Title: Proposed amendments to the Contracts for Difference scheme – Final Stage Impact Assessment **IA No:** BEIS029(F)-20-CE **RPC Reference No:** N/A **Lead department or agency:** Department for Business, Energy and Industrial Strategy **Other departments or agencies:** N/A	**Impact Assessment (IA)** **Date:** November 2020 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Secondary legislation **Contact for enquiries:** BEISContractsForDifference@beis.gov.uk

Summary: Intervention and Options

RPC Opinion: Not Applicable

Cost of Preferred (or more likely) Option			
Total Net Present Social Value: £0-240m	**Business Net Present Value:** N/A	**Net cost to business per year:** N/A	**Business Impact Target Status** Non qualifying provision

What is the problem under consideration? Why is government intervention necessary?

The UK's net zero emissions target means that substantial amounts of new, low carbon power will be needed by 2050. The Contracts for Difference scheme is the government's primary means of supporting low carbon power generation. In light of the net zero target and recent evolution of the renewable electricity sector, consideration has been given to how the scheme can best support the pace of renewable electricity deployment needed whilst continuing to provide value for money for the consumer. This IA only covers changes to scheme design; it does not cover specific allocation round parameters such as budgets and administrative strike prices which are published ahead of rounds opening.

What are the policy objectives and the intended effects?

The objectives of the policy changes proposed at consultation support the themes of delivering net zero, achieving value for money, supporting communities, advancing the low carbon economy, and maintaining energy security. They are to:

- **Make progress in delivering net zero** by ensuring a wider range of with technologies with decarbonisation potential are supported;
- **Encourage more effective development of supply chains;**
- **Encourage more effective engagement with communities;**
- **Update technology eligibility** by removing coal-to-biomass conversions in recognition of their support under the scheme coming to an end;
- **Encourage more effective development of decommissioning programmes;**
- **Improve allocation round design**, particularly through greater flexibility on how caps are applied;
- **Improve system integration of renewables** by introducing greater market signals;
- **Improve scheme operation**.

The intended effects are to ensure that the scheme can continue to decarbonise the electricity system while ensuring value for money for consumers.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

__Option 0 – Do nothing__: Retain the current scheme design including pot structure, eligible technologies, allocation round design, and contractual conditions.

__Option 1 – Policy package__: Implement policy proposals, of which the key ones assessed in this IA are to:

- **Recognise needs of particular technologies**: add floating offshore wind as a less established technology, remove biomass conversions due to support ending in 2027, and move offshore wind out of the pot of less established technologies;
- **Improve auction design**: allow flexibility on how caps on capacity in each allocation round are applied;
- **Responsiveness to market signals**: stop CfD payments during periods of negative wholesale electricity prices;
- **Scheme operation:** increase the period of exclusion from the scheme where projects don't deliver; extend the dates by which generators have to demonstrate progress towards delivery.

Will the policy be reviewed? It will not be reviewed. **If applicable, set review date:** N/A

Does implementation go beyond minimum EU requirements?		No		
Is this measure likely to impact on international trade and investment?		No		
Are any of these organisations in scope?	**Micro** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)		**Traded:** 0 to -0.26	**Non-traded:** 0	

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister: Kwasi Kwarteng Date: 23/11/2020

Summary: Analysis & Evidence — Final Government Position

Description: Implement policy proposals including moving offshore wind from Pot 2 to a separate third pot, classifying floating offshore wind as a separate technology, excluding new coal-to-biomass conversions from future allocation rounds, and changes to improve auction design, responsiveness to market signals, and scheme operation.

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2025	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: 0	**High:** 240	**Best Estimate:** N/A

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate	-		-	**N/A**

Description and scale of key monetised costs by 'main affected groups'

The costs of the proposals depend entirely on the outcomes of future allocation rounds across the scheme, and no attempt has been made to predict these. Illustrative scenarios have been estimated to demonstrate some potential impacts in relation to generation, carbon and support costs. However, across these scenarios none of the proposed changes incur additional monetised costs, because either:

(a) *the proposal is shown to have no impact under a particular scenario* – for example, removing coal-to-biomass conversions from the scheme has no costs if no projects were expected to come forward anyway; or

(b) *the proposal results in cost reductions under a particular scenario, which are counted as a benefit* – for example, if floating offshore wind is able to compete and bid lower than other technologies then this would mean the same renewable electricity could be delivered at a lower cost.

Other key non-monetised costs by 'main affected groups'

Due to the significant uncertainties involved in predicting the outcomes of future allocation rounds, no attempt has been made to estimate the impact on bidding behaviour in future allocation rounds of the consultation proposals. However, were these changes to affect bidding strategies this would likely result in a wider range of impacts than those illustratively estimated in this assessment, which could affect the costs for consumers and generators. Some proposals may result in increased administration requirements for bidders, but we expect the associated costs of this to be negligible.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	Optional		Optional	**0**
High	Optional		Optional	**240**
Best Estimate	-		-	**N/A**

Description and scale of key monetised benefits by 'main affected groups'

The benefits of the policy proposals depend entirely on the outcomes of future allocation rounds, which rely on an auction mechanism. No attempt has been made to predict these. The illustrative scenarios used to demonstrate some potential impacts show benefits in relation to: reductions in generation costs (Present Value (PV) £0 – 220m), and reductions in greenhouse gas emissions (PV £0 – 20m).

Other key non-monetised benefits by 'main affected groups'

Where floating offshore wind projects are successful in securing a CfD, further benefits are expected:

- Innovation benefits from the deployment of floating offshore wind projects, which could help reduce the future costs of decarbonisation.
- Depending on what projects are displaced by floating offshore wind, this could lead to improved air quality due to avoided particulate emissions from fuelled technologies.

The potential household bill impacts for theses illustrative scenarios have been estimated at savings of less than £1 per year.

Key assumptions/sensitivities/risks	**Discount rate (%)**	**3.5**

1. Which technologies are competitive in future allocation rounds is highly uncertain. As a result, a range of illustrative scenarios have been tested.
2. There is assumed to be no change in bidding behaviour as a result of these proposals. As it is highly uncertain if any impact on bidding behaviour would increase or decrease the total support costs, as the impact may be different across the pots.
3. The capacity and deployment mix of future projects is illustratively based on one commissioning year informed by previous allocation round results.
4. The costs estimated do not include wider electricity system impacts, such as balancing costs. These are covered qualitatively only but are expected to be small.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only) £m:**
Costs: N/A	**Benefits:** N/A	**Net:** N/A	N/A

Please note: Changes to future allocation rounds have been informed by the responses to the consultation and are detailed in the government response being published alongside this IA. This document intends to provide stakeholders with an indication of the possible impacts of the changes. All assumptions and impacts are illustrative and should not be interpreted as forecasts of future outcomes or as an indication of future allocation round parameters.

Section 1: Problem under consideration

The Contracts for Difference (CfD) scheme is the government's primary means of supporting new low carbon electricity generation. The scheme incentivises investment in renewable energy by providing developers of projects with high upfront costs and long lifetimes with direct protection from volatile wholesale prices, and they protect consumers from paying increased support costs when electricity prices are high. Since its introduction as part of the Electricity Market Reform (2013) programme, the scheme is regularly reviewed and adjusted to ensure it remains the most appropriate support mechanism, provides value for money for electricity consumers and is aligned to wider decarbonisation aims.

The government recently consulted on proposed changes to the scheme design, the key aspects of which are considered in this Impact Assessment (IA). The proposals are informed by a number of factors, including new evidence and experience from previous allocation rounds, and the increased decarbonisation ambition of a 2050 net zero target. An overview of all proposed changes can be found in Section 4.

Section 2: Rationale for intervention

The UK's net zero emissions target means that substantial amounts of new, low carbon power sources will need to be built by 2050. The Contracts for Difference (CfD) scheme is the government's primary means of supporting low carbon power generation, and changes to the scheme are necessary to enable it to best support new generation in line with our decarbonisation, cost reduction, and innovation ambitions, and provide value for bill payers in coming years.

In relation to the specific proposals considered in this Impact Assessment, a number of issues provide the rationale:

- **Competition and value for money:** At present the scheme groups technologies with very different characteristics (for example number of years to deliver a project, capacity size and expected costs) together into the same 'pot'. This introduces challenges when designing an auction in a way that ensures competitive tension is achieved. Consideration has therefore been given to alternative grouping of technologies, which could allow for more suitable parameters to be set for each of the pots to reflect project characteristics and reduce the risk of suboptimal auction outcomes.
- **Supporting diversity:** The CfD regime offers potential for preserving optionality and delivering innovation as well as competition. Nascent technologies such as floating offshore wind, currently not classed as a separate technology to fixed-bottom offshore wind, could have a role in the long-term decarbonisation of the UK, but they need to deliver value for money, and have the potential to both achieve cost reduction and contribute significantly to decarbonisation.
- **Appropriate support:** It is important that the eligibility of technologies to compete in the scheme is evaluated as new evidence becomes available and context evolves. The scheme currently includes coal-to-biomass conversions, which were always intended to be a transitional technology and support for which is already due to end in 2027. Consideration has now been given to removing this technology.

- **Misaligned incentives:** The scheme is designed to incentivise bidders to submit the lowest viable strike price. Whilst the evidence of speculative bidding by projects in previous allocation rounds is limited, strengthening the penalty for non-delivery could help reduce this and the risk of project failure in future. The scheme also currently incentivises projects to operate at times when the day-ahead market signals that additional electricity generation would attract a negative price, which may introduce unnecessary distortions into the wholesale market.
- **Improve the operation of the CfD scheme:** Several of the proposed changes aim to improve the efficiency and operation of the scheme and reduce the burden on applicants.

Section 3: Policy objective

There are a number of intended policy objectives underpinning the government's proposals to improve the CfD scheme ahead of the next allocation round. The proposed changes support the themes of delivering net zero, achieving value for money, supporting communities, advancing the low carbon economy, and maintaining energy security. They are to:

- **Make progress in delivering net zero:** The government's primary objective is to make progress towards the 2050 net zero target by ensuring that the scheme continues to secure significant levels of renewable electricity deployment over the coming years. At the same time the government wants to ensure that the CfD scheme provides value for bill payers by encouraging deployment of renewable capacity at the lowest cost to consumers whilst also supporting cost reductions.
- **Encourage more effective development of supply chains:** The government wants to ensure that the Supply Chain Plan Policy is still consistent with its overall objectives and is considering aligning this with the aims of the Industrial Strategy.
- **Update technology eligibility**: The government also wants to ensure that the scheme supports deployment of technologies whose best use lies in the electricity system and which deliver wider benefits to the UK economy such as the development of supply chains.
- **Encourage more effective engagement with communities**: The transition to a net zero greenhouse gas economy will require change across the whole of society and the government wants to ensure that the local impacts and benefits of energy developments are proportionate and measured.
- **Encourage more effective development of decommissioning programmes**: The government wants to ensure developers and owners of offshore renewable energy installations give appropriate consideration to the Energy Act 2004 decommissioning regime for offshore renewable energy installations.
- **Improve allocation round design:** The government wants to ensure value for money through design of allocation rounds and their parameters, as well as ensuring appropriate incentives are in place for project delivery.
- **Improve system integration of renewables:** In order to complement the significant growth in generation from variable renewable technologies, the government is also looking to support deployment in a way that minimises wider system costs for the consumer.
- **Improve operation of the CfD:** And lastly, the government wants to learn from the experience of previous allocation rounds to improve the operation and clarity of the CfD scheme, and ensure the contract is giving effect to the intended balance of risks between generators and consumers.

Since the consultation on proposals to improve the CfD scheme, on 6 October the government announced that the next Contracts for Difference auction will take place in late 2021, and that this will seek to support up to double the capacity of renewable energy supported through 2019's successful auction[1]. The proposed changes to the CfD scheme will help to further support the ambition for next year's auction and make progress towards the 2050 net zero target.

Section 4: Description of options considered

The following options are considered in this IA:

Option 0: Do nothing: Under this option there is no change to the CfD scheme. This option represents the counterfactual against which the costs and benefits of the policy proposals are assessed.

Option 1: Changes to CfD scheme: This option mirrors the proposals set out in the government response. The key aspects of these considered in this Impact Assessment are:

- **Delivering Net Zero**
  - Moving offshore wind from the group of 'less established technologies' ('Pot 2') to a separate, third pot;
  - Classifying floating offshore wind as a separate technology.
- **Update technology eligibility**
  - Excluding new coal-to-biomass conversions from future CfD allocation rounds.
- **Improve allocation round design**
  - Changes to the Non-Delivery Disincentive (NDD);
  - Introducing flexibility for use of capacity caps, maxima and minima.
- **Improve system integration of renewables**
  - Extending the negative pricing rule so that CfD payments are not made during periods of negative wholesale electricity prices.
- **Improve the operation and clarity of the CfD**
  - Extending the Milestone Delivery Date (MDD).

The key rationale behind these prosed changes are described in Table 1 below. Further detail can be found in the consultation document[2], and government response published alongside this IA.

Table 1: Overview of changes to the CfD scheme being implemented

Proposed change	Rationale
Moving offshore wind from Pot 2 to a separate, third pot	Offshore wind is currently classed as a less established technology (Pot 2), but has several differing characteristics compared to other technologies in the scheme, such as development timelines, typical size of projects, and expected cost – which has reduced significantly since the start of the CfD scheme. The government considers that there are advantages to moving offshore wind into another pot, but given the evidence suggests that there remain significant cost, maturity and capacity differences between offshore wind and established technologies (Pot 1) such as solar PV and onshore wind, it would not be appropriate to place

[1] Press release: New plans to make UK world leader in green energy (October 2020) https://www.gov.uk/government/news/new-plans-to-make-uk-world-leader-in-green-energy

[2] https://www.gov.uk/government/consultations/contracts-for-difference-cfd-proposed-amendments-to-the-scheme-2020

	offshore wind in Pot 1 at this stage. To support diversification of the renewable generation mix in the longer term and support continuing cost reduction, the government therefore proposes separating offshore wind into a third pot.
Classifying floating offshore wind as a separate technology	Floating offshore wind technology is currently less developed and more costly than fixed-bottom wind, although there is evidence to suggest costs could fall over time, due to learning and innovation through deployment. It offers the potential to deploy wind generation in places where the depth of the seabed mean fixed-bottom offshore wind is uneconomical or not feasible, which could offer optionality for making progress towards net zero. The government therefore proposes separately defining floating offshore wind from fixed-bottom offshore wind in the CfD scheme, together with introducing a distinct administrative strike price, and the opportunity to compete separately in future auctions for less-established (Pot 2) technologies. This could help accelerate the path from pre-commercial pilots to commercial deployment at scale, where the industry can benefit from learning and economies of scale to reduce costs, as well as supporting greater diversification of the electricity system, and the ambition to have 1GW of floating offshore wind by 2030 announced by the government on 6th October.
Excluding new coal-to-biomass conversions from future CfD allocation rounds	Power from coal-fired stations is due to end by 2025, and it is unlikely that coal-to-biomass conversions would be successful in future allocation rounds given the very limited pipeline, and because projects are not expected to be competitive even when using BEIS's most optimistic cost estimates. Two coal-to-biomass conversions were supported as a transitional technology through the Final Investment Decision Enabling for Renewables programme, ahead of implementation of the CfD scheme. Support for all coal-to-biomass conversions (including those supported through the Renewables Obligation) will end in 2027. Considering this limited timescale over which any new CfD contracts would apply, the government proposes to make new coal-to-biomass conversions ineligible for future CfD allocation rounds.
Changes to the Non-Delivery Disincentive (NDD)	The NDD excludes any projects that do not deliver from bidding into any future allocation rounds for a fixed period of time. This aims to incentivise applications only from projects likely to be delivered. Given the intention to run allocation rounds every two years rather than more frequently as originally envisaged, and following consultation, we now propose amending the terms of exclusion so as to ensure that an application cannot be made by an excluded site in the next applicable allocation round. This should better ensure the disincentive applies as intended.
Introducing flexibility to apply capacity caps, maxima and minima as a 'soft' auction constraint	The use of a 'hard' capacity constraint (whereby the bid that breaches the cap is unsuccessful) makes it difficult to manage the amount of capacity that is successful in the auction. This is due to the risk of a large project breaching the cap by a small amount and the auction closing well below the cap level. A 'soft' constraint would allow the project that breaches the cap to be successful (subject to the specific design of the auction rules), making it more likely the capacity secured will be closer to the ambition for that round. This flexibility could also apply to the maxima and minima rules.

Extending the negative pricing rule	Under the current negative pricing rule, CfD generators do not receive difference payments when the day-ahead hourly price is negative for six consecutive hours or more. This encourages generators to keep generating during these periods even if prices are negative in the day-ahead market, and facilitates negative bidding into the balancing mechanism, potentially increasing costs for consumers. We therefore propose to remove the six consecutive hours element of the negative pricing rule so that difference payments are not made to generators whenever the Intermittent Market Reference Price is negative for any period of time.
Extending the Milestone Delivery Date (MDD)	The Milestone Delivery Date (MDD) is a means of ensuring projects are making progress towards delivering their projects by demonstrating a certain amount of investment by a particular date. It is intended to be a significant but feasible requirement, to ensure that progress can be made with successful projects and the risk of non-delivery minimised. We understand from stakeholder feedback that the current 12 month period to MDD is not optimal given wider project timelines. The government therefore proposes to extend the MDD to 18 months after contract signature.

Section 5: Analytical approach

5.1 Overview of approach

In order to assess the impact of the overall package of proposals, a scenario-based cost-benefit analysis has been undertaken. This has been possible for changes affecting which technologies are eligible and which “pot” they are included in, however for the other proposals qualitative assessments have been undertaken in Section 9. The cost-benefit analysis has been undertaken using a scenario-based approach rather than projecting a central outcome. This is due to inherent uncertainties associated with forecasting the outcomes of CfD allocation rounds.

5.2 Evidence base updates

Since publication of the consultation stage IA, a number of updates to the evidence base have been made:

- BEIS has updated its modelling of the electricity market to reflect the UK’s net-zero emissions target. This has resulted in lower average wholesale market and technology-specific capture price projections than those assumed in the consultation stage IA, due (in part) to higher levels of low marginal cost, low carbon deployment required to meet the target.
- BEIS has updated some of the generation cost assumptions underpinning levelised cost of electricity (LCOE) estimates.

These data sources have been used to update the illustrative scenarios and assess the impacts, costs and benefits of the policy intervention. In particular, the lower average wholesale market and technology-specific capture price projections has resulted in higher bid price assumptions for most technologies, to reflect lower estimated revenues post-CfD contract.

5.3 Scenario descriptions

The scenarios used in this cost-benefit analysis are based on illustrative supply curves of eligible technologies, and show the potential impact on allocation round outcomes if the proposed policy changes are made, compared to a counterfactual where no changes are made to the CfD scheme. This is illustrated primarily through comparing alternative mixes of technologies assumed to be successful in an auction as a result of the policy changes, and at particular illustrative bid prices. For comparability and simplicity, the total annual generation from projects winning a CfD is assumed to be constant across the core options and scenarios. This means that we do not assume that any CfD support cost savings associated with a cheaper technology taking part are reallocated towards procuring increased generation capacity, as would happen in a future allocation round, but capture this impact in terms of cost savings (which are therefore illustrative only). Further detail on how these scenarios are constructed and the key assumptions are set out in Annex A.

Two scenarios (Scenario A and Scenario B) have been constructed to illustrate the potential scale of impact the proposals could have, from zero impact in many cases to impacts that would likely only occur if significant cost reductions are achieved by winning projects. These scenarios use the same assumptions about how much capacity of each technology bids, and these in turn have been informed by previous CfD auction outcomes.[3] The scenarios vary based on the degree to which different technologies can effectively compete within each pot (i.e. the range of bid prices assumed per technology), which in turn determines the successful capacity mix and associated costs and benefits. This approach allows a range of possible impacts from the policy proposal to be evaluated, as set out in Section 5.3.

The scenarios are:

- **Scenario A:** This reflects bid price assumptions in line with the government's current view on generation costs for typical projects within each technology group. In this scenario there is no change in the successful capacity mix between Option 0 (do nothing) and Option 1 (policy proposal) as floating offshore wind is not assumed to bid competitively with other Pot 2 technologies, coal-to-biomass conversions are assumed to not be competitive under Option 0 so there is no impact from removing them (see Section 8 for more detail), and moving offshore wind to a separate pot is assumed not to change bidding behaviour.
- **Scenario B:** In this scenario it is assumed that under Option 1 floating offshore wind is able to bid at a lower price that is competitive with other Pot 2 technologies. This results in a change in the successful capacity mix in Pot 2, whereby floating offshore wind replaces some of the more expensive remote island wind (RIW) and advanced conversion technologies (ACT). Again, coal-to-biomass conversions are assumed not to be competitive in Option 0 so there is no impact from removing them (see Section 8 for more detail).

Table 2 gives detail on the illustrative capacity mix and bid prices under each policy option and scenario.

Table 2: Illustrative successful capacity mix (MW) and bid prices (£/MWh) for scenarios[4]

Pot	Technology	Illustrative bid price (£/MWh, 2012 prices)	Scenario A (MW)		Scenario B (MW)	
			Option 0	Option 1	Option 0	Option 1
1	Onshore Wind	41	700	700	700	700
	Solar PV	43	300	300	300	300
2	Offshore wind	50	5,500	NA	5,500	NA

[3] For floating offshore wind it is assumed 100MW bids into the scheme, in line with pre-commercial project sizes assumed in the 2018 Crown Estate Scotland-commissioned study by ORE Catapult, available here: https://www.crownestatescotland.com/maps-and-publications/download/219

[4] These figures are illustrative to demonstrate potential impacts of policy changes being considered in this consultation, informed by the government's current view on generation costs and previous CfD auction outcomes. They are not forecasts of future outcomes nor are they an indication of future allocation round parameters.

	Advanced Conversion Technologies (ACT)	100	50	50	50	*50 Unsuccessful*
	Remote Island Wind: Low cost	59	NA	NA	220[5]	220
	Remote Island Wind: High cost	61	300	300	80	*80 Unsuccessful*
	Floating offshore wind: Low cost	60	NA	NA	NA	100
	Floating offshore wind: High cost	138	*100 Unsuccessful*	*100 Unsuccessful*	NA	NA
3	Offshore wind	50	NA	5,500	NA	5,500

5.4 Cost-benefit analysis approach

The cost-benefit analysis quantifies the difference between impacts under the policy package and the ‘do nothing’ option based on the following components:

- **Generation costs**: These costs encompass pre-development expenditure, capital costs, operating costs, financing, insurance costs, and generation at the relevant generating stations over the 25-year appraisal period and are discounted using the HM Treasury ‘Green Book’ social discount rate of 3.5%. These are similar but not the same as strike prices, which are the CfD price paid per MWh over the 15-year contract life.[6] A generation cost per MWh under each scenario has been estimated to be consistent with the strike prices assumed. These are calculated based on BEIS’s latest view on electricity generation costs for low-carbon technologies.
- **Greenhouse gas impacts**: These are estimated by applying an assumed greenhouse gas intensity per MWh of generation for fuelled technologies (which generate greenhouse gas emissions in producing and transporting the fuels burned in generating electricity), in line with the greenhouse gas emissions threshold set for solid and gas biomass projects bidding into the CfD.[7] The resulting emissions are valued using traded carbon values in line with the supplementary Green Book guidance on valuing greenhouse gas emissions.[8]

Whilst not forming part of the cost-benefit analysis, the following are also considered:

- **Support cost impacts**: These are calculated as the difference between the market prices assumed to be captured by the different technologies[9] and the strike price assumed to be given to winning projects. This does not form part of the cost-benefit analysis as it represents a transfer between consumers and generators, but the illustrative magnitude of support costs has been estimated to demonstrate the potential differences in costs and impact on consumers bills.
- **Air quality impacts**: Different generating technologies give rise to different levels of particulates that can affect air quality. It has not been possible to monetise these impacts for this IA; they are therefore considered qualitatively.

All impacts have been monetised in 2012 prices for comparability to the assumed strike prices (which are themselves set in 2012 prices) and discounted in accordance with the HM Treasury Green Book.[10] Further details of the analytical approach and key assumptions are set out in Annex A.

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[5] In scenario B the capacity of RIW has been adjusted in order to keep the amount of generation constant between options and scenarios. Please see Annex A for detailed assumptions on all technologies.

[6] For more detail see page 20 in the BEIS electricity generation cost report, available here: https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016

[7] 29kgCO_{2e}/MWh, from CfD consultation response Part B, available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/736588/Part_B_Consultation_Response.pdf

[8] Available here: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[9] These have been modelled using the Department’s Dynamic Dispatch Model (DDM)

[10] Available at: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent (accessed November 2019)

Section 6: Cost-benefit analysis

6.1 Generation costs

The estimated generation costs for each scenario are set out in Table 3.

Table 3: Illustrative changes in generation costs of policy scenarios, present value 2025 to 2050, 2012 prices, £m

Technology[11]	Scenario A		Scenario B	
	0: Do nothing	1: Policy proposal	0: Do nothing	1: Policy proposal
Offshore Wind	18,180	18,180	18,180	18,180
Remote Island Wind (RIW)	1,010	1,010	990	700
Advanced Conversion Technologies (ACT)	380	380	380	0
Floating offshore wind	0	0	0	430
Onshore Wind	1,340	1,340	1,340	1,340
Solar PV	180	180	180	180
Total	**21,090**	**21,090**	**21,069**	**20,850**
Avoided generation costs against appropriate baseline	**N/A**	**0**	**N/A**	**220**

Note: rows may not sum due to rounding to the nearest £10m

Under **Scenario A** there is no change between Options 0 and Option 1, as the proposals are assumed to have no impact on which projects are successful. In this scenario floating offshore wind is not price-competitive, and moving offshore wind to its own pot does not result in any change in how much offshore wind is contracted and at what price.

Under **Scenario B** generation costs are lower for Option 1 as floating offshore wind is assumed to bid competitively and therefore displaces the more expensive Advanced Conversion Technology and Remote Island Wind capacity. This leads to lower overall generation costs.

6.2 Impact on greenhouse gas emissions

The estimated value of changes in greenhouse gas emissions from electricity generation for each scenario is set out in Table 4.

Table 4: Illustrative changes in carbon cost of policy scenarios, present value 2025 to 2050, 2012 prices, £m, rounded to the nearest £10m

PV, £m	Scenario A		Scenario B	
	0: Do nothing	1: Policy proposal	0: Do nothing	1: Policy proposal
Value of saving in greenhouse gas emissions, £m	N/A	0	N/A	20

Under **Scenario A** floating offshore wind is not competitive and therefore their inclusion has no impact on which projects are successful, and total greenhouse gas emissions are constant between options.

Under **Scenario B** floating offshore wind is competitive and displaces Advanced Conversion Technology projects which have a higher greenhouse gas emissions intensity.

6.3 Combined cost-benefit analysis of illustrative scenarios

The combined estimated impact of the scenarios considered in this IA are set out in Table 5.

[11] Only generation costs from technologies which are competitive in at least one scenario are shown in this table.

Table 5: Summary of cost-benefit analysis for the illustrative scenarios, 2025 to 2050, Net Present Value, 2012 prices, £m, rounded to the nearest £10m

PV, £m	Scenario A	Scenario B
Value of avoided generation costs	0	220
Value of greenhouse gas savings	0	20
Net Present Value (£m)	**0**	**240**

These scenarios imply an illustrative range of impacts from £0 to £240m in Net Present Value terms (2012 prices). No central estimate is made as the outcome of future CfD allocation rounds is highly uncertain. Further detail on these scenarios can be found in Annex A.

6.4 Support costs

The illustrative impact on support costs shown in Table 6 has been estimated by assuming that each technology's highest successful bid price is the strike price they receive (equivalent to assuming that the highest bid price for a particular technology is equal to its administrative strike price[12]). These results are illustrative only and should not be read as an indication of government policy on administrative strike prices for future allocation rounds.

Table 6: Illustrative change in gross support costs under policy scenarios over the lifetime of the CfD, 2012 prices, £m, rounded to nearest £10m

£m	Scenario A	Scenario B
Change in support costs over the 15-year CfD lifetime	0	-90

Under **Scenario A** there are no support cost savings as there is no change to the successful capacity mix, and projects are assumed to bid at their administrative strike prices so there is no change to the offshore wind clearing price when offshore wind is moved to a separate pot.

Under **Scenario B** there are support cost savings from allowing floating offshore wind to compete as a distinct technology, as in this scenario it is assumed to bid competitively, displacing some more expensive ACT and RIW capacity, and therefore resulting in a lower clearing price for Pot 2.

In these scenarios if offshore wind were to bid below its administrative strike price, moving this technology to a separate pot would result in further cost savings as it would no longer have its clearing price pulled up by other more expensive technologies in Pot 2.

6.5 Impact on consumer bills

The support costs estimated in Table 6 would be expected to be passed through to electricity consumers. Under **Scenario A** the estimated change in support costs is zero and therefore there would be no impact on consumer bills. Under **Scenario B** where floating offshore wind has the effect of lowering the clearing price in Pot 2, lower consumer bills would be expected, although these reductions per household would be small (less than £1 per year). These savings would be larger if offshore wind were to bid below its administrative strike price under the proposal to move this technology to a separate pot, as described in Section 6.4.

[12] For example, if the highest successful bid price for RIW is assumed to be £61/MWh, then it is assumed that the RIW administrative strike price is also set at £61/MWh. Similarly, if offshore wind is assumed to bid at £50/MWh then it is assumed that the offshore wind administrative strike price is also set at £50/MWh.

6.6 Impact on Air Quality

These scenarios are likely to result in zero impact or an improvement in air quality, as classifying floating offshore wind as a separate technology has the potential to result in fuelled technologies being displaced. Scenario A should not have any impact on air quality. Scenario B is likely to result in air quality improvements due to displacing some ACT capacity, as less combustible fuel would be burned to generate electricity. It has not been possible to monetise these impacts.

6.7 Impact on jobs

The low carbon and renewable energy economy supports around 40,000 full-time equivalent jobs in the renewable electricity sector in the UK, including in wind, solar photovoltaic and hydropower.[13] The CfD scheme is likely to support many direct and in-direct jobs through projects which may not have proceeded without a CfD. It is possible the proposed changes to the scheme would lead to increases in employment in some sectors, displacing the jobs from the unsuccessful projects that otherwise would have been supported. However, the extent to which the proposed changes affect jobs is dependent on the design and results of future allocation rounds, and so any impact would be uncertain.

6.8 Wider impacts

The proposed changes could have wider system impacts, although these entirely depend on which projects are competitive in future rounds. Where renewable generators are successful in future allocation rounds, they could have implications for total system costs:

- by displacing more expensive generation at the margin in the wholesale market;
- affecting reliability at peak and the need to procure capacity in the capacity market;
- by having characteristics that either increase or decrease the need for system balancing and ancillary services;
- by being located close or far from demand centres and therefore either increasing or decreasing network costs.

Section 7: Impacts of individual proposals

7.1 Approach

In addition to testing the combined impact of the key policy proposals (moving offshore wind to a separate pot, and classifying floating offshore wind as a separate technology), the impacts of these proposals in isolation have been analysed using the same illustrative scenarios described in Section 6.

7.2 Moving offshore wind into a separate pot

In isolation of any other policy changes, moving offshore wind out of Pot 2 into a separate pot is assumed to have no impact on the projects successful in scenarios A and B, as this change is not assumed to impact on bidding behaviour or projects coming forward. Therefore, the same capacity is successful across the pots, at the same prices.

Moving offshore wind to a separate pot could reduce uncertainties for bidders and competition between technologies, potentially resulting in higher clearing prices than otherwise may have

[13] Office for National Statistics (2020). *All data related to Low carbon and renewable energy economy, UK: 2018*. Available at: https://www.ons.gov.uk/economy/environmentalaccounts/adhocs/11120lowcarbonandrenewableenergyeconomylcreesurveydirectandindirectestimatesofemploymentuk2014to2018. Figures include direct and indirect employment.

occurred. This could increase support costs, as well as meaning that Administrative Strike Prices may play a larger role in ensuring value for money. However, moving offshore wind to its own pot reduces the likelihood that clearing prices could be pulled up by more expensive technologies, enabling more efficient allocation of subsidy and reducing consumer costs.

7.3 Classifying Floating Offshore Wind as a separate technology

Table 7 shows the range of illustrative impacts from classifying floating offshore wind as a separate technology, in isolation of other proposed policy changes.

Table 7: Summary of cost-benefit analysis for classifying floating offshore wind as a separate technology, Net Present Value, 2025 to 2050, 2012 prices, £m, rounded to nearest £10m

PV, £m	Scenario A	Scenario B
Value of avoided generation costs	0	220
Value of greenhouse gas savings	0	20
Net Present Value (£m)	**0**	**240**

In **Scenario A** there is no impact on generation and carbon costs, as in this scenario floating offshore wind is not assumed to be bid competitively and therefore there is no change to the successful capacity mix and associated costs.

In **Scenario B** there are generation cost savings under Option 1 as floating offshore wind is assumed to bid competitively and therefore displaces the more expensive Advanced Conversion Technology and Remote Island Wind capacity. This leads to lower overall generation costs. There are also greenhouse gas savings as floating offshore wind displaces Advanced Conversion Technology projects which have a higher greenhouse gas emissions intensity.

Section 8: Excluding coal-to-biomass conversions from future allocation rounds

8.1 Approach

It is unlikely that coal-to-biomass conversions would be successful in future allocation rounds given the very limited pipeline, and because projects are not expected to be competitive even when using BEIS's most optimistic cost estimates. Further, support under the CfD scheme for conversions is due to end in 2027 meaning contracts would be much shorter than the standard 15 year term.

To assess the possible impact its exclusion would have on the scheme if it were able to bid competitively, we have assumed an illustrative low bid price of £45/MWh[14] for coal-to-biomass conversions and assumed 500MW[15] of capacity bid into the scheme. Note that this bid price assumption falls below our current view on generation costs for this technology and so results should be viewed as illustrative of an extreme bidding scenario. The eligibility of coal-to-biomass conversions is assumed to only impact on outcomes for Pot 1 (i.e. any reduction in generation as a result of excluding coal-to-biomass conversions from future allocation rounds is assumed to be replaced through other Pot 1 technologies). The two options tested are therefore:

[14] £45/MWh was the illustrative bid price used at consultation stage and reflects a price in between the cheapest and most expensive onshore wind and solar PV projects within assumed generation cost ranges, and is therefore competitive within Pot 1.
[15] A capacity of 500MW reflects the likely size of one biomass conversion plant.

- **Option 0:** 500MW of coal-to-biomass conversions is successful in pot 1, displacing the more expensive solar PV and onshore wind.
- **Option 1:** Coal-to-biomass conversions are no longer eligible to apply and therefore more onshore wind and solar PV are successful.

The total successful generation is higher in this sensitivity scenario than in the main scenarios in Section 6 due to the high load factor for coal-to-biomass conversions relative to onshore wind and solar PV (although the total annual generation from projects winning a CfD is assumed to be constant across the options for comparability). Furthermore, the lifetime of coal-to-biomass conversions is assumed to be 15 years, and so to compare Option 0 and Option 1 on a consistent and fair basis, the appraisal period for this sensitivity has been reduced to 15 years (rather than 25 years in the core scenarios). As a result, these cost-benefit analysis figures are not directly comparable with the core scenarios.

Table 8 details the bid price and capacity assumptions used in this sensitivity scenario.

Table 8: Illustrative successful bid prices and capacity mix for sensitivity scenario excluding biomass conversions

Pot	Technology	Illustrative bid price (£/MWh, 2012 prices)	Capacity (MW)	
			Option 0	Option 1
1	Onshore wind: Low cost	41	350	350
	Onshore Wind: High cost	52	*1100 Unsuccessful*	1100
	Solar PV: Low cost	43	150	150
	Solar PV: High cost	56	*400 Unsuccessful*	400
	Biomass conversions	45	500	N/A

Table 9 shows the combined estimated impact in net present value terms of this scenario.

Table 9: Summary of cost-benefit analysis for excluding biomass conversions for future rounds, Net Present Value, 2025 to 2040, 2012 prices rounded to nearest £10m

PV, £m	Sensitivity scenario
Value of avoided generation costs	-70
Value of carbon savings	100
Net Present Value (£m)	**20**

Note: rows may not sum due to rounding to the nearest £10m

Under Option 1 when coal-to-biomass conversions are excluded from bidding into the round, the generation is assumed to be met by more expensive (in bid-price terms) onshore wind and solar PV projects. This results in additional generation costs of £70m. The exclusion is also associated with a £100m benefit in avoided greenhouse gas emissions. Overall, this results in a positive impact of £20m in net present value terms (after rounding to the nearest £10m), although the circumstances which this situation would arise (i.e. coal-to-biomass conversions bidding more cheaply than onshore wind and/or solar PV) are deemed unlikely.

Section 9: Qualitative assessment of other proposals

9.1 Changes to the non-delivery disincentive (NDD)

The consultation sought views on strengthening non-delivery disincentives within the CFD scheme by extending the period that non-compliant projects would be excluded from allocation future rounds, as well as considering alternative incentives such as the use of a **bid bond**. In view of the consultation responses, government intends to maintain the current NDD for allocation round 4, but will alter the terms of the exclusion period to ensure excluded sites cannot apply in the next applicable round. Government does not intend to introduce use of bid bonds at this stage.

Ensuring excluded sites cannot apply in the next applicable allocation round could strengthen the following potential impacts of the exclusion period:

- **Reduced likelihood of speculative bidding:** Developers should be deterred from bidding at prices that are unrealistically low in order to secure a contract that then turns out to be economically unviable, due to the exclusion they would face from the next allocation round for non-delivery.
- **Improved utilisation of the scheme:** Projects that might not be able to deliver in the current round are more likely to be deterred from competing. This reduces the risk that undeliverable sites will win a contract and increases the likelihood of successful projects delivering their stated generation.
- **Greater clarity for the supply chain:** Projects would have a greater incentive to meet their Milestone Requirement and therefore make firm financial commitments with suppliers.

9.2 Introducing flexibility to apply capacity caps, maxima and minima as a 'soft' auction constraint

Government intends to proceed with the proposal to introduce flexibility to apply any capacity cap as a soft and/or a hard constraint for future allocation rounds. The key benefit of having the flexibility to use a 'soft' capacity cap is **reduced uncertainty in capacity secured**. Under a 'hard' capacity cap (where the project breaching the cap is unsuccessful) the round could result in awarding less capacity than intended as large-sized projects could breach the cap. Using a soft capacity cap would increase the likelihood of securing capacity in line with government ambitions.

Other potential impacts could include:

- **Setting lower capacity caps:** The use of a soft constraint would likely allow us to set a lower capacity cap than if a hard constraint was used. This is not intended to bring on lower levels of capacity but would impact how parameters are set for allocation rounds.
- **Risk of inflating clearing price and capacity:** It is possible that under a 'soft' constraint the project breaching the cap (but is successful under this approach) could result in the cap level being exceeded by some margin, setting a higher clearing price as a result. However, this would not necessarily be higher than under the current 'hard' constraint approach as this would be considered when setting the level of the cap. It is also heavily dependent on how the constraint is designed to operate. For example, accepting the bid that breaches the cap only if it increases total capacity awarded by less than a specified threshold and within the monetary budget would mitigate this risk.

The impact of a soft constraint will depend heavily on whether the flexibility to use a soft constraint is used, the specific design, and the auction parameters set for the allocation round. We consider that these issues can be addressed though the design of the constraint rules and represent a relatively low risk.

9.3 Extending the negative pricing rule

Extending the negative pricing rule so that difference payments are not paid to CfD generators when the Intermittent Market Reference Price is negative has several possible impacts:

- **Reduced electricity system balancing costs:** All relevant generators, including those holding CfDs, submit bids into the balancing mechanism which require payment to or from the system operator to turn down. CfD generators are more likely to bid negatively (i.e. be paid by the system operator), because the opportunity to earn a strike price for each unit of generation means that CfD generators will want to be compensated for any potential CfD top-up payment forgone to turn off. Therefore, when these generators are required to turn off for balancing it represents a more costly option for the system operator, and ultimately the electricity consumer. These balancing costs are expected to reduce as a result of the rule change.
- **Increased incentives to shift generation to higher wholesale price periods:** Generators will have sharper incentives to be more responsive in looking to shift their generation from negative price periods to higher wholesale price periods, for example through use of co-located storage. Storage technology does not currently allow for significant time shifting however, so the impact of this has not been estimated.
- **Change in scheme cost**: If generators increase strike price bids to compensate for lower revenues caused by this rule change, then this will increase payments relative to the counterfactual. In contrast, stopping CfD payments during these periods will put downward pressure on the cost of the scheme. The balance between these two effects is uncertain and has not been estimated.
- **Increase in project financing costs:** The negative pricing rule reduces certainty over revenue during these periods. This is likely to increase the level of risk in future projects which may translate as higher financing costs.

The extent to which these impacts materialise will depend on the frequency of negative periods in the day-ahead market during the lifetime of the deploying projects. BEIS has sought to understand the potential frequency through internal modelling using the department's Dynamic Dispatch Model (DDM). The results of modelling are outlined in **Error! Reference source not found.**Table 1 and compared to research by Baringa Partners (commissioned by BEIS)[16] carried out to support the previous introduction of the 6+ hour negative pricing rule.

Baringa modelled two scenarios; a 'market scenario', based on Baringa's central market scenario, and a 'policy scenario', based on DECC's 2014 policy aspirations. Baringa's key findings were that day-ahead negative prices are rare under both their modelled scenarios. The results did show sensitivity to input assumptions, including the amount of subsidised low carbon capacity, bidding behaviour of low carbon generators, and levels of interconnection and electricity storage.

At consultation stage we updated this analysis to cover the period 2025-2040 as well as including two scenarios, the first based on 30GW of offshore wind in 2030 (the upper end of deployment described in the Offshore Wind Sector Deal)[17] and the second based on an increased ambition scenario of 40GW of offshore wind in 2030 to illustrate the effect this could have on the frequency of negative pricing events (**Error! Reference source not found.**). We have now further modelled scenarios consistent with meeting the UK's net-zero emissions target, under both lower and higher electricity demand assumptions. Our updated analysis shows an increase in the expected frequency of day-ahead negative pricing events compared to the Baringa analysis, and consultation stage scenarios. This may reduce revenues for CfD generators. However, this analysis is likely to overstate the frequency of future negative pricing events as current BEIS modelling does not account for the impact of negative pricing rules on bidding behaviour, which would reduce negative bidding and therefore incidence of negative prices. Whilst the occurrence of negative pricing events in future is still expected to be rare, they are likely to increase, making it more important that CfD generators are encouraged to respond

[16] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/441809/Baringa_DECC_CfD_Negative_Pricing_Report.pdf
[17] https://www.gov.uk/government/publications/offshore-wind-sector-deal

to market signals. This could help incentivise alternative uses for surplus power, for example electricity storage solutions.

Table 10: Summary of analysis on frequency of periods of GB day-ahead hourly negative prices

Scenario	Description	Average annual number of negative day-ahead hours	Average annual number of day-ahead 6+ negative hour periods[18]
Baringa 2015: Market	Baringa's central view of the energy system (2020 – 2035)	2 (~0%)	0
Baringa 2015: Policy	DECC's published policy position (2014) (2020 – 2035)	48 (~0.5%)	4
BEIS 2019: Central, 30GW of offshore wind in 2030	BEIS central position at consultation stage, assuming 30GW of offshore wind in 2030 (2025 – 2040)	86 (~1.0%)	2
BEIS 2019: Central, 40GW of offshore wind in 2030	BEIS central position at consultation stage, assuming 40GW of offshore wind in 2030 (2025 – 2040)	399 (~4.5%)	13
BEIS 2020: Net Zero, lower demand	BEIS current net-zero consistent scenario (including 40GW of offshore wind in 2030), assuming lower electricity demand (2025 – 2040)	360 (~4.1%)	19
BEIS 2020: Net Zero, higher demand	BEIS current net-zero consistent scenario (including 40GW of offshore wind in 2030), assuming higher electricity demand (2025 – 2040)	518 (~5.9%)	28

In addition to analysis on frequency of negative price periods, we have also modelled the potential impact on revenues and strike prices of the proposed rule, based on an illustrative 1GW offshore wind project commissioning in 2025 as an example. This showed that moving from the current 6+ hour rule to the proposed rule could reduce annual revenues by up to 2%, and this revenue reduction could increase strike prices by around £1/MWh. Higher financing costs to reflect the increase in revenue uncertainty could push strike prices up further. However, impacts are uncertain and will depend on bidding strategies in the day-ahead market, as well as how developers factor in future wholesale price projections in their strike price bids. These are commercial decisions that will be made by developers considering the wider economic environment and their individual business models. Due to these uncertainties, this assessment has not included specific bill impacts. In terms of consumer costs, any potential increase in strike prices is likely to be offset at least partially by the reduced frequency of CfD payments.

9.4 Extending the Milestone Delivery Date (MDD)

Government intends to proceed with the proposal to extend the MDD within the CfD scheme, but plans to extend to 18 months rather than 15 months proposed at consultation stage. This has several potential benefits:

- **Reduced risk of non-delivery by developers:** Allowing a longer time could increase the likelihood of projects meeting their project milestones.
- **Benefits to supply chains and procurement activities:** Allowing more time through a later MDD could lead to improvements in procurement practice. This could be through longer periods to negotiate and choose between suppliers and establish new supply chain relationships.
- **Reduction in project costs:** More time could see better value deals in the supply chain, economies of scale, and give more time to negotiate lower cost / more efficient deals with

[18] Due to modelling limitations, it is possible the average annual number of day-ahead 6+ negative hour periods is underestimated in this analysis. We will explore whether this can be developed further for the Final Stage Impact Assessment.

suppliers. This could feed through into lower bid prices and better value for money for consumers.

Other potential impacts could include:

- **Loss of early information on project non-delivery:** A later MDD would increase the amount of time before a project has officially not delivered. This would mean losing early information about any projects that do not meet the Milestone Requirement, which can helpfully inform considerations for future allocation rounds.
- **Sub-optimal use of the CfD scheme:** A longer time to meet the MDD increases the risk that developers prefer to deploy on a merchant basis. Whilst the CfD should not disincentivise merchant delivery, any project which chooses to do this after securing a CfD would be displacing a project that would not be able to deliver without a CfD.

Section 10: Limitations, Risks and Uncertainties

The key areas of uncertainty identified are:

- **Competitiveness of technologies:** CfDs are awarded competitively, and therefore projects will only secure a CfD if they can compete with other technologies on a cost per MWh basis. A range of scenarios have been tested to demonstrate the illustrative impact, however the extent to which one scenario is more likely to occur over another is highly uncertain.
- **Behaviour change**: In this impact assessment we have assumed there is no change to bidding behaviour between options and scenarios. However, it is possible that changes to pot structure and technologies eligible to compete could affect competitive tension in the different pots and therefore how projects structure their bids.
- **Future deployment:** the impact of the proposed policy package will depend on the scale and mix of technologies that bid and are successful in securing a CfD. This IA has used scenarios to illustrate the potential impact, however there are a wide range of other future outcomes that may result in different impacts to those described here.
- **The overall impact on the electricity system**: Whilst the analysis has considered the generation costs quantitatively, the whole system impact on the electricity system such as network, transmission and balancing costs have only been considered qualitatively. Due to the relatively small-scale additional impact of these changes this is likely to be relatively low risk.

Section 11: Summary

The government's final position is to implement the proposals including moving offshore wind from Pot 2 to a separate third pot, classifying floating offshore wind as a separate technology, excluding new coal-to-biomass conversions from future allocation rounds, and changes to improve auction design, responsiveness to market signals, and scheme operation. The costs of these proposals depend entirely on the outcomes of future allocation rounds across the scheme, and no attempt has been made to predict these. However, the illustrative scenarios used to demonstrate some potential impacts show net benefits in relation to:

- reductions in generation costs (if floating offshore wind is able to bid competitively as a distinct technology, displacing other more expensive technologies); and
- reductions in greenhouse gas emissions (if floating offshore wind is able to bid competitively and displace other technologies with higher carbon intensities).

Although moving offshore wind to a separate pot is not estimated to impact on the overall NPV (assuming no changes in bidding behaviour) it is possible this could reduce support costs of scheme.

Annex A: Modelled Scenarios and Key Assumptions

Scenarios modelled

The analysis is based on illustrative scenarios informed by results from previous allocation rounds and BEIS's latest view on electricity generation costs. Figure 1 and Figure 2 illustrate an example of how the supply curves and auction outcomes have been determined in these scenarios.

Figure 1: Example supply curve, Scenario B, Pot 2, Option 0: Do nothing

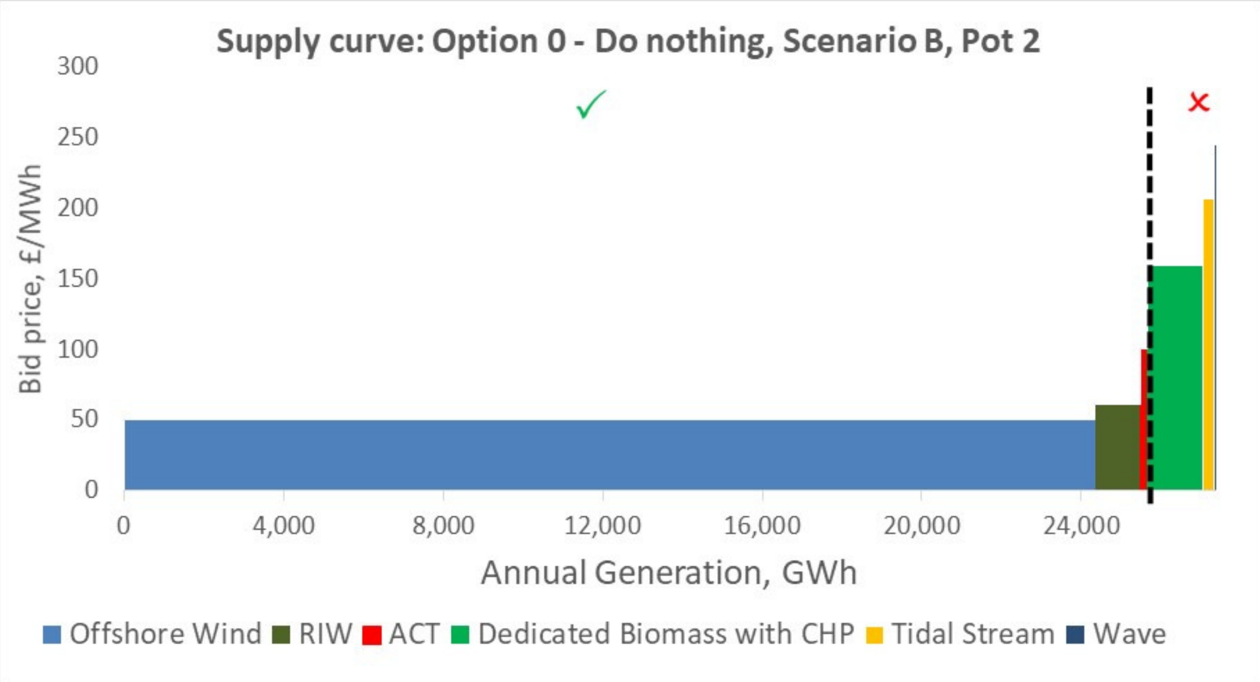

Figure 1 illustrates Scenario B, Pot 2, under Option 0: do nothing. In this scenario offshore wind, RIW and ACT projects are successful. Floating offshore wind is not classified as a separate technology and so does not appear in the bidding pipeline. All other Pot 2 technologies are assumed to be uncompetitive.

Figure 2: Example supply curve, Scenario B, Pot 2, Option 1: Policy Proposal

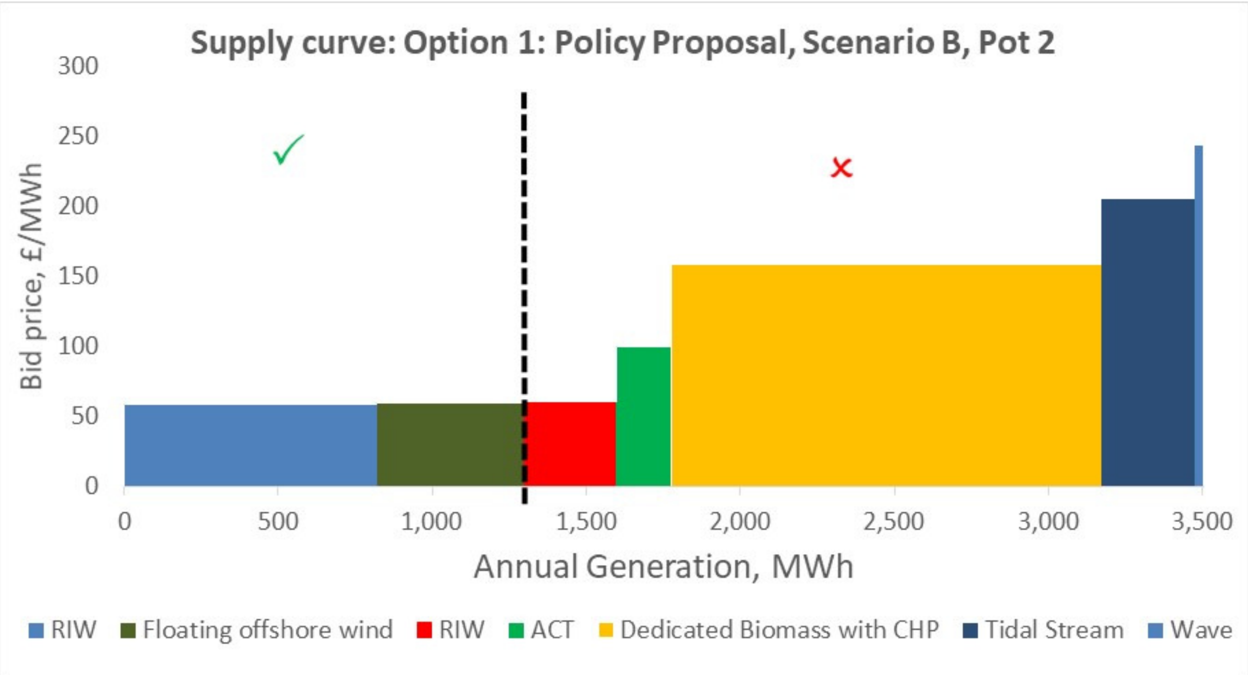

Figure 2 illustrates Scenario B, pot 2, under Option 1: policy proposal. In this scenario, offshore wind has been moved to a separate, third pot. Floating offshore wind is now eligible to compete as a distinct, separate technology and to illustrate the potential impact this could have on auction outcomes is assumed to bid competitively with other Pot 2 technologies, displacing ACT and some of the more expensive RIW capacity. All other Pot 2 technologies are assumed to be competitive.

Bid prices

Table 11 sets out the bid prices assumed for each technology. For the purposes of modelling, we have assumed one bid price (or in some scenarios, two) for each technology, however in reality there are likely to be a range of bid prices for projects within each technology. Bid price assumptions have been informed by BEIS's latest view on electricity generation costs, from the 2020 Electricity Generation Costs report.[19] This includes assumptions on pre-development costs, construction costs, operating and maintenance costs, connection and use of system charges, load factors and efficiencies, and project timings, to estimate levelised costs of electricity (LCOEs) for different technologies over time. Where available, clearing prices from previous allocation rounds have been incorporated into assumed cost ranges.

These LCOEs have been converted into an equivalent strike price for the purpose of this analysis. Bid prices have been calculated based on costs representing the 25% lowest cost capacity of each technology[20], in line with the proportion of pipeline capacity targeted when setting Administrative Strike Prices for allocation round 3.[21] This is for illustrative bid price assumption purposes only and should not be viewed as an indication of how auction parameters will be set in future allocation rounds.

For technologies not currently modelled in BEIS's generation costs, the following approaches have been taken:

- **Remote Island Wind (RIW):** Baringa's Scottish Islands Renewable Project Final Report[22] has been used as the primary data source for this technology. These assumptions have been updated in line with cost reductions estimated for onshore wind since 2013, from BEIS's latest generation cost assumptions.
- **Floating offshore wind:** Cost estimates have been informed by the 2018 Crown Estate Scotland-commissioned study by the Offshore Renewable Energy Catapult 'Macroeconomic Benefits of Floating Wind'.[23] LCOE assumptions for pre-commercial projects have been used as the central cost assumption, and the low cost assumption has been calculated by applying the percentage difference between central and low costs for offshore wind. The bid price is then set to be the 25[th] percentile of the cost range in line with other technology assumptions.

Table 11: Bid price assumptions and levelised cost (LCOE) equivalents assumed across scenarios, 2012 prices

Technology	Base price assumptions		Scenario variations		
	Bid price (£/MWh)	LCOE equivalent (£/MWh)	Approach	Bid price (£/MWh)	LCOE equivalent (£/MWh)

[19] BEIS Electricity Generation Costs 2020, available here: https://www.gov.uk/government/publications/beis-electricity-generation-costs-2020
[20] For ACT, the three variants of Standard, Advanced and with CHP have been combined to give a single supply curve based on an assumed breakdown of pipeline capacity informed by a sample of planning consents. A proportion of the cheapest ACT Standard capacity is excluded as it is assumed not to meet the ACT eligibility criteria introduced in AR3, again informed by a sample of planning consents.
[21] AR 3 Admin strike price methodology, available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765690/Admin_Strike_Prices_Methodology_AR3.pdf
[22] Scottish Islands Renewable Project, available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/199038/Scottish_Islands_Renewable_Project_Baringa_TNEI_FINAL_Report_Publication_version_14May2013___2_.pdf
[23] Macroeconomic benefits of floating offshore wind in the UK , available here: https://www.crownestatescotland.com/maps-and-publications/download/219

Onshore wind	41	38	In the biomass conversions sensitivity scenario it is assumed additional onshore wind capacity bids in at a higher price reflecting the upper end of the generations costs range, to illustrate impacts if it were displaced by cheaper biomass conversions.	52	46
Solar PV	43	38	In the biomass conversions sensitivity scenario it is assumed additional solar PV capacity bids in at a higher price reflecting the upper end of the generations costs range, to illustrate impacts if it were displaced by cheaper biomass conversions.	56	46
Biomass conversions	84	84	In the biomass conversions sensitivity scenario, a low bid price is assumed to make this technology competitive with onshore wind and solar PV. This is set to be between the cheapest and most expensive onshore wind and solar wind capacity assumed.	45	45
Offshore wind	50	44	NA	NA	NA
ACT	100	62	NA	NA	NA
Floating offshore wind	138	112	In Scenario B a low bid price is assumed to make this technology competitive with ACT and RIW. This is set to be marginally below the RIW assumed bid price.	60	53
RIW	61	53	In Scenario B it is assumed only the more expensive portion of RIW capacity is displaced by 'low cost' floating offshore wind. This is achieved by setting the bid price of the more expensive RIW to the base bid price assumption (£61/MWh), and setting the lower cost RIW to be marginally below this whilst ensuring floating offshore wind is still more expensive (resulting in a £2/MWh reduction in the RIW bid price for a portion of the capacity). This minimises the impact on the cost-benefit analysis from having different RIW price assumptions between options.	59	51