



Department  
of Energy &  
Climate Change

# Annex B: Strike price methodology

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## Introduction

1. This annex explains the methodological factors that determine the Contract for Difference (CfD) strike prices set out for consultation in the draft Delivery Plan. Our approach to strike prices in 2014/15 – 2016/17 is based on “RO minus X” (or RO-X). The RO signifies our intent to provide support aligned to that under the Renewables Obligation (RO), and the ‘minus X’ reflects the assumption that the required rate of return for a renewables project to proceed, the hurdle rate, is lower under the CfD than under the RO. This ensures that investors face similar incentives between the RO and CfD regimes which will overlap during this period. Beyond the closure of the RO, CfD strike prices are based on the expectation of declining costs due to learning through deployment and the requirement that deployment remains within the LCF affordability constraint.

## Overview of methodology for deriving a CfD strike price

2. There are a range of factors to consider in setting a strike price, covering:
  - technology specific factors such as capital and operating costs, financing costs as well as any build constraints;
  - market conditions such as wholesale prices and the discount which generators face when signing a power purchase agreement (PPA); and
  - policy considerations such as the specific contract design, choices about technology mix and meeting the ambition for renewable electricity.
3. These factors mean that a strike price for a particular technology is different to the ‘levelised cost’ – the average cost over the lifetime of the plant per MWh generated<sup>1</sup>. Relative to this figure a strike price could be higher or lower for a number of different reasons, including:
  - **Costs not included in DECC’s standard levelised costs:** CfD top-up payments will be paid on the basis of generation after taking account of the generator’s share of transmission losses, known as the Transmission Loss Multiplier so the strike prices need to be increased to account for this.
  - **Power Purchase Agreements (PPAs):** The revenue received by the generator is a combination of the electricity price achieved and the CfD top-up, which is the

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<sup>1</sup> ‘Electricity Generation Costs 2013’ DECC (2013)  
<https://www.gov.uk/government/publications/electricity-generation-costs>

difference between the strike price and the reference price. If the generator cannot achieve the reference price because it sells its power through a PPA at a discount to the market price, the strike price must be increased to compensate for this<sup>2</sup>. PPA discounts reflect trading, forecasting, and imbalance costs<sup>3</sup>, amongst other factors.

- **Contract length:** The levelised cost is defined over the operating life of a project. If the CfD contract length is shorter than the operating life and wholesale prices and capacity market revenue post-contract are lower than the levelised cost, then the strike price must be increased above the levelised cost to compensate for this.
  - **Other policy:** Levy Exemption Certificates (LECs) provide around £5/MWh of support. The modelling assumes CfD plants (like those supported under the RO) will receive LEC revenue and the strike price is reduced to account for this.
4. The key assumptions used for setting of strike prices, including for levelised costs, fossil fuel prices, effective tax rates, PPA discounts and maximum build assumptions are listed in The Government's levelised cost report<sup>4</sup> and the report from the System Operator (National Grid)<sup>5</sup>.

## Strike Prices during the cross-over period with the RO (2014/15 – 2016/17)

5. Strike prices for 2014/15 – 2016/17 are set so that, given our current assumptions as set out in paragraph 4, the marginal investor incentivised under the RO is indifferent between choosing the RO or CfDs. We refer to this approach as “Renewables Obligation minus X” or RO-X.
6. The ‘minus X’ reflects the assumption that the required rate of return for a renewables project to proceed, the hurdle rate, is lower under the CfD than under the RO. It also reflects changes to PPA discount assumptions to reflect the reduced risks in CfD PPAs.
7. Calculating strike prices on the basis of RO-X involves the following steps:

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<sup>2</sup> PPA discounts on wholesale revenue and support payments have also been included in the modelling of the revenues of RO supported plants.

<sup>3</sup> Here ‘imbalance costs’ refers to the overall costs of managing a generator’s contractual position between the reference market and delivery. For intermittent generators, this means the costs associated with managing the difference between generators’ forecast output 24 hours ahead of delivery and actual generation.

<sup>4</sup> See footnote 1.

<sup>5</sup> ‘National Grid EMR Analytical Report’, National Grid (2013)  
<https://www.gov.uk/government/consultations/consultation-on-the-draft-electricity-market-reform-delivery>

- I. Calculate, for each technology in each year, an RO range of the net present value (NPV) of lifetime costs of plants commissioning in that year based on plant capital, operating, fuel and financing cost estimates<sup>6</sup>. Variation in costs is derived from low, central and high capital costs<sup>7</sup>, with other costs held constant;
  - II. Combine these costs with revenue assumptions<sup>8</sup> to determine the discounted NPV of the marginal investment under the RO<sup>9</sup>;
  - III. Calculate a range of costs under CfDs, based on the same cost assumptions, except for lower financing costs. Combine this with revenue assumptions under the new EMR arrangements and vary the strike price in £1 increments until the NPV of the same marginal investment under CfDs is as close as possible to that under the RO; and finally,
  - IV. Round strike prices to the nearest £5<sup>10</sup>.
8. There are also a number of other considerations in the RO-X calculation for specific technologies:
- Technologies that are grouped together in a single category under the RO are given a common strike price e.g. the different ACT technologies
  - Technologies that were limited by the offshore wind band in the Renewables Obligation Banding Review (ROBR<sup>11</sup>) get the same, or lower strike price as offshore<sup>12</sup>

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<sup>6</sup> The costs included are pre-development, regulatory/licensing, capital, fixed operational costs, variable operational costs and fuel costs. Financing costs are included by discounting all costs/revenues at the appropriate technology and time specific hurdle rate.

<sup>7</sup> See footnote 1.

<sup>8</sup> The revenues included are wholesale (assuming investors have 5 year foresight of wholesale prices), RO/CfD support payments, LECs, capacity market revenues and heat revenues where appropriate and adjusting for assumed PPA discounts.

<sup>9</sup> For technologies with no modelled economic build under the RO, the strike price is set so that the (negative) NPV of the cheapest plant is the same under CfDs as under the RO.

<sup>10</sup> ROC bands have been set in 0.1 ROC increments, with 0.1 ROC indicating a difference in support of around £5/MWh. All strike prices are therefore rounded to the nearest £5 (2012 prices), to be consistent with this convention. The actual strike price paid to generators will be updated in line with CPI inflation. Further detail on the mechanics of strike price inflation indexation will be set out in August, when drafts of key CfD terms will be published.

<sup>11</sup> Government response to the consultation on proposals for the levels of banded support under the Renewables Obligation for the period 2013-17 and the Renewables Obligation Order 2012', DECC (2012)  
<https://www.gov.uk/government/consultations/supporting-large-scale-renewable-electricity-generation>

<sup>12</sup> In some cases the RO-X strike price for technologies that were linked to offshore wind in the ROBR will be lower than the offshore wind RO-X strike price. This is due to the technology specific hurdle rates that have been assumed.

- The biomass conversion CfD contract length is constrained to an end date in line with the RO (2027)
  - The landfill gas strike price reflects the expected level of the wholesale price, thereby offering a minimal support level. This is in line with the RO band of zero that open landfill gas sites receive under the RO. Strike prices have been set at the same level for open and closed landfill sites because the difference between the costs of the two types of landfill is marginal. A CfD is offered to give developers greater certainty about their revenue streams, reflecting the greenhouse gas reduction benefit of landfill gas resulting from its capture and combustion of methane.
9. Strike prices for all technologies are flat or degressing over time.

**Box 1. Worked example: RO-X strike price components for a generic onshore wind generator commissioning in 2015/16**

The following example demonstrates the components required to convert the level of support for a generic onshore wind farm commissioning in 2015/16 from 0.9 ROCs to a CfD strike price of £100/MWh. This calculation uses the assumptions described in paragraph 4; in reality different generators will face different costs and receive different revenues. It should be noted that the actual method used for calculating RO-X strike prices was as outlined in the text. This example is to illustrate the contribution of the different components.

**Stage 1: Calculate the levelised revenue for a generator under the RO**

Item	Amount (£/MWh)	Description
Wholesale Revenue (post PPA discount)	£51	Amount that generator can expect to receive over the lifetime of their plant, i.e. PV <sup>i</sup> (24 years wholesale revenue <sup>ii</sup> ) / PV (24 years of generation)
ROC Revenue (post PPA discount)	£38	Amount that generator can expect to receive over the lifetime of their plant, i.e. PV (20 years of ROC revenue) / PV (24 years of generation)
Other revenues (LEC post PPA discount and Capacity Market Revenue)	£5	Amount that the generator can expect to receive over the lifetime of their plant from LECs, and after RO support ends from the Capacity Mechanism, i.e. PV (4 years of CM revenue and 24 years of LEC post PPA discount revenue) / PV (24 years of generation)
<b>Lifetime Levelised Revenue (Under RO)</b>	<b>£94</b>	<b>£/MWh amount that the generator can expect to receive over the lifetime of their plant (using RO hurdle rate)</b>

**Stage 2: Adjust the RO levelised revenue for the key differences as a result of the CfD to get to the lifetime levelised revenue for the CfD**

Hurdle Rate Impact	-£2	Reduced costs of financing for investors means that less revenue is required for the generator so support can be reduced
<b>Lifetime levelised revenue required for the CfD</b>	<b>=£92</b>	

**Stage 3: Identify how much of the levelised revenue required needs to come from the strike price after accounting for other revenue streams if CfD contract lasted full lifetime (24 years)**

Other revenues (LEC and CM Revenue)	-£6	Generators are assumed to be still entitled to LEC payments and so the strike price can be reduced by an equivalent amount. In addition Capacity Mechanism revenues are received after the end of the CfD contract.
Wholesale PPA Discount	+£6	Generators would not be able to achieve the levelised revenue if the strike price was set at this level due to a PPA discount on the wholesale price. Therefore the strike price must increase to ensure the same level of support.
<b>Strike Price assuming support is spread over the life of the plant (24 years)</b>	<b>=£92</b>	

**Stage 4: Adjust the strike price for the shorter contract length**

Contract Length Impact	+£8	Levelised revenue covers the whole lifetime of the plant. However, strike prices are based on support for only 15 years of operation, and therefore strike prices must be set at a higher level to compensate generators for this.
<b>Strike Price</b>	<b>£100</b>	

**Stage 5: RO-X strike price for onshore wind in 2015/16 is £100.**

<sup>i</sup>PV = Present value. This gives the formula for levelised revenues, i.e. discounted revenues divided by discounted lifetime generation.

<sup>ii</sup>Wholesale price projections taken from National Grid's core scenario which reaches 32% renewable generation in 2020, with 5 years' foresight applied. See footnote 5.

## Comparison of support levels under the RO and CfDs

10. It is important that comparison of support levels between the RO and CfDs is carried out over a consistent time period because of the difference in the length of support.
11. The RO and CfDs can be compared by looking at the average support cost (per MWh) to consumers over the lifetime of the plant<sup>13,14</sup>. This is calculated by taking the present value of support payments and dividing by the present value of generation. The discount rate used is the social discount rate of 3.5%. Table 1 shows the difference in support costs for the RO and CfDs<sup>15</sup> for key renewable technologies.

**Table 1. Comparison of levelised support costs for key renewable technologies commissioning in 2015/16 under the RO or CfDs using the social discount rate**

(2012 £/MWh)	Under the RO	Under CfDs	CfD saving
<b>Onshore wind</b>	37	25	11
<b>Offshore wind</b>	84	66	17
<b>Biomass conversion*</b>	44	41	3

\*Support for biomass conversions ceases in 2027 under both the RO and CfDs.

12. From the consumer perspective, three key factors drive the differences between the RO and CfD support in Table 1:
- The lower hurdle rate under CfDs;
  - The shorter contract length for CfDs; and
  - Wholesale electricity prices are increasing over time resulting in a declining profile of CfD top-up payments, compared to fixed RPI-linked payments under the RO.

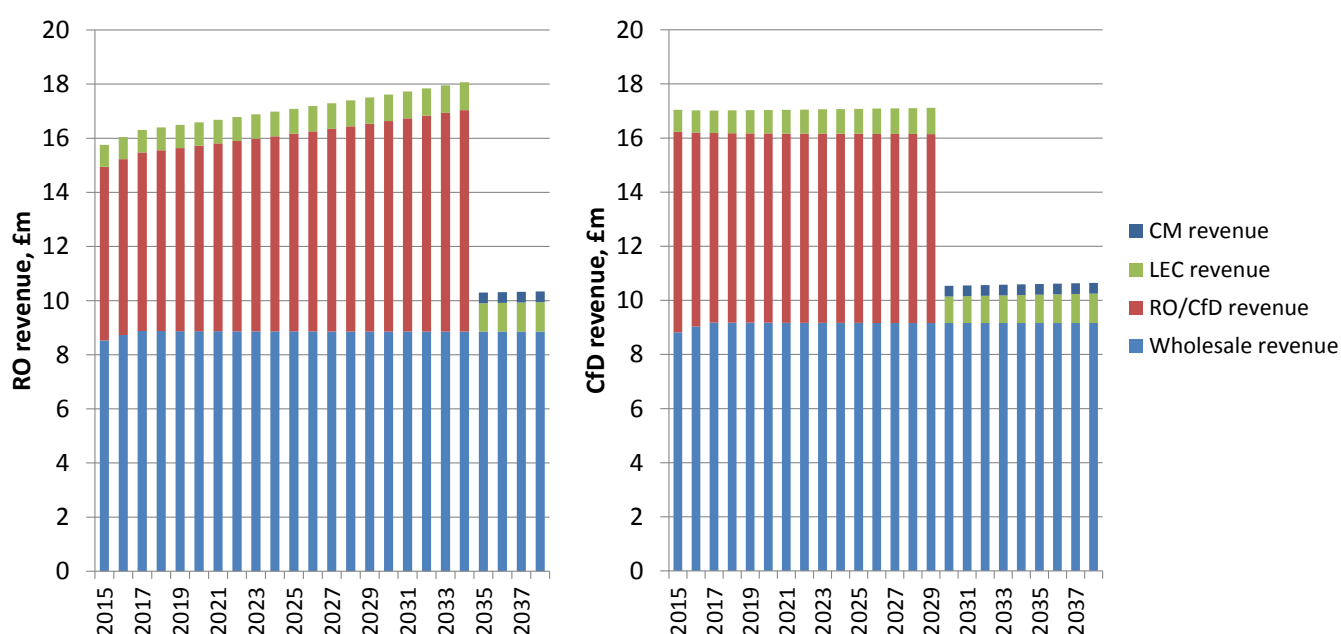
<sup>13</sup> This comparison refers only to RO and CfD support costs from the consumer perspective. If instead the levelised revenues (see footnote 8 for details of revenues considered) of a project under the RO and CfDs are compared using the investor hurdle rate, the difference between the two support mechanisms is significantly smaller, and defined by the reduced hurdle rate under CfDs, and any differences in PPA discounts. As an example, the difference for onshore wind commissioning in 2015/16 is £3/MWh.

<sup>14</sup> The comparison of support payments from a consumer perspective cannot be used to directly compare strike prices with support under the RO from the perspective of an investor.

<sup>15</sup> To calculate the CfD support payments, the wholesale price projections from National Grid's core scenario reaching 32% renewable generation in 2020 were used.



13. To illustrate the uncertainty of support costs to future electricity wholesale prices we have also estimated the level of support under CfDs for a high fossil fuel prices/high wholesale price scenario and for a low fossil fuel prices/low wholesale price scenario. This results in a range of levelised support costs under CfDs (in 2012 £/MWh for projects commissioning in 2015/16) of £13/MWh to £39/MWh for onshore wind, £54/MWh to £80/MWh for offshore wind and £25/MWh to £59/MWh for biomass conversion.
14. To illustrate the assumed investor perspective, Figure 1 shows modelled investor expectations of revenues under the RO and CfDs for onshore wind commissioning in 2015/16. This is illustrative of the lower level of support under CfDs – although CfD support payments in early years are higher than under the RO, they do not increase over time. By contrast, RO payments increase each year as a result of RPI rather than CPI indexing, and are for 20 years compared to 15 years of CfD payments.



**Figure 1. Modelled investor expectations of revenues for a generic onshore wind plant commissioning in 2015/16 under the RO (left) and CfDs (right) in CPI real terms.**

### Treatment of different risk allocation between the RO and CfD in setting of strike prices

15. Examining the risks for renewables plants under the RO regime vs. the CfD (Table 2), overall CfDs should reduce risks and hence the cost of capital. This is reflected in the

hurdle rate reduction assumptions based on work by Redpoint (2010)<sup>16</sup> and broadly corroborated by CEPA (2011)<sup>17</sup>.

**Table 2. Risks for renewables plants under the RO regime compared to the CfD**

Risk area	Treatment under RO regime	Proposed treatment under generic CfD	Our assessment of the impact of CfD on this risk
<p><b>1) Variability of overall revenue and offtake risk</b></p>	<p>Electricity offtake risk, forecasting/balancing risk and wholesale price risk sit with generators, mitigated (at a cost) through vertical integration and/or in some cases through PPAs</p> <p>Support payments are in certificates that independents have to sell to suppliers at a cost/risk, but the Obligation may provide an incentive on some suppliers to purchase renewable electricity over other forms of electricity.</p>	<p>Long term wholesale price risk removed, stabilising revenues.</p> <p>Offtake and forecasting/balancing risks remain with generators. Again, some generators may pay to mitigate offtake and imbalance risk through PPAs.</p> <p>Support payments in cash.</p>	<p>Reduction</p>
<p><b>2) Risk of change of support levels</b></p>	<p>Policy of grandfathering existing investments under the RO, but cannot fetter SoS discretion to change support levels for new or existing RO generators.</p>	<p>CfD allocation at earlier stage of project development locks in the strike price that a project will eventually receive at a far earlier stage than the RO.</p> <p>Strike price set in contract with no mechanism for SoS to change support levels.</p>	<p>Reduction</p>

<sup>16</sup> 'Electricity Market Reform: Analysis of policy options', Redpoint (2010)  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/42638/1043-emr-analysis-policy-options.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42638/1043-emr-analysis-policy-options.pdf)

<sup>17</sup> 'Note on Impacts of the CfD FIT support package on costs and availability of capital and on existing discounts in power purchase agreements, CEPA (2011)  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48136/2174-cepa-paper.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48136/2174-cepa-paper.pdf)

Risk area	Treatment under RO regime	Proposed treatment under generic CfD	Our assessment of the impact of CfD on this risk
<b>3) Visibility and future market</b>	<p>Four years of visibility given in banding reviews but can be revised post-financial commitment and before the point of generator accreditation.</p> <p>Budget managed through revisions to RO bandings.</p>	<p>Five years of strike prices known at the time of the publication of the Delivery Plan, and locked in for each project at the point of allocation.</p> <p>Can similarly be revised for the later years in annual updates to the Delivery Plan.</p> <p>Potential for CfD allocation to be rationed in the event that more projects apply than can be supported by the available budget.</p>	<p>Both the RO and CfDs need to operate within the same budget envelope.</p> <p>CfD provides more certainty over the level of support. CfD may provide less certainty over whether there will be support if constrained allocation is triggered, whilst RO budget management would be through revisions to support levels - no clear net effect.</p>
<b>4) Credit risk</b>	<p>The tradable certificate (the ROC) may be sold to alternative suppliers or auctioned in circumstances of off-taker default. The recycle value to suppliers and hence the price paid to generators can vary but is protected against supplier bankruptcy through the RO Mutualisation Fund.</p>	<p>The CfD Counterparty (a government-owned private body, but with no direct guarantee) will establish a framework of backstops to ensure payment, including the requirement for suppliers to post collateral, a mutualisation system and a Supplier of Last Resort Scheme and Energy Company Administration Scheme.</p>	<p>No clear net effect.</p>

Risk area	Treatment under RO regime	Proposed treatment under generic CfD	Our assessment of the impact of CfD on this risk
<b>5) Change in Law</b>	No Change in Law (CiL) protection is available in the RO. However generators may be able to recover some costs arising from certain changes in law (but only to the extent that they change the wholesale electricity price), or buy protection for some CiL risks through their PPA.	<p>Some contractual protection is provided for both specific and discriminatory changes (in contrast to RO), and for general changes in law that have discriminatory effects without objective justification. This includes protection against events that would not be reflected in the wholesale price.</p> <p>No protection for other general CiL, and thus unable to benefit from some changes in law to the extent that this is passed through to wholesale prices due to a fixed strike price.</p> <p>Protection against certain changes in network charges, relating to the costs of the balancing system and transmission losses.</p> <p>Protection extends to such changes in law that limit a generator's ability to either deliver its output or to receive appropriate payment.</p> <p>As under the RO, generators would be able to buy additional protection through a PPA.</p>	Reduction.
<b>6) Indexation</b>	Expected RO price each year linked to RPI; wholesale price may reflect inflation of costs of the marginal plant.	Strike price fully indexed to CPI.	No material change to risk, but differential in revenue inflation reflected in strike price.
<b>7) Refinancing</b>	No refinancing gain share provisions/requirements.	No refinancing clause in the generic CfD contract <sup>18</sup> .	No change.
<b>8) Duration</b>	Exposure to wholesale market risks for the entire asset life with 20 years of top-up support (except for biomass conversions).	15 years of support (except for biomass conversions), then exposure to market risks with no top-up payments after 15 years (but heavily discounted in the investment decision).	No clear net effect to risk, but differential support duration reflected in strike price.

<sup>18</sup> Bilaterally negotiated CfDs for large projects may have different approaches, including possible refinancing clauses, but might have different strike prices.

## Strike prices after the closure of the RO (2017/18 and 2018/19)

16. The strike prices in 2017/18 and 2018/19 do not overlap with the RO regime. In this period, strike prices are defined by factors including the affordability constraint presented by the LCF, as well as expectations of future technology costs.
17. There is significant uncertainty about how costs of certain technologies will evolve over time, due to learning from international or UK deployment. In general, estimates of the cost of different electricity generating technologies in the future is driven by expectations and assumptions of technology specific learning rates and global and UK deployment. The data sources referenced in the report from DECC (2013)<sup>19</sup> and the System Operator (2013)<sup>20</sup> set out more detailed information about the learning and deployment scenarios used. In general, IEA projections are the main source of global deployment for all technologies. Notable exceptions are ACT, marine and offshore wind.
18. For offshore wind The Government considers two major sources of evidence on costs for projects commissioning from 2017: the modelled deployment and learning rates based on the approach used for the Renewables Obligation Banding Review<sup>21</sup>; and recent evidence from the Crown Estate Offshore wind cost reduction pathways study<sup>22</sup> and the Offshore Wind Cost Reduction Task Force<sup>23</sup> which demonstrate paths to £100/MWh by 2020, implying a faster rate of cost reduction than those derived from modelled deployment and the learning rates from the ROBR.
19. A further factor is the requirement to stay within the agreed LCF profile of expenditure. Strike prices need to be consistent with levels of expenditure within this constraint.

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<sup>19</sup> See footnote 1.

<sup>20</sup> See footnote 5.

<sup>21</sup> Under this approach, a learning rate of 12% is used for offshore wind (ARUP 2011), i.e. every doubling of cumulative deployment is associated with a reduction in costs of 12%. See footnote 11 for reference.

<sup>22</sup> <http://www.thecrownestate.co.uk/media/305094/Offshore%20wind%20cost%20reduction%20pathways%20study.pdf>

<sup>23</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/66776/5584-offshore-wind-cost-reduction-task-force-report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66776/5584-offshore-wind-cost-reduction-task-force-report.pdf)

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