Draft Determination Supporting Document NGET Finance Annex FQ10 Technical report - Outperformance wedge

As a part of the NGET Draft Determination Response

nationalgrid

OUTPERFORMANCE WEDGE

Potential performance in RIIO-T2 – report for National Grid

4 September 2020

CONTENTS

EXECUTIVE SUMMARY

Ofgem published its RIIO-2 Draft Determinations (DD) on 9th July. As part of its proposals, Ofgem incorporated a reduction in the allowed return on equity of 25bps, relative to Ofgem's point estimate of the true cost of equity. According to Ofgem, this is to account for anticipated outperformance by licensees with respect to regulatory targets. We refer to this adjustment as the "outperformance wedge".

Frontier has consistently been of the view, as a matter of principle, that the imposition of any outperformance wedge is unjustified, unnecessary, and counter-productive to the underlying objectives of the regulator. In particular, it runs counter to the regulators' objective to protect the interests of customers in the short- and long-run. We continue to be of the firmest view against the imposition of an outperformance wedge on the allowed return on equity, as a matter of principle.

Nevertheless, since Ofgem is minded to introduce an outperformance wedge, it remains important to consider whether there is any evidence to support a view that one might reasonably expect outperformance of 25 bps. To that end, this report has been commissioned by National Grid to provide an evaluation of whether Ofgem has reasonable evidential basis to impose the outperformance wedge. The report builds on similar work we previously undertook for NGN (and which was submitted to Ofgem to inform discussions around the wedge).

We have modelled the overall performance of National Grid Gas Transmission (NGGT) and National Grid Electricity Transmission (NGET) in RIIO-T2 using a Monte Carlo simulation analysis. Inevitably, any forward-looking analysis of this type will be driven, at least in part, by the assumptions made. Throughout this report, we explain and justify all of our assumptions, and provide a number of sensitivities to check the robustness of the results. We have sought to take into account the specific comments that Ofgem had on our 2019 report, and we believe that our updated work fully reflects the guidance that Ofgem has provided. Our guiding principle has been to adopt, where appropriate, broadly conservative assumptions – meaning our results are likely to over-state the true potential returns that can be expected from the price control package.

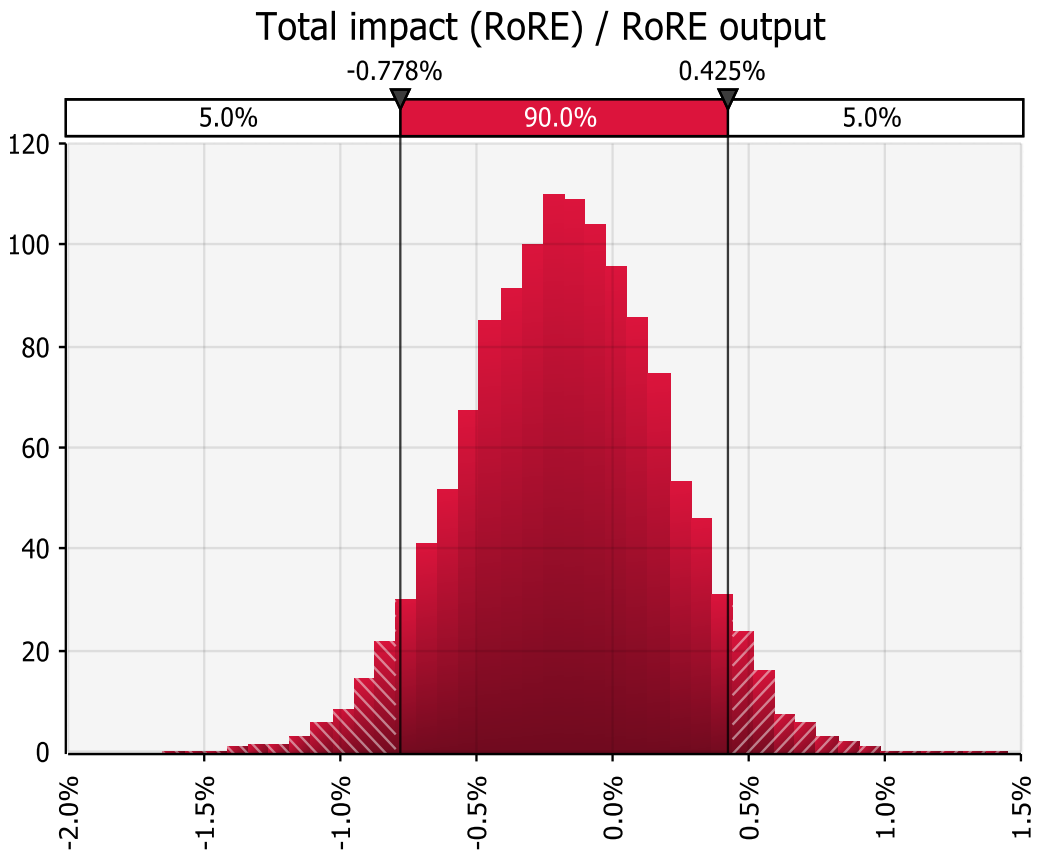
Results

Our baseline approach results in an estimated expectation of:

- a -16bps underperformance in RoRE terms, for NGGT, which is equivalent to an absolute underperformance of -£4m per year; and
- a -26bps underperformance in RoRE terms, for NGET, which is equivalent to an absolute underperformance of -£16m per year.

Figure 1 and Figure 2 below shows the Monte Carlo simulation results of our baseline model for NGGT and NGET.

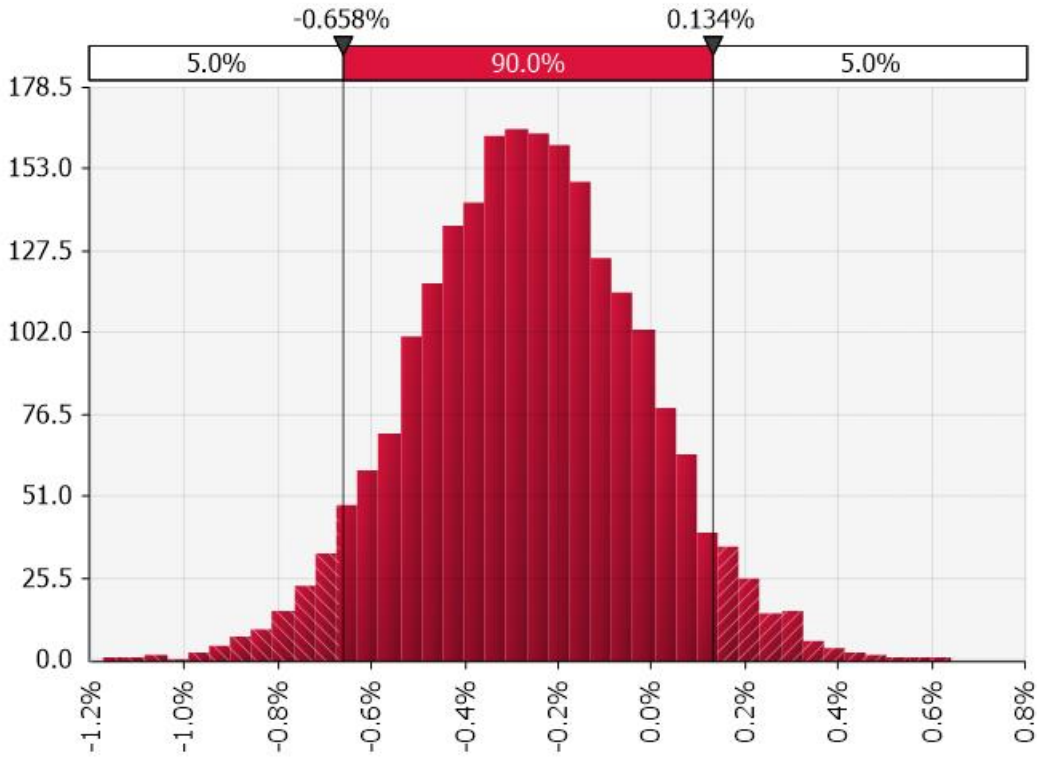
Figure 1 NGGT baseline model results – total impact (RoRE terms)



Source: *Frontier Economics analysis using @RISK*

Note: *The X-axis measures RoRE out/underperformance and the Y-axis measures the frequency of occurrences.*

Figure 2 NGET baseline model results – total impact (RoRE terms)



Source: *Frontier Economics analysis using @RISK*

Note: *The X-axis measures RoRE out/underperformance and the Y-axis measures the frequency of occurrences.*

The analysis shows that there is only a 13% chance that NGGT achieves outperformance at or above 25bps; and only a 2% chance that NGET achieves 25bps outperformance. In other words, National Grid can have every expectation that it will achieve less than 25bps of outperformance from the RIIO-2 package, and in fact the clear balance of probability is that National Grid will underperform, based on the DD proposals.

We also calculate that around 11% totex outperformance would be necessary for NGGT to achieve an expected outperformance of 25bps under our base case assumptions. For NGET the totex outperformance required is 26%. Given the constraints on totex in RIIO-2 (outlined in Section 3), we consider it is highly unlikely that NGGT or NGET would be able to outperform the T2 DD proposals by 25bps.

Figure 3 and Figure 4 provide more detail on the results arising for each incentive. This shows the following key results.

- The main driver behind the average expected underperformance in our base scenario for both NGGT and NGET is the Business Plan Incentive, which will have a significant negative impact on RoRE performance at RIIO-2.
- However, even if the BPI was removed from this analysis, the results do not support an outperformance wedge of 25 bps - particularly given the number of conservative assumptions that tend to bias our results upwards.
- The additional incentives have a broadly neutral expected impact in our base case. The range of outcomes on ODIs is generally very narrow - according to

our modelling the **maximum** P95 level of outperformance available across all ODIs is around 35bps of for NGGT, and 11bps for NGET – and this would only be achieved if maximum performance on every incentive is delivered simultaneously. Even here, our modelling approach embeds several conservative assumptions which implies that even this maximum upside from ODIs is likely, in fact, to be lower.

- As a consequence, it is clear that any assessment of likely outperformance in RIIO-T2 should focus primarily on totex. Here, we consider that any balanced assessment of the DD proposals would conclude that future performance is, at best, mean-zero (although we are aware that NG considers Ofgem's allowances to be insufficient to enable it to deliver its statutory duties, meaning that in reality the mean expected outperformance is more likely to be negative). Our totex modelling also splits out the effect of PCDs and NARMs but, again, adopts a conservative approach with a mean of zero, ignoring the real downside risks associated with both mechanisms.
- We also note that the skew of plausible outcomes is clearly to the downside, suggesting an asymmetrically calibrated price control.

Figure 3 Summary of incentive contributions to estimated underperformance - NGGT

NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	0.00%	-0.54% to 0.54%	0.00	-12.52 to 12.51
PCD	0.00%	-0.20% to 0.20%	0.00	-4.59 to 4.58
NARM	0.00%	-0.15% to 0.15%	0.00	-3.58 to 3.58
Entry and exit CCM	0.00%	-0.09% to 0.09%	0.00	-2.18 to 2.18
Customer satisfaction survey	0.07%	-0.12% to 0.20%	1.73	-2.84 to 4.69
Quality of demand forecast	0.00%	-0.00% to 0.00%	0.02	-0.03 to 0.07
Maintenance	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Residual balancing	0.02%	0.00% to 0.04%	0.53	0.20 to 0.86
Greenhouse gas emissions (venting)	-0.03%	-0.06% to 0.02%	-0.63	-1.5 to 0.43
BPI	-0.23%		-5.28	
Total impact	-0.16%	-0.75% to 0.43%	-3.64	-17.50 to 10.12

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Figure 4 Summary of incentive contributions to estimated underperformance - NGET

NGET	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Totex (excl. NARMs and PCDs)	0%	-0.28% to 0.28%	0.00	-16.8 to 16.8
PCD	0%	-0.23% to 0.23%	0.00	-14.04 to 14.04
NARM	0%	-0.08% to 0.08%	0.00	-4.99 to 4.99
Quality of connections	-0.03%	-0.10% to 0.08%	-1.57	-6.26 to 4.68
Energy not supplied	0.01%	-0.02% to 0.02%	0.79	-0.14 to 1.42
IIG Leakage	-0.03%	-0.06% to 0.01%	-1.73	-3.7 to 0.49
BPI	-0.22%		-13.20	
Total impact	-0.26%	-1.17% to 0.64%	-15.83	-39.39 to 8.02

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Conclusion

Our baseline results suggest that there is no evidence to justify Ofgem's 25 bps outperformance wedge. Given the RIIO-2 DD proposals, companies will in all likelihood underperform in RIIO-2. Even though there is, of course, a chance that outperformance reaches above 25bps, we do not consider it to be a reasonable exercise of regulatory judgement for Ofgem to base such a key regulatory decision on a scenario with such low likelihood – only 13% for NGGT and 2% for NGET. The degree of totex outperformance that would be required to reach 25bps (given that the ranges around the ODIs are generally very narrow) is simply implausible, given Ofgem's allowances and the number of mechanisms designed to constrain outperformance to a minimum.

We emphasise that our results arise despite the fact that we have introduced several conservative assumptions that mean our results are likely, in fact, to over-state the actual potential to outperform.

- On totex, we assume a mean expected outperformance of zero. However, we are of the view that the DD is likely to actually result in underperformance for the NG, given the changes that have been introduced in RIIO-2. A full explanation of these changes can be found in our ENA report, but they include, for example, a tougher approach to cost assessment, setting what appear to be highly stretching productivity targets given the evidence put forward, ramped down incentives, the removal of IQI interpolation, and more costs exposed to indexing or ex post true up than before. Given this, we anticipate that mean zero is a conservative assumption. We also note that NGGT has underperformed in RIIO-1. Given this, we anticipate that mean zero is a

conservative assumption. In the not-implausible scenario where there is 2% underperformance on totex, this could lead to a further downside of around 4bps for NGET and 7bps for NGGT;

- While we have modelled the effect of PCDs and NARM on totex incentives separately, we have ignored some material drivers of downside risk – for example the potential for late delivery penalties on some PCDs; and the asymmetric skew of risk associated with the NARM incentive (due to the Delivery Adjustment Factor, and the asymmetric application of tests for "genuine" under/over-spends). We have also ignored the asymmetric incentives around risk-target delivery – i.e. the fact that there is no upside for "justified" departures from the NARM target, but downside penalties for any "unjustified" departures.
- For NGGT's CCM, we conservatively assume Ofgem has correctly calibrated the incentive, rather than taking into account the downside view put forward by NGGT (which we test in a sensitivity);
- For NGGT's expected outcome on customer satisfaction, we conservatively assume continued improvement and outperformance at T2;
- For NGGT's maintenance incentive, we only model one of the three downside-only incentives, albeit the effect of the two not modelled is likely to be relatively immaterial;
- For NGET's energy not supplied outcome, we have conservatively chosen not to model the low probability of a large downside;
- We have not modelled the 'timely connections' or 'large project delivery' outputs for NGET, both of which are 'penalty-only' incentives; and
- Our assumptions on cross-correlations across NGGT and NGET leads to a larger range of outperformance, and therefore a higher probability of outperformance.

In addition to these issues, Ofgem has imposed a penalty on NGET of £556m during RIIO-2, referred to as the T1 Clawback. Since this does not explicitly relate to the RIIO-2 price controls, we have chosen not to model the impact on RoRE outcomes on RIIO-2. However, it is clearly a material issue that will reduce revenues in RIIO-2. In RoRE terms, the T1 Clawback implies a reduction in returns of 186bps – which will dwarf the impact of any of the other incentives under RIIO-2. Clearly on that basis the expectation for NGET is a very material underperformance in RIIO-2, even if performance under every incentive was at its maximum.

In short, despite these assumptions which bias our central case results upwards, our analysis still does not support a 25bps wedge. Our findings cast serious doubt over the validity of Ofgem's assumption that 25bps of outperformance can be expected in RIIO-2.

Finally, we note that this report sits alongside two other closely related studies, which have been commissioned as part of the response to Ofgem's DD.

- In our report for the ENA, we have investigated the various analyses Ofgem has put forward in support of its proposals for the outperformance wedge, which Ofgem has provided in the alternative to our Monte Carlo approach.

- We have also undertaken a similar Monte Carlo analysis for NGN.

We recommend that the three reports be considered in conjunction with each other. Collectively they provide consistent and, in our view, overwhelming evidence that the outperformance wedge cannot be justified.

1 INTRODUCTION

Ofgem published its RIIO-2 Draft Determinations (DD) on 9th July.[1] As part of its proposals, Ofgem incorporated a reduction in the allowed return on equity of 25bps, relative to Ofgem's point estimate of the true cost of equity.[2] According to Ofgem, this is to account for anticipated outperformance by licensees with respect to regulatory targets. We refer to this adjustment as the "outperformance wedge".

Ofgem's 25bps DD proposal is lower than the 50bps outperformance wedge which it had indicated (albeit as a placeholder) in its Sector Specific Methodology Decision (SSMD) in May 2019.[3] In response to the SSMD, one of the GDNs – Northern Gas Networks (NGN) – commissioned a report from Frontier (the original NGN/Frontier report[4], dated 27 September 2019) to evaluate the scope for potential outperformance/underperformance in RIIO-GD2. The purpose was to inform the discussion around the specific level of the wedge Ofgem was proposing.

In response to the DD, National Grid (NG) has commissioned this report from Frontier to undertake a similar analysis, in this case to be applied to NG's two transmission businesses – National Grid Electricity Transmission (NGET) and National Grid Gas Transmission (NGGT). As we explain further below, we have adopted the same methodological framework that we used in the original NGN/Frontier report – namely a Monte Carlo analysis to simulate plausible outcomes from the proposed regulatory arrangements. This report seeks to apply that framework to the two transmission sectors; and to reflect the specific set of proposals which have now been crystallised in the DD (meaning a number of uncertainties we faced when producing the original report have been resolved).

1.1 Purpose of the analysis

There was no clear analytical underpinning which specifically justified Ofgem's original 50bps value for the outperformance wedge at the SSMD, nor has any specific calculation been provided in support of Ofgem's DD value of 25bps. In fact, Ofgem states:

> *using our regulatory judgement, we consider that equity investors should expect at least 0.25% in outperformance returns, in addition to the baseline allowed return on equity*[5]

and that

> *For the avoidance of doubt, Step 3 is not designed to entirely or perfectly capture future outperformance.*[6]

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1 https://www.ofgem.gov.uk/publications-and-updates/riio-2-draft-determinations-transmission-gas-distribution-and-electricity-system-operator

2 RIIO-2 Draft Determination – Finance Annex, para 3.108 - 3.148

3 RIIO-2 Sector Specific Methodology Decision, 24 May 2019. Available at https://www.ofgem.gov.uk/system/files/docs/2019/05/riio-2_sector_specific_methodology_decision_-_core_30.5.19.pdf.

4 https://www.northerngasnetworks.co.uk/wp-content/uploads/2019/12/A31-NGN-RIIO-2-Outperformance-Wedge.pdf

5 RIIO-2 DD Finance Annex, 3.139

6 RIIO-2 DD Finance Annex, 3.148

Ofgem's position therefore appears to be that setting a number for the outperformance wedge is not a matter of science, but of judgement. In our view, however, any fair-minded approach to reaching such a judgement should seek to answer these critical questions:

- what are the potential sources of outperformance in RIIO-2?
- how material are they?
- how plausible is it that 25 bps of outperformance can be expected from the RIIO-2 package, given the specific DD proposals?

Such an analysis is inherently forward-looking. As far as possible it should factor in all the possible ups and downs associated with the proposed price control package.

It is also inherently probabilistic – neither Ofgem nor the sector can know for certain what the outcome will be from any given part of the incentive arrangements. This means that, in exercising its judgement, Ofgem should take into account not only the 'expected' or 'average' level of performance, but also the plausible range of scenarios either side of this baseline expectation.

Our objective, therefore, is to answer the questions above by modelling the RIIO-2 package, and to evaluate whether the resulting range of plausible out- or under-performance could justify an ex ante reduction in allowed equity returns of 25bps.

We note, however, that our analysis also serves a further purpose – namely to provide a comprehensive picture of what the RIIO-2 price control package looks like "in the round". The analysis therefore allows Ofgem, companies, investors and stakeholders to get a picture of the likely net effect of all the decisions on individual parameters, allowances and incentives which make up the RIIO-2 package. This enables us to evaluate, for example, the extent of any skew of risk in the overall package (to the downside or upside); and to stress-test scenarios and sensitivities.

Inevitably, any forward-looking analysis of this type will be driven, at least in part, by the assumptions made. Throughout this report, we explain and justify all of our assumptions, and provide a number of sensitivities to check the robustness of the results. Our guiding principle has been to adopt, where appropriate, broadly conservative assumptions – meaning our results are likely to over-state the true upside potential of the price control package. In our view, if this conservative approach still implies that 25bps overall outperformance is unlikely, this should provide clear evidence that the judgement exercised by Ofgem in reaching its 25bps proposal is unjustified.

We accept, of course, that there is room for debate and interpretation around the assumptions that are used. This is why we have run a number of sensitivities to test the robustness of our conclusions. We hope that Ofgem might find our approach and results informative, and we would be open to further engagement with Ofgem prior to the FD.

1.2 Scope

This report focusses on the DD proposals for NGGT and NGET. We are aware that there will be substantial engagement between NG and Ofgem (as well as input

from wider stakeholders) between the DD and the FD which may result in changes to Ofgem's proposals. We are also aware that there may be a number of errors and/or data issues in Ofgem's current proposals that need to be resolved.

In general, we have not sought to reflect any of these potential changes in our analysis. Rather, we have taken the DD proposals as set out by Ofgem on 9th July as the basis for our analysis. It is clear that this overall package must have been internally consistent from Ofgem's perspective (i.e. that Ofgem considered the 25bps wedge was appropriate, given its DD proposals as set out on 9th July). If Ofgem would find it helpful to see an updated analysis reflecting any changes or error corrections it intends to make for FD, we would be happy to discuss the provision of such an update.

We note that the allowances and incentives for the Electricity System Operator (ESO) have been separated from those of NGET in the DD. Consistent with this, we do not consider the ESO price control package in this report and focus only on NGET. In contrast, the allowances and incentives for NGGT incorporate the gas system operator function, and therefore we factor those arrangements into our analysis here.

In the original Frontier/NGN paper, we attempted to set out an analysis which conceptually reflected a "notional" GDN – i.e. where possible basing our analysis on average expected performance for the sector (rather than focussing on NGN specifically). This was a reasonable approach for the gas distribution sector where there are 4 different management groups and 8 different licensees, all of which are broadly comparable in terms of scope and scale. In contrast:

- NGGT is the sole gas transmission operator with its own bespoke set of price control arrangements; and
- while there are two other electricity TOs, the arrangements for electricity also generally reflect a largely bespoke treatment of specific issues for each licensee.

In this report we therefore focus on the NG licensees more specifically, and draw no conclusions as to whether our conclusions would also have applicability for the Scottish ETOs.

1.3 Other Frontier work

Alongside this report, two other closely related studies have been commissioned as part of the response to the Ofgem DD.

- In our report for the ENA, we have investigated the various analyses Ofgem has put forward in support of its proposals for the outperformance wedge, which Ofgem has put forward in the alternative to our Monte Carlo approach. While we do no repeat the detailed findings of that study here, where relevant we have indicated where the conclusions drawn from that study have been used to inform our thinking on the modelling approach in this paper.
- We have also provided an update of the original Frontier/NGN analysis, which provides an updated assessment of the RIIO-GD2 package, reflecting the new information now available in the DD. In that report, we have provided a full

response to the issues Ofgem identified in our original work in its DD.[7] Since the detailed issues are only applicable for the gas distribution control, we do not repeat these detailed points here. However, we do outline our high-level response to Ofgem's review in Section 3 and explain how Ofgem's feedback has informed our approach to the transmission sectors.

While each of these reports should therefore represent a self-contained assessment, it is also clear that there are degrees of overlap and read-across between them. It is also the case that Ofgem has not distinguished between any of the sectors for the purpose of setting a wedge, but rather has applied a blanket 25bps assumption. We therefore recommend that the three reports be considered in conjunction with each other.

1.4 In principle rejection of outperformance wedge

Frontier has consistently been of the view, as a matter of principle, that the imposition of any outperformance wedge is unjustified, unnecessary, and counter-productive to the underlying objectives of the regulator. In particular, it runs counter to the regulators' objective to protect the interests of customers in the short- and long-run. This is for a wide variety of reasons, including:

- The proposed adjustment would create a link between current performance outturn and future return on capital, thereby undermining incentives to make outperformance in the first place and leading to lower levels of dynamic efficiency.
- It would lead to a headline figure for the cost of equity that would not reflect Ofgem's assessment of the true cost of equity, thereby undermining a key incentive for investment.
- Ofgem's arbitrary adjustment undermines past stability and predictability of the UK regulatory model and would weaken investor confidence to the detriment of customers.
- The proposal of a 25bps reduction is arbitrary, not based on robust analysis and reliant on selective data.
- The proposal also reduces the clarity over how any element of the price control has actually been calibrated. Ofgem intends to set the wedge to correct for perceived errors in the calibration of potentially numerous other parts of the price control, but does not set out any further detail over which elements of the price control have been considered or how materially each element has driven this judgement. This weakens stakeholders ability to scrutinise the detail of the price control, and may frustrate focused appeal rights.

A fuller description of these issues is provided in the separate ENA report. As we explain further in that report, it is also the case that other regulators, including Ofwat, the CAA, and the CMA, have all been faced with the same evidence of past outperformance and the same sorts of challenges currently faced by Ofgem, yet they have adopted alternative approaches, rather than resorting to an

[7] RIIO-2 DD Finance Annex, para 3.113 – 3.119.

outperformance wedge. This demonstrates that more direct remedies for issues in previous price controls are available to regulators. Indeed, Ofgem appears to have adopted many such remedies (indexing RPEs being one such example) and yet has still layered the outperformance wedge on top of this.

We also note that, in many cases, some of the costs associated with achieving outperformance are funded through shareholder investment rather than by customers.[8] This has two implications: first, a review purely of regulatory performance may not fully reflect the actual returns earned by shareholders; and second, the likelihood of such voluntary shareholder investment will be diminished in RIIO-2 as a consequence of the wedge. We explain the potential consequences for customers of reduced incentives in our ENA report.

We continue to be of the firmest view against the imposition of an outperformance wedge on the allowed return on equity, as a matter of principle. We note that, in responding to the original Frontier/NGN report, Ofgem stated:

> *We consider it positive that Frontier have engaged on the topic and acknowledge that the allowed and expected return are not identical. We agree with the approach of making estimates of the AR-ER reflective of allowed and expected returns in RIIO-2.*[9]

For the avoidance of any doubt, our analysis should not be taken to imply our tacit agreement with the idea of separating allowed and expected returns for the purpose of setting the allowed return on equity. We were quite clear in our original report that if the results implied negative outperformance, we would not recommend that the allowed return on equity therefore be increased. Even if our analysis showed expected returns well above 25bps, for the reasons outlined above our view is that it would still represent poor regulatory policy to impose an outperformance wedge.

Our report should therefore be understood as an attempt to provide Ofgem with a tool to evaluate its judgement over the proposed level of the wedge at 25 bps. In other words, our report represents the sort of exercise we assume Ofgem would be interested in undertaking to test the validity of its judgements, given Ofgem's disagreement with our in-principle position.

In our view, Ofgem must undertake a careful review of what its price control package means in reality and in-the-round for company expectations in RIIO-2. Otherwise, a 'judgement' that 25bps can be expected for RIIO-2 is entirely abstract and arbitrary.

1.5 Report structure

The remainder of this report is structured as follows:

- section 2 describes the overarching methodology in this study, including setting out the broad steps we have taken and an overview of Monte Carlo analysis techniques; and

[8] While this point applies generally, one example of this is a decision made by NGN's shareholders in GD-1 to make additional pension payments to staff over 55 years old, which encouraged them to retire early. This reduced opex spend in subsequent years.

[9] RIIO-2 DD Finance Annex, Appendix 3, page 193.

- section 3 focusses on the assumptions we have used to model RIIO-2 totex, covering both NGGT and NGET;
- section 4 sets out a detailed description of how we have modelled NGGT's non-totex RIIO-2 incentives;
- section 5 sets out a detailed description of how we have modelled NGET's non-totex RIIO-2 incentives;
- section 6 sets out the overall results from our "base case" models for NGGT and NGET;
- section 7 sets out some sensitivities around our base case;
- section 8 pulls together the conclusions and implications we draw from the results in sections 6 and 7.

2 OVERVIEW OF METHODOLOGY

In this section we:

- first describe the structure and purpose of Monte Carlo simulation;
- second, set out at a high level the steps we have taken for the analysis of NGGT and NGET; and
- third, provide a high-level response to Ofgem's feedback on our original work for NGN, identifying how it has informed our approach here.

2.1 Monte Carlo simulation

Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted, e.g. due to the existence of random variables or shocks.[10] They involve running a large number of simulations of possible outcomes for a given variable, based on a specific expected mean value for that variable; and a probability distribution of potential variation around the mean. The probability distribution can be specified to reflect the particular characteristics of the variable being assessed (for example, by accounting for skew in the likely distribution of outcomes; by modifying the standard deviation of the probability distribution; and/or by using alternative types of distribution e.g. Normal, Bernoulli; or Triangular). More information on the probability distributions used in this analysis is available in Annex C.

In the context of the RIIO price controls, this probabilistic simulation approach is helpful because Ofgem and the companies cannot predict with certainty how companies will perform against their allowances or incentive targets. Performance can therefore be modelled using Monte Carlo simulation, subject to specifying the relevant assumptions for each incentive. The output from each individual simulation is a combination of probabilistically determined out/under-performance for each incentive, which can be aggregated together to derive an overall financial result. With a sufficiently large number of 'draws' from these probabilistic scenarios, an overall distribution of plausible total returns can be estimated by aggregating the output from each individual iteration.

In addition, Monte Carlo analysis enables us to test hypotheses around the extent to which different incentives in a price control package are correlated with one another. So, for example, if Ofgem was of the view that outperformance on costs is typically also associated with outperformance on some ODI targets, that correlation can be built into the Monte Carlo assumptions. This means each individual iteration/simulation is internally consistent, given prior expectations about these correlations between incentives. The effect of different plausible combinations of correlations on the overall results can therefore be tested (including, if relevant, an assumption of no correlation).

[10] https://www.investopedia.com/terms/m/montecarlosimulation.asp

2.2 Summary of methodology

Given the above, our methodology follows the following steps.

- **Step 1**. Identify the relevant incentives from RIIO-T2 Draft Determinations to be modelled, and establish the target levels and relevant financial incentivisation parameters Ofgem has proposed.
- **Step 2**. Establish key probability parameters for each individual incentive based on evidence e.g. of past performance, or of reasonable expectations of RIIO-2 performance, given the DD approach. Specifically, we identify:
  - the relevant form of probability distribution (normal, Bernoulli, triangular etc)
  - the relevant parameters to populate that distribution (e.g. for normal distribution, the mean expected performance and standard deviation).
- **Step 3.** Where relevant, identify any cross-correlations between incentives.
- **Step 4.** Run Monte Carlo simulations to produce probability distributions for aggregate financial performance.
- **Step 5.** Specify and test sensitivities around the core assumptions used to produce results at Step 4.

Each of these steps is described in detail for totex (Section 3); NGGT's non-totex incentives (Section 4); and NGET's non-totex incentives (Section 5). In each case we explain the relevant evidence that is used to underpin our assumptions.

2.3 Response to Ofgem critique

In its review of the original Frontier/NGN paper, Ofgem acknowledged that:

> *Frontier's work is a helpful contribution, which we recognise as a plausible framework for further work.*

However, Ofgem ultimately placed no weight on the analysis in exercising its judgement around the level of the outperformance wedge. Ofgem's principle concern was that it could not reconcile the input assumptions we had used with "*actual data, including observed returns*." Specifically, Ofgem identified two issues.

- First, our assumption of neutral totex performance as the mean/expected position for totex incentives was, in Ofgem's view, unjustified. This is based on Ofgem's assessment of a database on totex performance in regulated sectors spanning from 2000 to 2020[11], from which Ofgem concludes that average observed totex underspends in the past have been 7%[12]. In section 3 we therefore explore the relevance of Ofgem's assessment of past underspends for the likely performance in RIIO-T2, given the package Ofgem has set out. We also note that while Ofgem disputed the average assumed totex outperformance of zero, the key benefit of Monte Carlo analysis is that it allows us to the likely *range of possible outcome* around that average. Ofgem did not appear to engage with this at all in its DD review of our paper.

[11] Whilst Ofgem refers to totex performance from 2000 to 2020, much of the totex performance included in the analysis occurred in the mid-1990s. These price controls are clearly much less relevant comparators for the present day (for example, DPCR1 started in 1996/97).

[12] RIIO-2 DD Finance Annex, paragraph 3.123

- Second, Ofgem identifies that some of the results for certain ODIs (specifically GSOP and emergency response times) appeared to give more downside than historical data suggested was plausible. We explore this issue in more detail in our updated NGN report, in terms of the specific incentives identified (which are only relevant for the GDNs). More generally, however, we agree with Ofgem's view that it is important to sense check the results of the analysis against the available evidence, and to ensure closer alignment to verifiable data and to the emerging incentive framework that is now proposed for RIIO-2. This is a helpful steer from Ofgem and, throughout this report, we have therefore sought to explain fully how our assumptions are derived from the combination of both historical data and the now-crystallised proposals that are set out in the DD. We note, in particular, that there were substantial uncertainties surrounding the specifics of the RIIO-2 incentive framework when our original work was undertaken, the majority of which have now been resolved by the DD. Throughout this work we have therefore sought to tie our assumptions specifically to the DD proposals.

In short, we believe our updated work fully reflects the guidance Ofgem has provided in these comments.

2.4 Reporting financial impact

As explained in Section 1.4, in this analysis we are seeking to model expected outcomes specifically for NGGT and NGET. RoRE calculations require a RAV value, and many incentive payoffs are linked to metrics such as allowed totex or revenues (for example, NGGT's Customer Satisfaction Survey incentives are linked to its allowed revenues and the maximum penalty or reward is capped at ±0.5% of revenues).

We have used forecasts in Ofgem's license model for T2 (see Table 1 and Table 2 below). To calculate regulated equity, we assumed a notional gearing of 60% for NGGT and 55% for NGET. For the purposes of our modelling, we use a "notional year" of performance. To model this notional year, we take the average values across T2. The RoRE calculations and financial conversations are based on this notional year.

Table 1 Financial impact values - NGGT

Value (£m)	2021/22	2022/23	2023/24	2024/25	2025/26	Average
RAV	5,980	5,878	5,814	5,761	5,692	5,825
Regulated equity	2,392	2,351	2,325	2,304	2,277	2,330
Totex	392	432	465	450	434	435
Base revenue	963	946	930	930	928	939

Source: Ofgem DD RIIO-GT2 License Model

Table 2 Financial impact values - NGET

Value (£m)	2021/22	2022/23	2023/24	2024/25	2025/26	Average
RAV	13,834	13,463	13,293	13,056	12,817	13,293
Regulated equity	6,225	6,059	5,982	5,875	5,768	5,982
Totex	476	956	802	792	769	759
Base revenue	1,650	1,587	1,557	1,532	1,505	1,566

Source: Ofgem DD RIIO-ET2 License Model

3 TOTEX

As outlined above, each of the incentives in our Monte Carlo simulation requires us to specify the form and parameters of a probability distribution, reflecting the expected range and likelihood of plausible outcomes. In this section we set out our approach for totex, which is generally expected to be the most material source of outperformance/underperformance. We consider it is reasonable to assume a normal distribution for totex performance and therefore we need to specify two key parameters: the mean and the standard deviation.

In the previous Frontier/NGN report, we assumed a mean of zero. We explained that this reflected a scenario in which Ofgem was able to set totex allowances that a notional company can meet but not beat, on average. In other words, it reflected a price control that was a "fair bet". We considered this approach was justified because:

- we assumed it is Ofgem's aim to set allowances so as not to systematically provide expected reward (or penalty) for the companies; and
- there is evidence that Ofgem and other regulators have been able to set such price controls in the past, i.e. that some companies have in the past overspent vs. regulatory totex allowances.

Ofgem has argued that the mean zero assumption "contrasts with available evidence", pointing to its analysis of historical performance from a range of regulated sectors and past price controls. Ofgem concludes from this data that, on average, regulated companies have achieved outperformance of 7%, and that there is a tendency towards underspending.[13] Ofgem also provides an assessment of what, in its view, the outperformance in RIIO-1 would have been if a number of the new policy proposals set out in the RIIO-2 DD had been employed at RIIO-1.[14] Ofgem concludes that both analyses generally support its position that expected outperformance levels are above 0.25% in RoRE terms for RIIO-2.

Both of Ofgem's analyses are scrutinised extensively in our report for the ENA. In short, neither of them stands up to scrutiny. The result from the historical analysis is largely driven by price controls more than a decade old, which no longer hold any relevance to the situation faced by energy networks today. The re-statement of RIIO-1 outperformance contains a material spreadsheet error[15], and fails to reflect a substantial number of policy changes that almost entirely eradicates RIIO-1 totex outperformance (before even reflecting the increasing use of NARMs and PCDs). Similar sorts of adjustments would need to be made for all of the price controls contained in Ofgem's database of historical outperformance in order to undertake a proper analysis. More detail on our assessment can be found in the ENA report.

In the rest of this section we set out how correcting Ofgem's analyses reveals that an assumption of mean zero outperformance would be a conservative approach for evaluating the DD proposals for National Grid. We discuss in turn the historical

[13] RIIO-2 DD Finance Annex, paragraph 3.123

[14] RIIO-2 DD Finance Annex, paragraphs 3.129 – 3.132

[15] Whilst this spreadsheet error relates to the GT sector, this has an impact on Ofgem's estimate for "average" RIIO-1 restatement at RIIO-2.

data; and the relevant policy changes for RIIO-2. Finally, we set out what this means for the parameters we have assumed for modelling totex; and the results from the totex incentive for NGET and NGGT.

3.1 Ofgem's totex outperformance database

In undertaking its historical analysis, Ofgem constructed a dataset of performance from past price controls, covering a range of sectors including:

- Gas distribution;
- Electricity distribution
- Gas transmission;
- Electricity transmission;
- Water;
- Water and sewerage; and
- Aviation.

This comparator set is extremely wide, and covers 27 different price controls spanning almost 25 years. In principle, the risk with building such a wide set of comparators is that the differences between observations will lead to an including observations that are not comparable.

Indeed, the issue with this specific comparator set is that the very first price controls in gas and electricity distribution were calibrated in a very different way to the RIIO price controls, and performance against these are unlikely to be comparable with the most recent price controls before RIIO.

Specifically, this is an issue that applies to the first three electricity distribution price controls and the first gas distribution price control because the philosophy and methodologies that underpinned those price controls are far removed from those that have been adopted more recently, in particular those that are being used now to set RIIO-2. Price controls were smaller in scale and ambition with far fewer instruments. Benchmarking was comparatively limited and there was no heavy focus on ensuring that costs and revenues would track one another closely during a price control. The focus was entirely on setting a broadly reasonable "fixed target" alongside very strong incentives (particularly on opex) that would provide strong inducement for the only relatively recently privatised firms to pursue and reveal efficiencies as aggressively as possible.

If we exclude these four price control results from the comparator data, the remaining comparator set shows a new mean historical totex outperformance of 3.7%. Across these price controls, we also calculate the range of totex performance has a standard deviation of around 8.8%.

However, it should be noted that even this totex outperformance also includes data from other sectors including airports, air traffic control and water. While there are some high level similarities in the overall price control frameworks, there are also important differences in the way regulation is done and the underlying costs and

cost structures of these different businesses operating in different sectors. [16] Therefore, it is not clear that this data adds much to the debate about what the energy networks may be able to achieve in future. More detail on our assessment can be found in the ENA report.

3.2 Accounting for material shift in RIIO-2

There are a number of additional significant reasons to believe that NGET and NGGT can actually expect much lower totex outperformance. Below we discuss in turn:

- Indexing RPEs
- Price Control Deliverables (PCDs);
- Network Asset Risk Metric (NARM);
- Cost assessment approach; and
- Ongoing productivity assumptions.

3.2.1 Indexing RPEs

For RIIO-1, Ofgem set fixed ex ante allowances for RPEs over the eight year price controls, based on expectations at the time. For RIIO-2, Ofgem will move to indexing RPEs annually to a set of external indices. This should mean that the input price assumptions underpinning price control allowances more closely track actual movements in input prices year on year.

Ofgem has stated that it believes that the fixed RPE allowances in RIIO-1 were a material source of outperformance in those price controls. In fact, in the course of providing its analysis to re-state RIIO-1 outperformance to be on a RIIO-2 basis, Ofgem has directly estimated what the effect of indexing RPEs in RIIO-1 would have been. Ofgem's analysis shows that:

- For NGGT (SO + TO), Ofgem estimates that indexing RPEs would have resulted in totex allowances that were c. £189m lower over the eight year price control. Even before this change, NGGT has under-performed the RIIO-1 totex allowances by some £217m (approximately 10% underperformance). Indexing RPEs in RIIO-1, on its own, would therefore have increased NGGT's underperformance by a further 8%.
- For NGET (TO), Ofgem estimates that indexing RPEs would have reduced its RIIO-1 allowances by £637m. Ofgem calculates that NGET has outperformed RIIO-1 totex by £1,262m – so indexing RPEs would have reduced totex outperformance by approximately half, resulting in outperformance of under 7% of totex.

[16] To illustrate, Heathrow has an average revenue form of price control so there is a need to control for volumes. It seems that this has not been done, and hence it is not clear that the data for airports is reliable, even if we were to believe that it is otherwise comparable.

These numbers are material. On Ofgem's own analysis, indexing RPEs alone might justify a reduction vs. past totex outperformance of 7-8%. The equivalent figure for the GDNs is approximately 5%.[17]

Clearly these figures cannot be compared directly with the longer run historical mean totex outperformance of 3.7% (which will have been based on different levels of allowances for RPEs, as well as entirely different price controls). However, it is plausible to believe that indexing RPEs, on its own, would justify a very substantial reduction in the mean expected outperformance in RIIO-2, and potentially even to below mean zero.

3.2.2 Price Control Deliverables (PCDs)

Price control deliverables (PCDs) are characterised by specific deliverables for the funding allocated, and have mechanisms where customers are refunded if the specified output is not delivered. The funding for these projects are not transferrable to a different output.

The nature of individual PCDs are very bespoke, and so the way they are assessed will vary from PCD to PCD. As described by Ofgem, PCDs are subject to project-specific incentives. Some PCDs will have allowances recovered through a formulaic method, while others will be subject to an ex-post review from Ofgem.[18]

However, we understand that Ofgem's broad intention behind introducing PCDs is to restrict any totex outperformance in the event of non-delivery or late-delivery of specific projects, or changes in scope/specification of works vs. what was anticipated when the price control was set. This means another (potentially significant) source of outperformance that would have underpinned historical outperformance has now been removed in RIIO-2.

National Grid has provided some relevant examples in this respect:

- For NGGT, a large PCD relates to the Bacton Terminal in the North Sea. This site brings in flows from a number of North Sea gas fields onto both the NTS and the local Gas Distribution Network. The site is aging, and due to its coastal location, is in need of a major asset replacement program, particularly given NGGT predicts that the site will remain operational into the 2040s. Exactly how this is done is subject to some debate (for example whether to replace all equipment on a like for like basis, or engage in a piecemeal maintenance program). To determine this, NGGT proposed a PCD to develop the engineering design for the site. This design has been set as a PCD because Ofgem considers it important that the project has clear objectives and the output scope is well-defined. Therefore, there is limited scope for NGGT to outperform on an efficiency basis, because Ofgem is aiming to ensure the costs and outputs are carefully scoped and managed.[19]
- For NGET, a major non-load-related project within RIIO-T2 will be the London Power Tunnels (LPT) project. Ofgem has proposed £645.8m allowances for

[17] For electricity DNOs, whose price control was set two years later and with a slightly different RPE methodology, the RIIO-2 indexing approach would actually have led to slightly higher allowances according to Ofgem (albeit only 0.3%).

[18] RIIO-2 DD core document, paragraph 4.8-4.10

[19] RIIO-2 DD NGGT Annex, paragraph 3.296-3.312

this project,[20] which will be "ring-fenced with an individual PCD". This allowance was in line with NGET's business plan for this project, and Ofgem states that allowances were set at this level because Ofgem "had detailed project information backed up by tender information".[21] This is consistent with what we have been informed by NGET, which is that the project is currently at a very advanced stage – optioneering has already been undertaken, the project is fully scoped out, and contracts with delivery partners have already been struck. In essence, a material proportion of this allowance has already been 'locked in' – substantially reducing the scope for outperformance. On top of this, Ofgem's approach to apply a PCD is likely to mean that any narrow scope for further outperformance that does exist may not, in fact, materialise depending on Ofgem's ex post review. Ofgem is consulting on whether (as seems likely) the project will fall under its proposals for Large Project Delivery, which may include late delivery penalties.

- NGET also has a number of load-related projects that form PCDs. As with NGGT, these relate to projects where Ofgem considers clarity of objectives and a defined output to be important. For example, for the Wide Areas System Monitoring project (a project for the installation and operation of new system monitoring equipment), Ofgem considers the "limited cost analysis" to be a risk to the output. Therefore a PCD is proposed to manage this risk. Again, this limits the opportunity for outperformance for NGET.

We understand from National Grid that there are many more examples of the sort outlined above which Ofgem proposed to apply across a substantial proportion of the cost base. To be clear, we have not undertaken a detailed review of each of the projects subject to PCDs to inform our own judgement as to whether the allowances are reasonable (nor would we be qualified to do so, since this would require engineering/technical expertise).

Ofgem may consider that even the allowances that have been given still incorporate scope for some outperformance. However, in light of the general approach Ofgem appears to be adopting in RIIO-2, we consider it is likely that Ofgem has determined particularly tough cost allowances (and has layered on top of this a material productivity challenge which appears to go to the extreme end of the range of evidence available). Further, the clear intention behind PCDs is to enable Ofgem to minimise a large array of different sources of potential outperformance which previously would have been available to NG.

In light of this, for the purposes of our modelling of RIIO-2, we have split out the cost allowances associated with PCDs for NGGT and NGET and treated these separately (see Table 3). Given our understanding of the incentive arrangements and Ofgem's intended purpose, we consider it is sensible to assume that expected outperformance is zero on PCD-totex. We also expect that the range of potential performance on PCDs is likely to be significantly narrower than the range of performance observed historically. We therefore assume the standard deviation on PCDs to be around half of the variation for wider totex.

[20] RIIO-2 DD NGET Annex, table 28

[21] RIIO-2 DD NGET Annex, paragraph 3.63

3.2.3 Network Asset Risk Metric (NARM)

For the RIIO-1 controls, Ofgem introduced a mechanism to monitor the level of risk on the system across key asset classes, known as the Network Outputs Methodology (NOM). Broadly speaking, the NOM framework enabled Ofgem to measure network risk based on data reported by the companies on asset health, loading, and consequence of failure (among other things). This framework allowed Ofgem to introduce a target for the total amount of 'risk removed' from the system, given the expected deterioration in assets and similarly the improvement in asset health measures etc. based on planned interventions that were funded through totex allowances. The details of the NOM methodology, and how it was to be incentivised, evolved through RIIO-1.

3.2.3.1 Description of the RIIO-2 NARM framework

For RIIO-2, Ofgem has proposed to introduce a new incentive framework for what is now termed the Network Asset Risk Metric (NARM). Our understanding is that the NARM methodology is very similar to that for NOM, in the sense that it starts from a target for the monetised value of risk removed over the course of a price control.

However, the RIIO-2 NARM methodology differs from the RIIO-1 approach in a number of key respects:

- First, Ofgem's proposal for RIIO-2 is now to allocate a specific portion of the DD totex allowances to be targeted specifically at the investments and interventions to deliver NARM risk removed output. Our understanding is that this is a far more specific linking of cost allowances to NARM outputs than has been used for NOM in RIIO-1.
- Associated with this, Ofgem has introduced a new framework for financial incentivisation, which is called the 'NARM Funding Adjustment and Penalty Mechanism' (NARM FAPM). Under the NARM FAPM, companies will be set a target for the ratio of baseline allowed NARM-allocated totex over NARM risk removed. This target is referred to as the Unit Cost of Risk Benefit (UCR).
- Under the NARM FAPM, any outturn deviations from the UCR target will be closely scrutinised by Ofgem through an ex post review. Ofgem will apply various tests under this ex post review to determine whether/how to modify cost allowances; and whether/how to introduce rewards or penalties.

In our parallel ENA report, we set out in more detail how we understand the NARM FAPM will operate.

3.2.3.2 Effect of NARM framework on outcomes

The clear intention of Ofgem in developing this framework has been to try to remove the possibility of any windfall gains arising from the NARM incentive. Ofgem appears to have concerns that, without some constraints, companies might be able to materially outperform totex allowances while still delivering at (or above) the target NARM benefit - primarily by shifting some expenditure towards interventions which are lower cost but deliver equivalent/higher impact in terms of risk removed. Ofgem evidently would consider that such a shift was not a

"genuine" efficiency saving – rather, it would represent companies exploiting the underlying weaknesses of the NARM methodology.[22]

The issue, however, is that in attempting to impose these constraints, Ofgem has proposed a model that relies almost entirely on judgements made by the regulator ex post. Specifically, companies will now be significantly exposed to the decision that Ofgem makes ex post on whether costs savings were "genuine"; and on whether any departures from the risk target were "justified" or "un-justified". Importantly, Ofgem's underlying principle seems to be that companies must bear the burden of proof in these ex-post assessments – in other words, Ofgem's default position will be that deviations are unjustified, and it is up to the companies to convince Ofgem otherwise.

At the same time, the NARM framework imposes a significantly skewed balance of risk towards the downside, conditional on the exercise of Ofgem's ex post discretion.

- First, in relation to **totex over-/under-spends**, if Ofgem deems cost reductions are not genuine, there is virtually no upside (given the application of the so-called Delivery Adjustment Factor (DAF)). Companies will know that even if they pursue and deliver what they consider to be genuine efficiencies, there will still be a chance that Ofgem might not consider those efficiencies to be genuine after the fact. Ofgem has provided no guidance about what tests it will apply to determine whether or not costs are efficient – and by Ofgem's own admission, this exercise will not be straightforward.

  In light of the overall approach that Ofgem appears to be adopting towards incentive regulation and the general clamp-down on outperformance in RIIO-2, our view is that companies would quite reasonably expect that little (if any) cost reductions will be deemed "genuine efficiencies" by Ofgem. This will almost entirely undermine any incentive for the companies to reduce these costs.

  On the flip side, there is no symmetric protection applied to overspend – for this, the TIM sharing factor is applied. Overall this represents a sharp skew towards downside risk on totex related to NARM.
- Second, in relation to **NARM output delivery**, Ofgem has imposed (potentially material) downside penalties for any "unjustified" under-delivery or over-delivery, but quite literally no upside for "justified" under-delivery or over-delivery. Again, little if any guidance has been given by Ofgem about what tests it will apply or how in reaching these judgements.

Faced with this set of arrangements and the threat of penalties being applied ex post at the discretion of the regulator, in our view there is only one optimal strategy for the companies – they will stick as closely as possible to the specific allowed costs; and deliver as close as possible the NARM risk target.

It is also clear that, irrespective of whether Ofgem considers this will be the impact of its proposals, Ofgem is now introducing mechanisms which are specifically designed to eliminate sources of totex outperformance that were previously available to companies in RIIO-T1. We assume, therefore, that it is uncontroversial

[22] In a similar vein, Ofgem has also sought to remove the potential for any equivalent windfall gains/losses to arise due to "non-intervention" changes in the delivered risk output – for example due to NARM methodology changes; consequence of failure changes; or data cleansing.

that outperformance on NARM-related spend will be substantially below RIIO-1 levels during RIIO-2.

3.2.3.3 Consequence for modelling approach

As a result of this, any modelling of expected outperformance in RIIO-2 should start from the expectation that outperformance on totex allocated to NARM should have an expected value of zero and, importantly, a substantially reduced range of potential outcomes either side of this mean.

It is then relevant to consider whether to model the skewed downside risk associated with the imposition of the DAF (which materially reduces the upside potential for non-genuine cost reductions); and the lack of symmetrical tests for whether under/over-spends are "genuine". For our purposes, we have assumed simply that any under/over-spend vs. NARM-allocated totex has the full TIM sharing factor applied. Effectively this assumption implies that all outperformance is deemed to be "genuine" by Ofgem. We consider this to be a conservative approach in the sense that expected returns will be higher, on average, in the absence of modelling the downside skew.

Further, we also have ignored any effect of NARM over- or under-delivery in our modelling. Since Ofgem's approach contains zero upside (even for "justified" over- or under-delivery), we consider this approach to be conservative, since we have simply ignored the downside risk arising from the penalties for "unjustified" outcomes.

3.2.4 Tougher cost assessment

Ofgem stated that there have been significant adjustments to National Grid's allowances as a result of applying cost efficiencies. At a high level, Ofgem's allowances are significantly lower than NGET and NGGT's submitted allowances – and while a significant proportion of this is volume adjustment, this is also in part due to the tougher approach to cost assessment. The total amount of disallowed costs that result from applying cost efficiencies are around £2.4billion across the transmission sector, which is equal to a reduction in costs of around 15%.[23]

There are a number of examples where National Grid considers the cost assessment is particularly challenging:

- For NGET, Ofgem sets out its proposed volume and cost reductions relative to NGET's request.[24] These cost reductions are significant. For example, in Protection & Control category Ofgem's reductions imply a cost reduction of 76% versus NGET's request. NGET considers this category as already using innovative and targeted interventions that were introduced during T1, and the proposed cost reductions are considered extremely challenging. This is not a one-off example, with the transformers, OHL Conductor, and Non-lead cables categories all receiving cost reductions above 40%.
- For NGGT, Ofgem's proposed cost reductions are slightly less severe, but still challenging. For example, the cost assessment on the work associated with

[23] RIIO-2 DD, Core document, paragraph 5.12

[24] RIIO-2 DD, NGET Annex, Table 28

vales, actuators, cents and seals implies an almost 20% reduction in costs, whilst the cost assessment for civils implies around 20% reduction in costs across three categories.[25] Again, NGGT considers these reductions in cost to be extremely challenging at T2.

Again, we are not qualified (nor have we attempted) to evaluate or verify National Grid's concerns with the cost allowances. We understand that these sorts of issues are again replicated across most of the cost base (for example, a c. 60% reduction in Closely Associated Indirects vs. NGGT's business plan has been applied). The examples highlighted above are consistent with our impression that Ofgem has sought to introduce a generally aggressive approach to setting cost allowances.

3.2.5 Stretching productivity targets

At RIIO-1, Ofgem set the annual productivity challenge of 1% for opex and 0.7% for capex. For RIIO-2 Ofgem has set the tougher annual challenges of 1.4% for opex and 1.2% for capex.

While we have not undertaken a detailed review of Ofgem's approach to productivity, we note that Ofgem has chosen point estimates at the very top of the range proposed by CEPA, and has introduced what appears to be a novel additional increment of 0.2% to account for past innovation funding. Further, CEPA's range appears to be based on a longer run of historical data going back to prior to the financial crisis, which would appear to play down the relevance of the extended and ongoing productivity slump in the UK since the financial crash. These high-level issues appear to indicate that Ofgem's productivity target is not only tough relative to RIIO-1; but potentially overstates the level of productivity that might realistically be expected to be achievable in RIIO-2 (thereby 'baking in' some expected underperformance). It is also clear that when combined with a stretching "catch-up" challenge, the overall package appears to be very stretching.

Overall it seems likely that the productivity target will result in tougher cost allowances and reduce the companies' chance to outperform still further.

3.2.6 Removing IQI

The IQI has been removed for RIIO-2 and replaced by the BPI. When assessing the IQI compared to the BPI, and the applicability of RIIO-1 outperformance at RIIO-2, Ofgem states that it considers "that the impact of both may be similar".[26] For this reason, Ofgem does not quantify the change of removing the IQI and introducing the BPI in its assessment of re-stating RIIO-1 on a RIIO-2 basis.

We do not consider it is necessary to make such an assumption, since Ofgem's BPI decision is now known. For our purposes, we instead model the BPI outcome directly (see Section 4.1 for NGGT and Section 5.1 for NGET). However, it is important to also be clear that one significant aspect of the IQI in RIIO-1 appears to have been ignored by Ofgem, namely the setting of final allowances as a weighted average of 75% modelled costs and 25% submitted costs (sometimes referred to as 'IQI interpolation'). IQI interpolation had a material impact on final

[25] RIIO-2 DD, NGGT Annex, Tables 19 and 23

[26] RIIO-2 DD Finance Annex, Table 27

allowances at RIIO-1, and nothing at RIIO-2 could be considered to be equivalent to this or replacing it.

This is therefore a further source of reductions in the potential totex outperformance available in RIIO-2 relative to RIIO-1.

3.3 Consequences for our approach for NG

Given the issues set out above, and to provide a richer assessment of the potential for totex outperformance in RIIO-2, we consider it is necessary to separate the cost base into three buckets: costs allocated to PCDs; costs allocated to NARM; and remaining totex. Table 1 below shows the proportion of cost base for NGGT and NGET which is allocated to each bucket, based on data provided by National Grid and reflecting Ofgem's Draft Determination position.

For PCDs and NARM, we explained our approach to assuming mean outperformance and standard deviations in the sections above.

For the remaining totex, we consider that there is strong evidence (as set out above) to suggest that the DD proposals set out by Ofgem will in fact result in an expected totex underperformance in RIIO-2, for both NGET and NGGT. This arises due to indexing RPEs; tougher cost assessment; setting a stretching productivity target; and the removal of IQI, as well as other issues addressed in our ENA report. In aggregate we anticipate that the reality of this package is that NGET and NGGT might expect to underperform on totex, potentially materially. However, taking a cautious approach, we believe it remains plausible to assume an expected 0% outperformance, despite the evidence suggesting the reality is to the downside.

We note that the standard deviation of NGET's historical performance gives a value of 4.1%, and for NGGT the equivalent value is 2.2%. Taking a wider sample of RIIO-1 performance, the standard deviation of gas distribution performance is around 6.8%. However, despite this, we again consider it reasonable to adopt a cautious approach and use the standard deviation of 8.8% derived from Ofgem's (corrected) historical database.

The combination of these two conservative assumptions means that, in all likelihood, our central scenario will over-estimate the potential for totex outperformance and the range of plausible outcomes.

Table 3 below summarises our base case assumptions.

Table 3 Summary of approach to totex

	PCDs	NARM	Other totex
Proportion of cost case - NGGT	26%	20%	54%
Proportion of cost case - NGET	45%	16%	39%
Mean	0%	0%	0%
Standard deviation	0.5%	0.5%	8.8%

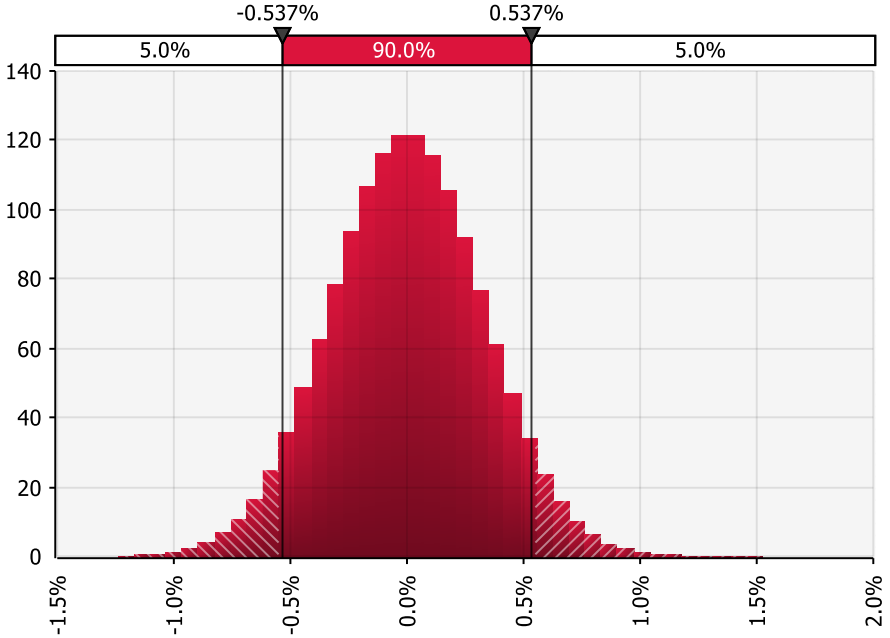
Source: Frontier Economics, based on: NGGT and NGET cost base, DD technical annex spreadsheet 'AR ER database', and Frontier analysis

3.4 Totex results

In order to estimate the financial impact of totex over or under performance we also define a totex sharing rate so as to convert the modelled outperformance into the value accruing to NGET and NGGT. This rate is 39.2% for NGET and 36.6% for NGGT.[27] This in turn is converted into RoRE values using the financial values set out in the RIIO-2 License Model.

Figure 5 shows the probability distribution of totex outperformance in RoRE terms for NGGT, and Figure 6 shows the equivalent chart for NGET. NGET has a narrower range of potential outcomes than NGGT, primarily because a larger proportion of totex is apportioned to NARMs and PCDs. For NGGT, 90% of the RoRE performance lies between +/-53.7bps; whilst for NGET, 90% of RoRE performance lies between +/-28.1bps.

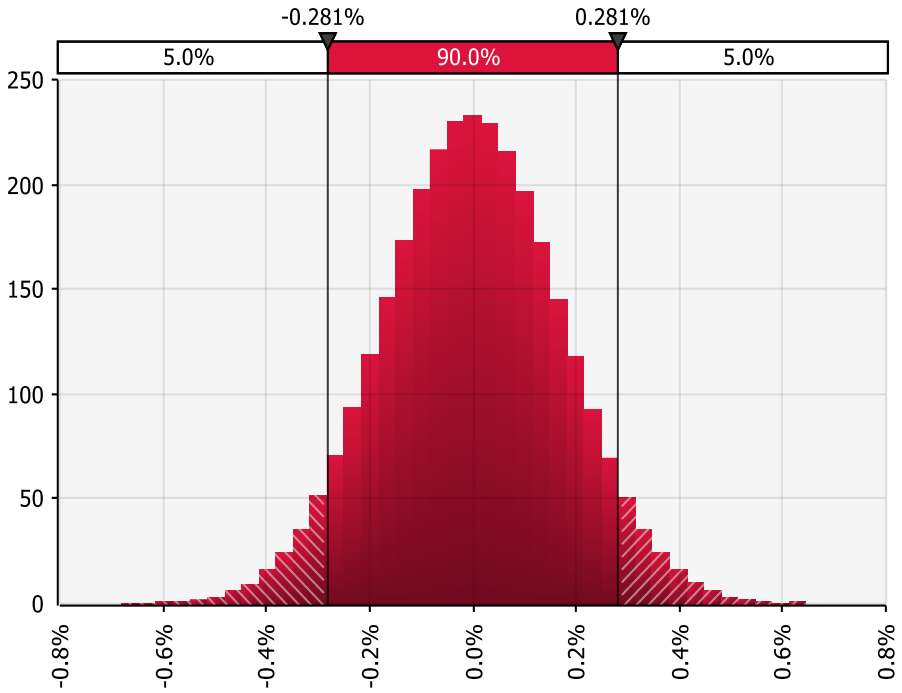
Figure 5 Totex outperformance results in RoRE terms – NGGT



Source: Frontier analysis using @Risk

[27] RIIO-2 DD Core Document, table 14

Figure 6 Totex outperformance results in RoRE terms – NGET



Source: Frontier analysis using @Risk

4 OTHER INCENTIVES - NGGT

The non-totex incentives for NGGT are shown in Figure 7 below. We have included all these incentives in our Monte Carlo model with the exception of the Environmental incentive, for the reasons explained later in this section.

Figure 7 Incentives in RIIO-2 Draft Determination relevant to the Gas Transmission sector

Incentive	Type	Description	Inclusion
Business Plan Incentive	BPI	Currently a fixed penalty for NGET of -£26.4m.	Included
Entry and exit capacity constraint management	ODI-F	Two-sided incentive which continues from RIIO-1.	Included
Customer satisfaction survey	ODI-F	Two-sided incentive, which was previously part of the RIIO-1 Stakeholder Satisfaction Output ODI.	Included
Quality of demand forecast	ODI-F	Two-sided incentive which continues from RIIO-1.	Included
Maintenance	ODI-F	Downside only incentive which continues from RIIO-1.	Included
Residual balancing	ODI-F	Two-sided incentive which continues from RIIO-1.	Included
Greenhouse gas emissions (venting)	ODI-F	Two-sided incentive which was previously downside-only at RIIO-1.	Included
Environmental	ODI-F	Two-sided incentive, with specific incentive rates note yet determined.	Not included

Source: *Frontier analysis of Ofgem RIIO-2 Draft Determinations Electricity Transmission Annex*

Note: *Descriptions of incentives used in this table are taken from the Source document, which can be found by following this link: https://www.ofgem.gov.uk/system/files/docs/2020/07/draft_determinations_-_gt_sector.pdf*

We note that Ofgem has generally set challenging targets and dialled down the incentives available at RIIO-2. In the interests of making conservative assumptions where possible, we assume that NGGT will be able to broadly perform well against these challenging targets. In the instances where our expectation is underperformance, we explain why this is a reasonable baseline.

The rest of this section describes the approach and parametrisation that we adopted for each incentive in turn.

4.1 Business Plan Incentive

For RIIO-2, the BPI is Ofgem's tool for encouraging the companies to submit high quality and ambitious business plans. It has replaced the IQI + fast-tracking

system which performed the same role in RIIO-1 (with the IQI also having been used at prior controls).

When we undertook our previous NGN report, we did not at that time know what the outcome of its application would be. Our approach was therefore based on assumptions and scenarios for what Ofgem might decide, given what Ofgem had set out about how the BPI would work.

We now know the impact of the BPI for NGGT, which has received a penalty of -£26.4m in the RIIO-2 DD. This penalty will reduce revenue allowances in RIIO-2, and reflects Ofgem's conclusion that NGGT's business plan failed to meet some of the steps/criteria Ofgem set out. We do not comment here on the reasonableness of that conclusion.

Since the penalty is known and fixed, we do not model it stochastically. Rather, we assume this penalty is imposed in every modelled iteration of the Monte Carlo analysis.

We note that the BPI should be considered as a key part of the overall package of incentives for RIIO-2. In much the same way that Ofgem has reflected IQI/fast-tracking returns in its assessment of RIIO-1 performance, we expect that Ofgem would similarly wish to reflect its BPI decision in any analysis of returns that may be achievable in RIIO-2.

4.2 Entry and Exit CCM

Ofgem states that the entry and exit capacity constraint management incentive (CCM) is designed to minimise the cost of constraints in the NTS against a forecast/target. It is also designed to encourage the release of additional capacity.[28]

Ofgem proposes setting a target equal to the historical RIIO-GT1 performance. This is equal to £0.2m per year, with a cap and collar of +/- £3.2m per year. The incentive rate is calibrated at 20% i.e. NGGT would earn a reward of 20% of the net underspend against the CCM target and similarly would be exposed to 20% of the net overspend against the target, subject to cap and collar limits.

It is worth noting that there is significant disagreement between Ofgem and NGGT in the way this incentive has been calibrated.[29] We do not offer any contribution to this debate – indeed our core model assumptions consider Ofgem's DD calibration is correct. However, we think this is likely to be a conservative assumption, given that NGGT considers there is material scope for downside risk. We consider this possibility as a sensitivity in Annex A.

4.2.1 Our approach and results

4.2.1.1 Probability distributions

Given there are substantial disagreements between Ofgem and NGGT around the appropriate level of performance, we have taken a prudent assumption and

[28] RIIO-2 DD GT Annex, paragraph 2.17

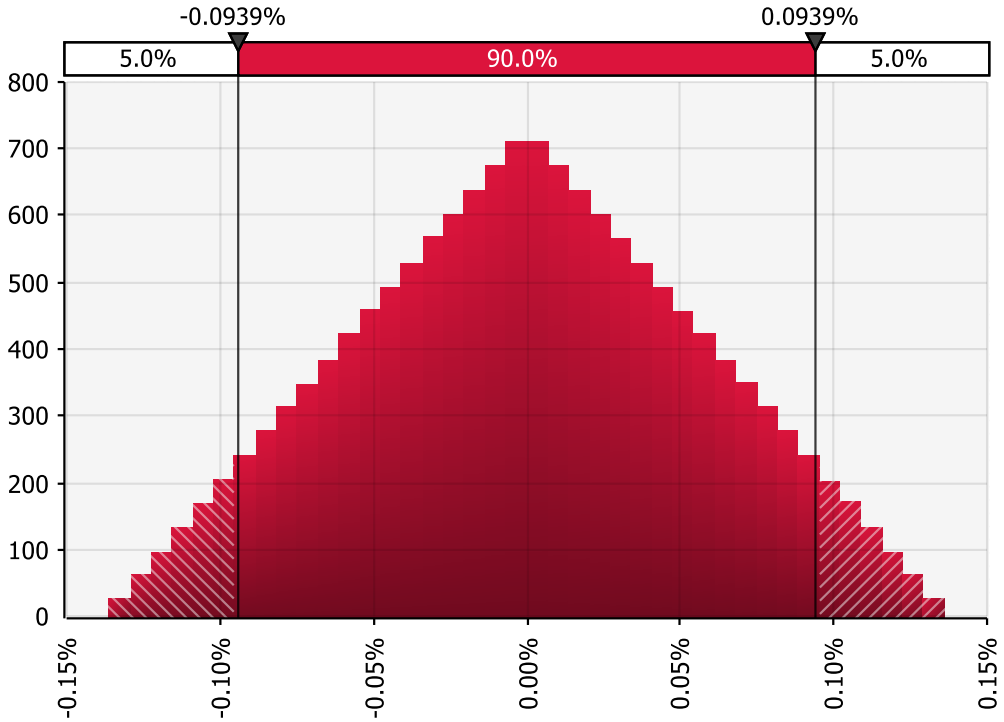
[29] RIIO-2 DD, GT Annex, paragraph 2.19; RIIO-2 DD NGGT Annex, paragraph 2.54

modelled Ofgem's draft determination assuming the incentive is well calibrated. This means that the expected outcome is at the target, with low likelihoods of hitting the cap and collar. For simplicity, we assume a simple triangular distribution that is centred at Ofgem's target level of £0.2m. We assume NGGT's maximum and minimum performance values equate to the +/-£3.2m cap and collar.

4.2.1.2 Results

The results from this output suggest an expected outperformance in RoRE terms of 0bps. This result is by design, driven primarily by the expectation that Ofgem has correctly calibrated its incentive. Given NGGT considers there to be material downside risk on this incentive we think this is a conservative assumption.

Figure 8 Entry and exit capacity constraint management – RoRE impact



Source: Frontier analysis using @Risk

4.3 Customer Satisfaction Survey (CSS) [30]

In the SSMD[31], Ofgem stated that it would retain only the customer satisfaction element of RIIO-1's Stakeholder Satisfaction Output measure. Specifically, the incentive will be calibrated against one key question determined by Ofgem, which will gauge overall satisfaction with NGGT's performance. The scope of this incentive will be narrower in comparison to RIIO-1 – focusing only on NGGT's direct customers rather than customers and wider stakeholders.

[30] RIIO-2 DD GT sector annex, para 2.5-2.8

[31] Ofgem SSMD, GT, paragraphs 2.32 – 2.47

Ofgem have proposed a target score of 7.8/10. The incentive rate is calibrated so each incremental 0.1 performance deviation from the target is worth +/- 0.071% of annual base revenue. Ofgem have proposed a cap at +/- 0.5% of base revenue.

4.3.1 Our approach and results

4.3.1.1 Probability distributions

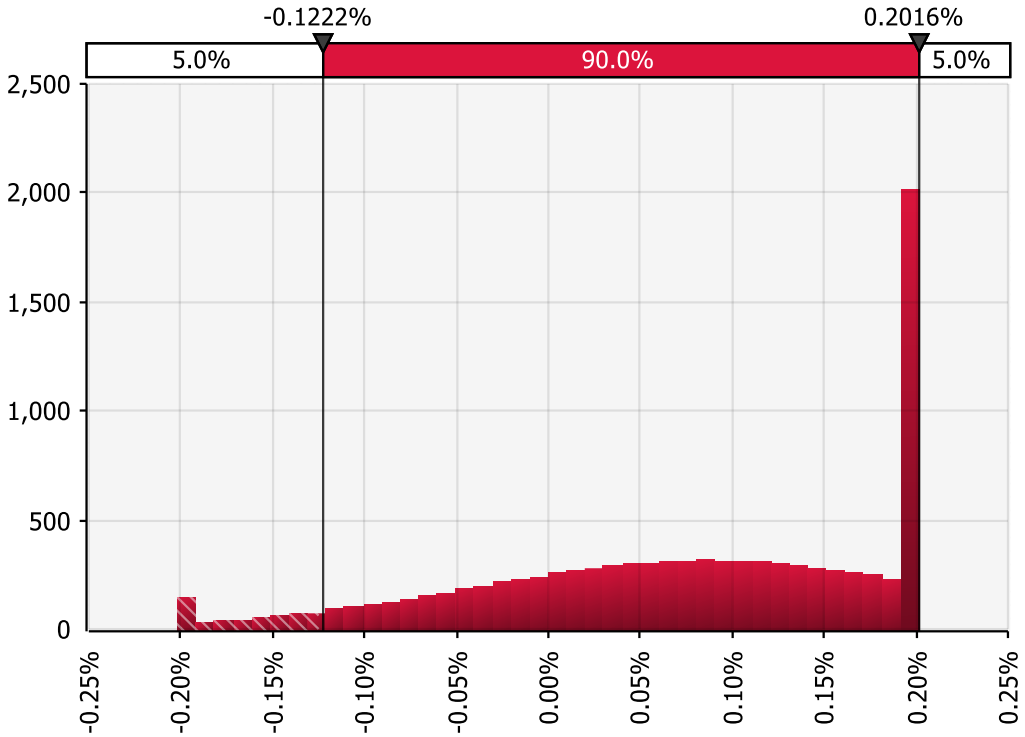
We assume that the likelihood of future performance is distributed normally. The mean outcome is set slightly above the target at 8.10/10. This is based on internal analysis from NGGT, which assumes continuous improvement from RIIO-1 performance throughout RIIO-2, but at a decreasing rate.

The historical NGGT sample is only 6 observations, so it would be difficult to reliably assess the variance of such few observations. In all likelihood, the associated standard deviation would be too low to be considered reliable. Instead, we take a standard deviation from historical performance on a similar customer satisfaction survey in the gas distribution sector, which is 0.44. That way we can model a more realistic range of plausible outcomes.

4.3.1.2 Results

The results suggest an expected outperformance in RoRE terms of 7 basis points, which is equivalent to just over £1.73m per year. This is driven primarily by the assumption that NGGT will frequently reach the cap, hence the concentration of observations at the maximum.

Figure 9 Customer Satisfaction Survey – RoRE Impact



Source: Frontier analysis using @RISK

4.4 Quality of demand forecast

The purpose of the quality of demand forecast incentive is to encourage the System Operator to make improvements to the accuracy of its gas demand forecasts. The associated benefits of improved forecasting help the industry make efficient decisions about its use of the network. [32]

The financial incentive proposed by Ofgem is based on a target forecast error of 8.35mcm/d. Each incremental 1 mcm/d performance deviation from the target is worth +/-£180k, with a symmetrical cap and collar at +/- £1.5m.

4.4.1 Our approach and results

4.4.1.1 Probability distributions

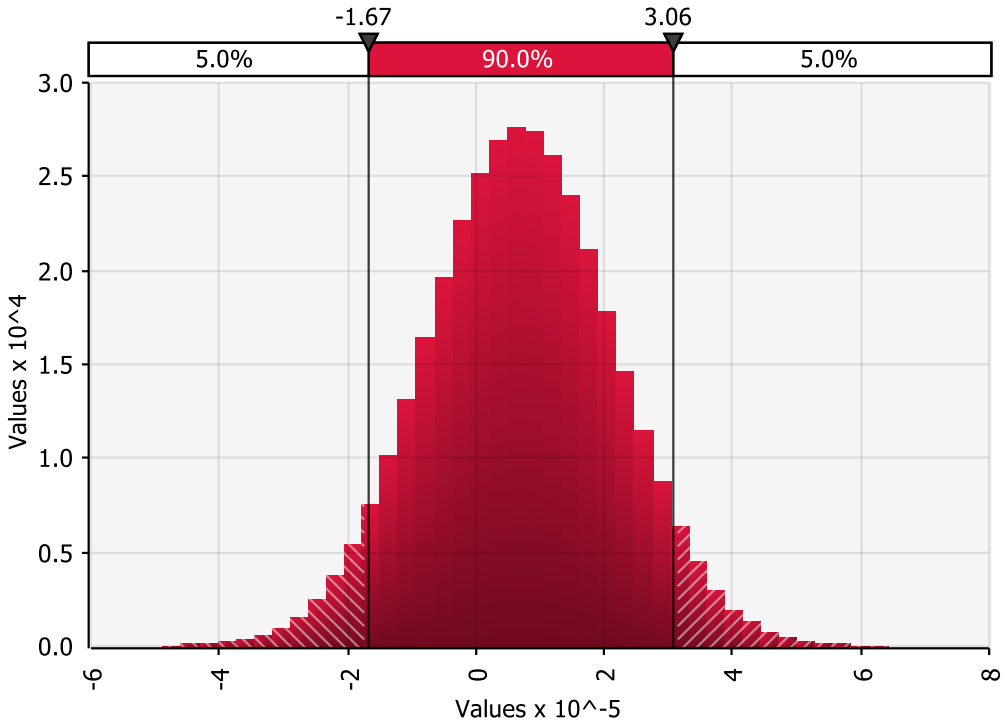
For simplicity the mean and standard deviation are taken from RIIO-1 historical performance, up to 2018. Mean performance was a forecast error of 8.26mcm/d, with a standard deviation of 0.19.

[32] RIIO-2 DD GT sector annex, para 2.9-2.12

4.4.1.2 Results

The results from this output suggest an expected outperformance in RoRE terms of close to 0 basis points, which is equivalent to around £0.02m per year. This reflects the significantly lower incentives on this ODI compared to RIIO-1.

Figure 10 Quality of demand forecast – RoRE Impact



Source: Frontier analysis using @RISK

4.5 Maintenance

At RIIO-1, the maintenance incentive was split into two schemes, the combination of which was designed in order to encourage efficient planning and execution of maintenance work. The two components were made to encourage:

- The minimisation of the use of maintenance days (MDs) to perform remote value operations maintenance (RVO) in no more than 11 RVO MDs; and
- The minimisation of changes initiated by NGGT to the agreed maintenance plan.

For the RIIO-2 DD[33], Ofgem also added an additional scheme to incentivise the minimisation of the use of MDs to perform non-RVO maintenance.

All incentives are downside only with each scheme having a collar of £500k (with a total maximum collar of -£1.5m). The incentive rates are slightly different for each scheme:

[33] RIIO-2 DD GT sector annex, para 2.13-2.16

- For the scheme minimising the use of MDs for RVO operations, there is a stepped incentive rate with tiered penalties; and
- For the remaining two schemes, there is a £50K penalty for every day above the target.

4.5.1 Our approach and results

4.5.1.1 Probability distributions

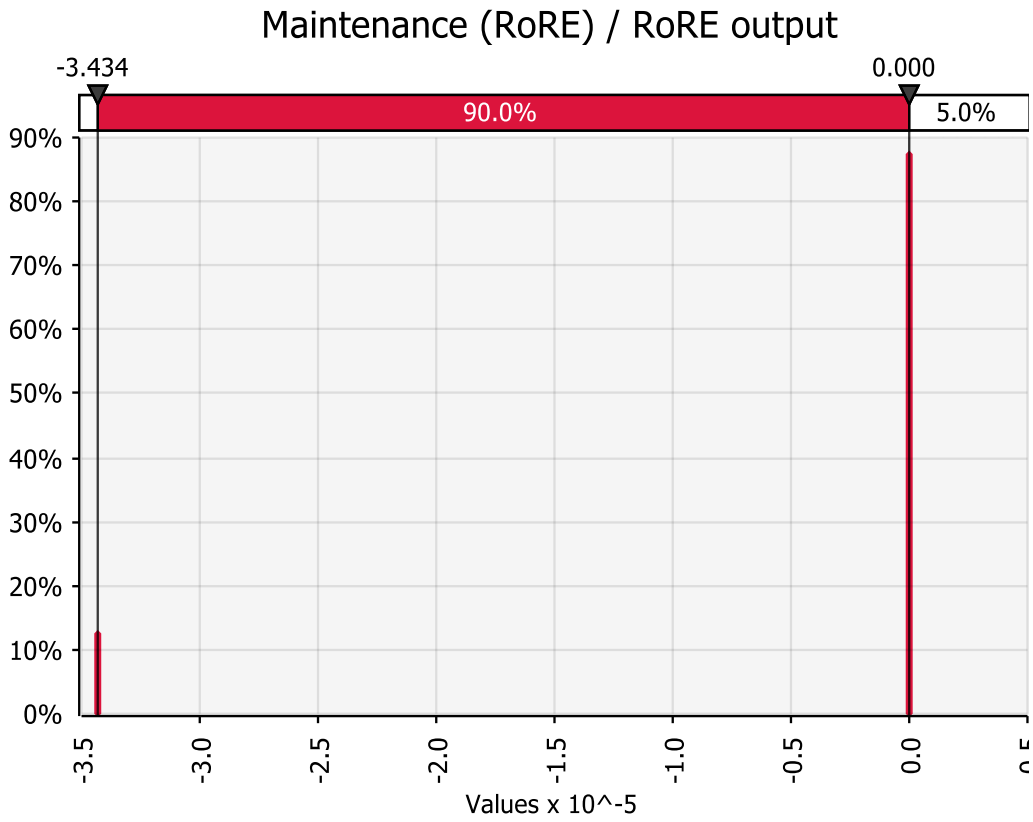
We have chosen only to model the use of days for RVO work. We have not modelled the Changes Scheme because NGGT considers the likelihood and scale of potential underperformance to be small. We have not modelled the use of days for non-RVO work because this is a new incentive, and we do not have a good sense of NGGT's expected performance.

For modelling the use of days for RVO work, we formulated a probability distribution in terms of likelihood of underperformance versus the target. In practice, that means we construct a Bernoulli distribution, where we predict the likelihood of an event happening. Based on assessment made by NGGT, we assume a one in eight risk of a scheme underperforming by four days. This is to reflect a low, but not improbable, likelihood of underperformance, where that underperformance is unlikely to reach the collar.

4.5.1.2 Results

The results from this output suggest an expected underperformance in RoRE terms of close to 2 basis points, which is equivalent to around -£0.41m per year. This reflects the downside-only nature of this incentive, but also the relatively low likelihood of triggering a downside event. We consider this a conservative assumption, simply by nature of not modelling the other two incentives, albeit we might expect these to have a relatively immaterial impact.

Figure 11 Maintenance – RoRE Impact



Source: Frontier analysis using @RISK

4.6 Residual balancing

This mechanism incentives efficient residual balancing role undertaken by the system operator, whilst minimising the impact of any action on market prices.[34] NGGT has some choice over how it fulfils these requirements, so the incentives are set in a way to encourage NGGT to do this in a way that causes least disruption to the gas market.

The incentive contains two elements:

- The price performance measure (PPM); and
- The linepack performance measure (LPM).

The incentives at RIIO-2 have been calibrated with the target rate for PPM to be 1.5% of system average price. The target rate for LPM is 2.8mcm/d for non-shoulder months, and 5.6mcm/d for shoulder months with a zero performance deadband from 2.8mcm/d to 5.6mcm/d. The incentive rates are as follows:

- For PPM, tiered daily payments up to £1.2k and penalties down to -£24k; and

[34] RIIO-2 DD GT sector annex, para 2.22-2.25

- For LPM tiered daily payments up to £3.2k and penalties down to -£24k.

The financial cap and collar is set at +£1.6m and -£2.8m across both schemes.

4.6.1 Our approach and results

4.6.1.1 Probability distributions

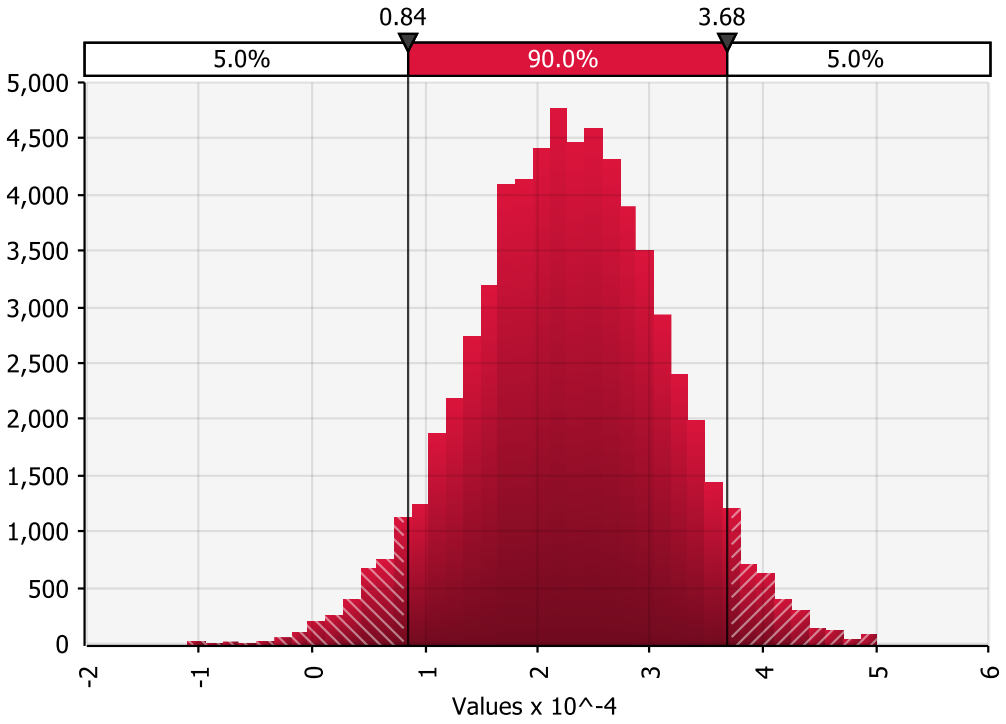
For PPM and LPM (in non-shoulder months) we assume a normal distribution of outcomes with the mean and standard deviation taken from RIIO-1 historical performance. For LPM (in shoulder months), which has no historical performance, National Grid informed us that they would expect a slightly value expected performance. This implies the following:

- For PPM, a mean outcome of 1.18% with a standard deviation of 0.48;
- For LPM (in non-shoulder months), a mean outcome of 1.90mcm/d with a standard deviation of 0.29; and
- For LPM (in shoulder months), a mean outcome of 3.90mcm/d with a standard deviation of 0.29.

4.6.1.2 Results

The results from this output suggest an expected outperformance in RoRE terms of close to 2 basis points, which is equivalent to around £0.53m per year. The relatively minor impact on performance reflects the tuning down of this incentive compared to RIIO-1.

Figure 12 Residual balancing – RoRE Impact



Source: Frontier analysis using @RISK

4.7 Greenhouse Gas Emissions (venting)

The greenhouse gas (GHG) emissions scheme[35] incentivises NGGT to take the cost of GHG emissions into account when deciding whether to depressurise compressor unit, or to keep units on standby. At RIIO-1, this was a downside-only incentive, but Ofgem now considers a financial upside is justified to motivate further reduction in GHG emissions, with the government's Net Zero targets in mind.

Ofgem sets the target at 2,897 tonnes of CO2 per year, with a symmetrical reward/penalty of approximately £1.7k for every tonne vented below/above the target up to the incentive cap/collar. The cap and collar is symmetrically set at +/- £1.5m.

4.7.1 Our approach and results

4.7.1.1 Probability distributions

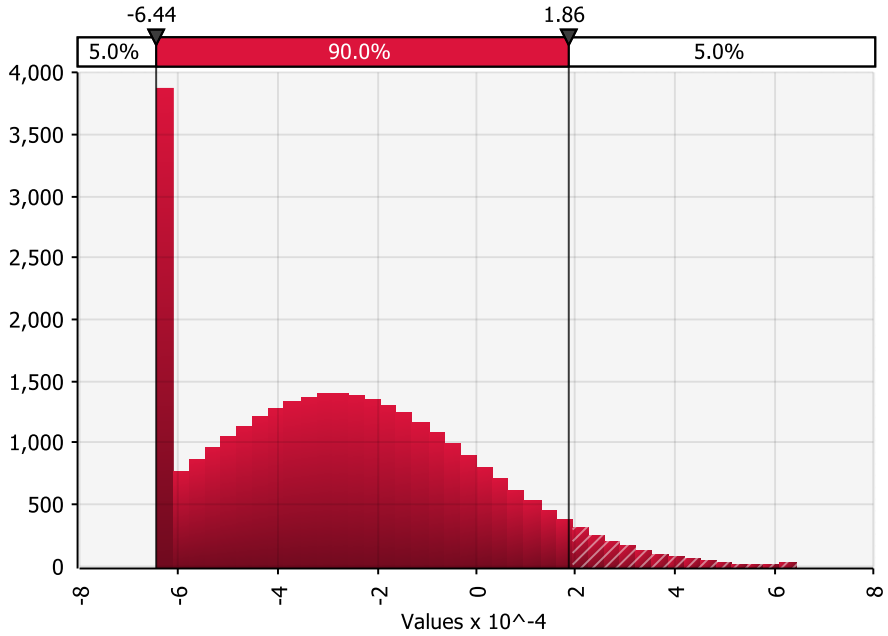
We assume a normal distribution of outcomes with the mean and standard deviation taken from RIIO-1 historical performance, which implies a mean of 3,285 tonnes of CO2 per year and a standard deviation of 391.

[35] RIIO-2 DD GT sector annex, para 2.59-2.62

4.7.1.2 Results

The results from this output suggest an expected underperformance in RoRE terms of close to 3 basis points, which is equivalent to around -£0.63m per year. There is some scope for outperformance here, but Ofgem's challenging targets drive underperformance at RIIO-2.

Figure 13 Greenhouse gas emissions (venting) – RoRE Impact



Source: Frontier analysis using @RISK

4.8 Incentives not modelled

For NGGT, there is one bespoke incentive, the environmental scorecard, which we have not modelled. This is because Ofgem has not yet fully decided on calibration of the incentive. However, Ofgem has stated the incentive will be symmetrical, with a maximum cap and collar at +/- £2.5m per year (or +/-11bps). This is may ultimately be a material incentive, but it is difficult to conclude whether this will contribute to expected upside or downside. It will, however, contribute to a wider range of potential RoRE performance.

Even if we assume the (unlikely) scenario that NGGT outperforms this incentive up to the cap, an increase to our baseline results of 11bps would not change the conclusion of overall expected underperformance.

4.9 Cross-correlations

There are two competing arguments for determining cross-correlations between totex and the non-totex incentives, each with an opposing effect on the RoRE impact:

- The first approach suggests that companies make trade-offs between standards of performance and costs. That is to say if a company spends more on totex, then one would expect an improvement in quality of service. The opposite would therefore be true: a reduction in spending leads to a worsening in the quality of service. We would characterise this as a negative correlation between totex outperformance and ODI outperformance.
- The second approach suggests that companies do not make such explicit trade-offs between standards of performance and costs. What occurs instead is that some companies make good management decisions on cost and quality of service, and some companies make bad decisions across cost and quality of service. We would characterise this as a positive correlation between totex outperformance and ODI outperformance.

In reality, there is little evidence in the GB transmission sector to suggest any correlation between totex outperformance and ODI outperformance. Ofgem has stated its view based on reviewing historical data that there is in fact negligible correlation between totex performance and non-totex performance,[36] albeit Ofgem also acknowledges there may be some evidence of positive correlation.[37] However, in the interests of making conservative assumptions in our modelling, we assume a small positive correlation (0.2) between totex outperformance and ODI outperformance for the ODIs relevant to the transmission operator which are:

- The customer satisfaction survey; and
- GHG emissions.

The core model assumptions are summarised in Figure 14 below. We also test sensitivities around this assumption.

Figure 14 Core model correlations for NGET

	Totex outperformance	Entry and exit capacity constraint management	Customer satisfaction survey	Quality of demand forecast	Maintenance outperformance	Residual balancing	Greenhouse gas emissions (venting)
Totex (excl. NARMs and PCDs)*	1						
Entry and exit capacity constraint management	0	1					
Customer satisfaction survey	0.2	0	1				
Quality of demand forecast	0	0	0	1			

[36] RIIO-2 DD Finance annex, paragraph 3.121

[37] RIIO-2 DD Finance annex, paragraph 3.126

Maintenance outperformance	0	0	0	0	1		
Residual balancing	0	0	0	0	0	1	
Greenhouse gas emissions (venting)	0.2	0	0	0	0	0	1

Source: Frontier analysis

Note 1: The correlation table above simplifies the category Maintenance outperformance which includes the categories of 'Use of Days for RVO work', 'Changes Scheme', and 'Use of days for non-RVO work'; and the Residual Balancing category which includes 'PPM', 'LPM-non-shoulder months', an 'LPM-shoulder months'.

Note 2: The component of totex outperformance correlated with other ODIs does not include the PCD or NARM component of totex. This is because PCDs and NARMs are both incentives on outputs and costs, and are therefore internally correlated.

5 OTHER INCENTIVES - NGET

Figure 15 below provides a summary of the incentives that were modelled and those that were not. We discuss each in turn in this section.

Figure 15 Incentives in RIIO-2 Draft Determination relevant to the Electricity Transmission sector

Incentive	Type	Description	Inclusion
Business Plan Incentive	BPI	Currently a fixed penalty for NGET of -£66.6m.	Included
Quality of connections outperformance	ODI-F	Two-sided incentive, which was previously part of the RIIO-1 Stakeholder Satisfaction Output ODI.	Included
Energy not supplied	ODI-F	Two-sided incentive, continued from RIIO-1.	Included
IIG Leakage	ODI-F	Two-sided incentive, continued from RIIO-1.	Included
Timely connections	ODI-F	Penalty only, continued from RIIO-1.	Not included
Environmental scorecard	ODI-F	Two-sided incentive, with specific incentive rates note yet determined.	Not included
Large project delivery	ODI-F	Penalty only, continued from RIIO-1.	Not included

Source: *Frontier analysis of Ofgem RIIO-2 Draft Determinations Electricity Transmission Annex*

Note: *Descriptions of incentives used in this table are taken from the Source document, which can be found by following this link: https://www.ofgem.gov.uk/system/files/docs/2020/07/draft_determinations_-_et_sector_0.pdf*

5.1 Business Plan Incentive

As for NGGT, the impact of the BPI is known and fixed for NGET at -£66.6m, and we model this as a fixed value in every scenario.

5.2 Quality of connections

In the SSMD, Ofgem stated it would retain only the connections element of RIIO-1's Stakeholder Satisfaction Output measure.[38] However, it is not currently clear how exactly the incentive will be calibrated. Ofgem is planning to pilot the incentive in the first year of RIIO-2, with the financial incentives in place for the following four years.

[38] RIIO-2 DD ET sector annex, para 2.29-2.45

5.2.1 Our approach and results

5.2.1.1 Probability distributions

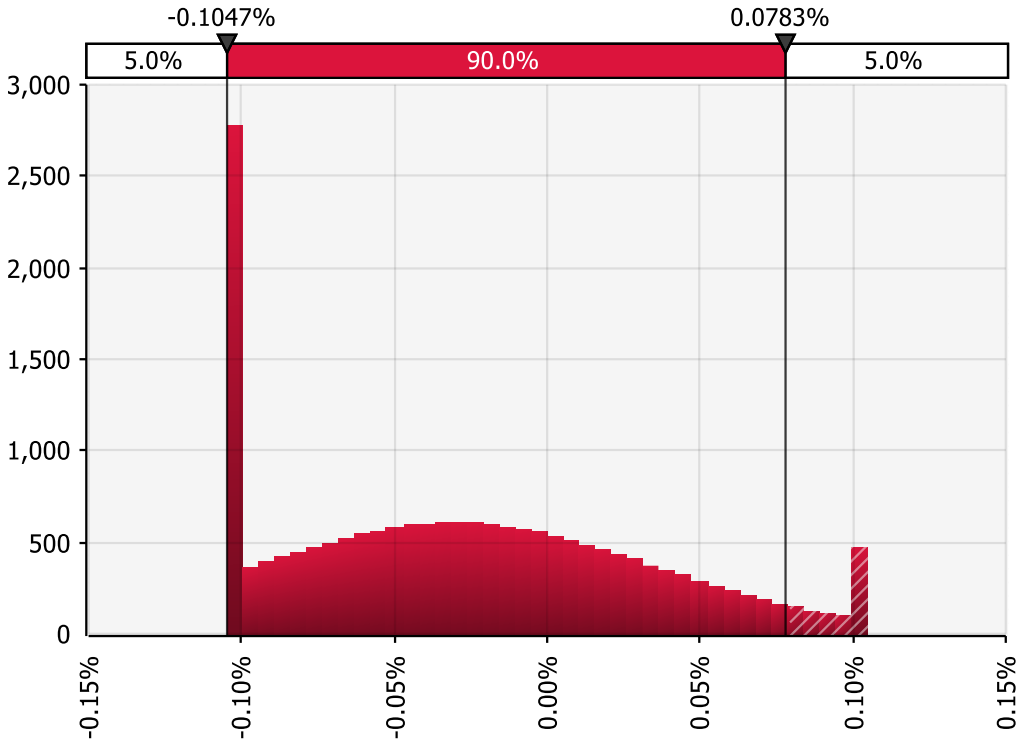
To avoid assuming a target, which has not yet been set by Ofgem, we instead model this output in terms of outperformance. The average performance is set at 0.2 points below target, based on the assumption that Ofgem will observe out/underperformance in year 1 and set a stretching target for the following years.

Similarly to the standard deviation on the customer satisfaction survey for NGGT, we set the standard deviation here equal to the observed standard deviation on customer satisfaction performance in the gas distribution sector at RIIO-1 (0.44).

5.2.1.2 Results

The results from this output suggest an expected underperformance in RoRE terms of close to 3 basis points, which is equivalent to around -£1.57m per year. However, this is based on the assumption of Ofgem continuing to set challenging targets, as per the rest of the draft determination.

Figure 16 Quality of Connections – RoRE Impact



Source: Frontier analysis using @RISK

5.3 Energy Not Supplied

The incentive works by setting a target level of performance for the electricity TOs based on the volume of Energy Not Supplied (ENS).[39] If a network company's incentivised ENS volume is lower than this target, they receive a financial reward, which is calculated by multiplying the volume of ENS below the baseline target by the incentive rate. Conversely, if a network company's ENS exceeds this baseline target, they receive a financial penalty, which is calculated by multiplying the volume of ENS above the baseline target by the incentive rate.

The incentive rate is the VoLL multiplied by the TIM. In RIIO-T2, a financial collar limits the penalty companies can receive, which is set at 3% of base revenue, with an assumed VoLL of £21.5k.

5.3.1.1 Probability distributions

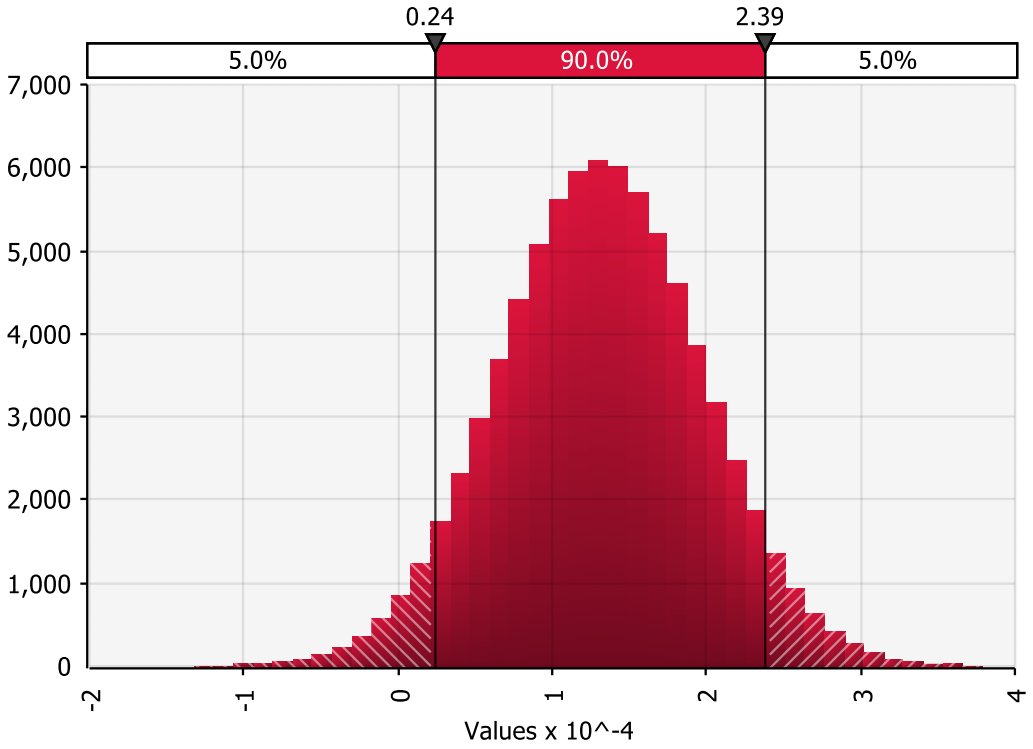
We assume a normal distribution with a mean and standard deviation based on 7 years of NGET historical performance, with a mean score of 53.7 and standard deviation of 46.3. A drawback of this approach is the very small chance of a catastrophic event that would result in NGET hitting the collar. In order to remain conservative, we choose not to model this potential downside to the performance.

5.3.1.2 Results

The results from this output suggest an expected outperformance in RoRE terms of close to 1 basis points, which is equivalent to around £0.79m per year. We consider this a conservative estimate since we do not explicitly model the low probability outcomes which may lead to large underperformance. We note NGET's view that the chances of such an outcome may arguably have increased given the significant cuts Ofgem has introduced for asset health spending.

[39] RIIO-2 DD ET sector annex, para 2.5-2.28

Figure 17 Energy not supplied – RoRE Impact



Source: Frontier analysis using @RISK

5.4 IIG Leakage

This incentive encourages a reduction in the leakage of SF_6 and other insulation and interruption gases (IIG) from assets, and supports the transition to low GHG alternative IIGs.[40] SF_6 and other IIGs are used in some transmission assets because of their excellent insulation properties, but leakage of these gases is harmful for the environment.[41]

However, there is no incentive calibrated for this output by Ofgem in the DD. In the absence of any incentive calibration, we assume the target level is set at a 15% improvement over RIIO-1 performance (9,074kg) to reflect a challenging target at RIIO-2. We also assume the incentive rate is set at the non-traded carbon price of SF_6 (£1,108/kg), since this is the cost of abating an additional unit of IIG. We assume a collar of -£3.7m and a cap at £1.7m.

[40] RIIO-2 DD ET sector annex, para 2.124-2.131

[41] 1 tonne of SF_6 is equivalent to 23,900 tonnes of CO2.

5.4.1 Our approach and results

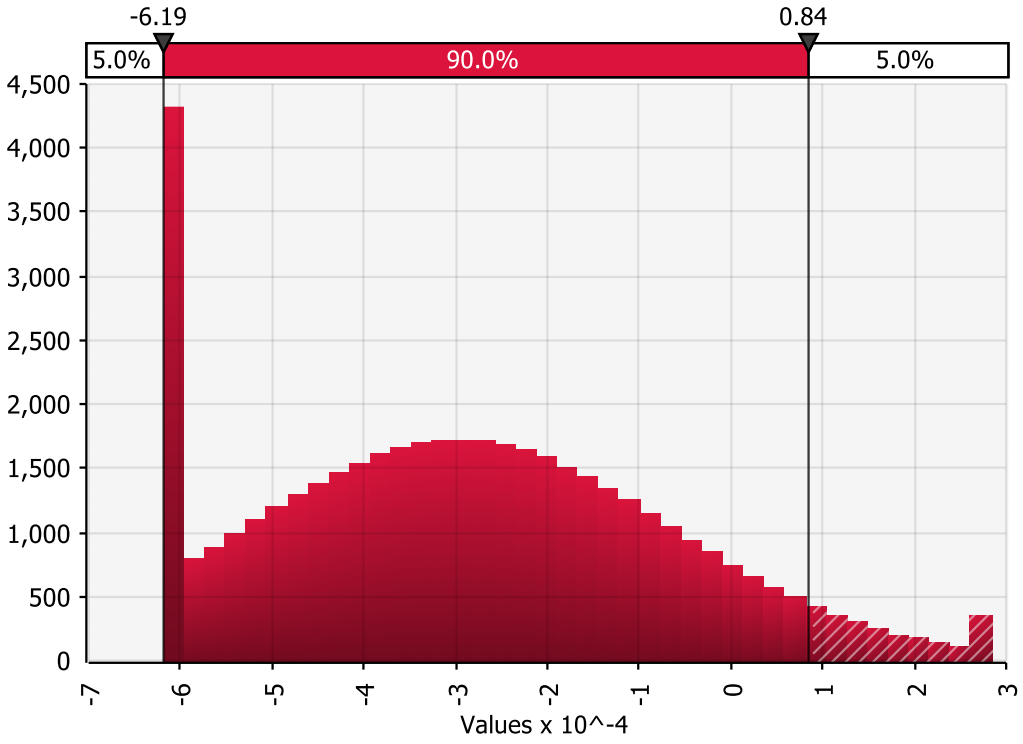
5.4.1.1 Probability distributions

We assume a normal distribution with mean and standard deviation based on NG's historic RIIO1 performance. We assume a mean performance of 10,675kg and standard deviation of 1,249kg.

5.4.1.2 Results

The results from this output suggest an expected underperformance in RoRE terms of close to 3 basis points, which is equivalent to around -£1.73m per year. This is due to a significantly tougher target than at RIIO-1 – around 15% tougher than previous performance.

Figure 18 IIG Leakage – RoRE Impact



Source: Frontier analysis using @RISK

5.5 Incentives not modelled

Ofgem has not provided properly calibrated incentives for the majority of NGET's outputs so far. However, we have decided to estimate models for the most material incentives, and have not modelled the less material incentives. These are:

- Timely connections - a penalty-only incentive, – while this has a maximum penalty of -0.5% of base revenue, we note that the incentive was applied to the Scottish TOs during RIIO-1 and there was only one penalty applied (for SPT) which was relatively small;

- Environmental scorecard - a symmetrical incentive, with a maximum cap and collar at +/- £2.5m per year;
- Large project delivery - a penalty-only rate, but there is no information on the potential maximum size of this penalty.

On balance, it is reasonable to suggest that including these incentives would cause some downside to the expected RoRE performance, so we would consider it a conservative approach to exclude these incentives.

5.6 Cross-correlations

There is little evidence in the GB transmission sector to suggest any correlation between totex outperformance and ODI outperformance. In the interests of making conservative assumptions in our modelling, we assume a small positive correlation (0.2) between totex outperformance and ODI outperformance for all modelled ODIs. Figure 19 below summarises these correlations. We also test sensitivities around this assumption.

Figure 19 Core model correlations for NGGT

	Totex (excl. NARMs and PCDs)	Quality of connections	Energy not supplied	IIG Leakage
Totex (excl. NARMs and PCDs)	1			
Quality of connections	0.2	1		
Energy not supplied	0.2	0	1	
IIG Leakage	0.2	0	0	1

Source: Frontier analysis

Note: The component of totex outperformance correlated with other ODIs does not include the PCD or NARM component of totex. This is because PCDs and NARMs are both incentives on outputs and costs, and are therefore internally correlated.

6 OVERALL RESULTS

In this section we draw together the overall impact of the core assumptions described in sections 3-5 above. We discuss NGGT and NGET in turn.

6.1 NGGT

Our core model specification results in an estimated expectation of a 16 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of -£3.644m per year during the RIIO-2 price control period. The results suggest there is only a 13% probability of outperformance at or higher than 25 bps in RoRE terms.

The key drivers of this underperformance are the Business Plan Incentive (contributing to 23 bps of the underperformance, with an equivalent absolute value of £5.28m per year), whilst the Customer Satisfaction Survey incentive contributes some expected outperformance (+7 bps and +£1.73m).

Figure 20 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 20 Summary of incentive contributions to estimated underperformance

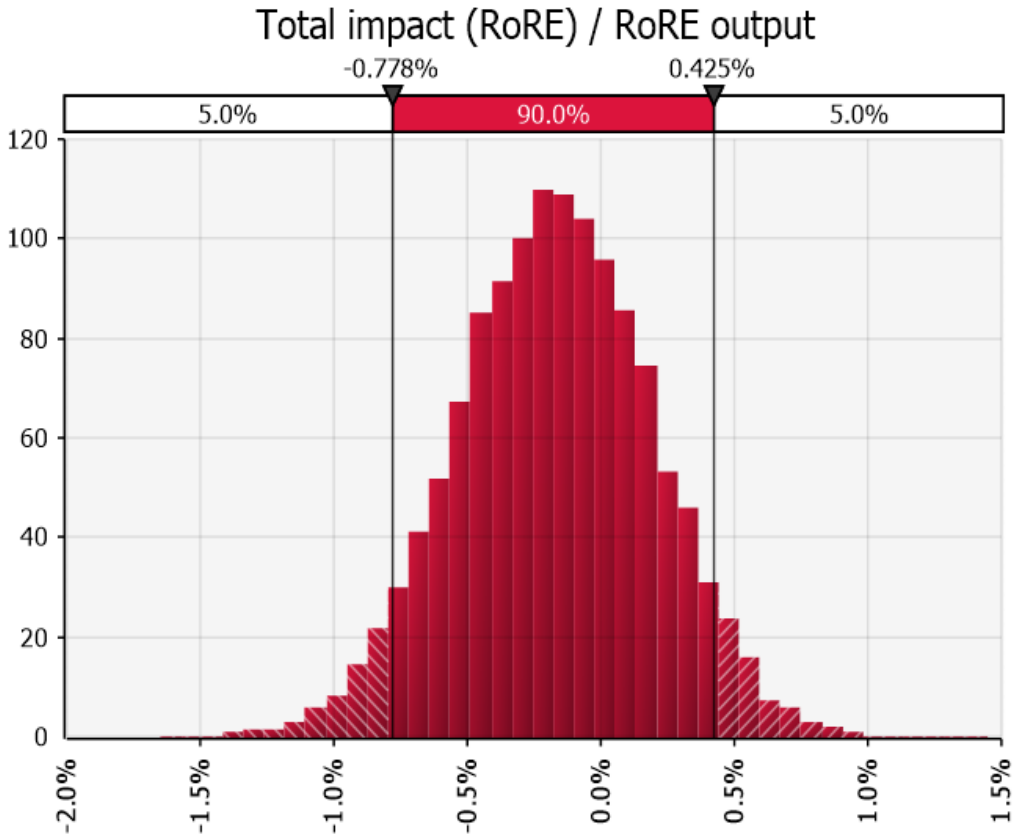
NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	0.00%	-0.54% to 0.54%	0.00	-12.52 to 12.51
PCD	0.00%	-0.20% to 0.20%	0.00	-4.59 to 4.58
NARM	0.00%	-0.15% to 0.15%	0.00	-3.58 to 3.58
Entry and exit CCM	0.00%	-0.09% to 0.09%	0.00	-2.18 to 2.18
Customer satisfaction survey	0.07%	-0.12% to 0.20%	1.73	-2.84 to 4.69
Quality of demand forecast	0.00%	-0.00% to 0.00%	0.02	-0.03 to 0.07
Maintenance	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Residual balancing	0.02%	0.00% to 0.04%	0.53	0.20 to 0.86
Greenhouse gas emissions (venting)	-0.03%	-0.06% to 0.02%	-0.63	-1.5 to 0.43
BPI	-0.23%		-5.28	
Total impact	-0.16%	-0.75% to 0.43%	-3.64	-17.50 to 10.12

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Figure 21 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes.

Figure 21 Core model results in RoRE terms: Total RoRE Impact



Source: Frontier calculations using @Risk

The horizontal axis shows financial outperformance in RoRE terms, and the vertical axis shows the frequency of occurrence in our simulation. As set out in our Methodology section above, our model randomly generates an outcome for each of our modelled incentives using the pre-defined probability distributions for each incentive. It then records the resulting RoRE outcome for that realisation. The diagram above shows the frequency of all iterations from the simulation.

6.2 NGET

Our core model specification results in an estimated expectation of a 26 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £15.83m per year during the RIIO-2 price control period. There are only 1.7% of iterations where the outperformance is at or higher than 25 bps in RoRE terms.

The key drivers of this underperformance are the Business Plan incentive (contributing to 22 bps of the underperformance, with an equivalent absolute value of £13.2m per year), the IIG leakage incentive (3bps and £1.73m), the quality of

connections incentive (3 bps and £1.57m), and the Energy not supplied incentive (1bps and £0.79m).

The table below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 22 Summary of incentive contributions to estimated underperformance

NGET	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Totex (excl. NARMs and PCDs)	0%	-0.28% to 0.28%	0.00	-16.8 to 16.8
PCD	0%	-0.23% to 0.23%	0.00	-14.04 to 14.04
NARM	0%	-0.08% to 0.08%	0.00	-4.99 to 4.99
Quality of connections	-0.03%	-0.10% to 0.08%	-1.57	-6.26 to 4.68
Energy not supplied	0.01%	-0.02% to 0.02%	0.79	-0.14 to 1.42
IIG Leakage	-0.03%	-0.06% to 0.01%	-1.73	-3.7 to 0.49
BPI	-0.22%		-13.20	
Total impact (£)	-0.26%	-1.17% to 0.64%	-15.83	-39.39 to 8.02

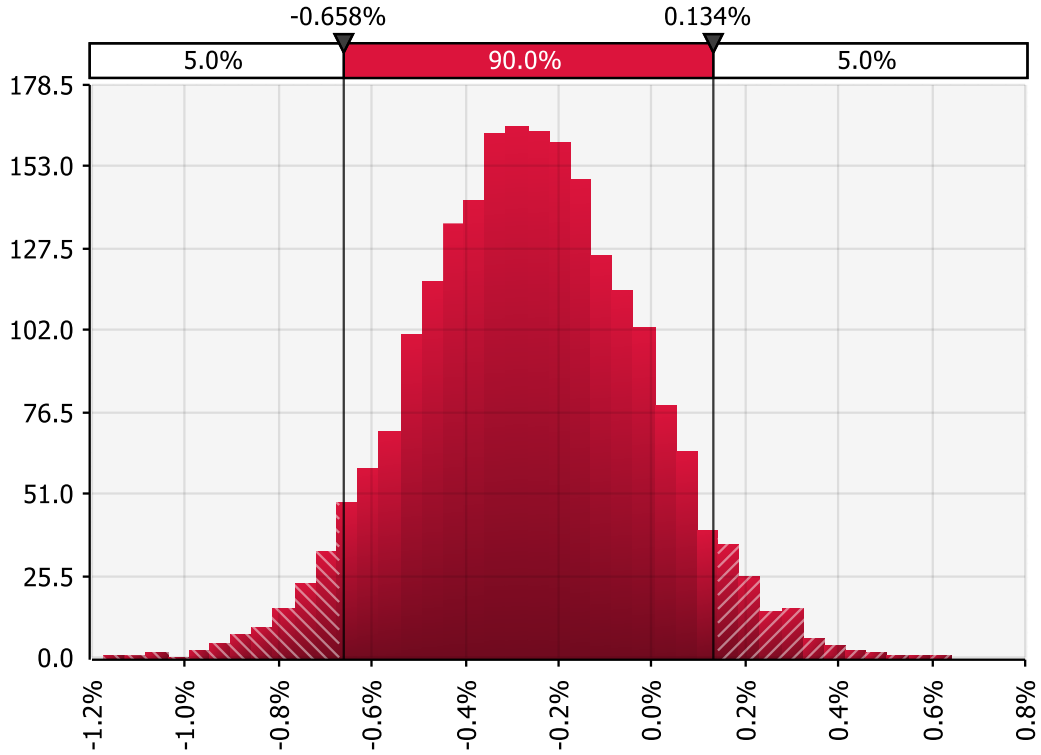
Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

In addition to these incentives, Ofgem has imposed a penalty on NGET of £556m during RIIO-2, referred to as the T1 Clawback. Since this penalty does not explicitly relate to the RIIO-2 price controls, we have chosen not to model the impact on RoRE outcomes on RIIO-2. However, it is clearly a material penalty that will reduce revenues in RIIO-2. In RoRE terms, the T1 Clawback implies a reduction in returns of 186bps – which will dwarf the impact of any of the other incentives under RIIO-2. Clearly on that basis the expectation or NGET is a very material underperformance in RIIO-2, even if performance under every incentive was at its maximum.

Figure 23 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes.

Figure 23 Core model results in RoRE terms: Total RoRE Impact



Source: Frontier calculations using @Risk

7 SENSITIVITY TESTS

We run sensitivities on two aspects of the NGGT and NGET models, and a separate sensitivity for NGGT only:

- Two sensitivities on the mean expected Totex outperformance;
- Two sensitivities on correlation between the output incentives and Totex; and
- A sensitivity on the Entry and Exit Capacity Constraint Management incentive, which takes into account NGGT's view of potential performance at RIIO-2.

7.1 Mean totex outperformance sensitivity

For the mean expected totex outperformance sensitivities, we model two scenarios outside our core model:

- A 'performance downside' model, based on a mean expected Totex underperformance of -2%. In the ENA report, we explain that if NGGT's performance at RIIO-1 was to be properly restated using the RIIO-2 framework, NGGT would have underperformed on its totex allowances by around 2%. We think this gives a reasonable downside assumption of totex performance for both transmission sectors. As described in the totex section above, based on our high level review of the DD we consider it likely that firms will underperform on totex allowances at RIIO-2.
- A 'performance upside' model based on a mean expected Totex outperformance of 3.7%. This is based on the Ofgem's analysis of historic totex outperformance, corrected to use appropriate comparator price controls. However, we reiterate that this number does not account for all the ways that we expect RIIO-2 to be more challenging, and so we cannot extrapolate strong historic performance to future performance.

7.2 Output incentives and totex correlation sensitivity

For the correlation sensitivities, in our core model for NGET, we are assuming positive correlations between totex and:

- Quality of Connections;
- Energy not supplied; and
- IIG leakage.

In our core model for NGGT we're assuming positive correlations between totex and:

- Customer satisfaction survey; and
- GHG emissions.

As explained in the previous sections on correlations [x-ref], these positive correlations imply that good performance on outputs is associated with good performance on totex. In our 'core' model for both NGGT and NGET, we assume

a positive correlation between outperformance on the relevant output incentives and outperformance on totex. We consider this to be a conservative assumption.

We model 2 sensitivities around these assumptions:

- A 'zero correlation' model with all zero correlation; and
- A 'stronger positive correlation' model where the relevant correlations are 0.4.

Other than the variables correlated with Totex, the structure of both the NGET and NGGT models are similar.

7.3 CCM sensitivity

We understand that there is disagreement between NGGT and Ofgem approaches to the Entry and Exit Capacity Constraint Management incentive. In NGGT's business plan, it was considered that there is a material risk of underperformance on this incentive, given the level of risk associated with CCM performance.

We model a downside performance that is equal to NGGT's central view of CCM performance. NGGT stated that a central assumption for the level of risk on the network is at £22.1m. We take a reasonably neutral view to the mode and upside outcomes - our mode outcome is the same as per the core model, and our upside performance outcome assumes National Grid improves by around 20% on its previous best performance. On balance, we consider this to be a realistic sensitivity to model.

7.4 Summary of sensitivities

The table below details all the sensitivities we model along with our core model and shows the mean estimated totex outperformance, the corresponding financial outperformance, and the percentage of outcomes greater than 25bps.

In terms of the totex sensitivities, we find that even in the (highly unlikely) upside sensitivity, average expected outperformance for both NGET and NGGT remains less than zero. For ET, only 3% of iterations give RoRE returns greater than 25bps. For GT this value is higher, at 23%.

The correlation sensitivities have no material impact.

Figure 24 Summary of sensitivities across NGET and NGGT models

NGGT	Mean Totex outperformance	Mean financial outperformance (£m)	Probability of outperforming 25bps
	GT		
Core	-0.16%	-3.64	13.1%
Totex downside	-0.23%	-5.37	9.2%
Totex upside	-0.02%	-0.44	23.0%
Correlation downside	-0.16%	-3.64	12.4%
Correlation upside	-0.16%	-3.64	14.3%
CCM sensitivity	-0.21%	-4.77	10.6%
	ET		
Core	-0.26%	-15.83	1.70%

Totex downside	-0.30%	-18.14	0.90%
Totex upside	-0.19%	-11.53	3.20%
Correlation downside	-0.26%	-15.82	1.50%
Correlation upside	-0.26%	-15.82	1.90%

Source: Frontier calculations

In Annex A and Annex B, we detail these results from the NGGT and NGET models respectively.

8 CONCLUSIONS

Our baseline results suggest that there is no evidence to justify Ofgem's 25 bps outperformance wedge. Given the RIIO-2 DD proposals, companies will in all likelihood underperform in RIIO-2. Even though there is, of course, a chance that outperformance reaches above 25bps, we do not consider it to be a reasonable exercise of regulatory judgement for Ofgem to base such a key regulatory decision on a scenario with such low likelihood – only 13% for NGGT and 2% for NGET. The degree of totex outperformance that would be required to reach 25bps (given that the ranges around the ODIs are generally very narrow) is simply implausible, given Ofgem's allowances and the number of mechanisms designed to constrain outperformance to a minimum.

This result arises *despite* the fact that we have introduced several assumptions that would tend to bias these results upwards relative to a more balanced approach:

- We have adopted a conservative approach to modelling totex performance, given the likelihood that this is a price control DD which would result in underperformance (and the fact that Ofgem accepts NGGT has materially underperformed in RIIO-1). In the not-implausible scenario where there is 2% underperformance on totex, this could lead to a further downside of around 4bps for NGET and 7bps for NGGT;
- While we have modelled the effect of PCDs and NARM on totex incentives separately, we have ignored some material drivers of downside risk – for example the potential for late delivery penalties on some PCDs; and the asymmetric skew of risk associated with the NARM incentive (due to the Delivery Adjustment Factor, and the asymmetric application of tests for "genuine" under/over-spends). We have also ignored the asymmetric incentives around risk-target delivery – i.e. the fact that there is no upside for "justified" departures from the NARM target, but downside penalties for any "unjustified" departures.
- For NGGT's CCM, we conservatively assume Ofgem has correctly calibrated the incentive, rather than taking into account the downside view put forward by NGGT (which we test in a sensitivity);
- For NGGT's expected outcome on customer satisfaction, we conservatively assume continued improvement and outperformance at T2;
- For NGGT's maintenance incentive, we only model one of the three downside-only incentives, albeit the effect of the two not modelled is likely to be relatively immaterial;
- For NGET's energy not supplied outcome, we have conservatively chosen not to model the low probability of a large downside;
- We have not modelled the 'timely connections' or 'large project delivery' outputs for NGET, both of which are 'penalty-only' incentives; and
- Our assumptions on cross-correlations across NGGT and NGET leads to a larger range of outperformance, and therefore a higher probability of outperformance.

These results are robust to changing the modelling assumptions around totex performance and different correlations.

Another key conclusion to draw from this analysis is that the firms are not only expected to underperform, but also there is a very slim chance of exceeding the 25bps at which Ofgem has set the "outperformance wedge".

For NGET the likelihood of outperforming by 25bps or more is 2%. Two additional factors that would drive NGET's expected RoRE performance lower.

- First the T1 clawback mechanism that may significantly impact NGET's RoRE allowances in RIIO-2.
- Second, we have chosen not to model some incentives which are clearly skewed to the downside.

For NGGT, where it should be noted there is much more clarity around Ofgem's proposed calibration of the ODIs, the likelihood of outperforming by 25bps is higher, at 13%. However, in our view this is an entirely insufficient basis to assume that 25bps of outperformance is likely enough to warrant the outperformance wedge. It should also be noted that the RIIO-1 performance of totex (restated at RIIO-2) implies a small underperformance. This again suggests there is no prior expectation of overall outperformance for NGGT.

There are some limitations to our modelling assumptions, particularly where Ofgem has not specified ODIs fully. However, we believe this study has accurately reflected Ofgem's incentive calibrations that have been outlined at Draft Determination.

Finally, we note that one interpretation of our finding of expected underperformance may be that rather than applying a deduction to the headline cost of equity, Ofgem should apply an uplift. We would encourage the reader not to reach this view. We disagree in principle with Ofgem's proposition that the allowed return on equity should be adjusted to account for expected outperformance (or indeed under-performance).

ANNEX A SENSITIVITIES TO NGGT MODEL

Expected totex performance: downside

Our first sensitivity to the core model specification is a mean estimated Totex outperformance set to -2%. This results in an estimated expectation of a 25 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £5.37m per year during the RIIO-T2 price control period. Figure 25**Error! Reference source not found.** below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 26 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -23 bps in RoRE terms. It also shows that there are only 9% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

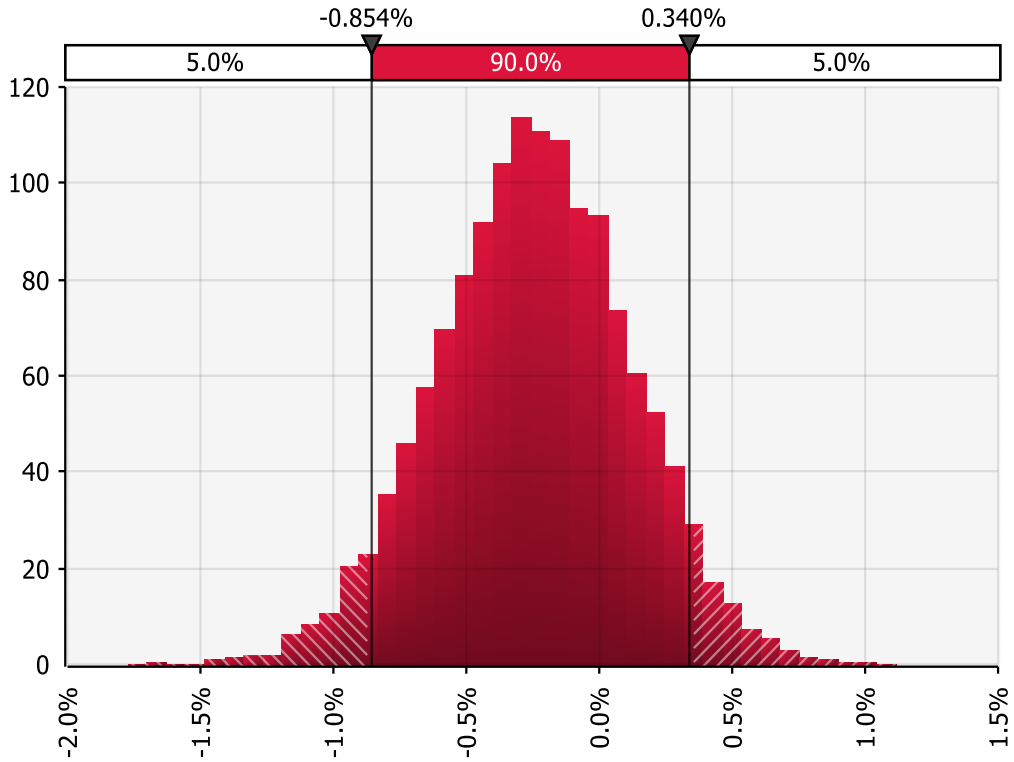
Figure 25 Summary of incentive contributions to estimated underperformance with a downside totex outperformance estimate

NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	-0.07%	-0.61% to 0.46%	-1.73	-14.24 to 10.78
PCD	0.00%	-0.02% to 0.02%	0.00	-4.58 to 4.58
NARM	0.00%	-0.02% to 0.02%	0.00	-3.58 to 3.58
Entry and exit CCM	0.00%	-.0.09% to 0.09%	0.00	-2.19 to 2.19
Customer satisfaction survey	0.07%	-0.12% to 0.20%	1.73	-2.85 to 4.69
Quality of demand forecast	0.00%	-0.00% to 0.00%	0.02	-0.03 to 0.07
Maintenance	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Residual balancing	0.02%	0.01% to 0.04%	0.53	0.19 to 0.86
Greenhouse gas emissions (venting)	-0.03%	-0.06% to 0.02%	-0.63	-1.5 to 0.43
BPI	-0.23%		-5.28	
Total impact	-0.23%	-0.83% to 0.36%	-5.37	-19.39 to 8.43

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Figure 26 RoRE underperformance with a downside totex outperformance estimate



Source: Frontier calculations using @Risk

Expected totex performance: upside

Our second sensitivity to the core model specification is a mean estimated totex outperformance set to 3.7%. This results in an estimated expectation of a 2bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of -£0.44m per year during the RIIO-T2 price control period. Figure 27 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 28 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -2bps in RoRE terms. It also shows that there are only 23% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

Figure 27 Summary of incentive contributions to estimated underperformance with a upside totex outperformance estimate

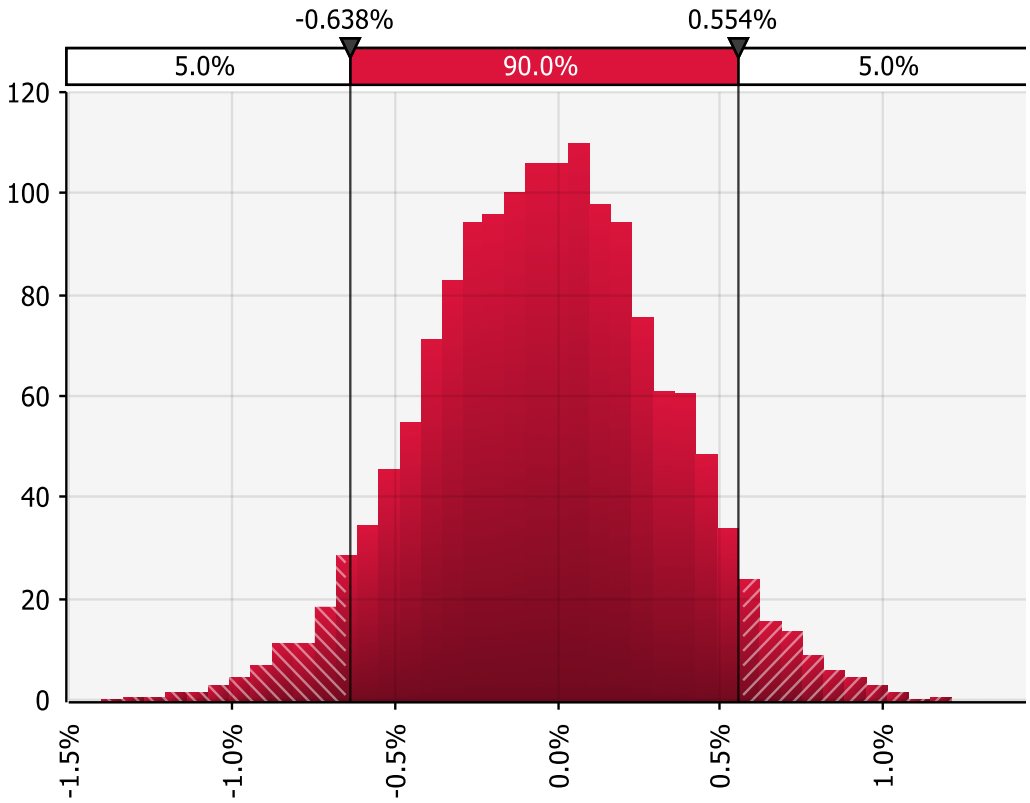
NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)

Rest of Totex outperformance	0.14%	-0.40% to 0.67%	3.19	-9.32 to 15.71
PCD	0.00%	-0.02% to 0.02%	0.00	-4.58 to 4.58
NARM	0.00%	-0.02% to 0.02%	0.00	-3.58 to 3.58
Entry and exit CCM	0.00%	-0.09% to 0.09%	0.00	-2.19 to 2.19
Customer satisfaction survey	0.07%	-0.12% to 0.20%	1.73	-2.85 to 4.69
Quality of demand forecast	0.00%	-0.00% to 0.00%	0.02	-0.04 to 0.07
Maintenance	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Residual balancing	0.02%	0.01% to 0.04%	0.53	0.19 to 0.85
Greenhouse gas emissions (venting)	-0.03%	-0.06% to 0.02%	-0.63	-1.5 to 0.43
BPI	-0.23%		-5.28	
Total impact	-0.02%	-0.63% to 0.57%	-0.44	-14.62 to 13.21

Source: *Frontier calculations*

Note: *The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals*

Figure 28 RoRE underperformance with an upside totex outperformance estimate



Source: *Frontier calculations using @Risk*

Zero correlations

Our third sensitivity to the core model specification is set the correlations between Totex and the Customer Satisfaction survey score and Greenhouse gas emissions to 0 instead of the core model correlation of 0.2. This results in an estimated expectation of a 16bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £3.64m per year during the RIIO-T2 price control period. Figure 29 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 30 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -16bps in RoRE terms. It also shows that there are only 12% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

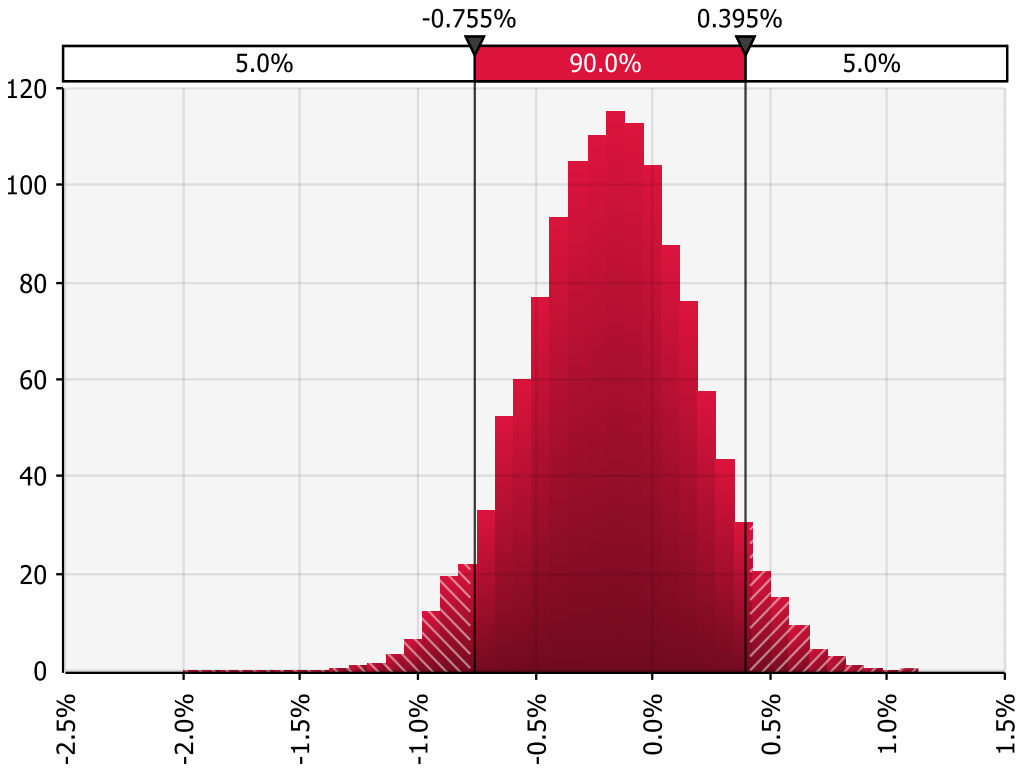
Figure 29 Summary of incentive contributions to estimated underperformance with zero correlations

NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	0.00%	-0.54% to 0.54%	0.00	-12.52 to 12.51
PCD	0.00%	-0.02% to 0.02%	0.00	-4.58 to 4.58
NARM	0.00%	-0.02% to 0.02%	0.00	-3.58 to 3.58
Entry and exit CCM	0.00%	-0.09% to 0.09%	0.00	-2.18 to 2.18
Customer satisfaction survey	0.07%	-0.12% to 0.20%	1.73	-2.84 to 4.69
Quality of demand forecast	0.00%	-0.00% to 0.00%	0.02	-0.04 to 0.07
Maintenance	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Residual balancing	0.02%	0.01% to 0.04%	0.53	0.20 to 0.86
Greenhouse gas emissions (venting)	-0.03%	-0.06% to 0.02%	-0.63	-1.5 to 0.43
BPI	-0.23%		-5.28	
Total impact	-0.16%	-0.74% to 0.40%	-3.64	-17.11 to 9.42

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Figure 30 RoRE underperformance with zero correlations



Source: Frontier calculations using @Risk

Stronger positive correlations

Our fourth sensitivity to the core model specification is set the correlations between Totex and the Customer Satisfaction survey score and Greenhouse gas emissions to 0.4 instead of the core model correlation of 0.2. This results in an estimated expectation of a 16 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £3.64m per year during the RIIO-T2 price control period. Figure 31 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 32 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -16bps in RoRE terms. It also shows that there are only 14% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

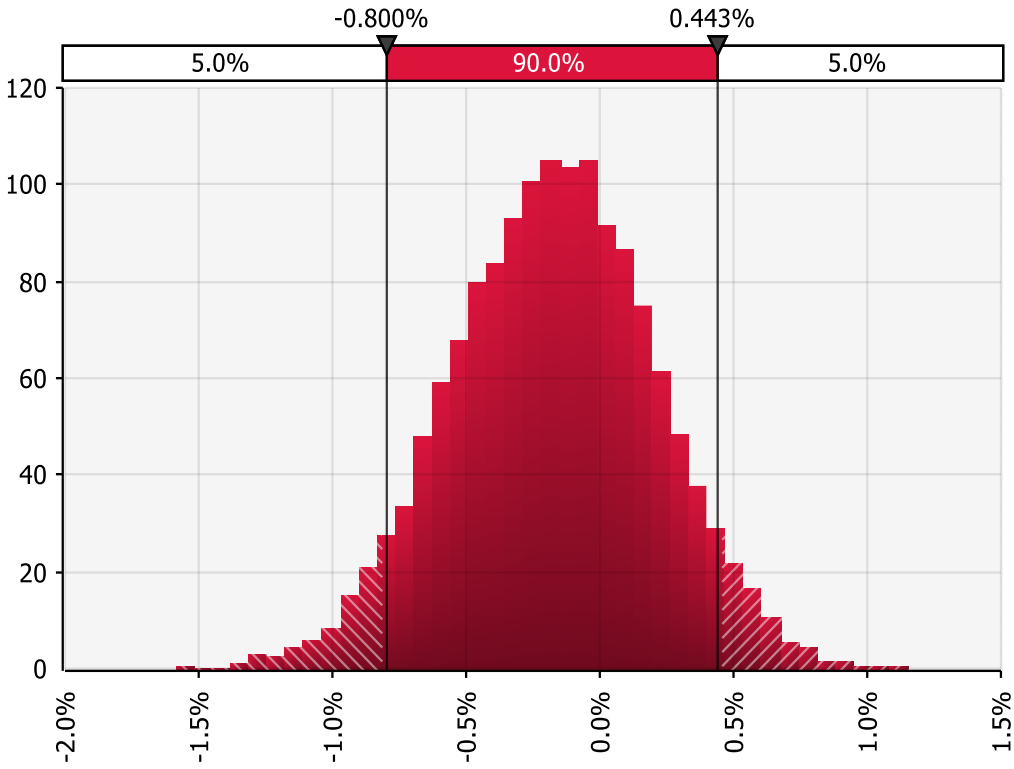
Figure 31 Summary of incentive contributions to estimated underperformance with a stronger positive correlation

NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	0.00%	-0.54% to 0.54%	0.00	-12.52 to 12.52
PCD	0.00%	-0.02% to 0.02%	0.00	-4.59 to 4.58
NARM	0.00%	-0.02% to 0.02%	0.00	-3.58 to 3.58
Entry and exit CCM	0.00%	-0.09% to 0.09%	0.00	-2.19 to 2.19
Customer satisfaction survey	0.07%	-0.12% to 0.20%	1.73	-2.85 to 4.69
Quality of demand forecast	0.00%	0.00% to 0.00%	0.02	-0.03 to 0.07
Maintenance	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Residual balancing	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Greenhouse gas emissions (venting)	-0.03%	-0.06% to 0.02%	-0.63	-1.5 to 0.43
BPI	-0.23%		-5.28	
Total impact	-0.16%	-0.79% to 0.46%	-3.64	-18.36 to 10.70

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Figure 32 RoRE underperformance with stronger positive correlations



Source: Frontier calculations using @Risk

NGGT view of Entry and Exit CCM

Our fifth sensitivity to the core model specification is to take NGGT's assumptions on Entry and Exit Capacity Constraint Management (CCM) performance. In NGGT's business plan, it was considered that there is a material risk of underperformance on this incentive, given the level of risk associated with CCM performance. In particular, NGGT claimed that a central assumption for the level of risk on the network is at £22.1m.

We use NGGT's central scenario as our maximum downside performance assumption. We take a reasonably neutral view to the mode and upside outcomes. Our mode outcome is the same as per the core model, and our upside performance outcome assumes National Grid improves by around 20% on its previous best performance. On balance, we consider this to be a realistic sensitivity to model.

The results from this output alone suggests an expected underperformance in RoRE terms of 5 basis points, which is equivalent to c. -£1m per year. Since we consider the maximum downside performance to be higher than the collar, this assumes NGGT triggers the maximum payments frequently in our simulations. This drives overall underperformance of around 21bps. However, there remains scope for outperformance(see Figure 34).

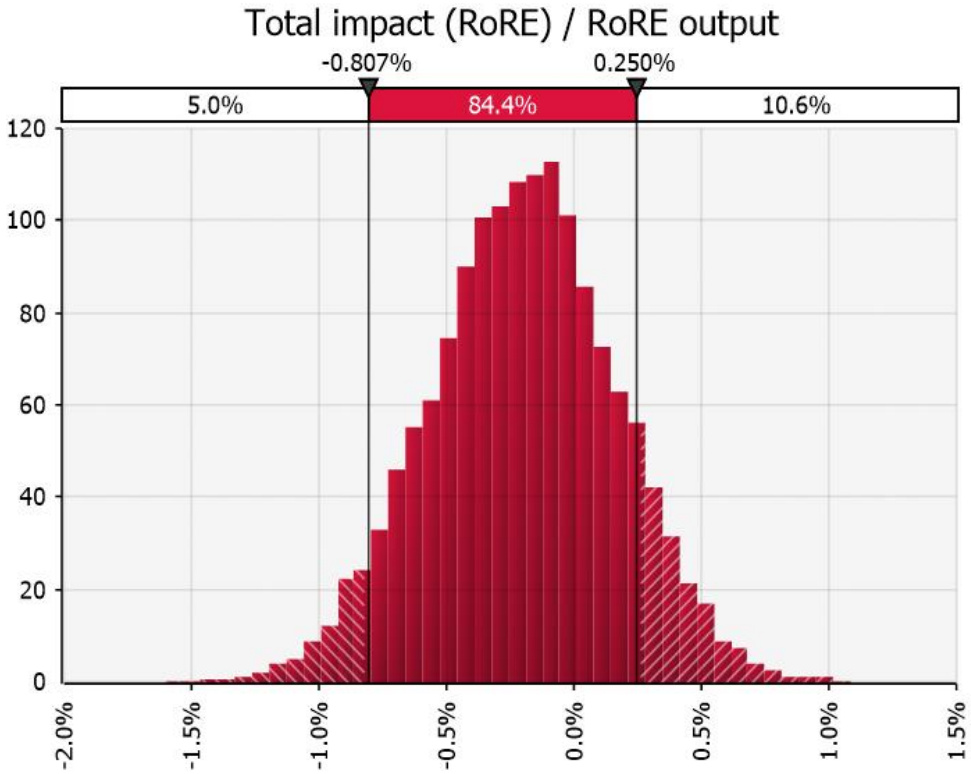
Figure 33 Summary of incentive contributions to estimated underperformance with a NGGT view of CCM

NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	0.00%	-0.54% to 0.54%	0.00	-12.52 to 12.52
PCD	0.00%	-0.02% to 0.02%	0.00	-4.59 to 4.58
NARM	0.00%	-0.02% to 0.02%	0.00	-3.58 to 3.58
Entry and exit CCM	-0.05%	-0.14% to 0.02%	-1.09	-3.2 to 0.51
Customer satisfaction survey	0.07%	-0.12% to 0.20%	1.73	-2.85 to 4.69
Quality of demand forecast	0.00%	0.00% to 0.00%	0.02	-0.03 to 0.07
Maintenance	-0.00%	-0.03% to 0.00%	-0.00	-0.08 to 0.00
Residual balancing	0.02%	0.01% to 0.04%	0.53	0.2 to 0.85
Greenhouse gas emissions (venting)	-0.03%	-0.06% to 0.02%	-0.63	-1.5 to 0.43
BPI	-0.23%		-5.28	
Total impact	-0.21%	-0.85% to 0.43%	-4.77	-19.81 to 10.11

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Figure 34 RoRE underperformance with alternative CCM assumptions



Source: Frontier analysis using @Risk

ANNEX B SENSITIVITIES TO NGET MODEL

Expected totex performance: downside

Our first sensitivity to the core model specification is a mean estimated Totex outperformance set to -2%. This results in an estimated expectation of a 30 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £18.14m per year during the RIIO-T2 price control period. Figure 35 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 36 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -30 bps in RoRE terms. It also shows that there are only 0.9% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

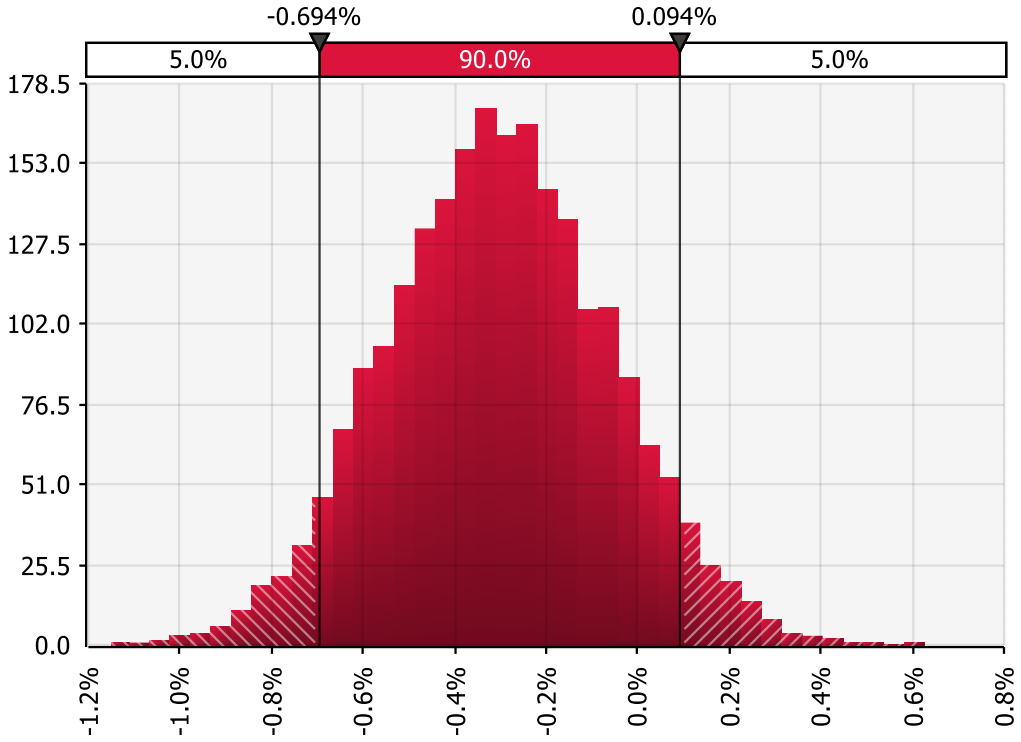
Figure 35 Summary of incentive contributions to estimated underperformance with a downside totex outperformance estimate

NGET	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	-0.04%	-0.31% to 0.24%	-2.32	-19.12 to 14.46
PCD	0.00%	-0.23% to 0.23%	0.00	-14.05 to 14.03
NARM	0.00%	-0.08% to 0.08%	0.00	-4.99 to 4.99
Quality of connections	-0.03%	-0.10% to 0.07%	-1.56	-6.26 to 4.68
Energy not supplied	0.01%	-0.00% to 0.02%	0.78	-0.14 to 1.42
IIG Leakage	-0.03%	-0.06% to 0.00%	-1.72	-3.7 to 0.5
BPI	-0.22%		-13.20	
Total impact (£)	-0.30%	-0.69% to 0.09%	-18.14	-41.49 to 5.64

Source: *Frontier calculations*

Note: *The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals*

Figure 36 RoRE underperformance with a downside totex outperformance estimate



Source: Frontier calculations using @Risk

Expected totex performance: upside

Our second sensitivity to the core model specification is a mean estimated Totex outperformance set to 3.7%. This results in an estimated expectation of a 19 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £11.53m per year during the RIIO-T2 price control period. Figure 37 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 38 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -19 bps in RoRE terms. It also shows there are only 3.2% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

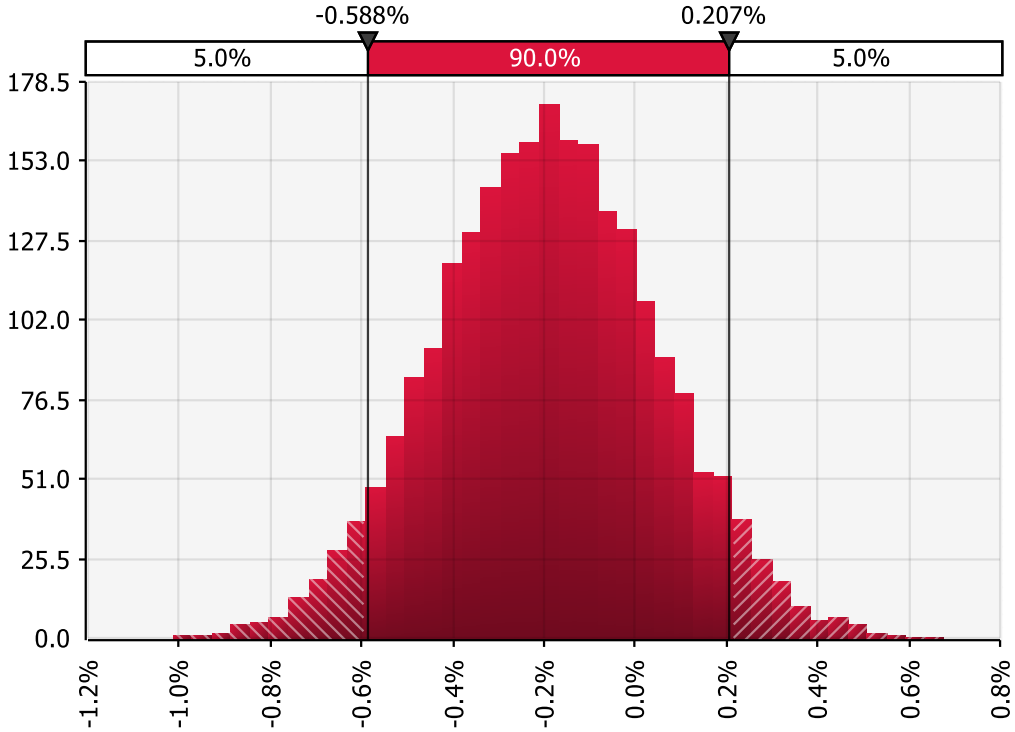
Figure 37 Summary of incentive contributions to estimated underperformance with an upside totex outperformance estimate

NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	0.07%	-0.21% to 0.35%	4.29	-12.5 to 21.08
PCD	0.00%	-0.23% to 0.23%	0.000061	-14.04 to 14.04
NARM	0.00%	-0.08% to 0.08%	-0.000083	-4.99 to 4.99
Quality of connections	-0.03%	-0.10% to 0.07%	-1.56	-6.26 to 4.68
Energy not supplied	0.01%	0.00% to 0.02%	0.78	0.14 to 1.43
IIG Leakage	-0.03%	-0.06% to 0.01%	-1.72	-3.7 to 0.5
BPI	-0.22%		-13.20	
Total impact (£)	-0.19%	-0.58% to 0.21%	-11.53	-35.18 to 12.40

Source: Frontier calculations

Note: The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals

Figure 38 RoRE underperformance with an upside totex outperformance estimate



Source: Frontier calculations using @Risk

Zero correlations

Our third sensitivity to the core model specification is set the correlations between Totex and the Customer Satisfaction survey score and Greenhouse gas emissions to 0 instead of the core model correlation of 0.2. This results in an estimated expectation of a 26 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £15.82m per year during the RIIO-T2 price control period. Figure 39 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 40 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -26 bps in RoRE terms. It also shows that there are only 1.5% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

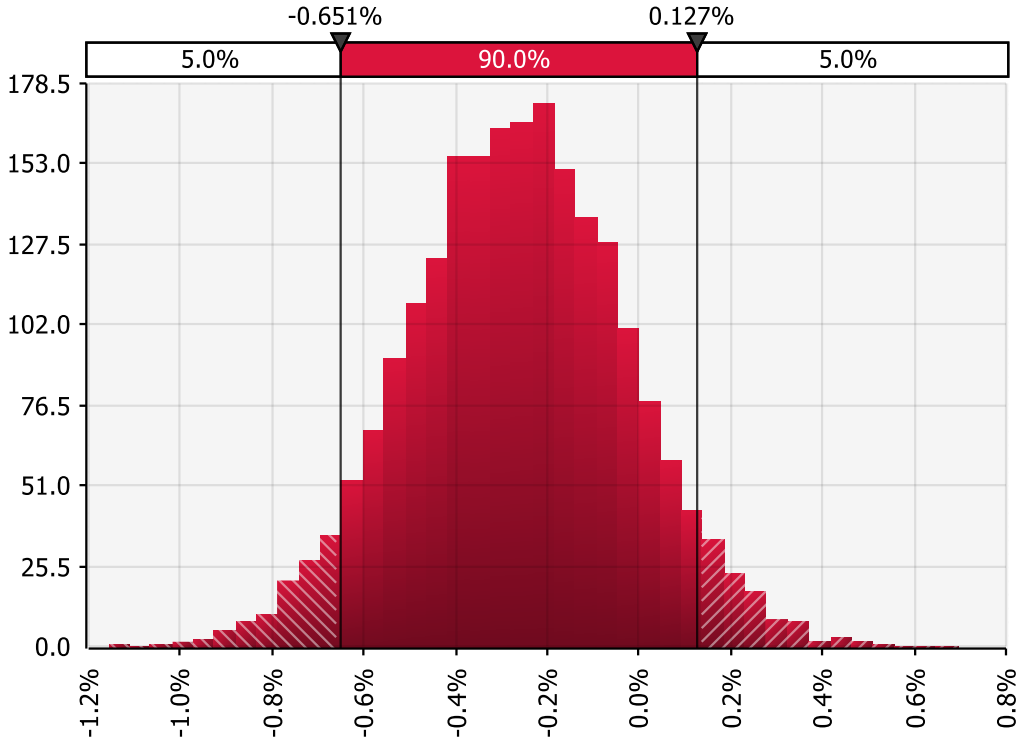
Figure 39 Summary of incentive contributions to estimated underperformance with zero correlations

NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)
Rest of Totex outperformance	0.00%	-0.28% to 0.28%	0.000261	-16.79 to 16.79
PCD	0.00%	-0.23% to 0.23%	0.000061	-14.05 to 14.04
NARM	0.00%	0.08% to 0.08%	0.000124	-4.99 to 4.99
Quality of connections	-0.03%	-0.10% to 0.08%	-1.56	-6.26 to 4.68
Energy not supplied	0.01%	0.00% to 0.02%	0.78	0.14 to 1.42
IIG Leakage	-0.03%	-0.06% to 0.01%	-1.72	-3.7 to 0.5
BPI	-0.22%		-13.20	
Total impact (£)	-0.26%	-0.65% to 0.12%	-15.82	-38.95 to 7.56

Source: *Frontier calculations*

Note: *The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals*

Figure 40 RoRE underperformance with zero correlations



Source: Frontier calculations using @Risk

Stronger positive correlations

Our fourth sensitivity to the core model specification is set the correlations between Totex and the Customer Satisfaction survey score and Greenhouse gas emissions to 0.4 instead of the core model correlation of 0.2. This results in an estimated expectation of a 26 bps underperformance in RoRE terms. This is equivalent to an absolute underperformance of £15.82m per year during the RIIO-T2 price control period. Figure 41 below shows the incentives that we have modelled and the estimated mean RoRE and financial impacts they are likely to have, along with the range of these impacts.

Figure 42 below shows the Monte Carlo simulation results of our core model, in the form of a probability distribution of potential RoRE outperformance outcomes. The resulting distribution has a mean outcome of -26 bps in RoRE terms. It also shows that there are only 1.9% of iterations where the outperformance was at or higher than 25 bps in RoRE terms.

Figure 41 Summary of incentive contributions to estimated underperformance with a stronger positive correlation

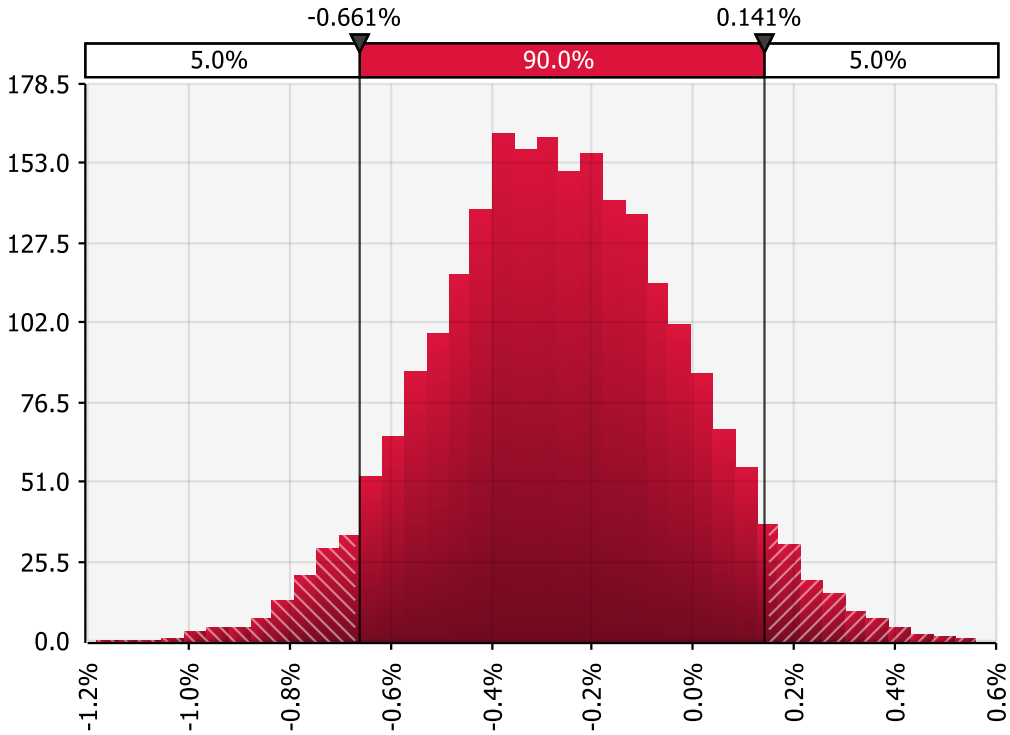
NGGT	Mean RoRE Impact	RoRE Impact Range	Mean Financial Impact (£m/year)	Financial Impact Range (£m/year)

Rest of Totex outperformance	0%	-0.28% to 0.28%	0.00	-16.8 to 16.79
PCD	0%	-0.08% to 0.08%	0.00	-14.05 to 14.04
NARM	0%	-0.23% to 0.23%	0.00	-4.99 to 4.99
Quality of connections	-0.03%	-0.10% to 0.07%	-1.56	-6.26 to 4.68
Energy not supplied	0.01%	0.00% to 0.02%	0.78	0.14 to 1.42
IIG Leakage	-0.03%	-0.06% to 0.01%	-1.72	-3.7 to 0.5
BPI	-0.22%		-13.20	
Total impact (£)	-0.26%	-0.66% to 0.14%	-15.82	-39.52 to 8.45

Source: *Frontier calculations*

Note: *The range of RoRE impact and financial impact in this table represents the 5% and 95% confidence intervals*

Figure 42 RoRE underperformance with stronger positive correlations



Source: *Frontier calculations using @Risk*

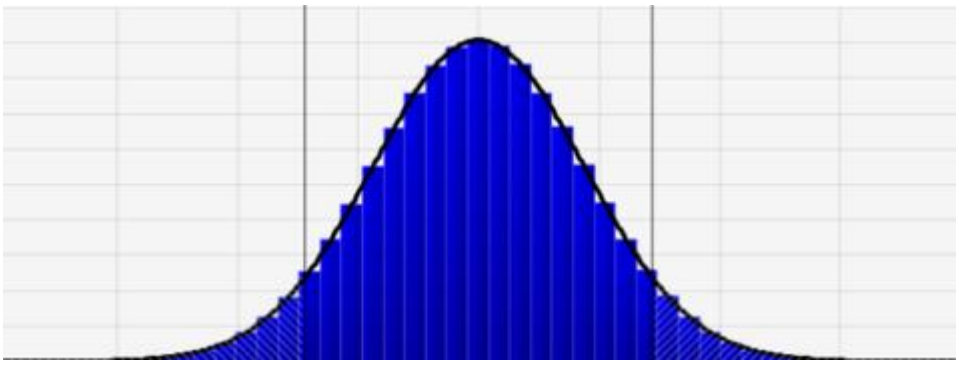
ANNEX C TYPES OF DISTRIBUTIONS MODELLED

A probability distribution is a description of all possible values taken on by a function, and the probabilities of a random variable taking on any of the observations in the range. Exactly how the points in the range take shape when their values are plotted against their probability of occurrence depends on the maximum, minimum, mean, standard deviation, skewness, and kurtosis of the data.[42]

As part of our analysis, we model our variables using 3 types of probability distributions: Normal, Triangular and Bernoulli. A brief description of each is below:

- A distribution in which the data are symmetrically spread across a bell-shaped graph is called a **normal distribution**. The most likely outcome is the mean, while all other data are distributed symmetrically around the mean. 68% of observations lie within one standard deviation on either side of the mean, and 95% of observations lie within two standard deviations on either side of the mean.[43]

Figure 43 A typical Normal distribution



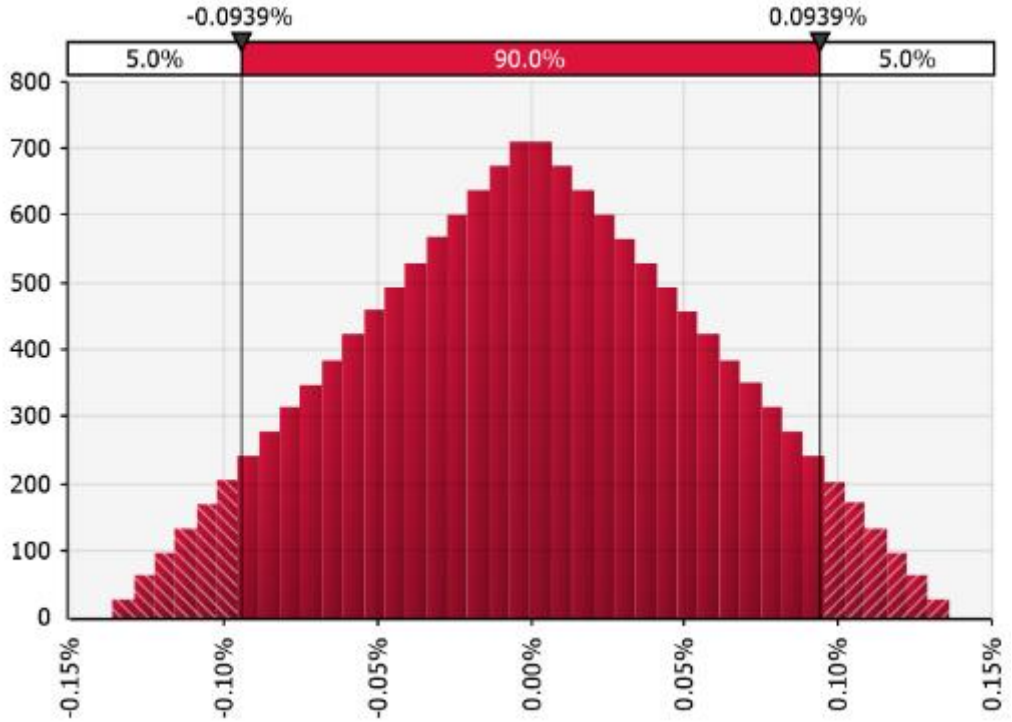
Source: Frontier example of a typical normal distribution

- A **triangular distribution** is a continuous distribution of observations which takes the shape of a triangle when these observations are plotted. This distribution has a lower limit (minimum) and an upper limit (maximum), which are the lowest and highest observations in the distribution and have equally low probabilities of occurrence. The distribution also has a mode, which is the highest point of the triangle and captures the observation with the highest probability of occurrence. Triangular distributions are used when the distribution of observations has a finite range and is bounded by a maximum and a minimum.

[42] https://www.investopedia.com/terms/p/probabilitydistribution.asp

[43] https://www.investopedia.com/terms/n/normaldistribution.asp

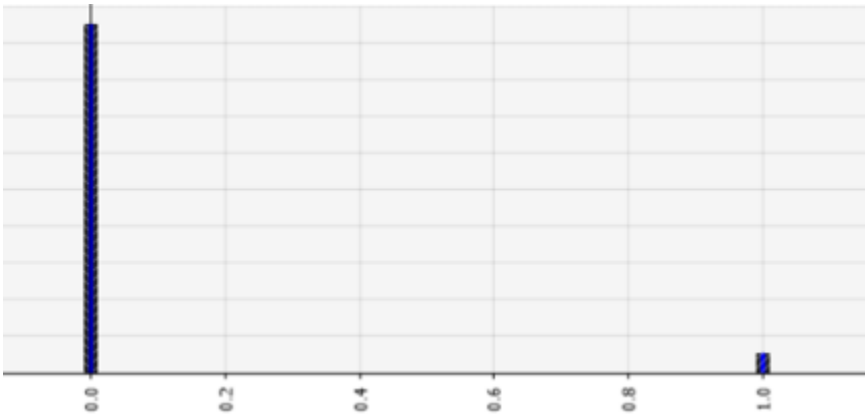
Figure 44 A typical triangular distribution



Source: Frontier example of a typical triangular distribution

- A **Bernoulli distribution** is used when the observations of interest are not in a continuous series but instead take on discrete values, with different probabilities associated with each of the discrete values. So, for example, in our analysis such a distribution is used as opposed to a Normal distribution when assessing outcomes associated with low probability, high impact events.

Figure 45 Bernoulli distribution



Source: Frontier example of a typical Bernoulli distribution

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