as contracted ‘strike prices’ were lower than the wholesale price for electricity.

New cheaper windfarms could pay back even more, especially as wholesale prices are forecast to be above renewable strike prices for the foreseeable future. The wholesale price of energy is largely set by gas power stations and therefore the price of gas. The new economic reality is that customers are vanishingly unlikely to have to make net payments in any year to these new CfD renewables projects, and instead the money will flow from renewables to customers.

But the Government has missed opportunities to move faster. The Levy Control Framework is designed to limit spending on low-carbon power, which is paid for with a ‘green levy’ on bills. But it has essentially capped the capacity of power generation that can be secured at CfD auctions. And this is at the expense of the new economic reality, which is that renewables, by displacing gas power, save money for consumers.
Treasury rules mean last year’s CfD auction, allocation round 4 (AR4), contracted 1GW less than it could have. This would have been worth up to £225million in savings each year, under forecast wholesale prices of £100/MWh.

Recognising that this year’s auction (AR5) comes alongside developers facing higher supply chain costs caused in part by inflation as a result of the gas crisis and supply chain bottle necks, the Government has upped AR5’s budget from £170 million (£30m lower than the previous round’s pot) to £190 million. However industry say this eleventh-hour move will make only a very limited impact on any new wind farm capacity secured and if the Government wanted to maximise bids at auction, the budget could even be upped, or the constraint removed entirely.

Even with costs increasing by up to 40%, as reported by industry, and higher interest rates, strike prices rising 20% to around £60MWh would still be a third lower than wholesale prices and half the cost of power from Hinkley C. The risk is that wind farms, despite them generating electricity cheaper than the predicted wholesale price and so saving bill payers money, will not get built if strike prices have been set too low by the Government not taking account of the new cost pressures. This would be a huge setback when Britain aims to generate 50GW from wind by 2030.

Even with the cost increases, projects secured in AR5 could be paying back £180million a year for every GW built. AR5 could have achieved similar capacity results to AR4 – securing around a further 6.5GW of wind capacity, saving customers £1.2billion a year.

Every GW of offshore wind secured means the UK needs less, more expensive, gas for electricity generation. And just 2.7GW, the same capacity as one large windfarm, would be enough to replace the new North Sea gas licenses affected by a Labour Government’s proposed moratorium on drilling, saving up to £600 million a year.

The question hanging over future CfD auctions is can the old rules be updated to reflect the new economic reality of high wholesale prices set by gas power plants? Updating the old rules would enable the Government to secure as much capacity as possible, bringing down bills, creating job opportunities, particularly for staff leaving the declining oil and gas industry.

**A VAST UK RESOURCE**
The UK has a vast resource of wind, the largest in Europe, it is renewable and so will not run out, and has the potential to turn Britain into a net energy exporter, selling electricity to Europe.

The Government has a target of 50GW of wind power generation by 2030 and the UK’s peak energy demand in winter is around 48GW.

But even though offshore wind has been the great success story of Britain’s energy sector, it is at risk of faltering. The UK went from the world’s largest fleet of offshore turbines, to second largest when China leapt ahead in 2021. There is 12GW installed and a further 9GW under construction, with almost 10GW more having secure planning permission, and even more at earlier stages in the pipeline.

**LOW AND STABLE PRICES**

The price of offshore wind has dropped 75-80% in little over a decade, as early investment paid off and the industry grew, driving down costs.

CfDs have a strike price, the guaranteed price per unit of output in £ per megawatt hour (£/MWh) paid to the generator. This brings two main benefits:

- It ensures customers do not pay more than is necessary, with the generator reimbursing any excess earned from the wholesale markets.
- It reduces energy costs by stabilising revenues and cutting the costs of financing new projects.

Contracts are awarded at auctions to encourage developers to offer their lowest prices:

- An administrative strike price (ASP) sets an upper limit on bid prices to try and drive competitive bids.
- Bids are arranged in order of ascending bid price, a sort of merit order.
- The auction is pay as clear, as in all successful bidders will be paid the strike price bid by the last successful bidder in the merit order.
- Projects must fit within the auction’s budget (total pot size) and a project that straddles the line will not be funded at all.

This report follows the practice of CfD auctions in expressing values in 2012 prices, unless otherwise stated.

Summary of prices:

- Prices were £149–191 per MWh in 2011 ([Offshore Wind Cost Reduction Task Force](#)), and £37 (2012 prices: £50 2023 prices) in the auction that concluded in 2022 ([Allocation Round 4](#)). the wind from AR4 is due to come online within the next 2–3years. It is expected that these windfarms will take part in CfD contracts when they come online, however there is an option for the operators to take the power to the wholesale electricity market should they wish.
- This is around half the wholesale power price of £90–100/MWh that is forecast until at least the end of this decade ([Cornwall Insight](#)), and 60% lower than the CfD strike price of around £90/MWh (2012 prices; c.£115/MWh in current prices) for Hinckley C nuclear power plant.
Some developers choose to bid for CfD contracts for only part of their capacity and to enter the open market with the remainder. This underlines the fact that offshore wind is competitively priced compared to other generation technologies because it competes with them for customers on the wholesale power market.

**Auction Parameters**

There are two interlinked issues with the CfDs: the ‘reference price’ and the ‘pot size’. The Treasury appears to have focussed on minimising the risk from an unlikely scenario in which gas is cheap, as opposed to maximising the benefits of a more likely scenario in which renewables are cost-competitive.

Firstly, the ‘reference price’ – the forecast of future wholesale electricity prices – has been low in CfD auctions, even before the gas crisis and more so now. It’s based on the low likelihood scenario that the gas prices that set most energy costs in the current market are cheap and even major dips in the price of renewables cannot complete. This approach does not give appropriate weight to the higher likelihood scenario that gas power stays more expensive, as analysts predict.

Secondly, the ‘pot size’ for each CfD auction has arguably been set too low. The rationale is partly to encourage competitive bidding and partly to limit customers’ payments to renewable generators, but this is unlikely to happen anyway, given high wholesale power prices are estimated to remain. The Government appears to have recognised this in the late stages of AR5, as it upped the original £170million budget to around £190million. This eleventh hour move is not expected to make a significant difference to the amount of offshore wind that may be secured, and it is still £10million less than the budget pot for AR4 despite noticeable and global increases in the inflation and the cost of most materials.

But the details were part of David Cameron’s ill-fated move to “cut the green crap”, which has added to £2.5 billion to energy bills, with some households missing out on savings of up to £1,750 in 2022. A share of those extra costs to energy consumers was down to the insufficient deployment of renewables, something that was slowed in part by limited CfD pot sizes and Levy Control Framework.

**Limiting Previous CfD Auctions**

Auctions are complicated and the organiser, the Low Carbon Contracts Company, has to set parameters to optimise the outcomes of price and volume, and maximise the stability of the project pipeline. Purely looking at capacity, there are four ways to maximise it, as illustrated in Figure 1 that uses the example of AR4 offshore wind:

- Decreasing the strike price, which the industry has achieved over the past decade, more so than was expected
- Being flexible so that bids that straddle the pot limit are included, ensuring full capacity is utilised
- Using a higher reference price (forecasts of future wholesale price)
- Increasing the size of the budget pot, noting this could become irrelevant if wind pays back.
Figure 1: Offshore wind capacity secured in a CfD auction for different combinations of pot size, reference price (RF) and strike price (SP). Chart is based on offshore wind in AR4, but the principles apply to any other technologies and other CfD auctions.

The full capacity available in each auction to date was not necessarily used and could have been secured if there had been a less rigid application of the pot size. Under current rules, if a project in the merit order straddles the auction’s capacity limit, then that project is unsuccessful, and the auction secures less than its maximum capacity.

The AR4 offshore wind clearing strike price of £37.35/MWh (2012 prices) could have secured 8GW within its £200 million pot, but instead secured only 7GW. Had the next project been included, then AR4 would have secured at least another 1GW of capacity. This would have required breaching the pot size, but this is essentially an arbitrary limit based on low likelihood risks. Instead, it is more relevant to focus on the high likelihood of benefits from that extra 1GW of wind power, particularly in the context of ongoing higher wholesale prices set largely by gas power plants.

A higher capacity of generation can also be secured by increasing the pot size and/or increasing the reference price. It is not quite as simple as the straight lines in the chart, because an auction with a larger budget pot would likely clear with a more expensive project, and hence have secured less than 16GW – but more than the 7GW from AR4.

Furthermore, the auction organiser has to make other considerations, such as keeping a steady flow of projects from the pipeline. But these examples serve to illustrate that these projects could potentially be moving faster, were the parameters set even just slightly higher, with benefits not just in lowering customers’ bills, but also in expanding the renewables industry to provide jobs for those leaving the declining oil and gas sector.

**RECENT SHOCKS TO THE SYSTEM**

Since AR4 was initiated in 2021, two major changes have occurred in the power sector.

Firstly, the gas crisis has pushed up wholesale energy prices for the foreseeable future. Estimates made pre-crisis expected prices to continue at around £40–50/MWh. In contrast, estimates made in 2023...
foresee gas power plants keeping wholesale power prices at around £90–100/MWh until at least the end of this decade. This doubling in forecast wholesale prices has two effects. Firstly, it changes the very low reference prices from an unlikely scenario into an almost outright impossibility. And secondly, it pushes prices above the strike prices of renewables from AR4 onwards. In this context, the Government is pursuing its Review of Electricity Market Arrangements (REMA) to maximise the benefits of cheap renewables.

The new economic reality is that customers are vanishingly unlikely to have to make net payments in any year to these new CfD renewables projects, and instead the money will flow from renewables to customers. This could have been the case without the gas crisis, given the dramatic drop in the costs of renewables; and it will certainly be the case during the lingering gas crisis, given the sustained high price of gas that largely sets wholesale power prices. The logical response would be to contract for as much CfD renewable capacity as possible, with the amount at each auction limited only by the rate at which projects can move through the pipeline, with some constraints to encourage competitive bidding.

The second major change is the inflation facing renewables projects. The gas crisis triggered inflation across all sectors of the economy, in the UK and overseas. Developers also face pressures due to growing demand for material and components and associated supply chain constraints. These constraints are expected to ease as the industry and supply chains develop more, as has happened with solar power. Interest rate rises to stem inflation have pushed up capital financing costs for all sectors. Renewables have been hit harder by inflation than fossil fuel developers such as gas power plants because renewables have higher upfront capital costs, whereas fossil fuel plants face higher costs from ongoing fuel purchases. However, renewables’ very low operating costs mean that they are cheaper overall, as discussed above, with AR4 coming in at half the forecast wholesale price set by gas power plants.

Overcoming that initial funding hurdle is the very purpose of the CfD scheme, providing guaranteed income streams in order to cut financing costs and benefit from renewables’ overall lower costs. The current CfD rules adjust the strike prices to reflect inflation, specifically CPI on an annual basis. CfD calculations use a strike price inflation of 10% between 2022 and 2023, whereas some offshore wind developers are reporting supply chain inflation of 20–40%, with one offshore wind developer pausing the Norfolk Boreas project citing a 40% increase in project costs. There are reports of similar inflation affecting upfront costs for other renewables, for example solar capital costs rising by 20–30% (and 50% in some cases).

Exactly how these cost increases translate into strike prices will depend on details that are confidential to each project. A first approximation could be that a 40% increase in project costs means up to a 20% increase in strike price. Some of this will be reflected in adjustments to strike prices based on CPI between the contract award and commencement of generation. Data from the EMRSB that calculates values for CfD contracts implies a value of 10% between 2022 and 2023; and the OBR forecasts 2% annually from 2024 onwards. Applying these values gives 10.6% from 2022 to 2026/27, which is in the middle of when these projects would come online. So, netting off expected CPI suggests that projects contracted in AR4 are facing inflation of up to 10% higher than is allowed for by CfD strike price adjustments.

Figure 2: Capacity secured by AR5 at different strike prices. Vertical lines indicate prices in AR4 and with increasing levels of inflation measured from 2022 to 2026/27
As well as causing the pausing of one AR4 project, this inflation is also posing a risk to the prospects of potential AR5 projects if the Government fails to take account of it. Projects under AR4 and AR5 would be delivered in an overlapping set of years, and so can be assumed to face similar rates of inflation. Figure 2 (in 2012 prices) illustrates that the administrative strike price for AR5 is 17.8% above the clearing strike price for AR4, or 7.2% above CPI, securing around 2GW of capacity compared to the 7GW in AR4. But that capacity could be a moot point, as the chart shows that strike price inflation of 20% would preclude developers from bidding into AR5. The results to be announced by early September will show whether any successful bids were submitted.

It is likely that one or more offshore wind project might have been entered into AR5. This depends on a range of factors, many of which will be confidential, such as the contracting strategies of companies within the developers’ supply chains. For example, a manufacturer might calculate that new turbine design will become cost-effective only if it achieves a certain volume of orders that could be reached by the addition of an AR project. These sorts of examples support the case for the UK developing larger renewables supply chains, to bring more options and greater economies of scale.

With CfD auctions being held annually since 2022 to speed up the deployment of renewables, there is the opportunity to get back on track quickly, by adapting the framework in time for AR6 that will be set up later in 2023, with its bids and results in 2024.

**The North Sea**

For context, just 2.7GW of offshore wind would generate as much electricity per year as could be generated using the amount of gas affected by a Labour Government’s proposed moratorium on North Sea exploration. It is quite plausible, given the scale of windfarms in the pipeline, that this extra capacity could have been secured by simply relaxing the application of the pot size for AR4 and contracting one more project at a similar strike price.
A 2.7GW offshore windfarm could also have saved consumers £485–600million/yr.

**COUNTING THE COST: MISSING OUT ON CHEAP RENEWABLES**

An offshore windfarm’s strike price that was 20% higher than under AR4 would be around £45/MWh (in 2012 prices), or around £60/MWh (2023 prices). This is still around two-thirds the forecast level of wholesale prices set largely by gas for the foreseeable future. These renewables would also generate at around half the price of Hinkley C nuclear power station at £90/MWh (2012 prices) or c.£115/MWh (2023 prices).

CfDs ensure that these lower costs result in savings for customers. For every 1MWh of electricity produced, if the wholesale price was £100/MWh, then an offshore windfarm would pay consumers £50 under AR4 strike prices, or £40 if project costs saw 20% inflation in its strike price (all in 2023 prices).

Every gigawatt of offshore wind capacity from AR4 onwards would produce on average 5.5TWh of electricity each year from the mid-2020s, selling it for £550M/yr, and returning to customers £225M/yr under AR4 prices, or £180M/yr if project costs saw 20% inflation in its strike price (all in 2023 prices).

This analysis can be combined with the earlier discussion about how auction parameters have limited CfD capacity, in order to estimate the potential savings that will be missed in coming years. For example:

- If the budget pot limit was not used as a hard barrier, and instead the final project straddling that limit had been offered a contract, then at least 1GW more offshore wind capacity would have been secured in AR4, saving customers at least £180–225M/yr (as above). If it had a similar strike price to the actual clearing price. The savings would have been larger is this project happened to be larger.

- Despite an eleventh-hour Whitehall decision to up the budget for AR5 from £170million to £190million, the AR5 auction parameters could have been amended earlier, and to a higher degree, to reflect the emerging realities of the gas crisis and future gas-led electricity wholesale prices being high. The administrative strike price could have been raised to reflect project cost inflation, accepting the fact that renewables’ strike prices would still be lower than wholesale prices forecasts, allowing more developers to bid, whilst still maintaining the incentive to make their best offers. If the budget pot size had been set at £400M/yr (as opposed to £190M/yr) and the reference price had been raised by just 5% (as opposed to actually being lowered compared to AR4), then even with strike prices of 20% above those from AR4, this new AR5 auction could have secured 7GW of capacity (similar to AR4) and saved customers £1.6bn/yr under forecast wholesale prices.

- With wholesale prices set to be higher than strike prices for the foreseeable future, the concept of the reference prices and budget pot size could be less relevant. In principle, the auctions could secure larger capacities, with the only legitimate limiting factors being the speed at which projects can move through the supply chain and the need to retain an incentive to submit the best bids.
This analysis is based on the following formulae that link the main CfD variables:

\[
\text{Payment \ [\text{£/yr}]} = \text{Output \ [MWh/yr]} \times (1 - \text{TLM \ [%]} \times (\text{Strike price \ [£/MWh]} \ - \ \text{Wholesale Price \ [£/MWh]})
\]

where

- Payments can be +ve (cost to customers) or -ve (payment to customers)
- Output \ [MWh/yr] = Capacity \ [MW] \times \text{Load factor \ [%]} \times 8,760 \text{ hrs/yr}
Load factor = 63% for offshore wind in AR4 and beyond

TLM = 0.9%, a measure of transmission losses

Figure 3 illustrates this linear relationship between payment and wholesale price, using the outcome of AR4, but the concepts are applicable to other CfD auction. Monetary values are expressed in 2023 prices, and the analysis reflects the outcomes of AR4 in using only 85% of the offshore wind budget pot i.e. c.£170M for 7GW.

Figure 3: CfD payments to or from 7GW of offshore windfarms vs. wholesale price, for AR4 strike prices with and without 20% project cost inflation.

The gradient of the payment line can be calculated in either of the following two ways, giving identical answers:

\[
\text{Gradient} = \frac{\text{Pot size} [\text{£/yr}]}{\text{(Strike price} - \text{Reference price})}
\]

or, equivalently,

\[
\text{Gradient} = \text{Capacity} \times \text{Load factor} \times 8,760 \text{ hrs/yr} \times (1 - \text{TLM})
\]

Implicit in the formulation of the budget pot size is that the reference price is less than the strike price, as the budget pot is designed to cap downside risk i.e. customer costs that can logically only occur when the wholesale price is less than the strike price.

Figure 4 illustrates the effect of using a higher reference price and a larger budget pot. The line with the shallowest gradient replicates that from above with AR4 parameters (7GW using £173M out of the £200M budget pot, and 20% strike price inflation). The other lines illustrate the impact of increasing the reference price by just 10% to around £48/MWh (2023 prices) and doubling the pot size to £400M/yr. This secures 8.4GW of capacity and savings for customers in the range of £1.5–2.0bn/yr, as would have been expected with non-inflated strike prices at forecast wholesale prices.

Figure 4: CfD payments to or from 7GW of offshore windfarms vs. wholesale price, for AR4 strike price +20% inflation, and with changes to reference price and pot size.
Furthermore, given the new paradigm of renewables being cheaper than the wholesale price for the foreseeable future, it might be helpful to re-evaluate the relevance of the use of the reference price and the budget pot. Once we move to a scenario in which the reference price should be larger than the strike price, then it is no longer relevant to use that approach. Figure 5 illustrates this some examples of payment lines, using the other formulation of the gradient, which requires only: Output (which is proportional to Capacity); Strike Price; and Wholesale Price. The capacity can be increased to any extent, increasing the benefits to customers under forecast prices.

*Figure 5: CfD payments to or from offshore windfarms vs. wholesale price, for AR4 strike price +20% inflation, for different levels of capacity.*