**The material in this paper is work in progress and is not a statement of government policy or policy intent**

**OFF-TAKER OF LAST RESORT ADVISORY GROUP PAPER 4   
BARINGA SUPPORTING PAPER B**

**Introduction**

1. Paper 3.3 submitted to the OLR advisory group considers the terms and conditions of the Backstop PPA.
2. One of the key design features of the CfD design is that the top-up payment is capped at the level of the strike price. For a CfD linked to the DA index, this therefore leaves the risk of negative pricing in the market with the generator, but reduces aggregate imbalance cost by providing a market signal to the generator to take the decision to self-curtail ahead of gate closure in the event of oversupply.
3. In relation to these incentives to self-curtail in both the day-ahead and intra-day markets, this paper looks to explore three questions:
   1. What are the incentives to self-curtail for a generator with an intermittent CfD who is trading directly in the market?
   2. How might these incentives be mirrored in the contractual provisions in a normal commercial PPA?
   3. Finally, how might these provisions change the incentives / impact on backstop offtakers under a backstop PPA?
4. We note that this analysis assumes that the generator is taking the risk of negative pricing in the day-ahead market, while the offtaker is taking imbalance risk (including basis risk with a move in power prices within day).

**Incentives to self-curtail in the DAH market**

*Incentives where there is no PPA*

1. In periods of negative pricing in the day-ahead market, the generator’s all in revenue will fall below the level of its strike price. There will be a point where the costs of generating (i.e. the generator’s SRMC plus the cost of paying the market to take its power) willexceed the top up (i.e. strike price) that it will earn for generating.
2. This will be the point at which the generator will be incentivised to decide not to sell its power and curtail its output in that half-hourly period.
3. For example, if a generator has a strike price of £100/MWh and a short run marginal cost (i.e. trading costs, average imbalance costs etc) of £10/MWh, it would decide to curtail its output at the point that prices in the day-ahead market fall below -£90/MWh.

*Maintaining incentives under market PPAs*

1. The PPA must ensure that the offtaker is appropriately incentivised to send a signal to the generator to curtail its output in the event that it would be more expensive to generate than the generator will receive in revenue.
2. Where the generator is taking negative price risk (as is assumed), then the PPA is likely to include the following provisions:
   1. ***Index Pass Through*** - The offtaker will be entitled to pass any negative pricing back to the generator in the DAH index to which electricity sales under the PPA are indexed.
   2. ***Pass Through Cap*** - However, the offtaker’s ability to pass negative prices back to the generator will be capped at the level at which, if the generator was actually marketing its power itself in the market, it would chose to self-curtail. This will be the generator’s top up less its short run marginal cost (including the PPA discount).
   3. ***Right of curtailment*** - However, to ensure that the offtaker does not then have an open ended commitment to continue to sell the generator’s power in the market notwithstanding the fact that its pass through top the generator is capped, the PPA would grant the offtaker the right to instruct the generator to curtail output.
   4. ***Curtailment incentive*** - The offtaker would therefore be incentivised to take the decision to instruct the generator to self-curtail where the prices in the day-ahead market reached the level of the Pass Through Cap.
   5. ***No compensation*** – The offtaker would not be required to compensate the generator in this scenario because the generators lost opportunity cost is zero.
3. A worked example is set out in Box [1] below:

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| Box 1 – Worked example showing incentives on the offtaker to curtail generator in the event of negative pricing in the day-ahead market   * A generator has a strike price of £100/MWh, and a PPA discount of £20/MWh * Where prices go negative, the offtaker will be passing through the liability to the generator under the PPA. * However, this pass through is capped at the value of the top-up that the generator will receive if it generates, net of the generator’s its short run marginal costs being its PPA discount (i.e. £100/MWh less £20 = £80MWh)[[1]](#footnote-1). * As such, when negative prices reach -£80/MWh (i.e. the cap), it would curtail the generator. * No compensation would be payable to the generator as its lost opportunity cost in this scenario is zero (i.e. market prices of -£80/MWh plus its top of £100/MWh less its SMRC of £20/MWh). * It is worth noting this example set out above assumes that the discount of £20/MWh being charged by the offtaker under the PPA is the *actual cost* of trading and imbalance. * If, however, the PPA discount includes a margin of, say £10/MWh, the offtaker may chose not to curtail the generator at the Pass Through Cap of -80/MWh, but instead keep selling the generator’s power into the market up to -£90/MWh since, up to that point, the offtaker will still be making money on the sale. |

*Maintaining incentives under the OLR*

1. We imagine the same provisions should be included in the Backstop PPA.
2. However it is worth noting that under the Backstop PPA, the incentives might be different owing to the fact that the discount being charged by the backstop offtaker *does not in fact reflect that actual imbalance and trading costs of marketing that power on the generators behalf*.
3. One might imagine, therefore, that the backstop offtaker might curtail the generator *before* the point at which the negative prices equal the Pass Through Cap. This is explained in a worked example in Box [2].

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| Box 2 – Worked example showing incentives on a backstop offtaker to curtail a generator in the event of negative pricing in the day-ahead market   * A generator has a strike price of £100/MWh and a backstop PPA with a discount of £20/MWh. * Imbalance costs rise to £30/MWh and it therefore enters the OLR and is allocated to a backstop offtaker. * Where prices go negative, the backstop offtaker will be passing through the liability to the generator under the backstop PPA. * As before, this pass through is capped at the value of the top-up that the generator will receive if it generates, net of its short run marginal costs, being its PPA discount (i.e. £100/MWh less £20 = £80MWh)[[2]](#footnote-2). * If the offtaker instructs the generator to curtail where the prices reach the level of the pass though cap (i.e. -£80/MWh) as it did in the example above, it will in fact be making a £10 loss. * This is because the actual cost to the offtaker of marketing that generators power is £30/MWh, not the £20/MWh fixed discount in the generator’s backstop PPA. * As such the backstop offtaker might instead look to curtail the generator where prices fall to -£70/MWh, and chose to pay the generator £10 in compensation to leave it indifferent to that decision. * It will therefore be important to consider how this cost to a backstop offtaker is reflected in the cost assessment process against which backstop offtakers are levelised (and the materiality of it given the probability of negative pricing). |

**Incentives to self-curtail in the intra-day market**

*Incentives where no PPA*

1. If the generator’s forecast has not changed from the day-ahead stage (where we assume it has contracted 100% of its output), a generator should self-curtail in the intra-day markets where negative prices reach a level where it would make more sense for it to curtail its output and instead satisfy its day-ahead contacted position with power sourced in the intra-day market.
2. This point will be where the market is paying the generator more than the top up the generator will receive if it generates (net of its SRMC). This is explained in a worked example in Box [3] below.

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| Box [3] – Worked example showing incentives on a generator to self-curtail in the event of negative pricing in the intra-day market (assuming no change in forecast output from day-ahead stage)   * A generator has a strike price of £100/MWh and its SRMC of generating is £10/MWh. * It contracts 100% of its forecast output in the day-ahead market at the clearing price of £30/MWh. * Where prices in the intra-day market fall below -£60/MWh, the generator would be better off curtailing its output. * This is because it can avoid its SMRC of £10/MWh and instead be paid £60/MWh by the market to take delivery of power being sold in the intra-day market and use that to satisfy its day-ahead contract, for which it will receive £30/MWh (giving it all in revenue of £90/MWh). |

1. The example above assumes that there is no change in forecast output between the day-ahead and intra-day stage. In reality, this may not be the case which will impact the incentives around self-curtailment in the intra-day market.
2. If the forecast output at gate closure is less than what was contracted at day-ahead stage, then a generator should be incentivised to self-curtail earlier (i.e. higher prices) than it would have done if its day-ahead forecast had been accurate.
3. Conversely, if the forecast output at gate closure is greater than what was contracted at day-ahead stage, then a generator should be incentivised to self-curtail later (i.e. at lower prices) than it would have done if its day-ahead forecast had been accurate. This is explained in more detail with a worked example in Box 4 below (assuming an increase in output from day-ahead stage).

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| Box [4] – Worked example showing incentives on a generator to self-curtail in the event of negative pricing in the intra-day market (assuming an increase in forecast output from day-ahead stage)   * A generator has a strike price of £100/MWh and its short run marginal cost of generating is £10/MWh. * It contracts 100% of its forecast output of 100MWh in the day-ahead market at the clearing price of £30/MWh. * However at gate closure, it is now forecasting 110MWh. * As such, prices would have to fall to -£69/MWh (rather than -£60/MWh in the example above where there is no change in forecast output) before the generator would be better off curtailing its output and satisfying its day-ahead position with power sourced in the intra-day market. * This is because this additional 10MWh has not been contracted at day-ahead stage and therefore will cost the generator the full £90/MWh in lost opportunity cost if curtailed (which when divided by the forecast error of 10MWh equals an additional cost of £9/MWh)[[3]](#footnote-3) |

*Maintaining incentives under market PPAs*

1. The incentives as set out above are maintained if an offtaker is granted a general curtailment right, with an obligation to pay compensation to the generator equal to:
   1. the day-ahead index price for that period; *plus*
   2. the top up payment that the generator would have received if it had generated; *less*
   3. its short run marginal costs of generating (which would include the PPA discount).
2. This is explained in Box 5 below, using the simple example where there is no change in forecast output from day-ahead stage.

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| Box [5] – Worked example showing incentives on an offtaker to curtail a generator in the event of negative pricing in the intra-day market (assuming no change in forecast output from day-ahead stage)   * A generator has a strike price of £100/MWh and PPA with an offtaker with a £20/MWh discount. * The offtaker sells 100% of forecast output in the day-ahead market at the clearing price of £30/MWh * Where prices in the intra-day market fall below -£50/MWh, the offtaker would be better off curtailing the generator’s output. * This is because being paid £50/MWh to accept power in the day-ahead market, and using that to satisfy its earlier day-ahead contract for which is will receive £30/MWh equals the cost of compensating the generator at £80/MWh (i.e. £100/MWh less the discount of £20/MWh). * As with curtailment incentives in the day-ahead market with a PPA overlay, if the real cost of marketing the generators power is in fact £10/MWh (i.e. the £20/MWh discount includes a £10/MWh margin), the offtaker may choose to continue to market that generator’s power in the intra-day market until prices reach -60/MWh. |

*Maintaining incentives under the OLR*

1. We imagine the same contractual provisions (i.e. curtailment right and compensation) being included in the Backstop PPA.
2. However, as with curtailment in the day-ahead market, it is worth noting that under the Backstop PPA, the incentives might be different owing to the fact that *the discount being charged by the backstop offtaker does not in fact reflect that actual imbalance and trading costs of marketing that power on the generators behalf*.
3. One might imagine, therefore, that the Backstop Offtaker might curtail the generator *before* the point at which prices in the intra-day market reach minus the generator’ strike prices less the discount in the backstop PPA.
4. This is demonstrated in a worked example in Box [6] (again this used the simple example where there is no change in the forecast from day-ahead to intra-day stage).

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| Box [6] – Worked example showing incentives on a backstop offtaker to curtail a generator in the event of negative pricing in the intra-day market (assuming no change in forecast output from day-ahead stage)   * A generator has a strike price of £100/MWh and a backstop PPA with a discount of £20/MWh. * Imbalance costs rise to £30/MWh and it therefore enters the OLR and is allocated to a backstop offtaker. * For a given half hourly period, the offtaker sells 100% of forecast output in the day-ahead market at the clearing price of £30/MWh. * The efficient point of curtailment in the intra-day market is now -£40/MWh (rather than -£50/MWh in the example above) as the actual cost of trading that power is £30/MWh not £20/MWh as before. * However, in the event that the backstop offtaker exercises that right of curtailment, it will be required to pay the generator compensation of -£80/MWh meaning it will make a £10/MWh loss (as it is only receiving £30/MWh under its day-ahead sale plus £40/MWh under its intra-day purchase). * Again, this potential cost may need to be considered as part of the regulated cost assessment process (to the extent deemed material). |

1. This example, and the examples below, assumes that the generator has no other cost of generating other than the discount in pays to the offtaker under its PPA. [↑](#footnote-ref-1)
2. Again, this example assumes that the generator has no other cost of generating other than the discount in pays to the offtaker under its backstop PPA. [↑](#footnote-ref-2)
3. Point of self-curtailment intra-day = ((DAH Price x DAH Forecast) – ((Top-Up – SMRC) x Gate Closure Forecast)) / DAH Forecast [↑](#footnote-ref-3)