Title: Consultation on classifying remote island wind as a separate technology in the Contracts for Difference (CfD) scheme
IA No: BEIS028(C)-17-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: 11/12/2017

Stage: Consultation

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 Value	**Business Net Present Value**	**Net cost to business per year** (EANDCB in 2014 prices)	**One-In, Three-Out**	**Business Impact Target Status**
£0-800m	N/A	N/A	Not in scope	Non qualifying provision

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

Electricity generation accounts for over 20% of UK greenhouse gas emissions and without government intervention market incentives are not sufficient to meet the UK's climate change commitments. The Contracts for Difference (CfD) scheme is the government's primary means of supporting low carbon power generation, providing various levels of support to technology groups depending on their level of maturity. Group 2 comprises less established technologies. Wind projects on remote islands have characteristics that make them more suited to competing with less established technologies in Group 2, rather than mature technologies. Government intervention is necessary to classify remote island wind as a Group 2 technology.

What are the policy objectives and the intended effects?

The Government's objective is to increase diversification of the UK electricity supply and increase competitive tension within Group 2 of the CfD scheme, bringing down the costs of electricity decarbonisation and improving security of supply. Inclusion of Remote Island Wind (RIW) could increase competitive tension, one of the key means by which the scheme ensures that projects are delivered at least cost. Where RIW projects cannot compete on price with other technologies in Group 2, they will not be awarded a CfD.

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

The following options have been considered in this IA:
(i) **Do nothing**: wind projects on the remote islands of Great Britain would not be defined as a distinct technology class and would not therefore be eligible to take part in future Group 2 CfD allocation rounds, being able to compete in Group 1 only where they would be unlikely to be competitive against established technologies;
(ii) **Classify remote island wind as a distinct technology class**: under this option a separate administrative strike price would be set for RIW, and it would be eligible to compete in future CfD allocation rounds for less established technologies (Group 2).
Option (ii) is the preferred option as it achieves the government's objectives and has the potential to generate net benefits to the electricity system.

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		
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:** -5.6	**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: Richard Harrington Date: 11/12/17

Summary: Analysis & Evidence

Policy Option 1

Description:

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2022	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: 0	**High:** 800	**Best Estimate:** N/A

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

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

The costs of the proposal depend heavily on the extent to which RIW projects are competitive in future Group 2 CfD allocation rounds. Where no RIW projects are competitive, the gross costs would be zero. Where RIW are successful in securing a CfD, costs have been illustratively estimated for the cost of generation (up to PV £1,500m). However RIW would displace other more expensive renewables and therefore on a net basis would represent a generation cost saving captured in the benefits below.

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

None identified.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	-		-	**0**
High	-		-	**800**
Best Estimate	-		-	**N/A**

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

The benefits of the proposal will also depend on the extent to which RIW projects are successful in future CfD allocation rounds. Where no RIW projects are successful, the benefits would be zero. Where RIW projects are successful, illustrative benefits have been estimated for reduced generation costs (up to PV £500m, assuming generation is held fixed), and carbon savings (up to PV £300m).

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

Where RIW projects are successful in securing a CfD in future, further benefits would be anticipated in terms of diversification leading to improved security of electricity supply, innovation among other less established technologies (particularly resulting from the infrastructure that would accompany RIW), improvements in efficiency of the local electricity grid arising from better connections to the mainland, and potentially air quality improvements from avoiding use of combustible fuels for generation.

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

1) The extent to which RIW projects are able to compete against other Group 2 technologies, therefore generating an impact, is highly uncertain. As a result, a range of scenarios have been tested.
2) The capacity and deployment mix of future projects is illustratively based on one commissioning year from CfD allocation round 2.
3) The costs estimated do not include wider electricity system impacts, such as balancing costs.

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

Section 1: Problem under consideration

1. There is potential for electricity generation from wind farms on the remote islands of Great Britain, particularly in Scotland, to contribute to the longer term energy mix in the UK and to help the government to meet its renewable energy and decarbonisation objectives.

2. Some remote islands are completely electrically isolated (with no connection at all to the mainland). Others do have distribution network connections, but these have very limited capacity. This means that any new renewable generation projects have limited ability to sell the power they produce - and have little ability to export any electricity they produce which is surplus to the islands' immediate needs. The construction of new, larger, transmission connections from the GB grid to, in particular, Orkney, Shetland and the Western Isles, are dependent on sufficient new generating capacity being installed on the islands to effectively underwrite the cost of investment.

3. Wind projects on remote islands have characteristics - including unavoidable higher transmission costs to connect the islands to the main electricity grid, which are only partly offset by high load factors - that means that they have higher costs that set them apart from onshore wind projects elsewhere in the UK. Under the current (CfD) scheme design, remote island wind (RIW) is not differentiated from onshore wind, which itself is classed as an established technology. This means that under the scheme at present – which recognises two distinct technology groups, the higher costs faced by RIW projects mean that they find it difficult to compete with other projects in the established technology group (Group 1).

Section 2: Rationale for intervention

4. Electricity generation accounts for over 20% of UK greenhouse gas emissions[1] and without government intervention market incentives are not sufficient to meet the UK's climate change commitments. These barriers and market failures are set out in detail in previous Electricity Market Reform Impact Assessments.[2]

5. The specific intervention considered in this Impact Assessment (IA) is the proposal for Government to define remote island wind as a separate technology from onshore wind. This would mean that RIW projects could compete against other, less established, technologies in future Group 2 CfD allocation rounds, subject to state aid approval. The rationale for this proposal is to maximise the benefits that may arise from deploying RIW, which can be summarised in terms of:

   - **Increasing competition to drive down costs**: RIW projects face unavoidably higher generation costs than mainland onshore wind, for example projects on the Scottish Island groups of Orkney, Shetland and the Western Isles are estimated to cost between £19 and £30 more per MWh of generation than mainland onshore wind (2014 prices, see Annex A for further details). This makes RIW projects uncompetitive against established technologies, whereas competing against less established technologies may be a catalyst for cost reductions, thereby reducing the cost of decarbonising the GB power system.
   - **Diversification**: There is significant longer term potential for the development of RIW,[3] and there are already over 1 GW of projects in relatively advanced stages of planning. The inclusion of RIW as a separate technology in the CfD allocation process provides the opportunity for further diversification of the UK's energy supply.
   - **Driving innovation**: The development of RIW projects has the potential to enable innovation across other less established renewable technologies. For example, successful RIW projects will require the construction of new transmission links, the

[1] See: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015
[2] For example see Section 2 of the January 2013 EMR Delivery Plan Impact Assessment, available here: http://www.parliament.uk/documents/impact-assessments/IA13-002.pdf
[3] An independent study by Baringa in 2013 suggested that around 2.4GW of RIW could be deployed if the barriers to deployment, particularly grid constraints, could be resolved. Report available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/199038/Scottish_Islands_Renewable_Project_Baringa_TNEI_FINAL_Report_Publication_version_14May2013__2_.pdf

establishment of which could reduce certain barriers to entry currently facing innovative tidal and wave generation technologies.

- **Enhancing local security of supply**: Support for remote island wind projects available through the CfD may, to an extent, offset the need for support that would otherwise be required to maintain security of supply. In addition, the existence of transmission links facilitated by remote islands wind could reduce the cost of delivering energy security.

Section 3: Policy objective

6. The primary policy objective is to improve diversity of renewable electricity supply and increase competitive tension among less established technologies to reduce the long term costs of decarbonising the power sector. This can be achieved by supporting the development of wind projects on remote islands, including off the coast of Scotland, where they may directly benefit local communities. The consultation that this IA accompanies, seeks views on a proposed definition for RIW which would allow RIW to compete alongside less established technologies in a future allocation round.

7. The proposed definition is that to qualify as remote island wind, the project would have to meet all of the following criteria.
   - The project is located on an island at least 10 km from mainland Great Britain (GB).
   - The connection between the unit's generation circuit and the Main Interconnected Transmission System (MITS) will require at least 50 km of cabling, of which 20 kilometres must be subsea cabling.
   - Upon completion, the project must be connected to the GB electricity network.

8. The criteria, when combined, ensure that islands are sufficiently remote from the GB coast and MITS connection point, and not readily accessed via another island that is connected to the transmission network. Qualifying island groups are expected to include the Western Isles (the Outer Hebrides), the Orkney Islands and the Shetland Islands, all of which have operational, consented, and / or planned wind farms on them. Land based wind projects not meeting all of these criteria would continue to be classified as an established technology (Group 1) for the purposes of the CfD scheme.

9. The proposed amendment is consistent with the original policy intention underlying the CfD scheme and does not have any further impact upon its overall design, operation, budget or purpose. In particular, RIW projects would be subject to the same competitive allocation process which applies in respect of other Group 2 technologies.

Section 4: Description of options considered

10. The following options are considered in this IA:
    i) <u>Do nothing</u>: under this option, wind projects on the remote islands of GB would continue to be classified as onshore wind and would not be defined as a distinct technology class. RIW projects would therefore be eligible to take part in Group 1 CfD allocation rounds.
    ii) <u>Remote island wind would be classified as a distinct technology</u>: under this option, a separate administrative strike price would be set for RIW, and it would be eligible to compete in future CfD allocation rounds for less established technologies (Group 2).

11. Alternative options, such as providing a separate subsidy to the monopoly transmission operator for investment in the necessary connections to the remote islands alongside the competitively allocated CfD, have been considered but it was concluded that this would create a greater risk of distortions because of the hidden subsidy and the distortion in charging to other potential system users. Provision of separate subsidies to generation and to transmission investment would also raise concerns in regard to the obligations on independent and cost reflective regulation of transmission charges in accordance with Directive 2009/72/EC (the "Third Package"). The provision of alternative investment aid to the transmission operator would also require an alternative source of funds, and would be a departure from the preferred model where

transmission infrastructure is funded through on-going charges. These alternatives are therefore not considered as part of this IA.

Option 1 – Do nothing

12. Under this option, wind projects on the remote islands of GB would not be defined as a distinct technology and would not therefore be eligible to compete in future 'less established technologies' (Group 2) CfD allocation rounds. They would still be eligible to compete as onshore wind in any future allocation rounds for established technologies but, because of their higher costs, would be unlikely to win. They could also decide to deploy on a merchant basis or look for support through, for example, a corporate Power Purchasing Agreement. Because of their higher costs relative to other technologies, particularly onshore wind (see above), both these potential routes to market are unlikely to be viable.

Option 2 – Define remote island wind as a distinct technology

13. Under this option, RIW would be classified as a distinct technology and, pending the outcome of the State aid approval process, would be eligible to compete for a CfD against other less established (Group 2) technologies in future allocation rounds. The proposed maximum support level (the administrative strike price) and the delivery years that it would be available for will be decided before the opening of any future allocation round.

Section 5: Analytical approach

14. Estimating the potential impact of the proposal depends on a range of highly uncertain future events, not least the outcomes of future CfD allocation. As a result, the approach taken here is to test a set of hypothetical scenarios which may demonstrate the impact of the proposal in certain future states of the world. These scenarios are illustrative and should not be interpreted as forecasts of future outcomes.

15. In order to calibrate the analysis against recent CfD outcomes, the scenarios are all based around variations of the outcomes of the second CfD allocation round in terms of capacities, technology mixes, and clearing price for the commissioning year 2021/22.[4] For comparability and simplicity purposes, a fixed RIW capacity of 500MW (around half of the current estimated pipeline) is assumed to be competing and the total annual generation from projects winning a CfD is assumed to be constant. This means that for simplicity we do not assume that any CfD support cost savings are reallocated towards procuring increased generation capacity, as would happen in a future allocation round, but capture this impact in terms of cost savings. This limits the already significant uncertainty in the analysis about the mix of technologies winning a CfD in future. Further detail on how these scenarios are constructed and the key assumptions are set out in Annex B.

16. Table 1 summarises the scenarios, which vary assumptions about the degree to which RIW projects can compete against other less established technologies, the prices that different technologies bid at and their capacities.

[4] For further details see: https://www.gov.uk/government/publications/contracts-for-difference-cfd-second-allocation-round-results. Some offshore wind bid price assumptions are based on clearing prices for the commissioning year 2022/23.

Table 1: Description of illustrative scenarios used to demonstrate potential impact, 2012 prices

Scenario	RIW Winning Capacity (Bid strike price)	Fuelled Technology Winning Capacity (Bid strike price)	Offshore Wind Winning Capacity (Bid strike price)	Clearing Price	Technologies winning CfDs
1A (Do Nothing)	N/A	150MW (£74.75/MWh)	860MW (£57.50/MWh)	£74.75/ MWh	Fuelled technologies Offshore wind
1B (Do Nothing)	N/A	150MW (£66.13/MWh[5])	860MW (£74.75/MWh)	£74.75/ MWh	Fuelled technologies Offshore wind
2A	0MW (£75.50/MWh)	150MW (£74.75/MWh)	860MW (£57.50/MWh)	£74.75/ MWh	Fuelled technologies Offshore wind
2B	500MW[6] (£56.50/MWh)	0MW (£74.75/MWh)	670MW (£57.50/MWh)	£57.50/ MWh	RIW Offshore wind
2C	500MW (£56.50/MWh)	150MW (£66.13/MWh)	415MW (£74.75/MWh)	£74.75/ MWh	RIW Fuelled Technologies Offshore wind

Note: Options assume that total generation of electricity remains the same across all scenarios.

17. Scenarios 'Option 1A' and 'Option 1B' are two illustrative outcomes of the 'Do Nothing' Option 1, the first where offshore wind is assumed to be cheaper than fuelled technologies[7] and the latter where the reverse is true.

18. Scenarios 'Option 2A', 'Option 2B' and 'Option 2C' are illustrative outcomes of policy Option 2 where RIW competes with fuelled technologies and offshore wind. In scenario 'Option 2A' RIW bids at a price above both fuelled technologies and offshore wind and is compared to Option 1A. In scenario 'Option 2B' RIW is more competitive than both alternative technologies and as fuelled technologies are assumed to be the most expensive are displaced. Scenario 'Option 2B' is compared to a baseline of scenario 'Option 1A'. In scenario 'Option 2C' RIW is more competitive than both alternatives but some offshore wind is assumed to be the most expensive in this scenario and is partially displaced. Scenario 'Option 2C' is compared against a baseline of scenario 'Option 1B'.

19. In the following section the costs of each scenario are estimated and compared on the basis of:

   i. **Generation costs**: this reflects the capital, operating, transmission and insurance costs of building and operating the relevant power stations. These are calculated based on the 2016 BEIS Generation Costs Report estimates of levelised cost of electricity for each technology and BEIS internal analysis (see Annex B)[8], with adjustments made as necessary to be consistent with the assumed strike prices set out in Table 1. Note this only reflects the generation cost, and not the whole impact of the generation on the electricity system (for

[5] This is an illustrative bid price and is an average of the observed offshore wind bid price of £57.50/MWh (the CfD round 2 auction clearing price for commissioning year 2022/23) and the assumed fuelled technologies bid price of £74.75/MWh (the CfD round 2 auction clearing price for commissioning year 2021/22).
[6] This is an illustrative capacity and does not reflect BEIS expectation of successful bidding technologies at future auction rounds.
[7] 'Fuelled technologies' are defined here as a mixture of Advanced Conversion Technologies (ACT) – Energy from Waste and Dedicated Biomass with combined heat and power. See Annex B for further details.
[8] Available here: https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016. Load factor for offshore wind is drawn from the Renewables Obligation Setting Publication for 2018/19: https://www.gov.uk/government/publications/renewables-obligation-level-calculations-201819

example, differences in balancing and network costs). For the final stage IA we will explore whether total electricity system costs can be included quantitatively. Note that while here we estimate changes in the costs of delivering a fixed level of generation, in future CfD auctions it is likely that any reduction in costs would mean that saving being allocated to supporting more capacity.

ii. **Carbon impacts**: different generating technologies produce different amounts of greenhouse gas emissions for each MWh of electricity, and altering the technology mix across the scenarios affects the emissions intensity of the generation. The analysis has calculated the carbon impact from a scenario where RIW replaces fuelled technologies in the generation mix (scenario 'Option 2B'). Fuelled technologies, which have the potential to reduce emissions compared to fossil fuels, may still produce greenhouse gas emissions as the fuel is burned to produce electricity. Scenarios 'Option 2A' and 'Option 2C' do not have any carbon impacts as there is no assumed change in generation from fuelled technologies.

iii. **Air quality impacts**: similarly, different generating technologies give rise to different levels of particulates that can affect air quality. This impact is considered only in qualitative terms.

iv. **Support cost impacts**: these are calculated as the difference between the wholesale electricity price and the strike price assumed to be given to winning projects. This does not form part of the cost-benefit analysis as it is a transfer between consumers and generators, but the illustrative magnitude of support costs are estimated to demonstrate the potential differences in costs to consumers.

20. All impacts have been monetised in 2012 prices for comparability to the assumed strike prices (which are set in 2012 prices), and discounted in accordance with the HM Treasury Green Book.[9] Further details of the analytical approach and key assumptions are set out in Annex B.

Section 6: Cost benefit analysis

6.1 Generation costs

21. Generation costs are estimated as the resource costs involved in producing electricity. They encompass pre-development expenditure, capital costs, operating costs, financing, insurance costs, and generation 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. Generation costs represent the costs to society per MWh over the entire appraisal period, and a cost per MWh under each scenario has been estimated to be consistent with the strike prices assumed.

22. The estimated generation costs for each scenario are set out in Table 2. Under the hypothetical scenario 'Option 2A', RIW projects are assumed to bid for CfDs at a price that is uncompetitive when compared to offshore wind and fuel technologies, and so are unsuccessful in securing a contract. As a result there is no change in total Group 2 generation costs when compared to the do nothing baseline, Scenario 'Option 1A'[10], as the generation mix of technologies continues to be consist of offshore wind and fuel technologies only.

[9] Available at: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent
[10] To ensure comparability, Option 2A and Option 2B are compared against Option 1A, where fuelled technologies set the clearing price. Option 2C is compared against option 1B, where offshore wind sets the clearing price.

Table 2: Illustrative changes in generation costs of policy scenarios, present value 2022/23-2047/48

Scenario	Offshore Wind Generation cost (PV £m)	Fuelled Technologies Generation Cost (PV £m)	Remote Island Wind Generation cost (£m)	Present Value of Total Generation Cost (£m)	Avoided generation costs against the appropriate baseline (£m)
Option 1A	3,000	1,200	0	4,300	N/A
Option 1B	3,800	1,100	0	4,900	N/A
Option 2A	3,000	1,200	0	4,300	0
Option 2B	2,300	0	1,500	3,800	500
Option 2C	1,800	1,100	1,500	4,400	500

Note: rows may not sum due to rounding to the nearest £100m.

23. Scenario 'Option 2B' results in a reduction in generation costs of around £500m compared to a baseline of scenario 'Option 1A'. Under this scenario RIW bids in at a price that is cheaper than offshore wind and fuelled technologies, and therefore RIW displaces all fuelled technologies and some of the offshore wind capacity. In this scenario, RIW is assumed to have a cheaper generation cost per MWh than the alternatives (assumed to be £55.45 compared to £70.75 for fuelled technologies), which results in a saving in generation costs.[11]

24. Scenario 'Option 2C' results in a reduction in generation costs of around £500m compared to a baseline of scenario 'Option 1B'.[12] In this scenario it is assumed that the generation cost of RIW is £55.45/MWh. The baseline – scenario 'Option 1B' – assumes that fuelled technologies have a lower generation cost than offshore wind, therefore here it is assumed that offshore wind is displaced in this scenario, rather than fuelled technologies. All five options assume the same amount of electricity generation is purchased.

6.2 Carbon impacts

25. The estimated changes in the value of carbon emissions from electricity generation for each scenario is set out in Table 3. 'Option 2B', is the only scenario where there is a carbon impact as this is the only scenario where RIW displaces fuelled technologies, which generate carbon emissions from the fuels burned in generating electricity. This is estimated by applying an estimated carbon intensity per MWh of generation for the fuelled technologies, derived from historical data under the Renewables Obligation, and valuing the resulting emissions estimates in line with the supplementary Green Book guidance on valuing greenhouse gas emissions.[13]

Table 3: Illustrative changes in value of carbon, present value, 2012 prices

Scenario	Value of saving in greenhouse gas emissions (£m)	Description
Option 1A	N/A	Do nothing Option A
Option 1B	N/A	Do nothing Option B
Option 2A	0	No change against scenario 'Option 1A' as RIW is assumed to be more expensive than alternatives
Option 2B	300	RIW displaces fuelled technologies leading to a reduction in emissions

[11] Note that these are levelised costs, which are consistent with, but not the same as, the strike prices assumed for the technologies considered in this IA. See Annex B for more details.
[12] Scenario 'Option 2C' is compared against a baseline of scenario 'Option 1B' for consistency of assumptions around technology costs and which technology would set the auction clearing price.
[13] Available here: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Scenario	Value of saving in greenhouse gas emissions (£m)	Description
Option 2C	0	No change against scenario 'Option 1B' as RIW displaces offshore wind and so 150MW of fuelled technologies still remain

6.3 Air Quality

26. The scenarios are likely to result in a zero impact or an improvement in air quality as a result of the displacement of fuelled technologies in certain scenarios. Scenarios 'Option 2A' and 'Option 2C' should not have any impact. Scenario 'Option 2B' would likely have a positive improvement in air quality as a result of less combustible fuel being burned to generate electricity. It has not been possible to monetise these impacts for the consultation stage IA. The viability of estimating air quality impacts will be explored ahead of the final stage IA that will accompany the government response.

6.4 Combined cost-benefit analysis of illustrative scenarios

27. The combined estimated impact of the scenarios considered in this IA are set out in Table 4. Scenario 'Option 2A' has zero impact as no RIW is deployed; whilst scenario 'Option 2B' generates net benefits of £800m comprised of around £500m of reduced generation costs and approximately £300m carbon savings from avoided fuelled technology generation, and scenario 'Option 2C' generates net benefits of around £500m from lowering the cost of generation by displacing fuelled technologies and some offshore wind. Further detail on these scenarios can be found in Annex B.

28. These scenarios imply an illustrative range of impacts from £0 to £800m in net present value terms. No central estimate is made as the outcomes of future CfD allocation rounds are highly uncertain.

Table 4: Summary of cost-benefit analysis for the illustrative scenarios, Net Present Value, 2012 prices

PV, £m	Scenario Option 2A	Scenario Option 2B	Scenario Option 2C
Value of avoided generation costs	-	500	500
Value of carbon savings	-	300	-
Net Present Value (£m)	0	800	500

6.5 Support costs

29. Whilst not forming part of the cost-benefit analysis, the CfD support costs have been estimated by comparing the relevant strike prices to a projection of the wholesale price over the lifetime of the projects (see Annex B for further detail). Administrative strike prices – which specify the maximum price per MWh that a particular technology can receive, irrespective of the auction clearing price – have not at this stage been set for any future allocation rounds. As a result, a range has been tested where the 'low' estimate assumes that each technology's bid price is the maximum administrative strike,[14] and 'high' assumes that all administrative strike prices are above the clearing price.[15] These results are illustrative only and should not be read as an indication of government policy on administrative strike prices of future allocation rounds.

[14] For example, if fuelled technologies are assumed to bid at £74.75/MWh, then it is assumed that the administrative strike price is also set at £74.75/MWh. Similarly, if offshore wind is assumed to bid at £57.50/MWh then it is assumed that the administrative strike price is also set at £57.50/MWh.

[15] For example, if the auction clearing price is £74.75/MWh, then in this scenario it is assumed that all winning projects are awarded a contract at £74.75/MWh.

Table 5: Illustrative gross support costs under policy scenarios over the lifetime of the CfD, 2012 prices

Scenario	Change in support costs 15 year CfD life (£m)	
	Low estimate	High estimate
Option 2A	0	0
Option 2B	-200	-900
Option 2C	-400	0

30. Scenario 'Option 2A' is estimated to have no support cost impacts because the illustrative outcome does not change as RIW is uncompetitive in this scenario. Scenario 'Option 2B' has potentially the largest support cost savings under the high estimate due to the reduction in clearing price from £74.75 to £57.50. Scenario 'Option 2C' generates 0 saving in support costs in the high scenario as the clearing price still remains at £74.75.

6.6 Impact on consumer bills

31. The support costs estimated in Table 5 would be passed through to electricity consumers. In scenario 'Option 2B', where RIW has the effect of lowering the clearing price of the CfDs awarded, lower consumer bills would be expected. It has not been possible to quantitatively assess this impact for this consultation stage IA. This will be explored for the final stage IA that will accompany the government response to this consultation.

6.7 Impact on jobs

32. Development of wind projects on remote islands could result in benefits to local areas through an increase in direct, indirect and induced jobs. Construction and operation of wind farms as well as developments in the supply chain could result in an increase in employment on the islands, as well as in the UK more widely. Some of this potential would be a result of displacement in other locations or other sectors. In the event of displacement or reduced deployment of other technologies, an increase in jobs supported on the islands will result in displacement effects elsewhere i.e. either a decrease in jobs associated with the technology displaced or a decrease in jobs in other locations in the UK. There is uncertainty around the extent to which jobs are displaced in other (non-power) sectors, and also the extent to which there is leakage of jobs outside the UK. Any net economic impact will be dependent on these factors.

6.8 Wider impacts

33. Allowing remote island wind projects to compete for CfD support as part of Group 2 should give the transmission owner the confidence to submit to Ofgem needs cases for building proposed transmission links. In turn, this may lead to the availability of additional capacity over proposed transmission links for other renewable projects on remote islands, including further wind projects, but also wave and tidal, which have significant potential if costs come down, to connect in the longer term. This additional renewable generation will contribute towards long term decarbonisation.

34. Whilst the Western Isles, Orkney and Shetland currently have adequate security of supply, renewable generation and associated transmission links could provide further benefits to local security of supply and the cost of local generation. Onshore wind generation could contribute towards meeting local energy demand on some of the islands, particularly if current and future demand is met by a diesel generator. If RIW displaces local diesel generation, there could be further generation, carbon and air quality savings. The support for remote island wind projects available through the CfD may, to an extent, offset the need for support that would otherwise be required to maintain security of supply. In addition, the existence of transmission links facilitated by remote islands wind could reduce the cost of delivering energy security.

35. It has not been possible to assess the wider electricity system impacts at this stage but the government will explore the potential to quantitatively assess this impact for the final stage IA that accompanies the government response to this consultation.

Section 7: Risks and Uncertainties

36. The analysis presented in this IA has been based upon the best available information available to the government at the time of publication. However, Government recognises that there may be areas where the evidence base could be strengthened. As part of this consultation, Government welcomes further evidence from consultees on the feasibility and impacts of the proposed policy changes.

37. The key areas of uncertainty identified are:

- Competitiveness of remote island wind projects: CfDs are awarded competitively, and therefore RIW projects will only secure a CfD if they can compete on a cost per MWh basis with other less established technologies. In this IA 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.

- Future deployment: the impact of RIW will depend on the scale and mix of other less established technologies that bid and are successful in securing a CfD. This IA has used scenarios based on variations of a single commissioning year's outcome from CfD Allocation Round 2 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. However, it is clear that the proposal will have a zero impact if RIW is not competitive, and a likely positive outcome where RIW can compete.

- The overall impact on the electricity system: The analysis has considered the impact of RIW on generation costs but at this stage it has not been possible to assess the wider impacts on the electricity system such as network, transmission and balancing costs.

Section 8: Summary and preferred option

38. Option 2 is the preferred option for meeting the government's policy objective. If one or more RIW projects are cost competitive relative to other projects in the allocation round then the NPV would be positive (all other things being equal) as the generation costs (and potentially the carbon costs and costs to consumers) would be lower for any given quantity of generation. If no RIW projects were cost competitive and they were not successful in the allocation round then the NPV would be zero.

Annex A: Remote Island Wind Costs

The most important difference between RIW and other onshore wind projects is the significantly higher costs of connecting to, and using, the electrical transmission system. The charge faced by each generator to use the network is therefore calculated to reflect the costs that connection of the new generator imposes on different parts of the transmission network. The long new connections to the Main Interconnected Transmission system which would be required for RIW projects to be developed mean that, under the transmission charging regime, they are forecast to be subject to Transmission Network Use of System (TNUoS) charges of an order of magnitude higher than the average for onshore wind generators located elsewhere in the UK.

There are other differences between RIW and onshore wind projects on the GB mainland which will affect their Levelised Cost of Electricity (LCOE). RIW projects face high air moisture and salinity, as they are being built in maritime conditions with similarities to those experienced offshore wind projects. This will in many cases require the use of offshore class turbines and related technologies; all internal components are likely to require an offshore specification, and all turbine exteriors, transformers, hubs, air intakes and nacelles are expected to require offshore class anti-corrosion protection.

Remote islands have consistently higher wind speeds, meaning their expected load factors are at levels much closer to offshore wind and considerably above those achievable by onshore wind projects on the GB mainland. This is advantageous in terms of increased renewable electricity generation, however it does bring some operational challenges which – when combined with more complex access arrangements – may see operating costs more than double that of an onshore wind farm on the mainland.

The islands, like offshore sites, are also subject to extreme weather events. In practice, this means turbines being capable of withstanding wind speeds comparable to those found at far-offshore wind sites. Developers need to balance this requirement for turbines that can cope with highly demanding ‘offshore wind’ conditions, with the inevitable practical limitations on the maximum turbine size (both as a result of local planning considerations on maximum tip heights that limit scope for larger offshore-scale turbines, and limitations to what scale of turbine can feasibly be transported and installed on land). Whilst in some instances it might be possible to deploy larger turbines, in practice most projects are likely to use turbines in the 3-4 MW range, but with an enhanced level of robustness to environmental conditions. For comparison, the latest offshore wind projects are expected to deploy turbines in the 8-10 MW range, with even larger turbines in development.

Table A1 summarises the estimated impact of higher transmission charges, operational costs, capex and load factor on the LCOE of the three main island groups, relative to the LCOE of onshore wind. It shows that the higher costs that RIW projects face are only partially offset by their greater output.

Table A1: Impact of different characteristics of remote island wind on levelised cost, compared to UK onshore wind (£/MWh LCOE, 2014 prices)

<table>
<tr><th>Island Group</th><th>Increased power[16]</th><th>Capex</th><th>Construction cost / phasing</th><th>Lifetime</th><th>Hurdle rate</th><th>Opex</th><th>Transmission</th><th>Load factor</th><th>Overall impact</th></tr>
<tr><td>Orkney</td><td rowspan="3">-4</td><td rowspan="3">+6</td><td rowspan="3">+2</td><td rowspan="3">+4</td><td rowspan="3">+3</td><td>+11</td><td>+25</td><td>-28</td><td>+19</td></tr>
<tr><td>Shetland</td><td>+14</td><td>+40</td><td>-39</td><td>+25</td></tr>
<tr><td>Western Isles</td><td>+3</td><td>+34</td><td>-17</td><td>+30</td></tr>
</table>

Taken together, these differences therefore result in RIW projects having higher levelised costs than other existing Group 1 technologies, such that they would not be able to compete effectively in a Group 1 CfD allocation process.

[16] To account for RIW potentially having a larger capacity than onshore wind - for example if coastal locations could accommodate more wind turbines within a specific surface area compared to an average onshore wind farm, or if turbine designs partially optimised for offshore wind could be deployed

Annex B: Analytical approach and Key Assumptions

Scenarios modelled

The analysis has used evidence from the last auction round to form a range of illustrative scenarios. The illustrative scenarios used in this impact assessment are set out in further detail below, including the key assumptions. Fuelled technologies (FT) are assumed to include Biomass CHP and Advanced Conversion Technologies in line with the capacity mixes delivered through the 2nd CfD allocation round. OSW refers to offshore wind technologies and RIW is remote island wind.

Chart B1: Scenario 'Option 1A' (Fuelled technologies set the clearing price)

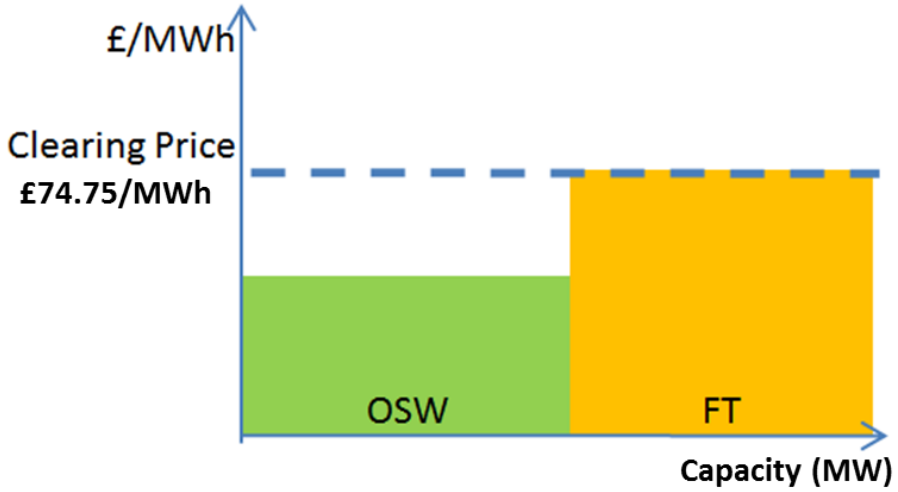

Table B1: Detailed assumptions for Scenario 'Option 1A' (2012 prices)

	Offshore Wind	Fuelled Technologies
Bid Price, £/MWh *(Low support costs)*	£57.50	£74.75
LCOE (£/MWh)	£56.21	£70.96
Capacity (MW)	860	150
Generation (000s, hrs)	3,535	1,058

Clearing Price, £/ MWh *(High support costs)*	£74.75
Total Generation across (000s, hrs)	4,594

Chart B2: Scenario 'Option 1B' (offshore wind sets the clearing price)

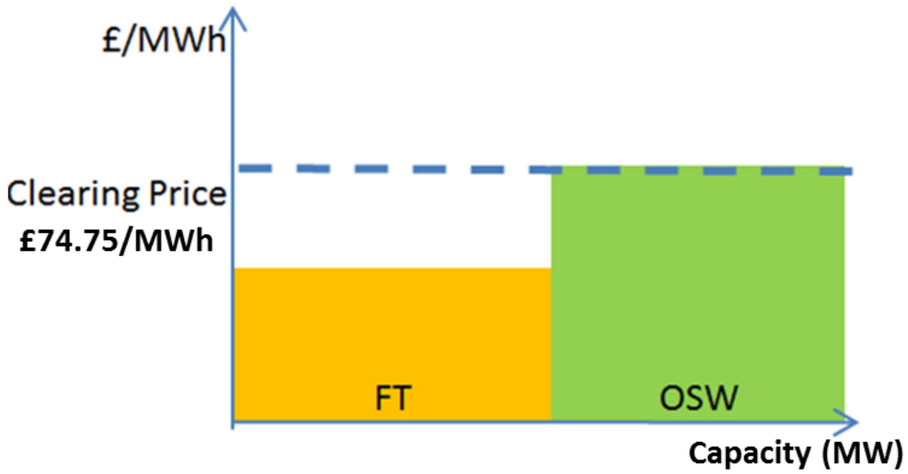

Table B2: Detailed assumptions for Scenario 'Option 1B' (2012 prices)

	Fuelled Technologies	Offshore Wind
Bid Price, £/MWh *(Low support costs)*	£66.13	£74.75
LCOE (£/MWh)	£63.59	£70.91
Capacity (MW)	150	860
Generation (000s, hrs)	1,058	3,535

Clearing Price, £/ MWh *(High support costs)*	£74.75
Total Generation across (000s, hrs)	4,594

Chart B3: Scenario 'Option 2A' (fuelled technologies set the clearing prices)

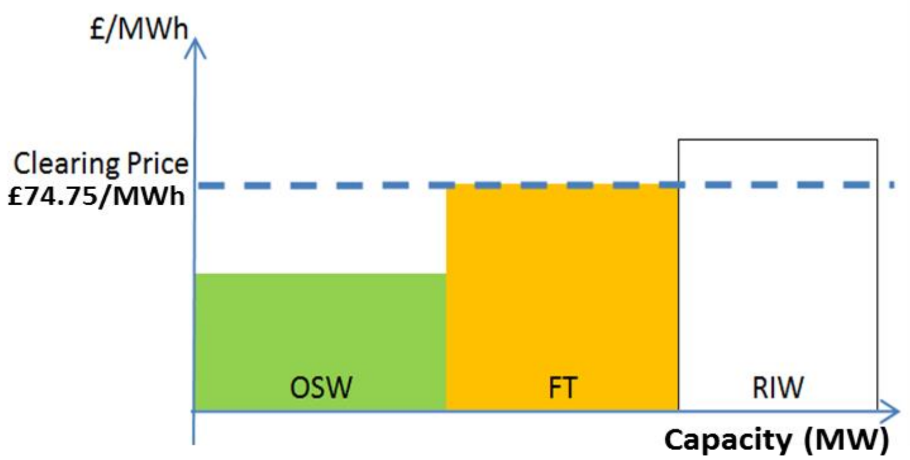

Table B3: Detailed assumptions for Scenario 'Option 2A' (2012 prices)

	Offshore Wind	Fuelled Technologies	Remote Island Wind
Bid Price, £/MWh *(Low support costs)*	£57.50	£74.75	£75.50
LCOE (£/MWh)	£56.21	£70.96	N/A
Capacity (MW)	860	150	-
Generation (000s, hrs)	3,535	1,058	-

Clearing Price, £/ MWh *(High support costs)*	£74.75
Total Generation across (000s, hrs)	4,594

Chart B4: Scenario 'Option 2B' (offshore wind sets the clearing price)

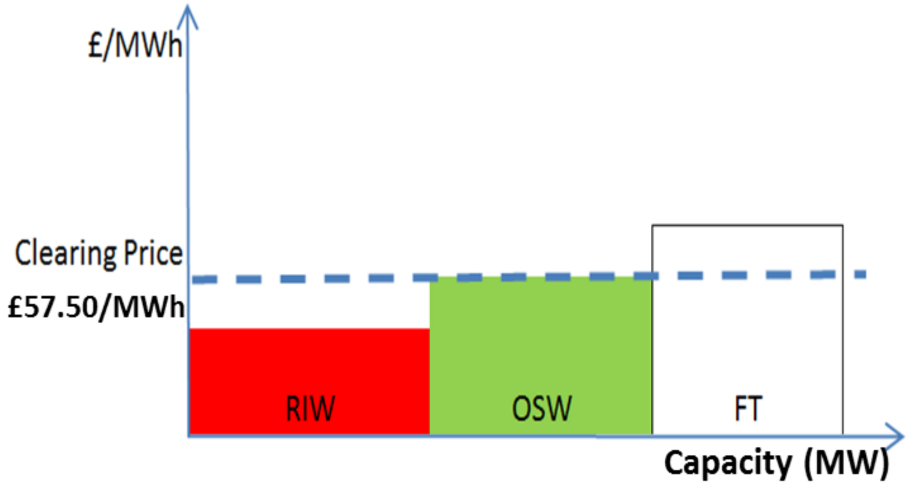

Table B4: Detailed assumptions for Scenario 'Option 2B' (2012 prices)

	Remote Island Wind	Offshore Wind	Fuelled Technologies
Bid Price, £/MWh *(Low support costs)*	£56.50	£57.50	£74.50
LCOE (£/MWh)	£55.45	£56.21	N/A
Capacity (MW)	500	668	-
Generation (000s, hrs)	1,847	2,747	-

Clearing Price, £/ MWh *(High support costs)*	£57.50
Total Generation across (000s, hrs)	4,594

Chart B5: Scenario 'Option 2C' (offshore wind sets the clearing price)

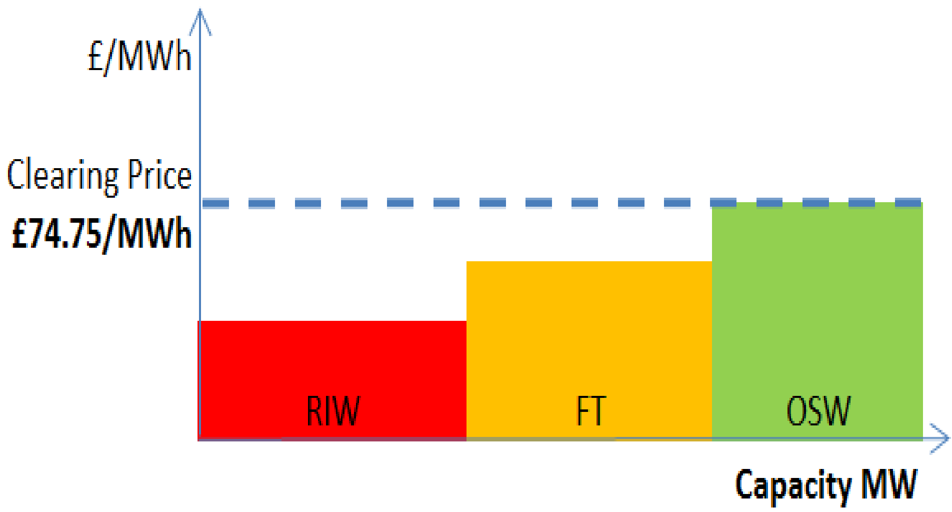

Table B5: Detailed assumptions for Scenario 'Option 2C' (2012 prices)

	Remote Island Wind	Fuelled Technologies	Offshore Wind
Bid Price, £/MWh *(Low support costs)*	£56.60	£66.13	£74.75
LCOE (£/MWh)	£55.45	£63.59	£70.91
Capacity (MW)	500	150	411
Generation (000s, hrs)	1,847	1,058	1,688

Clearing Price, £/ MWh *(High support costs)*	£74.75
Total Generation across (000s, hrs)	4,594

Bid Prices

Table B6 sets out the bid prices assumed for each technology. For the purposes of modelling, we have assumed one bid price for each technology, however in reality there are likely to be a range of bid prices for projects within each technology. These bid prices are used to calculate the change in support costs and estimate the LCOE.

Table B6: Assumed Bid Prices, £/MWh, 2012 prices

Scenario	Offshore Wind		Fuelled Technologies		Remote Island Wind	
	Value	Rationale	Value	Rationale	Value	Rationale
Option 1A	£57.50	Round 2 offshore wind clearing price in 2022/23[17]	£74.75	Round 2 clearing price in 2021/22 for ACT and Dedicated Biomass with CHP	N/A	N/A
Option 1B	£74.75	Flexes bid price to assume that offshore wind is more expensive than fuelled technologies.	£66.13	Illustrative estimate to model a scenario where offshore wind sets the clearing price at £74.75. £66.13 is an average of Scenario 'Option 1A' price (£57.50) for offshore wind and fuelled technologies (£74.75)	N/A	N/A
Option 2A	£57.50	Round 2 offshore wind clearing price in 2022/23	£74.75	Round 2 clearing price in 2021/22 for ACT and Dedicated Biomass with CHP	£75.50	Illustrative estimate to model a scenario where remote island wind is less competitive than other Group 2 technologies.
Option 2B	£57.50	Round 2 offshore wind clearing price in 2022/23	£74.75	Round 2 clearing price in 2021/22 for ACT and Dedicated Biomass with CHP	£56.50	Illustrative estimate to model a scenario where remote island wind is more competitive than other Group 2 technologies.
Option 2C	£74.75	Flexes bid price to assume that offshore wind is more expensive than fuelled technologies.	£66.13	Illustrative estimate to model a scenario where offshore wind sets the clearing price at £74.75. £66.13 is an average of Scenario 'Option 1A' price (£57.50) for offshore wind and fuelled technologies (£74.75)	£56.50	Illustrative estimate to model a scenario where remote island wind is more competitive than other Group 2 technologies.

[17] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/643560/CFD_allocation_round_2_outcome_FINAL.pdf

Generation Costs

Generation costs are calculated through multiplying the levelised cost of electricity by the generation assumed for each technology. The levelised cost of electricity is a measure of cost per MWh of electricity produced and is a function of the lifetime of the technology, the hurdle rate[18] and the wholesale price of electricity. Key assumptions used to estimate the generation costs and LCOE are outlined in Table B7.

Table B7: Generation Costs Input Assumptions.

Assumption	Offshore Wind	Fuelled Technologies	Remote Island Wind
Hurdle Rates	8.90% BEIS Electricity Generation Costs Report[19]	11.01% BEIS Electricity Generation Costs Report. The Hurdle Rate is a weighted average of ACT's and dedicated Biomass (weighted 60% towards biomass and 40% towards ACTs to reflect the mix from the previous auction outcome.	7.30% BEIS Internal Analysis, informed by hurdle rates for onshore and offshore wind published in the BEIS Electricity Generation Costs Report.
Operating Lifetime (years)	22 BEIS Electricity Generation Costs Report [20]	25 BEIS Electricity Generation Costs Operating lifetime is the maximum of ACT and dedicated biomass with CHP.	20 BEIS assessment of the Baringa report[21]
Load Factors	47.3% BEIS, Setting the Level of the Renewables Obligation for 2018/19[22]	81.0% BEIS Electricity Generation Costs - weighted average of ACT and Biomass technologies	42.5% BEIS assessment of Baringa report
Wholesale Electricity Prices	£49 (2012 prices) 2016 EEP reference case[23] central fossil fuel assumptions (15 year average 2022/23-2036/2037)		

Support Costs

The change in support costs have been estimated by calculating the difference between the technology price and wholesale price of electricity and multiplying this differential by the generation of each technology. The low estimate assumes that the bid price is the ASP for that technology whereas the high assumes that highest bid price across technologies sets the clearing price. ASP's will be calculated prior to an auction round and so the ASPs presented here are not an indication of Government policy but have been used to provide a sense of scale of support cost impacts. Support costs are a transfer and so have not been included as part of the cost benefit analysis.

BEIS wholesale electricity prices (loss-adjusted) 2016 EEP reference case central fossil fuel assumptions have been used. The relevant prices have been used from 2022/23 onwards over the 15 year contract for difference support lifetime.

Carbon Impact

Carbon impact has been assessed in line with the government's supplementary *Green Book* guidance on the valuation of energy use and greenhouse gas emissions[24]. Traded carbon values have been used. We have deflated the values from the guidance into £2012 values using GDP deflators from table 19 of the IAG data tables and converted into financial years.

The carbon intensity of fuel has been calculated by BEIS using Ofgem Sustainability data[25]. The analysis assumes a carbon intensity of fuel for fuel technologies of 60.25 gCO2e/kWh. This is a weighted average of biomass (60%) and ACT (40%) reflecting the outcome of the second allocation round.

[18] This is defined as the required rate of return above which a project would go ahead.
[19] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf
[20] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf
[21]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/199038/Scottish_Islands_Renewable_Project_Baringa_TNEI_FINAL_Report_Publication_version_14May2013__2_.pdf
[22] P.11 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/648424/Renewables_Obligation_2018_19_FINAL.pd
[23] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/599539/Updated_energy_and_emissions_projections_2016.pdf
[24] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[25] https://www.ofgem.gov.uk/environmental-programmes/ro/applicants/biomass-sustainability