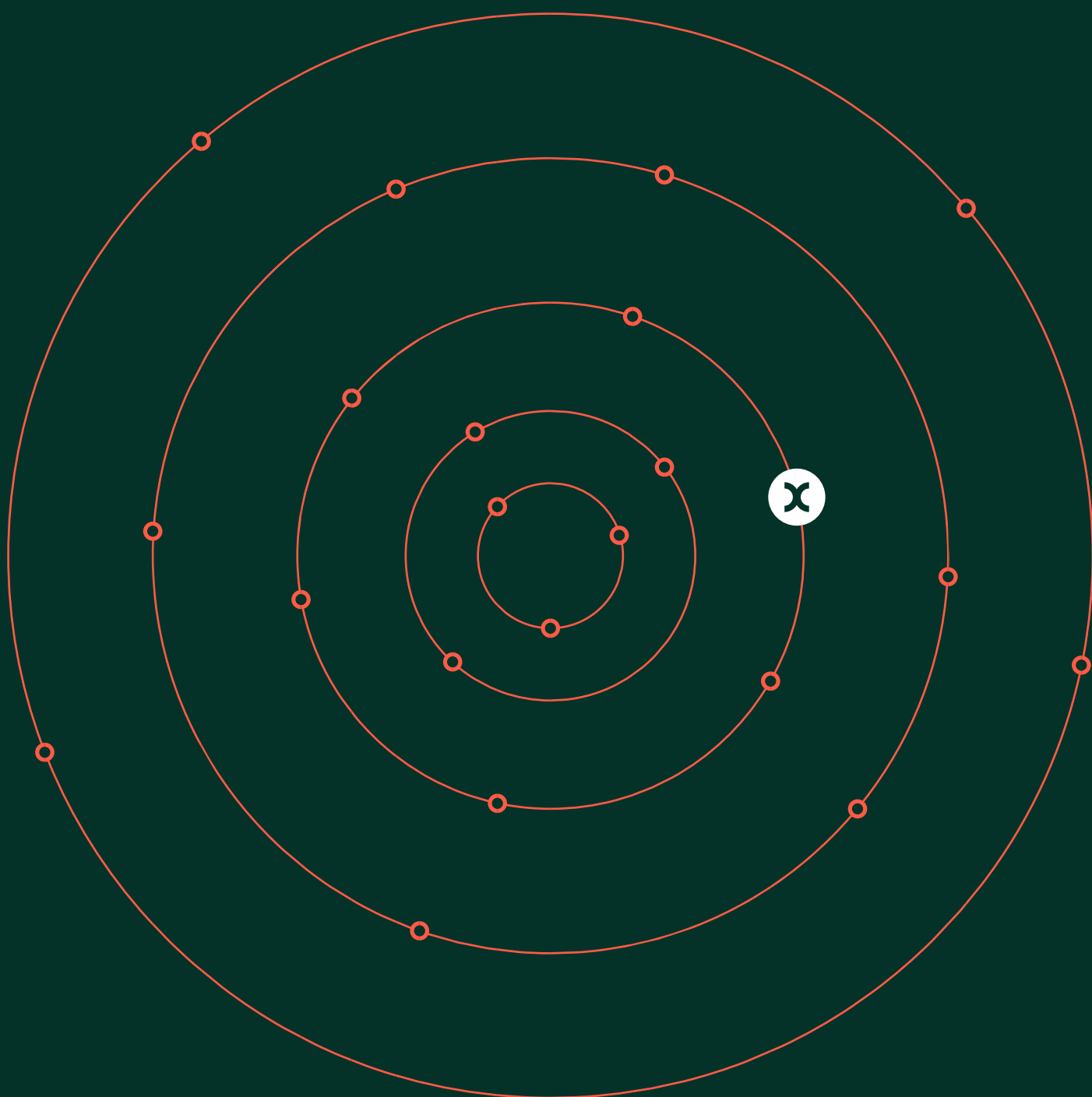


RIO-3 draft determinations—CAPM parameters and debt-based cross-checks

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Prepared for Energy Networks Association

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Oxera Consulting LLP is a limited liability partnership registered in England no. OC392464, registered office: Park Central, 40/41 Park End Street, Oxford OX1 1JD, UK with an additional office in London located at 200 Aldersgate, 14th Floor, London EC1A 4HD, UK; in Belgium, no. 0651 990 151, branch office: Spectrum, Boulevard Bischoffsheim 12–21, 1000 Brussels, Belgium; and in Italy, REA no. RM - 1530473, branch office: Rome located at Via delle Quattro Fontane 15, 00184 Rome, Italy with an additional office in Milan located at Piazzale Biccamano, 8 20121 Milan, Italy. Oxera Consulting (France) LLP, a French branch, registered in Nanterre RCS no. 844 900 407 00025, registered office: 60 Avenue Charles de Gaulle, CS 60016, 92573 Neuilly-sur-Seine, France with an additional office located at 25 Rue du 4 Septembre, 75002 Paris, France. Oxera Consulting (Netherlands) LLP, a Dutch branch, registered in Amsterdam, KvK no. 72446218, registered office: Strawinskylaan 3051, 1077 ZX Amsterdam, The Netherlands. Oxera Consulting GmbH is registered in Germany, no. HRB 148781 B (Local Court of Charlottenburg), registered office: Rahel-Hirsch-Straße 10, Berlin 10557, Germany, with an additional office in Hamburg located at Alter Wall 32, Hamburg 20457, Germany.

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Executive summary

Following the publication of the Draft Determinations for the RIIO-3 price controls (RIIO-3 DD), Energy Networks Association (ENA) asked Oxera to:

- 1 review Ofgem's methodological choices in the RIIO-3 DD when estimating the parameters of the capital asset pricing model (CAPM);
- 2 update Oxera's CAPM-based cost of equity (CoE) estimate previously provided in a report that we wrote for the ENA (the 'RIIO-3 SSMD Oxera report'¹) responding to Ofgem's Sector Specific Methodology Decision (SSMD), based on, or in response to, further considerations and evidence presented by Ofgem in the RIIO-3 DD, and updated market data where relevant;
- 3 assess Ofgem's and Oxera's CoE ranges against the debt-based cross-checks (including the one previously referred to as the ARP–DRP²).

Energy networks are expected to face significant challenges during RIIO-3, which will have a material impact on the CoE estimates for RIIO-3. This suggests that the baseline estimates that do not fully capture forward-looking risks should be considered as a lower bound when setting the allowed CoE for RIIO-3. We note that in the RIIO-3 DD Ofgem did not consider this to be case.

In recent years the wider economy has gone through a step change in capital market and macroeconomic contexts compared with those in which the RIIO-2 price controls were determined. Similarly, the level of investments required to facilitate the net zero transition, and the uncertainty around the risk of asset stranding, impose a bigger constraint on energy networks than in RIIO-2. All of these aspects stress the critical role played by the regulatory allowance in enabling companies not only to retain existing capital, but also to attract new capital. This was, and remains, a key premise in our RIIO-3 reports. We note that, in line with the RIIO-3 SSMD, in the RIIO-3 DD Ofgem continues to recognise the importance of ensuring the investability of the energy sector.

¹ Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November.

² Asset risk premium; debt risk premium.

As part of the RIIO-3 DD, Ofgem proposed to implement a series of changes to its CoE CAPM methodology that are consistent with the methodology set out in the RIIO-3 SSMD Oxera report. We welcome these changes, which include:

- excluding the Cost of Living Index (COLI)-Consumption Expenditure Deflator (CED) and serial correlation adjustments from the calculation of the ex ante total market return (TMR);
- reintroducing Pennon in the sample of UK water companies used to estimate the beta;
- confirming the inclusion of the European energy networks in the calculation of the beta.

However, we continue to disagree with Ofgem's approach in a number of areas. Specifically, to achieve an investable allowed CoE, we consider that Ofgem should:

- account for the convenience premium embedded in government bonds when estimating the risk-free rate (RFR);
- while we welcome the recognition by Ofgem that there is no longer the need to apply a COLI-CED adjustment, and that there is no definitive evidence on serial correlation that would justify adjusting the historical ex ante estimate of TMR, we maintain that Ofgem should inform its TMR range predominantly on the basis of the ex post TMR, instead of positioning its approach as: '[w]e continue to recommend we give equal weight to both ex ante and ex post TMR estimates';³
- reflect the change in the interest rate environment in its TMR estimate, consistent with the previous regulatory decisions, as this is likely to be required for investability;
- narrow the asset beta range to the upper half of the estimated range, to account for (i) forward-looking risks faced by energy networks to support the government's net zero objectives which are placing upward pressure on the investability of the energy sector, and (ii) the 'low beta anomaly'.

In this report, we provide updates to the CoE estimates from the RIIO-3 SSMD Oxera report based on, or in response to, further considerations and evidence presented by Ofgem in the RIIO-3 DD. Our analysis reflects the methodology that is appropriate for RIIO-3 in light of regulatory

³ We note that while Ofgem positioned its TMR estimate as placing equal weight to both ex ante and ex post approaches, its proposed TMR point estimate (6.9%) sits at the top of its proposed TMR range (6.8–6.9%). See Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para 3.42 and Tables 17 and 18 (accessed 9 July 2025).

precedents, developments in capital markets, academic evidence, the operational and political environment of the energy networks, and the UK Regulators Network (UKRN) cost of capital estimation guidance.

The cut-off date for our analysis is 31 March 2025, which is the same date used by Ofgem in the RIIO-3 DD.

Below, we provide an overview of the areas where we consider Ofgem should amend its methodology for estimating the CAPM parameters.

Risk-free rate

In setting the RFR, Ofgem did not accept the evidence submitted by stakeholders and confirmed its decision not to account for the convenience premium embedded in government bonds. As we highlighted in the RIIO-3 SSMD report, there is extensive evidence supporting the inclusion of the convenience premium, including academic literature and recent regulatory precedents, such as those from the Competition and Markets Authority (CMA), the Civil Aviation Authority (CAA) and the Utility Regulator (UR) (in Northern Ireland).⁴

In section 2.1, we show empirically that a large and positive convenience premium can be observed across the gilts yield curve, including at the 20-year investment horizon. While we recognise that the level of the convenience premium can fluctuate over time, depending on the underlying market conditions, in Figure 2.1 we show that the convenience premium has been present during periods of calm and distressed financial markets. We consider that adjusting gilt yields to reflect the convenience premium is a necessary step in arriving at an accurate estimate of the RFR, and that relying solely on index-linked gilt (ILG) yields would be an error that would underestimate the RFR.

In relation to the inflation wedge assumption, Ofgem continued not to include a wedge between the Consumer Price Index (CPI) and the Consumer Price Index with Housing (CPIH) (the CPI–CPIH wedge). However, Ofgem stated that it would review whether an adjustment to the inflation assumption is warranted to reflect the long term CPI–CPIH forecast wedge estimated by the Office for Budget Responsibility (OBR) in October 2024. In section 2.2, we identify several reasons why the OBR’s CPI–CPIH forecast wedge should not be considered. Specifically, we note that (i) the historical evidence does not support the existence

⁴ Oxera (2024), ‘[RIIO-3 cost of equity—CAPM parameters](#)’, prepared for the Energy Networks Association, 8 November (accessed 1 August 2025).

of a stable or predictable CPI–CPIH wedge; (ii) the CPI–CPIH forecast wedge estimated by the OBR does not have the track record and evidential basis needed to support regulatory application; and (iii) some of the underlying drivers of CPIH cannot be forecast reliably.

Ofgem’s proposed RFR is 2.01% (CPIH-real). Including the convenience premium leads to a RFR of 2.25% (CPIH-real).

Total market return and equity risk premium

In setting the TMR range, Ofgem continued to place equal weight on ex ante and ex post approaches. In section 3.3, we explain why we continue to consider that ex ante approaches are not particularly informative and that they are subject to a degree of subjective judgement about how the future will be different from the past. This also applies to the Dimson, Marsh and Staunton (DMS) decompositional approach considered by Ofgem which, in reality, is closer to an ex post approach than an ex ante one, as it does not actually attempt to predict a forward-looking TMR.

In addition, while the UKRN guidance suggests that ‘the TMR should be primarily based on historical ex post and historical ex ante evidence’, it does not recommend placing equal weight on ex ante and ex post approaches.

For these reasons, we consider that Ofgem should inform its TMR range predominantly on the basis of the ex post TMR, and place little to no weight on historical ex ante approaches.

Ofgem also confirmed its approach of not reflecting the higher-interest-rate environment in the estimation of the TMR. In section 3.4, we discuss how Ofgem’s approach is inconsistent with its decision to reduce the TMR in RIIO-ED1 and RIIO-2, also in recognition of the falling interest rate environment. In line with the RIIO-3 SSMD Oxera report, we maintain that following a ‘through-the-cycle’ approach⁵ and placing no weight on changes in market conditions risks underestimating the TMR for RIIO-3. In turn, this could result in companies not being adequately supported in retaining and attracting capital during RIIO-3.

On this point, we note that the UKRN guidance specifies that regulators should not consider the TMR to be fixed, and that it also notes that ‘it is

⁵ Whereby the TMR is not adjusted to reflect prevailing market conditions, under the assumption that positive and negative short-term deviations will offset each other over time.

important to recognise that depending on the macroeconomic environment, this largely 'through-the-cycle' approach could either overstate or understate returns required by investors in a specific price determination.⁶

Ofgem clarified that it plans to continue to use cross-checks to assess whether its bottom-up TMR estimate is 'materially' out of line with what investors require, but has not defined what constitutes a 'materially' out-of-line TMR. Instead, Ofgem has performed a suite of cross-checks at the CoE level to assess whether the overall allowed CoE is properly calibrated, concluding that its cross-checks support its preferred CoE range. Instead, our debt premia cross-check suggests that Ofgem's allowed CoE and the bottom half of its CoE range are too low.

Based on the above, we consider that Ofgem should account for the current interest rate environment when setting the TMR, to ensure that allowed returns are sufficient to safeguard the investability of the energy sector.⁷ Ofgem's proposed TMR range is 6.80–6.90% (CPIH-real). Our analysis of the historical evidence and current market conditions points towards a TMR range of 7.00–7.50% (CPIH-real) for RIIO-3. The historical evidence reflects the through-the-cycle estimate, while the current market conditions suggest that, at this point in time, investors would require higher market returns than the through-the-cycle TMR of 7.00%, and we cannot exclude the possibility that values higher than 7.50% would be required.

Considering the upward trend in gilt yields, it is reasonable to expect that investors have revised their expectations upwards. We note that, when gilt yields were last seen at similar levels (prior to the 2008 financial crisis), the TMR allowance was in the 7.50–8.00% range in CPIH-real terms. A TMR above the through-the-cycle estimate is also supported by the analysis of Frontier Economics (Frontier), with its TMR Glider suggesting a TMR range of 7.8–8.0%, which supports a TMR for RIIO-3 towards the top of the 7.00–7.50% range.

We consider this point to be of particular importance in the current context of the energy networks, that are facing challenges in relation to investment intensity and/or transition risk. Setting a return that is too low risks causing a welfare loss by not adequately supporting the energy networks in attracting and retaining the necessary capital to

⁶ UKRN (2023), '[UKRN guidance for regulators on the methodology for setting the cost of capital](#)', p. 19 (accessed 24 July 2025).

⁷ For a price control to be 'investable', it must be highly likely that the company can attract and retain the equity capital needed to deliver the desired investment.

carry out the investments required to support the government's net zero objectives.

Beta

In the RIIO-3 DD, Ofgem confirmed that it does not intend to adjust the baseline asset betas to separately account for forward-looking risks, and proposed to use the midpoint of the range as its point estimate.⁸ In section 4.3, we explain that many factors are placing upward pressure on the energy networks' risk, and it is unclear whether these are fully reflected in the comparators' historical betas.

We observe that in a previous regulatory decision, Ofgem recognised that the return allowance should reflect energy networks' exposure to cash-flow risks, with reference to their CAPEX/Regulated Asset Value (RAV) ratio. On this basis, Ofgem allowed a higher asset beta for companies with higher CAPEX/RAV ratios, reflecting its assessment of increased systematic risk associated with larger CAPEX programmes. This is relevant precedent, given that there is investment intensity associated with delivery of net zero targets in the RIIO-3 period, and beyond.

Furthermore, we show that there is extensive evidence suggesting that the CoE estimated using the CAPM may underestimate the required returns for regulated utilities (a phenomenon known as the 'low beta anomaly').

We consider that using the lower part of Ofgem's proposed asset beta range of 0.30–0.45 neither addresses the 'low beta anomaly' nor adequately reflects the challenges that energy networks are expected to face during RIIO-3. As a result, a point estimate based on the midpoint of this range risks being too low to ensure that allowed returns are sufficient to enable companies to attract and retain capital, and to support the investability of the energy sector. In fact, in the RIIO-3 DD, Ofgem itself recognised that the midpoint of the estimated beta range may not be the most appropriate point estimate.⁹

⁸ By baseline asset betas, we refer to the asset betas estimated by Ofgem using comparators' data.

⁹ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para 3.84 (accessed 9 July 2025).

Taking all of this into account, we consider that it is more appropriate to rely on a narrower asset beta range of 0.375–0.45 when selecting the point estimate.

Cost of equity

Ofgem's proposed allowed CoE for RIIO-3 is a range of **4.76–6.45% at 55% gearing** and **5.06–6.96% at 60% gearing**. These estimates are in CPIH-real terms, with proposed point estimates of 5.64% and 6.04%, respectively.

Adjusting the RFR, TMR and beta for the points discussed above results in an Oxera CoE range of **5.77–7.02% at 55% gearing** and **6.17–7.57% at 60% gearing** (both ranges in CPIH-real terms), with **midpoints of 6.38% and 6.84%**, respectively.¹⁰ The point estimates proposed by Ofgem (5.64% at 55% gearing and 6.04% at 60% gearing) are below the bottom of the Oxera CoE ranges, suggesting that the point estimates of the Ofgem CoE ranges are too low.

The following tables outline the CAPM parameters underlying the CoE estimates at 55% and 60% gearing.

¹⁰ The midpoints of the Oxera CoE ranges are based on the midpoint of each of the estimated CAPM parameters. This does not equate to the midpoints of the overall CoE ranges due to rounding.

Cost of equity estimates at 55% notional gearing

Formula		Ofgem (RIIO-3 DD)			Oxera		
		Low	High	Proposed point estimate	Low	High	Midpoint
RFR	[A]	2.01%	2.01%	2.01%	2.25%	2.25%	2.25%
TMR	[B]	6.80%	6.90%	6.90%	7.00%	7.50%	7.25%
Asset beta	[C]	0.300	0.450	0.375	0.375	0.450	0.413
Re-levered equity beta at 55% gearing ¹	$[D] = \{[C] - (\text{gearing} \times \text{beta debt})\} / (1 - \text{gearing})$	0.58	0.91	0.74	0.74	0.91	0.83
CAPM CoE	$[E] = [A] + [D] \times ([B] - [A])$	4.76%	6.45%	5.64%	5.77%	7.02%	6.38%

Note: ¹ The debt beta is assumed to be 0.075. Values may not add up due to rounding.

Source: Oxera analysis and Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, Table 18 (accessed 9 July 2025).

Cost of equity estimates at 60% notional gearing

Formula		Ofgem (RIIO-3 DD)			Oxera		
		Low	High	Proposed point estimate	Low	High	Midpoint
RFR	[A]	2.01%	2.01%	2.01%	2.25%	2.25%	2.25%
TMR	[B]	6.80%	6.90%	6.90%	7.00%	7.50%	7.25%
Asset beta	[C]	0.300	0.450	0.375	0.375	0.450	0.413
Re-levered equity beta at 60% gearing ¹	$[D] = \{[C] - (\text{gearing} \times \text{beta debt})\} / (1 - \text{gearing})$	0.64	1.01	0.83	0.83	1.01	0.92
CAPM CoE	$[E] = [A] + [D] \times ([B] - [A])$	5.06%	6.96%	6.04%	6.17%	7.57%	6.84%

Note: ¹ The debt beta is assumed to be 0.075. Values may not add up due to rounding.

Source: Oxera analysis and Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, Table 17 (accessed 9 July 2025).

Debt-based cross-checks

In addition to assessing the CAPM-based CoE estimates discussed above, we have cross-checked Ofgem's and Oxera's CoE ranges against

cost of debt evidence used by Ofgem in setting the cost of debt allowance. We have used a few specifications of the test, namely:

- 1 comparing the unlevered CoE with the cost of new debt (CoND), using only Ofgem's parameters with no additional assumptions—the principle is that the CoE, even at zero gearing (i.e. unlevered), should never be below the CoND;
- 2 comparing the ARP for Ofgem's allowance with the DRP, where the former must be at least as high as the latter at all times. We estimate the DRP using three averaging periods: one-month, one-year and five-year averages;
- 3 implying the minimum appropriate ARP (and CoE) from the DRP estimate, by re-levering the DRP estimate to approximate the DRP at 100% gearing, where in theory it equals ARP. We then imply asset beta from the ARP to estimate the minimum CoE.

All three specifications serve as a lower bound for the CoE, but some are tighter than others. The test needs to be passed in all its specifications given that market conditions that affect credit spreads for a given set of assets would also affect the (required return for the) equity risk of those assets, notwithstanding that some volatility in DRP may be temporary.

The table below summarises the outcome of the considered specifications of the debt-based cross-checks for Ofgem's and Oxera's CoE ranges for electricity transmission networks at 55% gearing. We test the CoE only at the 55% gearing for electricity transmission networks because Ofgem does not set the CoND for these networks at 60% notional gearing, which would be required for the cross-check.

Summary of debt premia cross-check

	Ofgem (RIIO-3 DD)			Oxera		
	Low	High	Proposed point estimate	Low	High	Midpoint
Unlevered CoE > CoND	Fail	Pass	Fail	Pass	Pass	Pass
Positive ARP–DRP	Pass	Pass	Pass	Pass	Pass	Pass
Implied CoE—one-month	Fail	Pass	Fail	Fail	Pass	Pass
Implied CoE—one-year	Fail	Pass	Fail	Fail	Pass	Fail
Implied CoE—five-year	Fail	Fail	Fail	Fail	Pass	Fail

Note: For electricity transmission networks at 55% gearing. For the implied CoE tests for Ofgem's RIIO-3 DD and Oxera's CoE range, we derive the implied minimum CoE using Ofgem's RIIO-3 DD and Oxera's RFR and TMR respectively. For an explanation of how the minimum COE estimates have been implied, see section 6.

Source: Oxera analysis.

The table shows that Ofgem's proposed point estimate of the CoE allowance fails to meet most of the specifications of the debt-based cross-checks discussed in this report. While the midpoint of the Oxera range passes most of the specifications, only Oxera's high end of the range passes all of them. This suggests that, in selecting a point estimate within the CoE range, a value towards the upper end of the Oxera CoE range would be appropriate to support the investability of the networks.

1 Introduction

In July 2025, Ofgem published the RIIO-3 DD for gas distribution and gas and electricity transmission networks (GD, GT and ET).¹¹ As part of the RIIO-3 DD, Ofgem set out its proposed methodology for setting the CoE allowance in RIIO-3, and provided its proposed CoE range.¹²

The RIIO-3 DD provides an update on the RIIO-3 Sector Specific Methodology Consultation (SSMC) and SSMD published in December 2023 and July 2024, respectively. The RIIO-3 DD reflects Ofgem's further analysis of the CoE parameters and its response to some of the evidence submitted by stakeholders, including some of the evidence in the reports that we wrote for ENA in response to the RIIO-3 SSMC (the 'RIIO-3 SSMC Oxera report') and SSMD (together, 'the RIIO-3 SSMC and SSMD Oxera reports').^{13, 14}

While the methodology proposed by Ofgem in the RIIO-3 DD incorporates some of the suggestions made in the RIIO-3 SSMD Oxera report,¹⁵ it rejects or omits assessment, or response, to other recommendations.¹⁶

In this report on behalf of ENA, we review Ofgem's RIIO-3 DD methodology for estimating the CAPM parameters and CoE range, and provide evidence supporting the approaches to the estimation of the CoE range that we consider appropriate. We provide estimates of the RFR and TMR, as well as updates to the beta estimation contained within the RIIO-3 SSMC and SSMD Oxera reports, based on, or in response to, further considerations and evidence presented by Ofgem in the RIIO-3 DD.

¹¹ Ofgem (2025), '[RIIO-3 Draft Determinations for the Electricity Transmission, Gas Distribution and Gas Transmission sectors](#)', 1 July (accessed 9 July 2025).

¹² Ibid., section 3.

¹³ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 1.7 (accessed 9 July 2025).

¹⁴ Oxera (2024), 'RIIO-3 cost of equity', prepared for the Energy Networks Association, 23 February; and Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November.

¹⁵ For example, including European companies in the sample used to estimate the beta and removing the COLI-CED and serial correlation adjustments from the ex ante TMR.

¹⁶ For example, including the convenience premium in the estimation of the RFR, not placing equal weight to the ex ante and ex post TMR estimates, and uplifting the TMR to reflect the higher-interest-rate environment.

The report is structured as follows.

- Section 2 presents a review of Ofgem's RIIO-3 DD position on the RFR, and our response to issues such as the convenience premium and the treatment of the inflation wedge. In this section, we also provide our estimate of the RFR.
- Section 3 presents a review of Ofgem's RIIO-3 DD position on the TMR and equity risk premium (ERP), and our response to issues such as uplifting the TMR to reflect the higher-interest-rate environment and the weight to place on the 'historical ex ante' method. In this section, we also provide our estimate of the TMR.
- Section 4 presents a review of Ofgem's RIIO-3 DD position on the beta, and our response to issues such as how wide the range for the beta should be. In this section, we also provide our estimate of the beta.
- Section 5 presents our estimate of the CoE range.
- Section 6 presents debt-based cross-checks of Ofgem's and Oxera's CoE ranges.
- Section 7 concludes the report.

2 Risk-free rate

The RFR represents the expected return on an asset that is free of risk—that is, a situation where the expected return exactly matches the realised return on the investment, meaning that no risk is involved. In the CAPM framework, this theoretical risk-free asset is also called a ‘zero-beta asset’ (i.e. an asset with no sensitivity to overall market risk). The CAPM assumes that all investors are able to borrow and lend unlimited amounts at the RFR. In economies with low sovereign default risk, regulators have generally estimated the RFR by referring to the yield to maturity (YTM) on government-issued bonds (referred to as ‘gilts’ in the UK), either as a baseline to which they add premia, or as one of the instruments that they rely on. These bonds are typically assumed to be free of default and systematic risk.¹⁷

Recently, however, there has been discussion in the UK and other parts of Europe about whether government bonds are the best proxy for the RFR. It has been noted that private borrowers, even those with minimal credit risk, cannot borrow at the same rate as the government—in other words, the yield on top-rated corporate bonds (those rated AAA) is generally higher than the yield on government bonds of the same maturity.¹⁸ It has also been argued that government bond yields may fall below the return on a zero-beta asset because these bonds possess special features that create a price premium, usually reducing their yields below the true RFR.

In line with our previous reports, we refer to the spread between the government bond yields and the return on a zero-beta asset as a ‘convenience premium’—this spread reflects these special properties of the government bonds. As discussed in the RIIO-3 SSMC and SSMD Oxera reports, we consider that it is important to account for the convenience premium when estimating the RFR, and note that allowing for a convenience premium adjustment in the calculation of the RFR (e.g. by including highly rated corporate bonds in the assessment) is an

¹⁷ In the past, UK regulators have typically followed this approach while allowing for a certain amount of additional headroom above traded (spot) yields to allow for interest rate uncertainty.

¹⁸ For example, see Oxera (2020), ‘Are sovereign yields the risk-free rate for the CAPM?’, prepared for the Energy Networks Association, 20 May.

approach that other UK and European regulators are increasingly using.¹⁹

In Box 2.1, we summarise the approach followed by Ofgem in the RIIO-3 DD for estimating the RFR.



Box 2.1 Ofgem's RIIO-3 DD approach for estimating the risk-free rate

Ofgem's proposed RFR estimate is based on the following methodology and set of assumptions.

- **Benchmark yield:** Ofgem confirmed the use of the 20-year ILG as a benchmark for setting the RFR.
- **Averaging period and indexation:** Ofgem confirmed the use of a one-month average of historical 20-year ILG yields. Ofgem also confirmed its intention to update the RFR allowance on an annual basis ('RFR indexation'), and, as a result, not to adjust the RFR to take account of implied forward rates (the 'forward premium').
- **Inflation:** Ofgem continued to estimate the wedge between the Retail Price Index (RPI) and CPIH (RPI–CPIH wedge) using (i) official forecasts of CPI and RPI from the OBR up to the point of convergence of the RPI and CPIH rates (assumed to be in February 2030);¹ (ii) a zero wedge for the remaining years until the maturity of the 20-year ILG. Ofgem did not include a CPI–CPIH wedge.
- **Convenience premium:** Ofgem confirmed that it does not intend to include a convenience premium in the RFR allowance.
- Based on the above, **Ofgem's proposed RFR** is 2.01%.

¹⁹ Oxera (2024), 'RIIO-3 cost of equity', prepared for the Energy Networks Association, 23 February, section 2.2.1; and Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, section 2.1.

Note: ¹ The OBR's forecasts of RPI and CPI cover only the first four financial years of RIIO-3 (2027, 2028, 2029 and 2030). For the financial year 2031, Ofgem estimated the value of RPI by taking a weighted average of the OBR's long-term forecast of RPI (2.8%) and CPI (2.0%) to account for the RPI and CPIH convergence.

Source: Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, section 2; Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, paras 3.6–3.32 (accessed 9 July 2025); Ofgem (2025), 'RIIO GDT3 Allowed Return on Equity Summary File_Draft Determinations_Jun25.xlsx.', 1 July.

We continue to disagree with Ofgem's exclusion of the convenience premium when estimating the RFR in the RIIO-3 DD. In section 2.1, we present further evidence to support the inclusion of the convenience premium. In section 2.2, we discuss the available evidence on the CPI–CPIH wedge and whether it should be included in the estimation of the RFR. In section 2.3, we present our estimate of the RFR.

2.1 Convenience premium

In the RIIO-3 DD, Ofgem did not accept the evidence submitted by stakeholders and it confirmed its SSMD position of excluding any allowance for a convenience premium in the RFR. Ofgem justified the exclusion of the convenience premium based on various arguments. These are discussed in turn below.

2.1.1 UKRN guidance

In the RIIO-3 DD, Ofgem stated that while the UKRN guidance highlights that recently there has been a debate as to whether real government bonds alone provide a sufficient proxy for the RFR, Ofgem's recommendation remains to estimate the RFR using ILGs.²⁰ Specifically, as highlighted by Ofgem, the UKRN states that:²¹

While noting arguments for a convenience yield in gilts, this is not a well-established topic in economic regulation, and the taskforce notes that in academic literature there are no empirical estimates of the convenience yield in index-linked gilts at the 10-20 year CAPM investment horizon used by most regulators. Given divergence in

²⁰ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.21 (accessed 9 July 2025).

²¹ UKRN (2023), '[UKRN guidance for regulators on the methodology for setting the cost of capital](#)', p. 14 (accessed 24 July 2025).

approaches across regulators, this guidance does not therefore propose alignment to a particular stance [...]

This excerpt from its guidance suggests that UKRN does not dismiss the existence of a convenience premium, but it observed a lack of empirical evidence at the ten- and 20-year investment horizons, in deciding to not recommend 'a particular stance' on the inclusion of a convenience premium. In fact, the UKRN guidance also states that:²²

However regulators should clearly set out their assessment of the evidence base in making their decisions. Regulators identify this as an area that may benefit from further work to consider the necessity of adjustments to index-linked gilt yields at the 10-20 year horizon.

In section 2.1.5 below, we empirically show that a large and positive convenience premium can be found across the gilts yield curve, including at the ten- and 20-year investment horizons mentioned in the UKRN guidance.

2.1.2 The RIIO-2 appeals precedent

In the RIIO-3 DD, Ofgem reiterated that, as part of the RIIO-2 appeals, the CMA concluded that Ofgem's decision to rely solely on ILGs when estimating the RFR was 'not wrong'.²³

As discussed in the RIIO-3 SSMD Oxera report, we do not consider that the CMA's conclusion in the RIIO-2 appeals implies that using ILGs as the sole proxy for the RFR can be considered a better approach than a combination of ILGs and AAA non-government bonds—the approach the CMA itself used for the PR19 redeterminations.²⁴

Furthermore, while considering Ofgem's approach to be 'not wrong', the CMA reiterated that there was evidence that supports the existence of a convenience premium:²⁵

²² UKRN (2023), '[UKRN guidance for regulators on the methodology for setting the cost of capital](#)', p. 14 (accessed 24 July 2025).

²³ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.21 (accessed 9 July 2025).

²⁴ Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, p. 13.

²⁵ Competition and Markets Authority (2021), '[Cadent Gas Limited, National Grid Electricity Transmission plc, National Grid Gas plc, Northern Gas Networks Limited, Scottish Hydro Electric Transmission plc, Southern Gas Networks plc and Scotland Gas Networks plc, SP Transmission plc, Wales & West Utilities Limited Vs the Gas and Electricity Markets Authority—Final determination Volume 2A: Joined Grounds: Cost of equity](#)', 28 October, para. 5.68.

[...] we agree that ILGs are an imperfect proxy for the RFR (a view shared by GEMA [Gas and Electricity Markets Authority]). Specifically, **we noted that there is evidence to support the notion of a convenience yield in government-issued securities**, and we disagreed with the view that the appropriate investor when considering the RFR is a net lender. [Emphasis added]

2.1.3 Alternative calculation of the convenience premium

In the RIIO-3 SSMD Oxera report, we criticised Ofgem's proposed methodology for estimating the convenience premium based on adjusting AAA non-government bond yields for credit and liquidity risks and comparing the result with gilt yields.²⁶ In the same report we also highlighted that Ofgem's finding of a negative convenience premium was driven by methodological errors.²⁷

In the RIIO-3 DD, Ofgem reiterated that estimating the convenience premium by adjusting the AAA bond data to account for higher liquidity and credit risk was considered by the CMA in its PR19 redeterminations, originally based on suggestions from Oxera's analysis of historical risk premia.²⁸

As discussed in the RIIO-3 SSMD Oxera report, and as acknowledged by Ofgem, the approach based on adjusted AAA non-government bonds has been superseded by recent regulatory determinations, including the CMA's PR19 redeterminations, in which this approach was discussed and ultimately disregarded in favour of a simpler approach based on the average of gilts and non-government bond yields.²⁹

In addition, in the RIIO-3 SSMD Oxera report we highlighted that the estimation of the credit and liquidity risk premium is characterised by a significant degree of uncertainty. As such, relying on a single point estimate can be problematic, which is also why, in our previous submissions, we identified a wide range for the credit risk premium.³⁰

Furthermore, the credit risk should be already reflected in the yield of both government and non-government bonds, according to their

²⁶ Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, pp. 18–22.

²⁷ Ibid., pp. 19–22.

²⁸ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.27 (accessed 9 July 2025).

²⁹ Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, p. 18; and Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.27 (accessed 9 July 2025).

³⁰ Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, p. 21.

respective credit ratings. As presented in Figure 2.1, our estimate of the convenience premium is based on non-government bonds with a AAA credit rating, which is broadly comparable to the sovereign credit rating of the UK.³¹ As such, under our approach, there is no need to adjust the convenience premium for any incremental credit risk.

In section 2.1.4 below we discuss the reasons why an adjustment to the convenience premium to account for the liquidity premium is not warranted.

Based on the above, we continue to consider that Ofgem's alternative estimation is not a consistent and robust approach to estimating the convenience premium, even as a cross-check of our convenience premium estimate. Instead, we maintain that Ofgem should rely on a methodology that has built on recent regulatory determinations from the CMA, the CAA and the UR. Specifically, Ofgem should estimate the convenience premium comparing the yield on AAA rated non-government bond indices with the yield on duration-matched zero-coupon nominal gilts.

2.1.4 Alternative interpretation of the convenience premium

In the RIIO-3 DD, Ofgem noted that the inclusion of AAA bond data could confuse the liquidity premium embedded in thinly traded assets with any convenience yield embedded in the yield of gilts.³²

Unlike Ofgem, we find that, overall, the superior liquidity of government bonds is consistent with the explanations of the existence of the convenience premium in the academic literature. For example, Krishnamurthy and Vissing-Jorgensen (2012) explain that the unique 'money-like' properties of government bonds drive the existence of the convenience yield through both extreme liquidity and safety.³³

The liquidity component of the convenience premium embedded within the pricing of gilts does not contradict the existence of the convenience premium. In fact, if two assets have close to zero default risk (as in the case of gilts and AAA rated non-government bonds), the liquidity

³¹ The UK credit rating is AA-/AA/Aa3, according to Fitch, S&P and Moody's respectively. Fitch Ratings (2025), '[Fitch Affirms United Kingdom at 'AA-'; Outlook Stable](#)', 28 February; Moody's Investor Services (2025), '[Government of the United Kingdom – Aa3 stable: Regular update](#)', 27 May; S&P Global (2024), '[Research Update: United Kingdom 'AA/A-1+' Ratings Affirmed; Outlook Stable](#)', 18 October.

³² Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.28 (accessed 9 July 2025).

³³ Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), 'The Aggregate Demand for Treasury Debt', *Journal of Political Economy*, **120**:2.

premium on the asset that is less liquid (the non-government bond) would drive the convenience premium on the more liquid asset (the government bond).

Indeed, one of the reasons why government bonds attract a convenience premium is their high liquidity and 'money-like' features. Therefore, attempting to adjust the estimate of the convenience premium to reflect the high liquidity of government bonds would result in an underestimation of the convenience premium.

It is also important to note that our estimation methodology does not place full weight on the yields implied by the benchmark indices. Instead, similarly to the methodology used by the CMA in the PR19 redeterminations, we calculate the implied convenience premium by considering the premium implied by the difference in the gilt yields and the average yields of gilts and benchmark indices—further refined to control for the duration of the instruments. This implicitly assumes that the RFR available to investors is at the midpoint of the gilt and AAA non-government bond yields.

2.1.5 Insufficient supporting evidence on the convenience premium

In the RIIO-3 DD, Ofgem discussed how stakeholders had not provided 'compelling' evidence supporting the inclusion of a convenience premium when estimating the RFR. Specifically, Ofgem argues that the literature and empirical estimates presented by stakeholders do not provide evidence of a convenience premium in UK gilts at the 20-year investment horizon, and that some of the evidence presented suggests that during periods of market distress government bonds tend to be the only asset considered to be risk-free.³⁴

In this section, we respond to the points raised by Ofgem in relation to the papers we cited in the RIIO-3 SSMD Oxera report, and we present new evidence supporting the inclusion of a convenience premium when estimating the RFR.

Evidence from the academic literature

In relation to the supporting literature that we cited as part of the RIIO-3 SSMC and SSMD Oxera reports, we agree that none of the papers seeks to estimate a convenience premium in long-term UK gilts. However, we

³⁴ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, paras 3.23–3.32 (accessed 9 July 2025).

do not consider this to be a reason for dismissing the evidence presented in these papers.

In relation to Feldhütter and Lando (2008), in the RIIO-3 SSMD Oxera report we highlighted how this paper shows that most of the drivers of the convenience premium are not linked to the maturity of the underlying instruments. This implies that, even if a convenience premium cannot be directly estimated for 20-year gilts, its value could be inferred by looking at the evidence from shorter-term instruments.

In addition, Ofgem reiterated that this paper shows that 'a range of assets can be assessed as very low risk during more stable markets, but that when there are periods of market distress government bonds tend to be the only asset considered to be risk-free', suggesting that a convenience premium is visible only in periods of distressed financial markets.³⁵ As discussed in the RIIO-3 SSMD Oxera report, we disagree with this suggestion. In the following sub-section, we present further evidence on the stability of the convenience premium over time.

Furthermore, we disagree with Ofgem's suggestion that estimating the convenience premium requires a prediction of what type of market will be faced in the future. The existence of a convenience premium is premised on market participants' knowledge that, in the event of a crisis, a government bond would retain liquidity to a greater extent than other assets. This knowledge creates an excess demand for government bonds that suppresses yields beneath the true RFR. The existence of a convenience premium therefore requires only that market participants' perceived likelihood of a crisis is non-zero. It does not depend on forecasting exactly when that crisis would occur, as Ofgem seems to suggest.

In relation to the Bank of England study cited by Oxera, to which Ofgem also referred in the RIIO-3 DD, the authors examined the preferred-habitat behaviour of investors in the gilts market.³⁶ Specifically, they examined investors' gilt transactions and their stock of gilt holdings to study whether investors show a preference towards a particular maturity for gilts. As discussed in the RIIO-3 SSMD Oxera report, the authors found that some investor groups in UK government bonds display the behavioural properties that theory associates with

³⁵ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.24 (accessed 9 July 2025).

³⁶ Ibid., para. 3.25; Giese, J., Joyce, M., Meaning, J. and Wolridge, J. (2021), 'Preferred habitat investors in the UK government bond market', Bank of England Research Paper Series, 10 September.

preferred-habitat investors.³⁷ The paper found that these groups of investors, which comprise institutional investors such as life insurers and pension funds, were less sensitive to price movements than other investor groups. This empirical finding is consistent with the academic theories underlying the convenience premium, where investors have reasons to hold government bonds, and these reasons go beyond the rate of return expected on these instruments.

While Acharya and Laarits (2023) find that the convenience premium is likely to increase during periods of distressed financial markets, they do not suggest that a convenience premium can be observed only under these circumstances.³⁸ Specifically, the authors refer to a widening of the convenience premium at times when the aggregate stock–bond covariance is large and negative, suggesting that a convenience premium is also observable during periods of stable financial markets.

In keeping with this evidence, Diamond and Van Tassel (2025) find a persistent and positive convenience premium in UK government bonds across the 2005–20 period. Specifically, the authors measure the convenience yield as the spread between government bond yields and the 'box rate'—a RFR implied by options prices.³⁹ While the authors focus on short-term instruments, as discussed in relation to Feldhütter and Lando (2008), the convenience premium estimated for short-term instruments could still be informative of the convenience premium embedded in longer-term instruments.

Finally, we note that the authors find a broadly similar level of convenience premium between the USA and UK, suggesting that the evidence from the USA could still be informative of the convenience premium embedded in the gilts.

We also note that the inclusion of a convenience premium when estimating the RFR is supported by the findings of Brennan (1971), which suggests that the appropriate RFR should take account of the difference between an investor's borrowing and saving rates. This issue is also discussed by Berk and DeMarzo (2013) in a section on 'Determining the risk-free rate':⁴⁰

³⁷ Giese, et al. (2021), op cit."

³⁸ Acharya, V.V. and Laartis, T. (2023), 'When do treasuries earn the convenience yield? – A hedging perspective', BER Working Paper No. 31863, November.

³⁹ Diamond, W. and Van Tassel, P. (2025), 'Risk-Free Rates and Convenience Yields Around the World'.

⁴⁰ Berk, J. and DeMarzo, P. (2013), *Corporate Finance*, third edition, Pearson, p. 404.

The risk-free interest rate in the CAPM model corresponds to the risk-free rate at which investors can both borrow and save. We generally determine the risk-free saving rate using the yields on U.S. Treasury securities. Most **investors, however, must pay a substantially higher rate to borrow funds**. In mid-2012, for example, even the highest credit quality borrowers had to pay almost 0.30% over U.S. Treasury rates on short-term loans. Even if a loan is essentially risk-free, this premium compensates lenders for the difference in liquidity compared with an investment in Treasuries. [Emphasis added]

We note that the above is in line with what we discuss in relation to attempting to adjust the convenience premium for the liquidity premium (see section 2.1.4). As highlighted also by Berk and DeMarzo (2013), the high liquidity of the government bonds is one of the drivers of the convenience premium.

In addition, Berk and DeMarzo highlight that, because of the observed difference between an investor's borrowing and saving rates, 'practitioners sometimes use rates from the highest quality corporate bonds in place of Treasury rates'.⁴¹

This point was considered extensively by the CMA as part of the PR19 redeterminations. Specifically, the CMA concluded that:⁴²

We consider it unlikely that the yield on ILGs is a perfect representation of a theoretical RFR (or the average market participant rate in the Brennan approach). We consider that, on balance, **it is likely that the RFR appropriate for a range of relevant investors sits above the return available from ILGs, but below the level suggested by the return on AAA bonds**. [Emphasis added]

Stability of the convenience premium

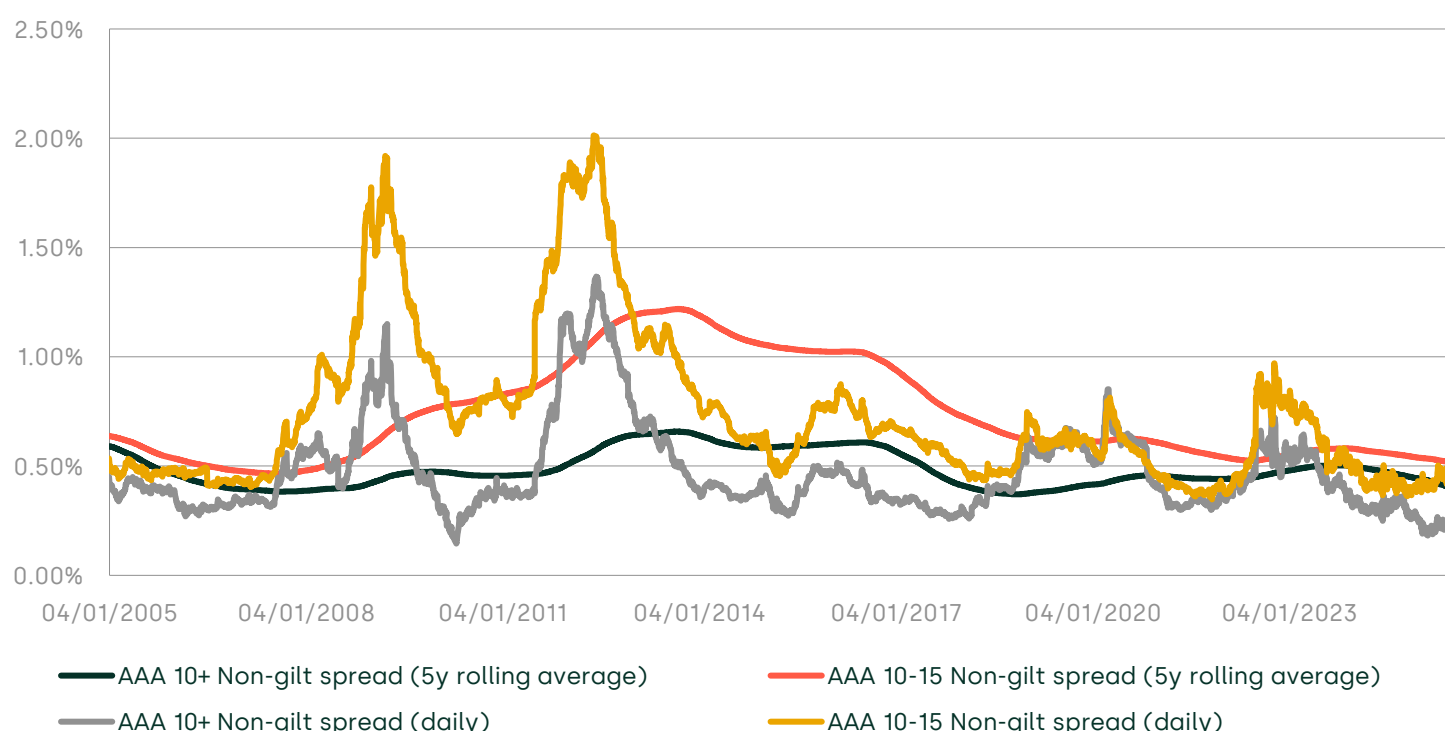
As discussed above, we do not agree with Ofgem's suggestion that a convenience premium is visible only in periods of distressed financial markets. While it is true that the convenience properties of government bonds will fluctuate according to market conditions and the perceived level of safety relative to riskier instruments, we find no evidence of the convenience premium disappearing during periods of stable markets.

⁴¹ Ibid.

⁴² Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, Final report', 17 March, para. 9.264 (accessed 22 July 2025).

In Figure 2.1, we present an updated version of the figure we presented in the RIIO-3 SSMD Oxera report, which shows a large and positive spread throughout the entire period. While the spread between AAA rated bond indices and gilts increased during periods of financial distress (e.g. during the 2008 financial crisis), Figure 2.1 shows that a large spread can be observed even during calm financial markets. This evidence contradicts Ofgem’s argument that the spread should be approaching zero in periods of calm financial markets.

Figure 2.1 Nominal spreads of AAA rated bond indices relative to benchmark government bonds, 2005–23



Note: The spreads are calculated by deducting yields on duration-matching nominal gilts from yields on non-gilts AAA 10+ and non-gilts AAA 10–15 indices.

Source: Oxera analysis of Bank of England and HIS Markit data.

Empirical evidence that 20-year UK gilts have a convenience premium

In relation to our estimate of the convenience premium—based on matching AAA non-government bond indices and UK gilts with respect to the duration of the AAA non-government bond indices—Ofgem suggested that we should match 20-year gilts with AAA rated non-

government bonds with a 20-year duration, instead of matching the duration of available AAA rated indices with corresponding gilts.⁴³

On this point, we note that the available data on GBP-denominated AAA non-government bonds does not allow us to construct a portfolio with a stable duration of 20 years across the five-year period considered in our analysis in a meaningful and robust way.

In any case, we consider that our estimate of the convenience premium, based on duration-matching, provides sufficient justification for the inclusion of the convenience premium, even if it is not based on exactly 20-year gilts. This is because we find it reasonable to assume that the convenience premium does not vary significantly across the gilts yield curve, such that the convenience premium on 20-year gilts can be inferred from the convenience premium observed on shorter-term gilts through our duration-matching approach.

To test our hypothesis, we estimate the convenience premium across the gilts yield curve using the full set of available AAA rated non-government bonds indices. For each index, we calculate the average Macaulay duration over a five-year period and use this to identify a duration-matching gilt benchmark in order to estimate the corresponding convenience premium.⁴⁴

In line with the approach outlined in the RIIO-3 SSMD Oxera report, we rely on the gilts yield curve estimated by the Bank of England, which reflects the yield on zero-coupon bonds. As a result, the duration on these zero-coupon bonds will equal their maturity.⁴⁵

Table 2.1 below presents the average duration and the number of constituents of each index.

⁴³ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.29 (accessed 9 July 2025).

⁴⁴ The Macaulay duration measures the weighted average time (in years) until a bondholder receives the bond's cash flows, including both coupons and the final principal repayment. For zero-coupon bonds, which make no coupon payments and pay only the face value at maturity, the Macaulay duration is exactly equal to the bond's maturity, because the entire cash flow occurs at a single point in time.

⁴⁵ Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, p. 19.

Table 2.1 Characteristics of available AAA rated non-government bonds indices

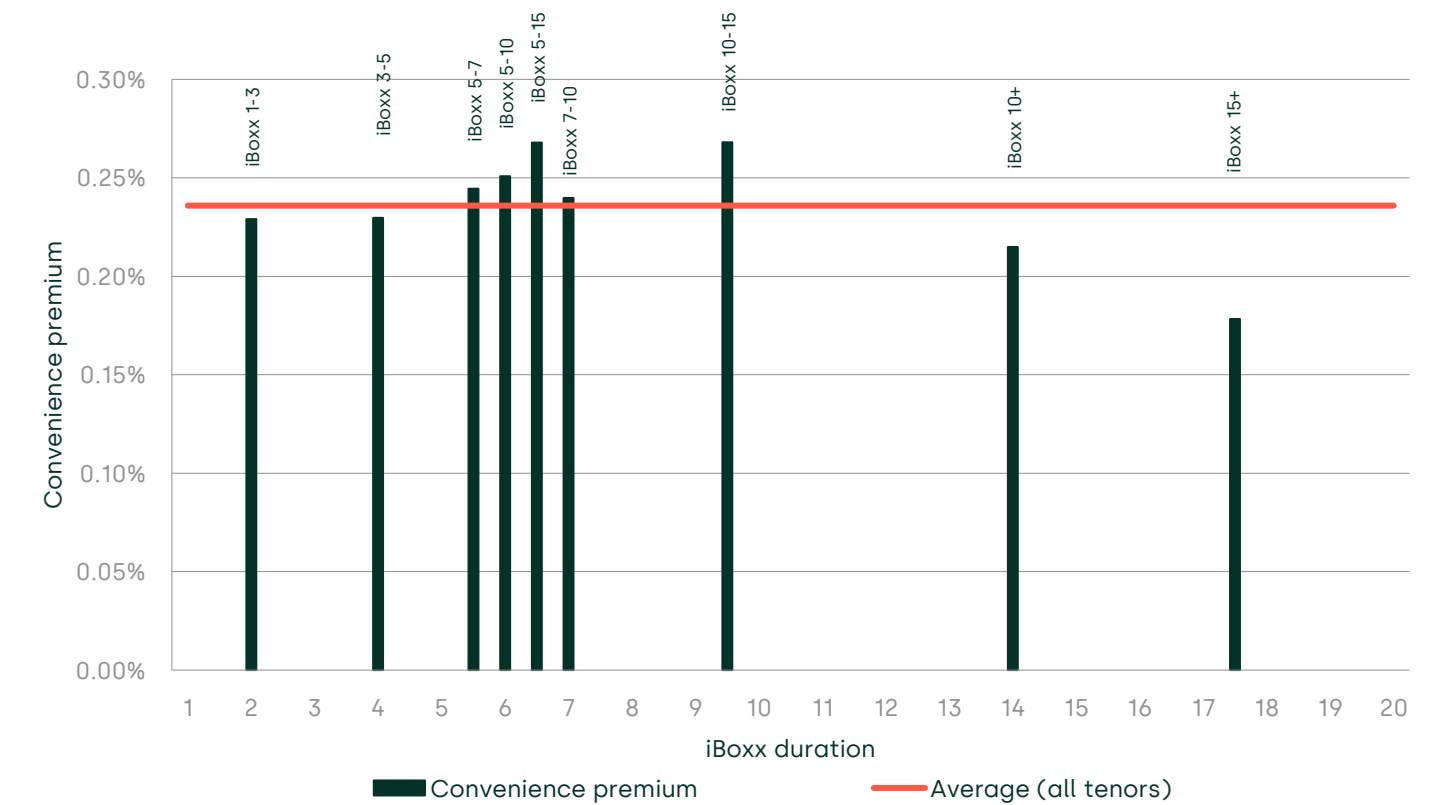
Index	Average duration	Number of constituents¹
iBoxx £ Non-gilt AAA 1-3	1.90	68
iBoxx £ Non-gilt AAA 3-5	3.76	50
iBoxx £ Non-gilt AAA 5-7	5.38	16
iBoxx £ Non-gilt AAA 5-10	5.97	23
iBoxx £ Non-gilt AAA 5-15	6.54	28
iBoxx £ Non-gilt AAA 7-10	6.96	7
iBoxx £ Non-gilt AAA 10-15	9.62	5
iBoxx £ Non-gilt AAA 10+	14.20	12
iBoxx £ Non-gilt AAA 15+	17.60	7

Note: ¹ As at 31 March 2025.

Source: Oxera analysis using IHS Markit data.

For each index presented in Table 2.1, we estimate the convenience premium by taking half of the five-year average nominal spread between the yield on the AAA rated non-government bond index and the yield on the relative duration-matching gilt. The results of our analysis are presented in Figure 2.2 below.

Figure 2.2 Convenience premium across different AAA rated non-government bond indices (iBoxx £ AAA non-gilt)



Note: The average duration reflects the average Macaulay duration over the last five years. Our analysis relies on the gilts yield curve estimated by the Bank of England, which reflects the yield on zero-coupon bonds. As a result, the duration on these zero-coupon bonds will equal their maturity.
 Source: Oxera analysis using IHS Markit, S&P Capital IQ and Bank of England data.

As illustrated in Figure 2.2, our analysis shows that a large and positive convenience premium can be found across the gilts yield curve. Our estimates range between 18bps and 27bps and result in an average convenience premium of 24bps, which is consistent with the value proposed in the RIIO-3 SSMD Oxera report. This evidence is also in line with the findings of Feldhütter and Lando (2008), which suggest that most of the drivers of the convenience premium are unrelated to the maturity of the underlying instruments.

While none of the available indices had an average duration of 20 years, we note that the 10+ and 15+ indices were fairly close to the 20-year threshold, with an average duration of 14.20 and 17.60 years, respectively. Based on these two indices, we estimate a convenience premium of 21bps and 18bps.

To further test our hypothesis and to directly address Ofgem’s concerns in relation to the lack of evidence on the presence of a convenience premium in 20-year gilts, we have examined all available AAA rated non-government bonds indices to identify periods in which some of the indices had a duration of around 20 years.

Between April 2019 and March 2021 the 15+ AAA non-government bond index had an average duration of 20.04 years. Restricting the analysis to the 2019–21 period allowed us to estimate the convenience premium on a duration-matching 20-year gilt, as proposed by Ofgem. The results of this analysis are shown in Table 2.2.

Table 2.2 Convenience premium estimation based on the 15+ AAA non-government bond index, April 2019–March 2021

	Formula	Oxera estimates
Two-year average of AAA 15+ index, nominal	[A]	1.45%
Two-year average of 20-year gilt, nominal ¹	[B]	1.04%
Average AAA 15+ index, gilt	[C] = avg ([A], [B])	1.25%
Convenience premium estimate (2Y)	[D] = [C] - [B]	0.20%

Note: ¹ Our analysis relies on the gilts yield curve estimated by the Bank of England, which reflects the yield on zero-coupon bonds. As a result, the duration on these zero-coupon bonds will equal their maturity.

Source: Oxera analysis using IHS Markit and Bank of England data.

As presented in Table 2.2, our analysis also shows a large and positive convenience premium in the case of 20-year gilts. Despite the limitations of this analysis, we note that the resulting convenience premium of 20bps is consistent with our estimate presented in the RIIO-3 SSMD Oxera report (27bps) and with the evidence presented in Figure 2.2.

2.1.6 Our estimation of the convenience premium

Building on the discussion above, we consider that adjusting gilt yields to reflect the convenience premium is a necessary step in arriving at an accurate estimate of the RFR, and that relying solely on ILG yields would be an error that underestimates the RFR.

In line with the methodology presented in the RIIO-3 SSMC and SSMD Oxera reports, we estimate the convenience premium over a five-year period, consistent with the duration of the RIIO-3 price controls.

We consider the 10+ and 10-15 AAA non-government bond indices to be the most appropriate benchmark from which to calculate the convenience premium. While Ofgem continued to express concerns about relying on AAA bond indices that are thinly populated with instruments, we note that their use follows the regulatory precedents set by the CAA and the CMA.⁴⁶

While the 15+ AAA non-government bond index would a priori allow us to more closely track the 20-year investment horizon (than the 10+ and 10-15 indices), we note that a significant proportion of its constituents have very long tenors that deviate from the 20-year investment horizon.⁴⁷ For this reason, we consider that the evidence from the 15+ AAA non-government bond index should be considered only as a cross-check of our convenience premium estimate.⁴⁸

Over the last five years, the 10+ and 10-15 AAA non-government bond indices have shown average durations of 14.20 and 9.62 years, respectively. Accordingly, we calculate the convenience premium by matching the AAA non-government bond indices with zero-coupon gilts with a maturity of 14.0 and 9.5 years.

On this basis, we estimate the convenience premium to be 24bps. The results are shown in Table 2.3 below.

Table 2.3 Convenience premium estimation

	Formula	Oxera estimates
Five-year average of AAA 10+ and 10-15 indices, nominal	[A]	3.12%
Five-year average of 9.5- and 14.0-year gilts, nominal ¹	[B]	2.64%
Average of AAA indices, gilts	[C] = avg ([A], [B])	2.88%
Convenience premium estimate (5Y)	[D] = [C] - [B]	0.24%

Note: The cut-off date for the analysis is 31 March 2025. Discrepancies may be due to rounding. ¹ Our analysis relies on the gilts yield curve estimated by the Bank of England,

⁴⁶ Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, Final report', 17 March; Civil Aviation Authority (2023), 'Economic regulation of Heathrow Airport Limited: H7 Final Decision. Section 3: Financial issues and implementation', March, p. 9.

⁴⁷ Over the five-year period under consideration, bonds with more than 30 years to maturity represent over 38% of the 15+ index.

⁴⁸ We also note that the 10-15 and 15+ indices are a sub-set of the 10+ index.

which reflects the yield on zero-coupon bonds. As a result, the duration on these zero-coupon bonds will equal their maturity.

Source: Oxera analysis using IHS Markit and Bank of England data.

In line with the empirical evidence presented in section 2.1.5, Table 2.3 further highlights the importance of accounting for a convenience premium when estimating the RFR to avoid introducing a downward bias in the allowed CoE.

2.2 Inflation

In the RIIO-3 DD, Ofgem estimated the RPI–CPIH wedge based on the same methodology as set out in the RIIO-3 SSMD. Specifically, Ofgem estimated the RPI–CPIH wedge by:⁴⁹

- relying on official forecasts of CPI and RPI from the OBR up to the point of convergence of the RPI and CPIH rates (assumed to be in February 2030);
- assuming a zero wedge for the remaining years until the maturity of the 20-year ILG.

As discussed in the RIIO-3 SSMD Oxera report, overall we consider this approach to be appropriate.

In the RIIO-3 DD, Ofgem confirmed the RIIO-3 SSMD approach and did not include a CPI–CPIH wedge.⁵⁰ However, we note that Ofgem pointed to the OBR’s October 2024 Economic and Fiscal Outlook, which assumes a long-run CPI–CPIH wedge of 0.4%.⁵¹ Based on this, Ofgem mentioned that the 2% inflation assumption, based on the Bank of England’s CPI target, may understate long-term CPIH expectations. As such, Ofgem mentioned that it would review whether an adjustment to the inflation assumption and inflation wedge was warranted to reflect the OBR’s CPI–CPIH long-run wedge.

We do not consider it appropriate to include the OBR’s CPI–CPIH wedge in the estimation of the RFR. First, historical evidence does not support the existence of a stable or predictable wedge—the observed differential between CPIH and CPI is highly variable over time, with no

⁴⁹ Ofgem (2025), ‘[RIIO-3 Draft Determinations - Finance Annex](#)’, 1 July, para. 3.17 (accessed 9 July 2025).

⁵⁰ Ibid.

⁵¹ Ibid.; and Office for Budget Responsibility (2024), ‘Economic and fiscal outlook’, October, pp. 38–39.

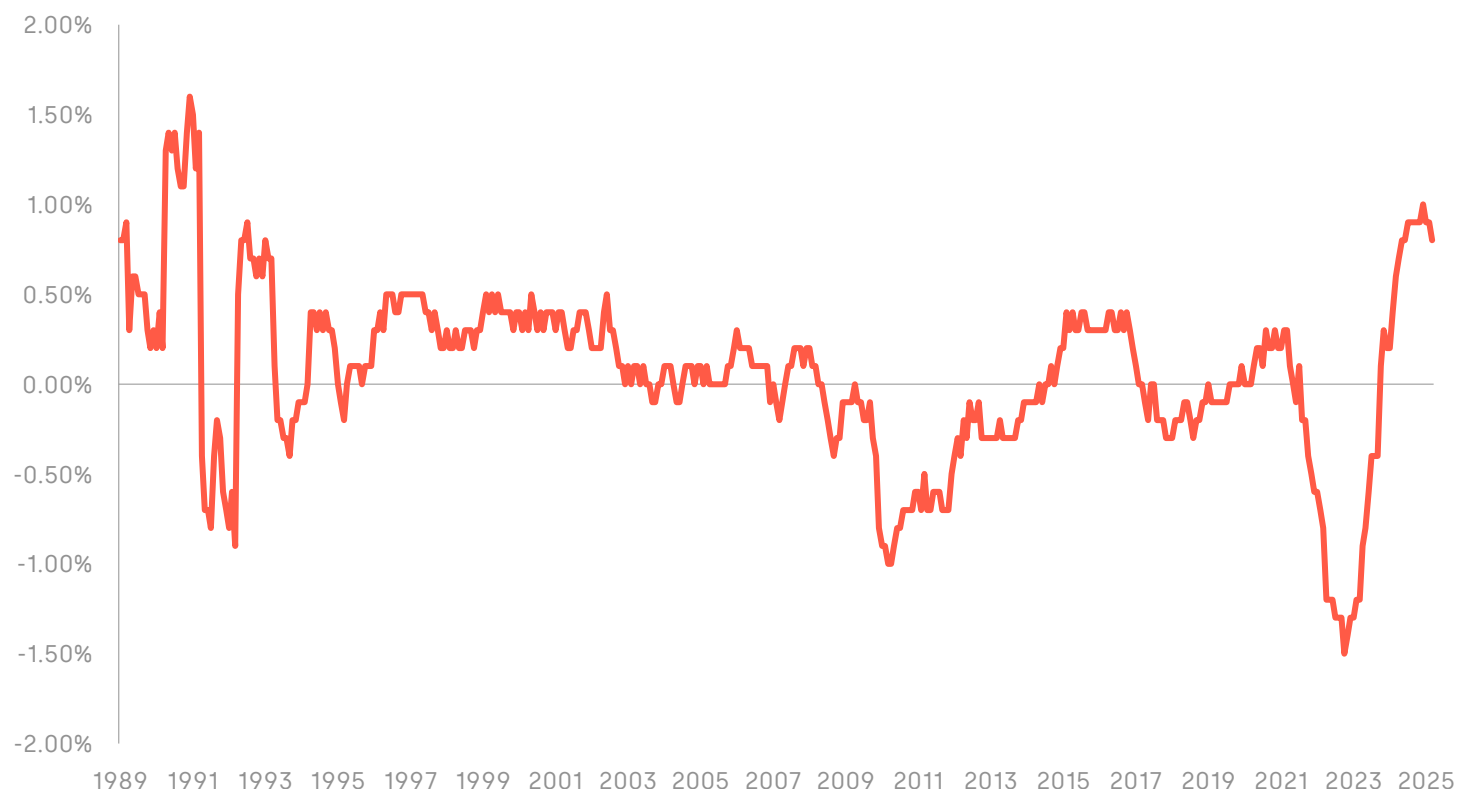
clear long-term trend.⁵² Second, the underlying drivers of estimating the long-term CPIH are conceptually complex and extremely challenging to project reliably. Finally, the OBR has started to publish CPIH forecasts only since its October 2024 report. As a largely untested measure, it lacks the track record and evidential basis needed to support regulatory application. Therefore, introducing a CPI–CPIH wedge into the regulatory framework should not be done without robust and tested evidence of a predictable level of the wedge, at this stage.

2.2.1 Outturn data indicates no persistent or material wedge

As discussed above, the historical evidence does not support the introduction of a wedge between CPI and CPIH in regulatory modelling. As illustrated in Figure 2.3 below, the differential between CPI and CPIH has been highly unstable over time, frequently fluctuating above and below zero, with extended periods in which CPI has exceeded CPIH. This volatility demonstrates that the relationship between the two measures lacks the consistency required to justify the application of a fixed wedge in long-term regulatory assumptions.

⁵² Oxera (2024), 'RIIO-3 cost of equity', prepared for the Energy Networks Association, 23 February, p. 33.

Figure 2.3 Historical outturn CPI–CPIH wedge, 1989–2025



Source: Oxera analysis based on Office for National Statistics (ONS) data.

The analysis shows that, over the time horizons typically considered in regulatory decisions, the average wedge is in fact both small and negative. Over the past ten years, the average difference between CPIH and CPI is -0.04%, while over the past 20 years it is -0.12%. These results indicate that CPIH has not exhibited a persistent or material premium over CPI, but rather that the data reflects an unstable relationship between the two indices over time.

The finding above is consistent with Ofgem’s own view, as articulated in the RIIO-3 SSMD:⁵³

Historical CPI and CPIH rates of inflation have typically been very close on average: between June 2013 and June 2023 (inclusive), average monthly CPIH and CPI inflation varied by only 14bps. This approach has also been adopted by Ofwat and by the CMA. **Although the difference between CPI and CPIH varies in the short term, in making a long-term**

⁵³ Ofgem (2024), ‘[RIIO-3 Sector Specific Methodology Decision – Finance Annex](#)’, 18 July, para. 3.56 (accessed 23 July 2025).

estimate for RFR commensurate with the use of 20-year ILGs, we consider assuming that CPI is a close proxy for CPIH is appropriate.

[Emphasis added]

In this context, the recent suggestion that a CPI–CPIH wedge may now warrant consideration represents a change in Ofgem's position, which is not supported by the evidence of volatility in the estimated wedge.

2.2.2 The underlying parameters are challenging to estimate

The measurement of CPIH differs from CPI by including also (i) owner occupiers' housing (OOH) costs (which represent 16% of the CPIH basket), and (ii) council tax (which represent 3% of the CPIH basket), alongside the same components included in CPI (which account for 81% of the CPIH basket). As council tax is only a small share of the CPIH index, while OOH costs represent a more substantial portion, the assumptions underpinning growth in OOH costs drive the long-term forecast divergence between CPI and CPIH.⁵⁴

The OBR forecasts long-term OOH costs by growing these in line with CPI actual private rental inflation—which in the long run is assumed to grow in line with average nominal earnings. In turn, the main determinants of average nominal earnings growth, and as such the CPI–CPIH wedge, are assumed to be the GDP deflator and productivity growth, which are assumed to grow at 2.3% and 1.5% respectively.⁵⁵

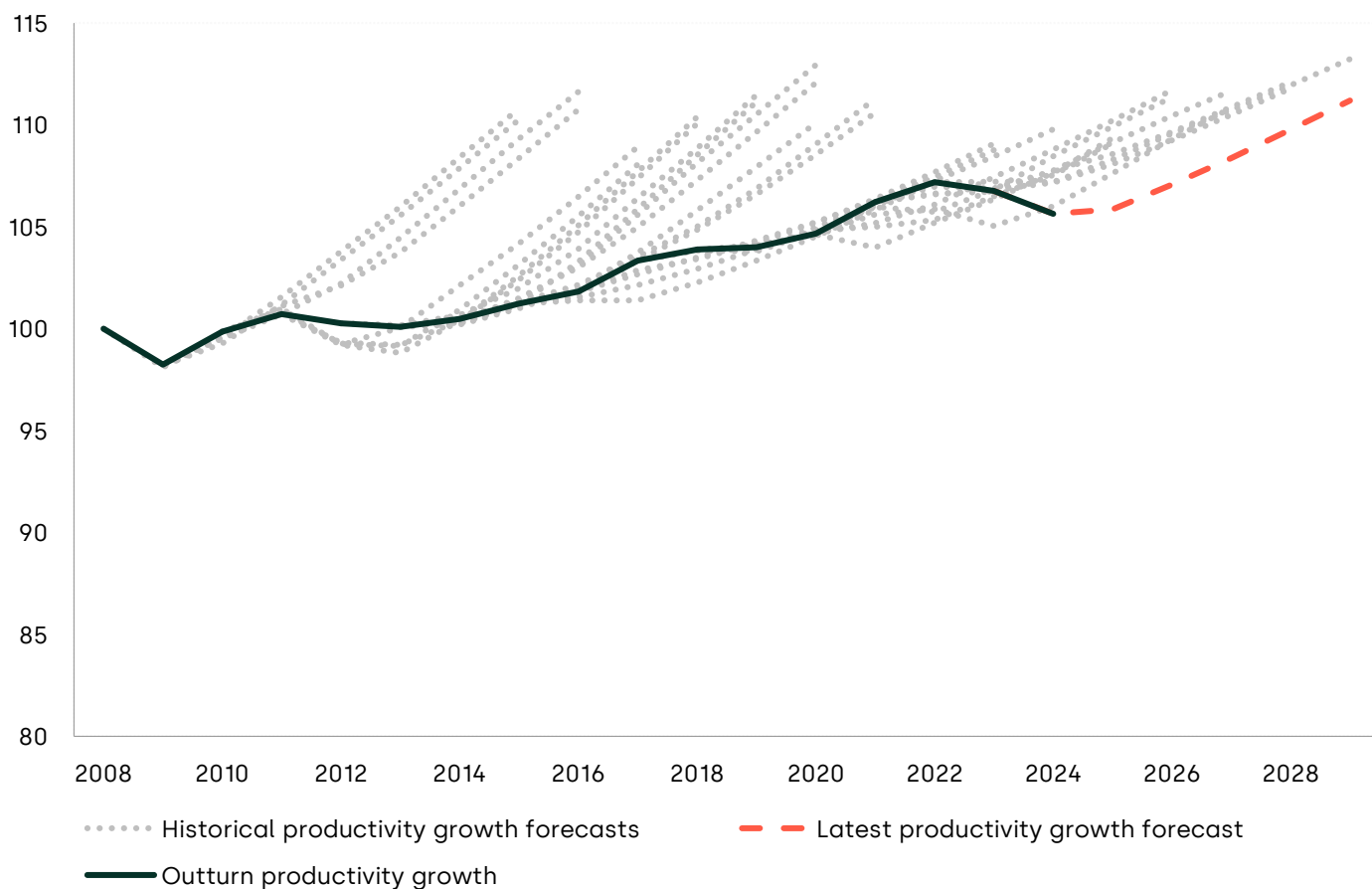
First, it is unclear why the GDP deflator is a more appropriate index to use when forecasting nominal earnings growth than CPI itself, which is projected to grow at 2%.

Second, it is challenging to forecast productivity growth accurately, with most OBR forecasts of productivity growth materially overshooting outturn growth, as illustrated in Figure 2.4 below.

⁵⁴ Office for Budget Responsibility (2024), 'Economic and fiscal outlook', October, pp. 38–39.

⁵⁵ 'Ibid.

Figure 2.4 Productivity growth forecasts and outturn productivity growth (2008=100)



Note: Latest productivity growth forecast is based on the March 2025 OBR Forecast.
Source: Oxera analysis on historical OBR productivity forecasts.

The challenge with forecasting productivity is well documented. For example, Professor David Miles—a member of the Budget Responsibility Committee—has made the following remarks to the Parliamentary Treasury Committee on the gaps between forecasts and outturn results:⁵⁶

Productivity is really difficult to forecast. Fifteen years ago, people thought that the level of GDP in the UK now would be 30% higher than it is. That has been absolutely transformational. It has been

⁵⁶ UK Parliament (2024), '[Oral evidence: Economic and fiscal outlook](#), HC 454', Treasury Committee, 17 April.

catastrophically bad for a long period of time, and I do not think anybody—any economist—really saw that coming. It is a really difficult thing to predict.

A similar debate is present in RIIO-3 in relation to the ongoing efficiency/frontier shift, in which Ofgem proposes to retain an ongoing efficiency target of 1.0% for all companies across RIIO-3,⁵⁷ which in itself is higher than productivity growth ranges proposed by the companies in their business plans.⁵⁸ The 1.5% long-term annual productivity growth is therefore inconsistent with, and higher than, Ofgem's own assumptions.

More generally, we note that in recent publications the Bank of England highlighted that accurately forecasting inflation has become more challenging in recent years:

Economic forecasters have had a challenging time over the last few years in forecasting the inflation process, given the series of unprecedented and overlapping shocks which have hit the global economy.⁵⁹

The August CPI projection is somewhat higher than the profile in May during the first and second years of the forecast period, and broadly similar in the medium term. There remains considerable uncertainty around the calibration of the Committee's judgement on the path of second-round effects in domestic prices and wages.⁶⁰

Finally, it is worth noting that the OBR has started to publish CPIH forecasts only since its October 2024 economic outlook, explicitly noting that it will 'keep our estimates and forecast methodology under review'.⁶¹ While the OBR published supplementary forecast information in June 2025, these calculations do not address any of the limitations identified in the preceding sections of this report.

Based on the above, we consider that the application of a CPI–CPIH wedge to the long-term CPI forecast is inappropriate at this stage due

⁵⁷ Ofgem (2025), '[RIIO-3 Draft Determinations – Electricity Transmission](#)', 1 July, para. 2.10 (accessed 9 July 2025).

⁵⁸ For example, in its RIIO-T3 business plan, SP Energy Networks embedded a 0.4% p.a. challenge. SP Energy Networks (2024), '[Cost Assessment and Benchmarking Approach \(including RPEs & OE\) RIIO-T3 Business Plan SP Energy Networks](#)', 11 December.

⁵⁹ Bank of England (2024), '[Outlier or laggard: divergence and convergence in the UK's recent inflation performance – speech by Dave Ramsden](#)', April, p. 2 (accessed 8 August 2025).

⁶⁰ Bank of England (2025), '[Monetary Policy Report](#)', August, p. 6 (accessed 8 August 2025).

⁶¹ Office for Budget Responsibility (2024), 'Economic and fiscal outlook', October, pp. 38–39.

to the material uncertainty surrounding the forecasting basis and the potential for significant future revisions of the forecast methodology.

2.3 RFR estimate

We estimate the RFR by taking the one-month average 20-year ILG yield using 31 March 2025 as the cut-off date, in line with the approach followed by Ofgem. However, in contrast to Ofgem’s RIIO-3 DD approach, we add the convenience premium calculated in Table 2.3. Finally, we convert our estimate of the RFR into CPIH-real terms by applying the RPI–CPIH wedge calculated by Ofgem. The results are presented in Table 2.4.

Table 2.4 Risk-free rate estimation

	Formula	Ofgem (RIIO-3 DD)	Oxera estimates
20Y ILG yields, RPI-real ¹	[A]	1.91%	1.91%
Convenience premium	[B]	–	0.24%
Benchmark RFR estimate, RPI-real	[C] = [A] + [B]	1.91%	2.15%
RPI–CPIH wedge	[D]	0.10%	0.10%
RFR, CPIH-real	[G] = (1+[C]) × (1+[D]) - 1	2.01%	2.25%

Note: ¹ Based on a cut-off date of 31 March 2025. Values may not add up due to rounding.
Source: Oxera analysis and Ofgem (2025), 'RIIO GDT3 Allowed Return on Equity Summary File_Draft Determinations_Jun25.xlsx', 1 July (accessed 9 July 2025).

3 Total market return and equity risk premium

The ERP is a premium above the RFR that investors demand for investing in a market equity portfolio. The ERP is calculated as the difference between the TMR and the RFR. UK regulators have tended to follow the view that the expected real TMR is *fairly* stable over time, and that changes in the real RFR are *largely* offset by changes in the ERP.⁶² Ofgem takes the position that it is inappropriate to change the TMR to reflect prevailing interest rates.⁶³ However, the TMR is likely to vary over time to some extent, and it is therefore important to consider how the high-interest-rate environment affects the energy networks and their ability to finance their activities in RIIO-3. As discussed in the RIIO-3 SSMC and SSMD Oxera reports, notwithstanding the fact that the TMR has historically been more stable than the ERP, we observe that regulatory precedent on the TMR has supported higher allowances in high-interest-rate environments and vice versa over time. As further discussed in this section, this has important implications for the appropriate CoE allowance in RIIO-3.⁶⁴

Keeping the regulatory precedent in mind, the TMR can be estimated using a range of methodologies. One method is the historical ex post approach, which is based on the average of observable historical returns. This is the most widely used method. Two other approaches are as follows.

- **Historical ex ante**, which can be based on either: (i) the average of adjusted historical returns, where the adjustment accounts for 'unexpected' events that generated a return that was lower or higher than expected (the 'DMS decompositional approach'); or (ii) the historical dividend or earnings yields plus expected growth (the Fama–French approach).
- **Forward-looking**, which is based on investors' expectations of future returns. Various methodologies can be used to estimate this, from survey evidence to dividend discount models.

⁶² See, for example, UKRN (2023), '[UKRN guidance for regulators on the methodology for setting the cost of capital](#)', p. 16 (accessed 24 July 2025).

⁶³ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.47 (accessed 9 July 2025).

⁶⁴ Oxera (2024), 'RIIO-3 cost of equity', prepared for the Energy Networks Association, 23 February 2024, section 2.2.4.



Box 3.1 Ofgem's RIIO-3 DD approach for estimating the total market return

Ofgem's proposed TMR estimate is based on the following methodology and set of assumptions.

- **Approaches:** Ofgem confirmed its approach in the RIIO-3 DD of deriving the TMR by placing equal weight on ex post and ex ante approaches. For the ex post TMR, Ofgem relies on the arithmetic mean of one-year returns. For the ex ante TMR, Ofgem relies on the DMS decomposition approach. We note that, in line with our suggestion in the RIIO-3 SSMD Oxera report, Ofgem is no longer applying the COLI-CED and serial correlation adjustments when estimating the ex ante TMR.
- **Treatment of inflation:** Ofgem confirmed the use of the following combination of inflation series when estimating the ex post TMR: (i) the CED series (for the period 1900–49); (ii) the new backcast series for the CPIH (for the period 1950–88); (iii) the CPIH estimates published by the ONS (from 1989 onwards).
- **Relationship between the TMR and gilt yields:** Ofgem mentioned that it does not believe that it is appropriate to make 'manual adjustments' to the TMR to reflect prevailing interest rates. As such, Ofgem confirmed the RIIO-3 SSMD through-the-cycle approach.
- Based on the above, **Ofgem's proposed TMR range** is 6.80–6.90%.

Source: Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, section 3; Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, paras 3.33–3.47 (accessed 9 July 2025).

While we note that Ofgem has incorporated some of our suggestions in relation to the ex ante TMR, the approach that it follows to set the TMR remains only partially consistent with the overall methodology outlined in the RIIO-3 SSMD Oxera report. The main differences are with respect to the weight placed on ex ante approaches and the need to adjust the TMR to reflect the higher-interest-rate environment.

In the next sub-sections, we discuss in more detail Ofgem's methodological choices in relation to:

- the ex post TMR (section 3.1);
- the ex ante TMR (section 3.2);
- the weight placed on ex ante approaches (section 3.3);
- the relationship between the TMR and gilt yields (section 3.4).

In section 3.5, we present the TMR range that we consider to be most appropriate based on the discussion in the previous sections.

3.1 Ex post total market return

In the RIIO-3 DD, Ofgem confirmed the approach set out in the RIIO-3 SSMD, based on the one-year arithmetic average. As a result, Ofgem proposed to set 6.92% (rounded to 6.90%) as the upper bound of the TMR range.⁶⁵

In line with the RIIO-3 SSMD Oxera report, we agree with Ofgem's approach of relying solely on the one-year arithmetic average, and note that this is also the averaging approach recommended by DMS for estimating the TMR in the context of a regulatory determination.⁶⁶

While we agree with Ofgem's approach, we have been unable to replicate the value presented in the RIIO-3 DD. As such, in section 3.5, we provide our estimate of the one-year arithmetic average TMR.

We disagree with Ofgem's decision to constrain the top of the TMR range to the historical average, for reasons set out in section 3.4.

3.2 Ex ante total market return

In the RIIO-3 DD, Ofgem confirmed its decision to estimate the ex ante TMR by relying solely on the version of the DMS decompositional approach used by the CMA in the PR19 redeterminations.⁶⁷ The ex ante TMR estimated by Ofgem is presented in Table 3.1 below.

⁶⁵ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, paras 3.41–3.42 (accessed 9 July 2025).

⁶⁶ Dimson, E., Marsh, P. and Staunton, M. (2021), '[Assessment of BNetzA's/Frontier's position on a DMS-based MRP](#)', 21 August, p. 16 (accessed 18 September 2024).

⁶⁷ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, paras 3.38–3.40 (accessed 9 July 2025).

Table 3.1 Ofgem ex ante total market return based on the DMS decompositional approach

	Formula	Value
Geometric mean dividend yield	[A]	4.55%
Growth rate of real dividends	[B]	0.64%
Geometric mean ex ante TMR	$[C]=[A]+[B]$	5.19%
Geometric-to-arithmetic conversion	[D]	1.61%
Raw arithmetic ex ante TMR	$[E]=[C]+[D]$	6.79%
COLI-CED adjustment	[F]	–
Serial correlation adjustment	[G]	–
Final arithmetic ex ante TMR estimate	$[H]=[E]+[F]+[G]$	6.79%

Source: Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, Table 15 (accessed 9 July 2025).

As illustrated in Table 3.1, as part of the RIIO-3 DD, Ofgem incorporated our suggestion of excluding the COLI-CED and serial correlation adjustments.⁶⁸ Specifically, Ofgem acknowledged that the COLI-CED adjustment was no longer required as DMS now provides the necessary data for calculating the ex ante TMR in nominal terms, which means that the ex ante TMR can be calculated using the same inflation series used for the ex post TMR.⁶⁹ In relation to the serial correlation adjustment, Ofgem decided to remove it in recognition of the conflicting views about the presence of a serial correlation in returns.⁷⁰ As a result of these changes, the ex ante TMR estimated by Ofgem increased compared with the value estimated in the RIIO-3 SSMD (6.50%).⁷¹

In line with the RIIO-3 SSMD Oxera report, we agree with Ofgem's decision to rely solely on the DMS decompositional approach for estimating the ex ante TMR, and we welcome the exclusion of the COLI-CED and serial correlation adjustments from its calculation. However, as discussed in section 3.3, we maintain that Ofgem should not position its

⁶⁸ Ofgem previously used the COLI-CED adjustment to account for the difference in the inflation series used by DMS and Ofgem in the 1900–49 period. Ofgem considered that the serial correlation adjustment accounted for potential negative autocorrelation in returns, which could affect the relationship between arithmetic and geometric mean returns.

⁶⁹ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.39 (accessed 9 July 2025).

⁷⁰ Ibid., para. 3.40.

⁷¹ Ibid., Table 15.

approach as: '[w]e continue to recommend we give equal weight to both ex ante and ex post TMR estimates'.

Also in the case of the ex ante TMR, we have been unable to replicate the value presented in the RIIO-3 DD. As such, in Table 3.2 we provide our estimate of the ex ante TMR based on the DMS decompositional approach.

Table 3.2 Oxera ex ante total market return based on the DMS decompositional approach

	Formula	Value
Geometric mean dividend yield	[A]	4.55%
Growth rate of real dividends	[B]	0.65%
Geometric mean ex ante TMR	[C]=[A]+[B]	5.19%
Geometric-to-arithmetic conversion	[D]	1.64%
Ex ante TMR	[E]=[C]+[D]	6.84%

Source: Oxera analysis based on DMS data.

3.3 Weight placed on ex ante total market return

In the RIIO-3 DD, Ofgem acknowledged that, as highlighted in the RIIO-3 SSMD Oxera report, using the ex ante approach requires subjective adjustments. However, Ofgem did not believe that this detracted from the value of the DMS decompositional approach.⁷² As a result, Ofgem confirmed its intention to assign equal weight to the ex ante and ex post estimates when setting the TMR range for RIIO-3.⁷³

Ofgem justified its decision to place equal weight on the ex ante and ex post estimates based on UKRN guidance, which proposes that regulators should place weight on historical ex ante evidence.⁷⁴ However, while the UKRN guidance suggests that 'the TMR should be

⁷² Ofgem (2025), 'RIIO-3 Draft Determinations - Finance Annex', 1 July, para. 3.44 (accessed 9 July 2025).
⁷³ Ofgem (2025), 'RIIO-3 Draft Determinations - Finance Annex', 1 July, para. 3.42 (last accessed on 9 July 2025).
⁷⁴ Ofgem agrees with the UKRN that, to the extent that historical returns were not expected ex ante by investors, using achieved returns as a guide to future expectations may be unreliable. Based on the above, Ofgem concluded that an ex ante approach could add balance to an ex post approach. See Ofgem (2025), 'RIIO-3 Draft Determinations - Finance Annex', 1 July, para. 3.44 (accessed 9 July 2025).

primarily based on historical ex post and historical ex ante evidence', it does not recommend assigning equal weight to ex ante and ex post estimates. Given the methodological concerns with the ex ante approach we consider that Ofgem's approach that seeks to place equal weight on ex ante and ex post approaches, when setting the TMR range, remains unjustified.

Furthermore, as discussed in the RIIO-3 SSMD Oxera report, we do not consider that the DMS decompositional approach provides the ex ante insight that Ofgem and the UKRN are looking for. This is because the DMS decompositional approach does not actually attempt to predict a forward-looking TMR; rather, it seeks to assess whether the returns that investors were expecting in the past are well approximated by the historical mean.

As illustrated in Table 3.1 above, the ex ante TMR estimated using the DMS decompositional approach is based on historical data on dividend yields and dividend growth rates. Under this formulation, the DMS decompositional approach is more akin to an 'adjusted ex post estimate' than an actual ex ante approach, which would attempt to predict an event before it occurs.

While we welcome the recognition by Ofgem that there is no longer the need to apply a COLI-CED adjustment, and that there is no definitive evidence on serial correlation that would justify adjusting the historical ex ante estimate of TMR, we continue to suggest that Ofgem should inform its TMR range predominantly on the basis of the one-year arithmetic mean approach, and place little to no weight on historical ex ante approaches.

Moreover, we note that while Ofgem argued in favour of placing equal weight to both ex ante and ex post approaches when setting the TMR range, its proposed TMR point estimate reflects the upper bound of the range, which is based only on the ex post approach.⁷⁵

3.4 Total market return determinations and gilt yields

In the RIIO-3 DD, Ofgem clarified that it believes that it is inappropriate to make manual adjustments to the TMR to reflect prevailing interest rates, and that it plans to continue to use cross-checks to assess whether its bottom-up TMR is 'materially' out of line with what investors

⁷⁵ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para 3.42 and Tables 17 and 18 (accessed 9 July 2025).

require.⁷⁶ As a result, Ofgem's proposed TMR range reflects only its ex ante (i.e. DMS decompositional approach) and ex post estimates.⁷⁷

In relation to Ofgem's proposed solution to ensure that the TMR is set correctly, we note that Ofgem has not defined what constitutes a 'materially' out-of-line TMR. Instead, Ofgem performed a suite of cross-checks at the CoE level to assess whether the overall allowed CoE is properly calibrated, concluding that its cross-checks support its preferred CoE range.⁷⁸ Instead, in section 6, we present the results of our own debt-based cross-checks, which show that Ofgem's allowed CoE and the bottom half of its CoE range are too low.

More generally, in the RIIO-3 SSMD Oxera report, we highlighted that in previous Ofgem decisions the TMR allowance was reduced in an environment of declining gilt yields, and that only a part of these reductions could be explained by the transition from RPI to CPIH.⁷⁹ As such, we consider Ofgem's approach in the RIIO-3 DD to be inconsistent with how similar issues were approached in past decisions.

In Figure 3.1 below, we present an update of a figure presented in the RIIO-3 SSMD Oxera report showing the relationship between Ofgem's allowed TMR and gilt yields.

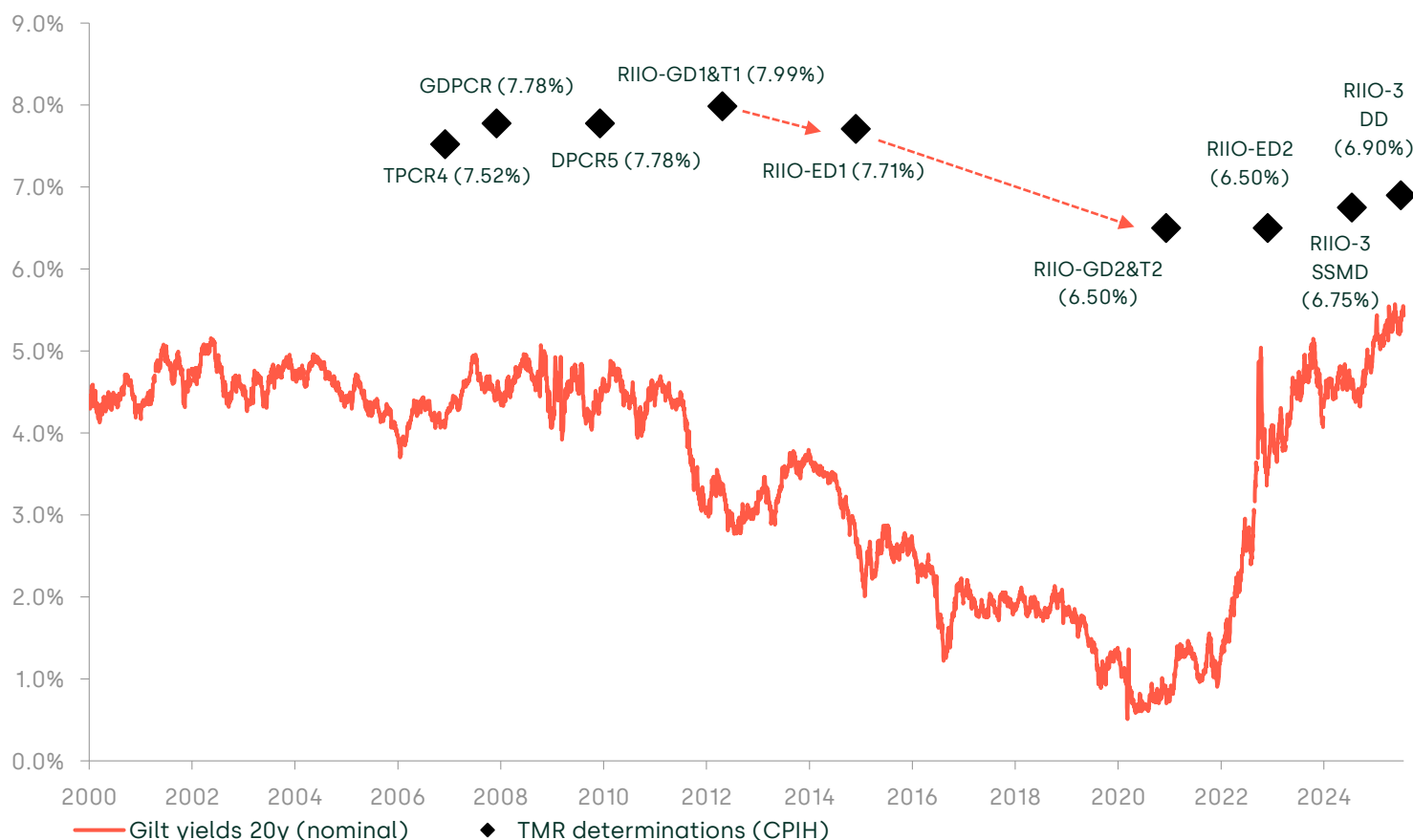
⁷⁶ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.47 (accessed 9 July 2025).

⁷⁷ Ibid., Tables 17 and Table 18.

⁷⁸ Ibid., Table 19.

⁷⁹ Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, pp. 37 and 40.

Figure 3.1 Historical total market return determinations and underlying gilt yields (CPIH-real)



Note: Historical RPI-real determinations have been converted to CPIH-real using the long-term wedge, as stated by the OBR. We have reflected the changes in the long-term wedges over time. For the years before the Bank of England started targeting CPI, we use the 2.5% RPI target.

Source: Oxera analysis based on Bank of England data and Ofgem determinations: Ofgem (2024), 'RIIO-3 Sector Specific Methodology Decision – Finance Annex', 18 July, Table 5; Ofgem (2024), 'RIIO-3 Sector Specific Methodology Decision – Finance Annex', 18 July, Table 6; Ofgem (2022), 'RIIO-ED2 Final Determinations Finance Annex', 30 November, pp. 38 and 48; Ofgem (2021), 'RIIO-2 Final Determinations – Finance Annex', 3 February, p. 49; Ofgem (2014), 'Final determinations for the slow-track electricity distribution companies Overview', 28 November, p. 40; Ofgem (2013), 'Strategy decision for the RIIO-ED1 electricity distribution price control Financial issues', 4 March, p. 15; Ofgem (2012), 'RIIO-GD1: Final Proposals Finance and uncertainty supporting document', 17 December, p. 22; Ofgem (2011), 'Decision on strategy for the next transmission and gas distribution price controls - RIIO-T1 and GD1 Financial issues', 31 March, p. 35; Ofgem (2006), 'Transmission Price Control Review: Final Proposals', 4 December, p. 55; Ofgem (2006), 'Transmission Price Control Review: Initial Proposals', 26 June, p. 42.

As shown in Figure 3.1, the increase in gilt yields observed in recent years has coincided with only a marginal increase in the allowed TMR. Specifically, between 8 December 2020 and 31 March 2025, gilt yields increased by 4.52% (from -2.58% to 1.93%) on a real basis, while the

allowed TMR increased by only 0.4%. In comparison, between 17 December 2012 and 8 December 2020, gilt yields reduced by 2.56% (from -0.02% to -2.58%) on a real basis, while the allowed TMR decreased by 1.49%.

In keeping with this evidence, in the RIIO-3 SSMD Oxera report we noted that, in 2024, DMS predicted significantly higher equity returns compared with projections made in 2022. A similar finding can be found in the 2025 yearbook, in which DMS now predicts equity returns that are 240bps higher than projections made in 2022. According to DMS, this rapid change is the result of the sharp increase in real interest rates and the 'very poor' returns experienced in 2022.⁸⁰ This further shows how Ofgem's through-the-cycle and fixed TMR risks becoming more and more detached from investors' required returns.

As discussed in the RIIO-3 SSMD Oxera report, we consider that there is a risk that Ofgem's decision not to adjust the TMR upwards could be interpreted by investors as a signal to expect different treatments in scenarios of increasing and decreasing interest rates. This could undermine investors' confidence and counteract Ofgem's objective of providing a 'stable and predictable' financial framework in a particularly challenging period for the electricity and gas sectors that are facing challenges in relation to investment intensity and/or transition risk.⁸¹

In our previous reports, we pointed at how the UKRN guidance specifies that regulators should not consider the TMR to be fixed, and also note that 'it is important to recognise that depending on the macroeconomic environment, this largely 'through-the-cycle' approach could either overstate or understate returns required by investors in a specific price determination'.⁸² We note that, while Ofgem relies on UKRN guidance to justify the use of both ex ante and ex post TMR approaches, it does not address the concerns about the through-the-cycle approach highlighted in the UKRN guidance.

3.5 Total market return estimate

Based on the discussion above, we consider that the simple arithmetic average based on a one-year holding period is the most appropriate approach to estimate the TMR, with an appropriate adjustment to the

⁸⁰ Dimson, E., Marsh, P. and Staunton, M. (2025), 'UBS Global Investment Returns Yearbook 2025', p. 103.

⁸¹ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 1.4 (accessed 9 July 2025).

⁸² See UKRN (2023), '[UKRN guidance for regulators on the methodology for setting the cost of capital](#)', p. 19 (accessed 24 July 2025); and Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November.

through-the-cycle estimate to take into account current market conditions. This is because a TMR based on a very long-run sample could produce results that are no longer representative of the expected market returns at any one point in time.

Our analysis points towards a long-run average TMR of 6.95% which, in line with Ofgem's approach, we round up to 7.00%. Similarly to Ofgem's methodology, our estimate reflects the arithmetic average of real equity returns assuming a one-year holding period and using CPIH backcast inflation series.

As discussed above, we consider that it is not correct to place 50% weight on historical ex ante approaches. When setting our view on the TMR range, we consider that Ofgem should place little to no weight on historical ex ante approaches, as we do not consider the evidence from these approaches to be robust.

Contrary to Ofgem's position, the evidence presented in this section indicates that investors are likely to expect Ofgem to recognise higher required market returns than the central estimate of 7% for the through-the-cycle TMR. Indeed, UKRN guidance cites that 'there is empirical evidence of a positive relationship between real interest rates and real returns on equity, for example, as shown in the DMS Yearbook.'⁸³

Given the recent significant and sustained rise in gilt yields, it is reasonable to expect that investors have revised their return expectations upwards. As noted above, adjusting the TMR to reflect the current interest rate environment would align with past regulatory decisions and the UKRN guidance. Historically, when gilt yields were last seen at similar levels (prior to the 2008 financial crisis), the TMR allowance was in the 7.50–8.00% range in CPIH-real terms. Therefore, it is also possible that returns exceeding 7.50% may be necessary.

We consider this point to be of particular importance in the current context of the energy networks. Setting a return that is too low risks causing a welfare loss by not adequately supporting the energy networks in attracting and retaining the necessary capital to carry out the investments required to support the government's net zero objectives.

⁸³ UKRN (2023), '[UKRN guidance for regulators on the methodology for setting the cost of capital](#)', p. 20 (accessed 24 July 2025).

Frontier's updated analysis on the relationship between TMR and gilts also supports a TMR well above the through-the-cycle value considered by Ofgem.⁸⁴ Specifically, Frontier's updated TMR Glider suggests a TMR range of 7.8–8.0% depending on the length of the trailing average.⁸⁵ Based on the above, Frontier concludes that the TMR Glider would suggest that the top end of the 7.00–7.50% range would be a suitable value of the TMR for RIIO-3, given that cross-check values currently lie beyond the range.

In view of these considerations, it is essential to ensure that the TMR is set at a sufficient level to address the above points. Taking into account the through-the-cycle estimate, as well as gilt yields and the welfare loss of setting a return that is too low, we consider that it would be appropriate to set a **TMR range of 7.00–7.50% for RIIO-3**.

⁸⁴ Frontier Economics (2025), 'Updated cost of equity cross-check evidence', a report prepared for the Energy Networks Association, August, Section 8.

⁸⁵ As discussed by Frontier, 7.8% refers to the value of the TMR Glider based on a two-year moving average, while 8.0% refers to the value of the TMR Glider as at March 2025.

4 Beta

The equity beta in the CAPM is a measure of how risky an equity investment is compared with the average market portfolio. An equity beta of one implies that the movements of a stock are, on average, aligned with the average market return. An equity beta between zero and one means that it tends to move in the same direction as the market return, but to a lesser magnitude (or greater magnitude, for a beta above one).

The beta is a measure of systematic risk in the CAPM. Although it is a forward-looking concept, in practice its estimation requires the interpretation of historical market data. This may lead to betas not capturing some risks that companies expect to face in the future and that may not yet have started affecting share prices, even for those estimates based on the shortest regression windows.

For a company listed on the stock market, estimating the equity beta using regression analysis is fairly straightforward because market data is publicly available.⁸⁶ For companies that are not listed, listed comparator companies that can be used as a proxy need to be identified. Observable equity betas for these comparators need to be adjusted to the level of gearing for which the CoE is being estimated, in order for them to be comparable (i.e. de-levering and re-levering needs to be undertaken consistently with reference to the target capital structure). This is how the beta allowance has been calculated in Ofgem's past determinations, and is the approach that Ofgem intends to follow for RIIO-3.

In Box 4.1 below, we summarise Ofgem's approach in the RIIO-3 DD for estimating the beta.

⁸⁶ Since the market portfolio is unobservable, it is standard practice to proxy it using an equity index such as the FTSE All-Share.



Box 4.1 Ofgem's RIIO-3 DD approach to estimating the beta

Ofgem's proposed beta estimate is based on the following methodology and set of assumptions.

- **Timeframe and measurement frequency:** Ofgem confirmed that it would continue to estimate the beta with reference to daily returns over two-, five- and ten-year estimation windows and would not consider rolling averages. In selecting the range, Ofgem placed most weight on the ten-year estimation window.
- **Listed comparator set:** in addition to National Grid and UK water companies (Severn Trent, United Utilities and Pennon), Ofgem confirmed the inclusion of the European utilities (Enagás, Red Eléctrica, Terna and Snam).¹ We note that, in line with our suggestion in the RIIO-3 SSMD Oxera report, Ofgem reintroduced Pennon in the sample of UK water companies.
- **Index:** Ofgem confirmed the use of local or regional stock markets instead of a global index.
- **Gearing and debt beta:** Ofgem continued to use the enterprise value of gearing as a working definition of gearing and a debt beta of 0.075 in the de-levering of the raw equity beta.² The asset beta is re-levered at a notional gearing of 60% for GD and GT and 55% for ET.
- **Forward-looking risks:** Ofgem did not make any specific adjustment to its baseline asset beta estimates to separately account for forward-looking risks.
- Based on the above, **Ofgem's proposed asset beta range** is 0.30–0.45 with a point estimate of 0.375. This translates to a re-levered equity beta range of 0.64–1.01 at 60% gearing and 0.58–0.91 at 55% gearing.

Note: ¹ Ofgem ultimately removed Italgas from the sample as it considered the company's beta to be less valuable due to the impossibility of estimating a ten-year beta for it. While Italgas' trading data indeed does not suffice to estimate a ten-year beta, we have checked that its estimated asset beta is 0.39 for the eight-year period for which data is available; this is consistent with our beta range estimate, as set out later in this section. Ofgem also noted that it considered Elia, REN, and Hera but finally excluded them due to limited regulatory comparability, low shares of regulated business, or unexplained low betas. ² The enterprise value of gearing is computed as net debt divided by market capitalisation plus net debt.

Source: Oxera (2024), 'RIIO-3 cost of equity—CAPM parameters', prepared for the Energy Networks Association, 8 November, section 4; Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, paras 3.48–3.67 (accessed 9 July 2025).

In relation to the methodology and set of assumptions discussed above, we disagree with Ofgem in the assessment of the energy networks' forward-looking risks and how these should be accounted for when choosing the asset beta range and point estimate.

In the next subsections, we discuss in more detail Ofgem's approach in relation to:

- comparator selection (section 4.1);
- data frequency and timeframe of analysis (section 4.2);
- proposed beta range and point estimate (section 4.3).

In section 4.4, we present the beta range and point estimate that we consider to be most appropriate based on the discussion in the above sections.

4.1 Comparator selection

In the RIIO-3 DD, Ofgem confirmed that it will continue to include National Grid and three UK water companies—United Utilities, Severn Trent and Pennon—in the comparator sample. Additionally, starting in RIIO-3, the comparator set will include four European energy network companies—Enagás and Red Eléctrica in Spain, and Terna and Snam in Italy.⁸⁷

We note that, in the RIIO-3 DD, Ofgem decided to reintroduce Pennon in the sample of UK water companies. As discussed in our previous reports, since Pennon's acquisition of SES Water, Pennon now operates three of the 17 UK water companies and controls approximately 5.2% of the total

⁸⁷ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.55 (accessed 9 July 2025).

regulatory capital value (RCV) in the water sector.⁸⁸ This demonstrates Pennon's strategic focus on the UK water sector, and its inclusion helps to ensure that the comparator group accurately reflects the sector's risk profile. Therefore, to the extent that Ofgem places weight on water companies, we support Ofgem's decision to revise its position at the RIIO-3 SSMD and include Pennon in the comparator set.

We also welcome Ofgem's decision to include the European energy network operators in the comparator set. As set out in our previous reports, we consider these companies to be relevant benchmarks due to their operations and asset risk profiles being comparable to those of UK energy networks.

We note that, in the RIIO-3 DD, Ofgem removed Italgas from the sample of European energy networks.⁸⁹ Specifically, Ofgem clarified that it considered the evidence from Italgas's beta to be less valuable, as it was not possible to estimate a ten-year beta for this company.⁹⁰ While we agree with Ofgem's reasoning, we consider that it will be important to keep monitoring the evolution of Italgas's beta in the coming years.

In section 4.4, we provide our estimate of the asset beta range based on the same set of comparators considered by Ofgem as part of the RIIO-3 DD.

4.2 Data frequency and the timeframe of analysis

In the RIIO-3 DD, Ofgem calculated the beta based on two-, five- and ten-year estimation windows, but ultimately decided to set the proposed range and point estimate on the basis of the ten-year betas.⁹¹

As discussed in the RIIO-3 SSMD Oxera report, relying on longer-term betas, such as ten-year estimates, has both advantages and disadvantages which should be taken into account. Overall, we consider Ofgem's decision to place more emphasis on the ten-year betas to be appropriate in the current context of the energy sector in RIIO-3, given,

⁸⁸ Oxera analysis based on data from Ofwat (2024), '[Monitoring Financial Resilience report 2023-24](#)', November, p. 13 (accessed 29 July 2025).

⁸⁹ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.58 (accessed 9 July 2025).

⁹⁰ Italgas was re-listed in November 2016. Therefore, based on a cut-off date of 31 March 2025, it is not possible to estimate a ten-year beta for this company. See '[About Italgas](#)' (accessed 24 July 2025).

⁹¹ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.53 (accessed 9 July 2025).

for example, the lack of UK-specific, gas-based evidence in shorter-term estimation windows.

In relation to frequency, Ofgem confirmed that it would follow the same approach as used in RIIO-2 and focus on daily observations. In line with the RIIO-3 SSMD Oxera report, we consider that this is an appropriate approach for setting the beta for RIIO-3.

Finally, in line with the RIIO-3 SSMD position, Ofgem did not use rolling averages when estimating betas. We consider Ofgem's approach to be appropriate.

4.3 Proposed beta range and point estimate

In the RIIO-3 DD, Ofgem clarified that it does not intend to set different asset betas for gas and electricity, and proposed a common asset beta range of 0.30–0.45, with a point estimate of 0.375 based on the evidence from the ten-year betas.⁹² This translates into an equity beta range of 0.58–0.91 and a point estimate of 0.74 at 55% notional gearing, and a range of 0.64–1.01 and a point estimate of 0.83 at 60% notional gearing (both assuming a debt beta of 0.075).⁹³

Ofgem also clarified that it does not intend to adjust the baseline asset betas set based on the comparators to separately account for forward-looking risks. Specifically, Ofgem suggested that it did not consider that any of the additional risks identified for the different sectors were systematic. As such, investors should not be compensated for incurring these risks.⁹⁴

In the RIIO-3 SSMD Oxera report, we highlighted that many factors are placing upward pressure on the energy networks' risk, which suggests that using the baseline beta range to set the point estimate may not be sufficient to reflect the challenges that energy networks will face during RIIO-3.

This underpinning context—that both electricity and gas sectors are facing significant challenges throughout RIIO-3—is acknowledged by Ofgem in the RIIO-3 DD. Electricity networks will undertake significant

⁹² Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, para. 3.61 (accessed 9 July 2025).

⁹³ Ibid., Table 18.

⁹⁴ Ibid., para. 3.62.

capital investments over RIIO-3, while gas networks are facing the uncertain future of gas and the asset-stranding risk.⁹⁵

Ofgem argued that the potentially higher risk profile in RIIO-3 than in RIIO-2 should be explicitly addressed by incorporating the European energy networks in the sample.⁹⁶ While we agree that the risks faced by UK energy networks and European comparators in the sample are similar, it is not clear to what extent these shared forward-looking risks are captured in the historical beta estimates. Therefore, the inclusion of European comparators does not necessarily ensure that the entirety of UK energy networks' anticipated systematic risks is adequately reflected.

In the RIIO-3 SSMD Oxera report, we also highlighted how reaching the government's net zero objectives will require substantial investment—both equity and debt—at a time when alternative investment opportunities are highly competitive. Ensuring the investability of UK energy networks is therefore critical. Without sufficient and timely investment to expand electricity infrastructure and maintain secure and reliable gas networks, there is a significant risk that operators will not be able to deliver what is needed to support Ofgem's net zero duty. To avoid this, allowed equity returns must be set at a level that attracts and retains capital—recognising not only the scale of the challenge, but also the significant and asymmetric consumer welfare risks associated with underinvestment. As highlighted in our previous reports, the choice of the allowed beta will be a significant determinant of investability.

On this point, we observe that as part of RIIO-T1, Ofgem itself recognised that the return allowance for energy networks should reflect their exposure to cash-flow risks, with reference to their CAPEX/RAV ratio.⁹⁷ On this basis, Ofgem allowed a higher asset beta for companies with higher CAPEX/RAV ratios, reflecting its assessment of increased systematic risk associated with larger capital investment programmes and greater TOTEX variability.⁹⁸

⁹⁵ Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, paras 3.63 and 3.118 (accessed 9 July 2025).

⁹⁶ Ibid., paras 3.58 and 3.118.

⁹⁷ The riskiness of an investment programme is more accurately captured by the CAPEX/RAV ratio than by the absolute level of CAPEX. Specifically, a higher ratio indicates that a company is potentially exposed to higher cash-flow risk. See Ofgem (2021), '[RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas](#)', 17 December, para. 3.19 (accessed 8 August 2025).

⁹⁸ Ibid., paras 3.25, 3.45 and 3.47.

As discussed above, over RIIO-3, energy networks are expected to undertake significant CAPEX spend as they upgrade and expand existing infrastructure to handle increasing demand for electrification as part of the net zero transition. This will tend to put upward pressure on their CAPEX/RAV ratios, indicating higher cash-flow volatility and systematic risk exposure as per Ofgem's RIIO-T1 methodology. It is not clear to what extent this effect is captured in the beta allowance by Ofgem in the RIIO-3 DD.

This suggests that, in line with the RIIO-T1 precedent, the expected increase in systematic risk exposure should be addressed by considering a point estimate towards the top end of the asset beta range. In fact, this would be consistent with Ofgem's own statement:⁹⁹

As stated in our SSMD, in general terms, we would expect higher levels of risk exposure to be accompanied by an offsetting increase in expected returns (ie a higher cost of equity).

Furthermore, as discussed in the RIIO-3 SSMC report, there is extensive academic literature suggesting that the CoE implied by the CAPM for companies characterised by relatively low levels of beta and volatility (such as regulated utilities) understates the actual returns earned by these companies.¹⁰⁰ This phenomenon is known as the low beta anomaly, and is a well-documented bias of the CAPM framework which results in underestimated returns for low-beta stocks. There is empirical evidence that the security market line (the curve depicting the rate of return as a function of systematic risk) is flatter than predicted by the beta implied by the CAPM. Considering that regulated utilities typically have equity betas lower than one, there is a material risk that the CoE estimated using the CAPM may underestimate the required return. This further justifies choosing a point estimate towards the top end of Ofgem's asset beta range.

In keeping with this evidence, Ofgem had itself recognised that the midpoint of the estimated range may not be the most appropriate point estimate for beta.¹⁰¹

⁹⁹ Ofgem (2025), 'RIIO-3 Draft Determinations - Finance Annex', 1 July, para. 3.113 (accessed 9 July 2025).

¹⁰⁰ For example, see Black, F., Jensen, M. and Scholes, M. (1972), 'The Capital Asset Pricing Model: Some Empirical Tests', studies in the theory of capital markets.

¹⁰¹ Ofgem (2025), 'RIIO-3 Draft Determinations - Finance Annex', 1 July, para 3.84 (accessed 9 July 2025).

We stated that UKRN Guidance recommends that the RFR, TMR and (re-levered) equity beta assumptions should be combined using the CAPM to produce a cost of equity range, and that the mid-point of the range should be used as the point estimate for the CAPM cost of equity. We said we broadly agreed with this. However, we said that this recommendation best applies where CAPM metric ranges are broadly symmetrical. This is likely to apply to the TMR (we do not supply a range for the RFR) **but not to beta. We said we retained the ability to weight individual or groups of beta comparators where this will lead to a more accurate estimate. As a result, the most accurate estimate may not be the same as the middle of the identified range.** [Emphasis added]

Accordingly, we consider that Ofgem should consider a range that is in the upper end of the observed betas to better adjust for the risks of the low beta anomaly and the challenges that energy networks will face during RIIO-3.

4.4 Beta estimate

While we have aligned with Ofgem's methodological approaches in estimating the asset betas in relation to (i) its choice of the comparator set; (ii) use of daily observations; (iii) use of broad indices in the relevant currency, and (iv) its choice of debt beta of 0.075 to de-lever the raw equity betas, we have been unable to fully replicate all the values presented in the RIIO-3 DD.¹⁰² As such, in Table 4.1 we present our estimates of the asset betas.

Table 4.1 Asset betas for two-, five- and ten-year periods

Comparator	Two-year	Five-year	Ten-year
United Utilities	0.38	0.30	0.32
Severn Trent	0.40	0.30	0.32
Pennon	0.44	0.38	0.38
National Grid	0.35	0.31	0.36
Enagás	0.29	0.29	0.36
Snam	0.29	0.39	0.44
Red Eléctrica	0.25	0.26	0.30

¹⁰² We also estimate gearing using net debt and market capitalisation in line with Ofgem's approach.

Comparator	Two-year	Five-year	Ten-year
Terna	0.26	0.37	0.43
Italgas	0.29	0.34	N/A

Note: The cut-off date is 31 March 2025. On 28 January 2025, Pennon announced a rights issue offering 13 new shares for every seven shares held. The new shares were listed on the London Stock Exchange on 18 February 2025. As rights issues increase the number of shares outstanding, they typically cause a sudden drop in share price. To ensure consistency and comparability of share prices before and after the rights issue, we use adjusted share prices as reported by Bloomberg. See Armitage, S. (2012), 'The calculation of returns during seasoned equity offers', *European Journal of Finance*, 18:5, p. 397; and London Stock Exchange (2025), '[Pennon – Results of Rights Issue](#)'. Source: Oxera analysis based on Bloomberg data.

In line with Ofgem, we consider that more emphasis should be placed on ten-year betas when choosing the asset beta range for RIIO-3. As shown in Table 4.1, our ten-year estimates point towards an asset beta range of 0.30–0.44, which is aligned with the 0.30–0.45 range proposed by Ofgem in the RIIO-3 DD.

We explained in the preceding sub-section why we do not consider that the midpoint estimate proposed by Ofgem within the wide beta range of 0.30–0.45 adequately captures the statistical biases and forward-looking risks for energy networks' betas in RIIO-3. Therefore, we consider that it is more appropriate to narrow the beta range to the upper half of Ofgem's proposal, i.e. 0.375–0.45. This would ensure that the point estimate is based on market evidence but supports investability. Accordingly, in Table 4.2, we present the asset beta range and point estimate that we consider to be appropriate for RIIO-3.

Table 4.2 Asset beta range and point estimate

	Ofgem			Oxera		
	Low	High	Proposed point estimate	Low	High	Midpoint
Asset beta	0.300	0.450	0.375	0.375	0.450	0.413

Source: Oxera analysis based on Bloomberg data and Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, Tables 17 and 18 (accessed 9 July 2025).

In Table 4.3 below, we present the equity beta range and point estimate, assuming a debt beta of 0.075 and a notional gearing of 55% and 60%.

Table 4.3 Equity beta range and point estimate

	Ofgem			Oxera		
	Low	High	Proposed point estimate	Low	High	Midpoint
Equity beta (55% gearing)	0.58	0.91	0.74	0.74	0.91	0.83
Equity beta (60% gearing)	0.64	1.01	0.83	0.83	1.01	0.92

Note: Asset betas have been re-levered using the Harris–Pringle formula.
Source: Oxera analysis based on Bloomberg data and Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, Tables 17 and 18 (accessed 9 July 2025).

5 Our estimate of the cost of equity range

Based on the discussion in the sections above, we present our estimate of the CoE and compare it against Ofgem's proposal for the allowed CoE for RIIO-3, as presented in the RIIO-3 DD. In line with Ofgem, we present the CAPM-implied CoE at 55% (Table 5.1) and 60% notional gearing (Table 5.2).

Table 5.1 Cost of equity estimates at 55% gearing

Formula		Ofgem (RIIO-3 DD)			Oxera		
		Low	High	Proposed point estimate	Low	High	Midpoint
RFR	[A]	2.01%	2.01%	2.01%	2.25%	2.25%	2.25%
TMR	[B]	6.80%	6.90%	6.90%	7.00%	7.50%	7.25%
Asset beta	[C]	0.300	0.450	0.375	0.375	0.450	0.413
Re-levered equity beta at 55% gearing ¹	$[D] = \{[C] - (\text{gearing} \times \text{beta debt})\} / (1 - \text{gearing})$	0.58	0.91	0.74	0.74	0.91	0.83
CAPM CoE	$[E] = [A] + [D] \times ([B] - [A])$	4.76%	6.45%	5.64%	5.77%	7.02%	6.38%

Note: ¹ The debt beta is assumed to be 0.075. Values may not add up due to rounding.

Source: Oxera analysis and Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, Table 18 (accessed 9 July 2025).

Ofgem's proposed allowed CoE at 55% gearing for RIIO-3 is a range of **4.76–6.45%** (CPIH-real), using 31 March 2025 as the cut-off date, with a proposed point estimate of 5.64%.

Our proposed adjustments to the RFR, TMR and beta result in an Oxera CoE range of **5.77–7.02%**, with a midpoint of 6.38% (CPIH-real, at 55% gearing).¹⁰³

¹⁰³ This midpoint is based on the midpoints of each of the estimated CAPM parameters and does not equate to the midpoint of the overall CoE range due to rounding.

Table 5.2 Cost of equity estimates at 60% gearing

Formula		Ofgem (RIIO-3 DD)			Oxera		
		Low	High	Proposed point estimate	Low	High	Midpoint
RFR	[A]	2.01%	2.01%	2.01%	2.25%	2.25%	2.25%
TMR	[B]	6.80%	6.90%	6.90%	7.00%	7.50%	7.25%
Asset beta	[C]	0.300	0.450	0.375	0.375	0.450	0.413
Re-levered equity beta at 60% gearing ¹	$[D] = \{[C] - (\text{gearing} \times \text{beta debt})\} / (1 - \text{gearing})$	0.64	1.01	0.83	0.83	1.01	0.92
CAPM CoE	$[E] = [A] + [D] \times ([B] - [A])$	5.06%	6.96%	6.04%	6.17%	7.57%	6.84%

Note: ¹ The debt beta is assumed to be 0.075. Values may not add up due to rounding.

Source: Oxera analysis and Ofgem (2025), '[RIIO-3 Draft Determinations - Finance Annex](#)', 1 July, Table 17 (accessed 9 July 2025).

At 60% gearing, Ofgem's proposed CoE range is **5.06–6.96%** (CPIH-real), with a proposed point estimate of 6.04%. Applying the adjustments to the CAPM parameters discussed above results in an Oxera CoE range of **6.17–7.57%**; the Oxera midpoint estimate is 6.84% (CPIH-real, at 60% gearing).¹⁰⁴

The point estimates proposed by Ofgem (5.64% at 55% gearing and 6.04% at 60% gearing) are below the bottom of the Oxera CoE ranges, which suggests that the proposed point estimates of the Ofgem CoE ranges are too low.

¹⁰⁴ This midpoint is based on the midpoints of each of the estimated CAPM parameters and does not equate to the midpoint of the overall CoE range due to rounding.

6 Debt-based cross-checks

In this section, we assess whether Ofgem's RIIO-3 DD CoE allowance, and Oxera's CoE estimates, satisfy the debt-based cross-checks. To present a comprehensive assessment, we use several specifications of the cross-checks:

- in section 6.1, we compare the CoND and the unlevered CoE, which is the form of the test that requires the least number of assumptions;
- in section 6.2, relying on the debt premia framework (previously referred to as ARP–DRP), we first compare the ARP for Ofgem's RIIO-3 DD CoE allowance and Oxera's CoE estimate with the DRP. We then compare the ARP estimates with the minimum ARP implied by the DRP, and compare the CoE estimates with the implied minimum CoE.

We note that in the RIIO-3 DD, Ofgem proposed not to consider the debt premia framework for the purposes of cross-checking its CAPM-based CoE.¹⁰⁵ We summarise Ofgem's view in Box 6.1.



Box 6.1 Ofgem's RIIO-3 DD view on the debt premia cross-check

In the RIIO-3 DD, Ofgem proposed not to use debt-based evidence to cross-check the CAPM-based CoE.

- First, Ofgem did not consider that any debt-based cross-check 'can definitely prove or "back-solve" to a required return on equity'.¹ In particular, Ofgem noted that the assumption that 'real equity returns do not respond one-for-one with the RFR is a generally accepted UK regulatory principle'. According to Ofgem, this means that 'when interest rates rise, the ARP is likely to fall', and that the relationship is unlikely to be constant.²
- Second, Ofgem noted that the CMA 'did not consider the ARP–DRP cross-check to provide superior insight

¹⁰⁵ Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July, para. 3.100 (accessed 23 July 2025).

into the correct cost of capital', and that 'the assumed inputs are not universally accepted'.³

Note: ¹ Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July, para. 3.100 (accessed 23 July 2025). ² Ibid. ³ Ibid.
Source: Oxera.

We respond to Ofgem's critique of the debt premia cross-check in section 6.3.

Lastly, in section 6.4, we summarise our findings from the debt-based cross-checks.

One of the core inputs into our debt-based cross-checks is the CoND, which drives the DRP estimate. In this assessment, we use Ofgem's CoND benchmark for electricity transmission networks, i.e. the average yields of the iBoxx A and BBB GBP non-financial 10+ index.¹⁰⁶

6.1 Unlevered cost of equity and cost of new debt

Since claims for payments to debt holders have priority over those to equity holders, investors should expect a higher return on their equity investment than on their debt investment in the same company—i.e. the CoE must be above the CoND. This principle applies at any level of gearing, even zero—i.e. even when the CoE is unlevered.

Comparing the CoE of a fully equity-financed company (i.e. an unlevered company) with the CoND is therefore a simple, unambiguous test to check whether the CAPM CoE is set at a sufficient level.

For the CoND, we consider the average yields of the iBoxx A and BBB GBP non-financial 10+ index—the index used by Ofgem to set the cost of debt allowance for ET networks. The nominal yields are converted to CPIH-real terms using an inflation assumption of 2.03%,¹⁰⁷ consistent with Ofgem's methodology for the cost of debt allowance. To avoid putting too much emphasis on the spot market volatility, and to make it

¹⁰⁶ Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July, paras 2.14–2.18 (accessed 23 July 2025).

¹⁰⁷ This figure reflects Ofgem's CPIH long-run assumption as at the RIIO-3 DD cut-off date (31 March 2025). See Ofgem (2025), '[RIIO-3 GDT3 WACC Rates Model_Draft Determinations_Jun25](#)', 1 July (accessed 24 July 2025).

consistent with Ofgem's RFR estimation methodology, the CoND is calculated as a one-month average of the yields.

The unlevered CoE is estimated based on Ofgem's RIIO-3 DD asset beta, the RFR, and the CoND estimates.

In Table 6.1 we compare the unlevered CoE based on both Ofgem's RIIO-3 DD CoE point estimate and Oxera's CoE midpoint, with the CoND estimate.

Table 6.1 Unlevered cost of equity and cost of new debt (CPIH-real)

Parameter	Formula	Ofgem (RIIO-3 DD)	Oxera
RFR	[A]	2.01%	2.25%
Asset beta	[B]	0.375	0.413
TMR	[C]	6.90%	7.25%
ERP	[D] = [C] - [A]	4.89%	5.00%
Unlevered CoE	[E] = [A] + ([B] * [D])	3.84%	4.32%
CoND (one-month average yield of iBoxx A and BBB GBP non-financial 10+ index in nominal terms)	[F]	6.10%	6.10%
Ofgem's CPIH long-run assumption	[G]	2.03%	2.03%
CoND	[H] = (1 + [F]) / (1 + [G]) - 1	3.99%	3.99%
Unlevered CoE vs CoND	[I] = [E] - [H]	-0.15%	0.33%

Note: The cut-off date is 31 March 2025.

Source: Oxera analysis based on Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July (accessed 23 July 2025).

Using Ofgem's RIIO-3 DD proposed point estimate, the table shows that the relationship between the CoE and the cost of debt is violated, as the unlevered CoE is 15bps lower than the CoND. In contrast, when considering Oxera's CoE range, we note that the unlevered CoE stands 33bps above the CoND, i.e. it passes the test.

Having established the insufficiency of Ofgem's RIIO-3 DD CoE based on a comparison of the unlevered CoE and the CoND, we next consider how the debt premia cross-check can provide a more precise lower bound for the estimate of the appropriate CoE.

6.2 Debt premia cross-check

In this section we use the debt premia framework (referred to in our previous submissions as the ARP–DRP framework).¹⁰⁸ More specifically:

- in section 6.2.1, we compare Ofgem’s ARP with the DRP implied by the average yield of the iBoxx A and BBB GBP non-financial 10+ index;
- in section 6.2.2, we compare Ofgem’s ARP (and CoE) with the minimum ARP (and CoE) implied by the DRP.

6.2.1 Comparison between Ofgem’s ARP and the DRP

Instead of comparing the unlevered CoE with the CoND, one could compare the risk premia underlying these two parameters, i.e. the ARP and the DRP. The ARP must be equal to or above the DRP at any level of gearing.

We estimate the premia as follows.

$$ARP = \text{asset beta} * (TMR - RFR)$$

$$DRP = CoND - \text{duration-matched gilt} - \text{expected loss}$$

The ARP is calculated based on Ofgem’s CAPM parameters. In the DRP calculation, the ‘expected loss’ parameter represents the annualised probability of default multiplied by the losses that a debt investor would suffer if a borrower defaults. For debt rated A and BBB, we have previously estimated this parameter to be equal to 0.30%.¹⁰⁹ Subtracting the expected loss converts the CoND into an expected return on debt. We then estimate the DRP by further subtracting the duration-matched gilt.

Therefore, to derive a DRP, we first match the average Macaulay duration of the iBoxx A and BBB GBP non-financial 10+ index with the Macaulay duration of nominal gilts—with the corresponding gilt being

¹⁰⁸ For example, see Oxera (2024), ‘RIIO-3 cost of equity’ prepared for Energy Networks Association, 23 February, section 3.

¹⁰⁹ For the full methodology behind the 0.30% point estimate, see Oxera (2019), ‘[Risk premium on assets relative to debt](#)’, 25 March, p. 11 (accessed 21 July 2025). Our expected loss calculation uses annualised default rates based on Feldhütter and Schaefer (2018) that are higher than those reported by Moody’s. Using Moody’s reported default rates would produce a lower expected loss assumption, i.e. a higher DRP estimate. See Feldhütter, P. and Schaefer, S.M. (2018), ‘The myth of the credit spread puzzle’, *The Review of Financial Studies*, 31:8, pp. 2897–942; and Moody’s (2025), ‘Annual default study: Corporate default rate to fall below its long-term average in 2025’, 28 February, Exhibit 36.

based on the Bank of England nominal zero coupon gilt spot curve—and then subtract 30bps for the expected loss adjustment.^{110,111}

Table 6.2 compares the ARP estimated using Ofgem's RIIO-3 DD and Oxera's CoE parameters with the DRP implied by the one-month average yield of the iBoxx A and BBB non-financial 10+ index, i.e. the indices used by Ofgem to proxy the CoND.

Table 6.2 ARP based on allowance parameters vs DRP

Parameter	Formula	Ofgem (RIIO-3 DD)	Oxera
Asset beta	[A]	0.375	0.413
ERP	[B]	4.89%	5.00%
ARP	$[C] = [A] * [B]$	1.83%	2.07%
CoND (one-month average yield of iBoxx A and BBB GBP non-financial 10+ index in nominal terms)	[D]	6.10%	6.10%
11-year nominal gilt yield	[E]	4.74%	4.74%
Expected loss	[F]	0.30%	0.30%
DRP (one-month average)	$[G] = [D] - [E] - [F]$	1.06%	1.06%
ARP – DRP	$[H] = [C] - [G]$	0.77%	1.01%

Note: The cut-off date is 31 March 2025. For the one-month median, the DRP estimate is 1.08%, i.e. almost identical to the one-month average.

Source: Oxera analysis based on Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July.

The table indicates that Ofgem's ARP is above the DRP, meaning that this specification of the test does not identify any issues with Ofgem's CoE allowance. The same conclusion holds when considering the ARP from the midpoint of Oxera's CoE range, which also sits well above the DRP. However, this is only a necessary and not a sufficient condition. In the next section we introduce a tighter benchmark for the ARP.

¹¹⁰ The Macaulay duration of the gilt is the same as its remaining time to maturity, since we use zero-coupon benchmark gilts.

¹¹¹ While the 30bps adjustment is based on debt rated Baa1/BBB+, the average credit quality of the average iBoxx A and BBB non-financial 10+ index lies between Baa1/BBB+ and A3/A-. Given that higher credit ratings are associated with lower expected losses, applying a 30bps adjustment for expected loss can be considered a conservative assumption.

6.2.2 Comparison between Ofgem's ARP/CoE and the implied minimum ARP/CoE

While the ARP being above the DRP is a necessary condition, it is not a sufficient one. The ARP must always exceed the DRP at levels of gearing below 100%. At 100% gearing, however, the ARP would equal the DRP—this is because, when a company is fully debt-financed, the claim on its assets is equivalent to the claim on its debt. We therefore estimate what the DRP is likely to be at 100% by re-levering it, in order to arrive at a minimum required ARP—i.e. for this test, we assume that the notional company is fully debt-financed.

To estimate the lower bound of the possible DRP at 100% gearing, we extrapolate the DRP on a linear basis from the applicable gearing to 100% gearing. We test the CoE only at the 55% notional gearing for ET networks because Ofgem does not set the CoND assumption for ET networks at 60% notional gearing. We have shown in a separate report that a linear extrapolation is likely to be an underestimation of the actual risk premium that would be expected for a hypothetically 100% debt-financed company.¹¹²

Therefore, the ARP estimated in this way is the minimum ARP threshold. Similarly, one could imply the minimum CoE threshold that the CoE allowance must exceed in order to satisfy the test.

Table 6.3 below compares the ARP for Ofgem's RIIO-3 DD CoE and for Oxera's CoE midpoint, with the implied minimum ARP that is based on the DRP at 100% gearing.

¹¹² Oxera (2024), 'Evaluation of the ARP–DRP framework', prepared for Energy Network Association's electricity distribution network operator and transmission owner members, 8 November. The key assumption affecting the effectiveness of a linear extrapolation is the convexity of the DRP curve. Based on volatility estimates for a regulated utility company within a Merton model, the convexity assumption is very likely to hold. Our approximation therefore suggests that a linear extrapolation is likely to underestimate the actual lower bound for the DRP at 100% gearing and hence also the implied minimum ARP.

Table 6.3 ARP vs the implied minimum ARP (55% gearing)

Parameter	Formula	Ofgem (RIIO-3 DD)	Oxera
ARP (see Table 6.2)	[A]	1.83%	2.07%
DRP (one-month average) (see Table 6.2)	[B]	1.06%	1.06%
Gearing	[C]	55%	55%
Implied minimum ARP	$[D] = [B] / [C]$	1.93%	1.93%
ARP - implied minimum ARP	$[E] = [A] - [D]$	-0.09%	0.14%

Note: The cut-off date is 31 March 2025. Ofgem's implied minimum ARP value based on the one-month median (rather than the average) is 1.96%, i.e. similar to the ARP estimate based on the average.

Source: Oxera analysis based on Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July.

The results of our cross-check suggest that Ofgem's CoE allowance is insufficient, as Ofgem's ARP is 9bps below our estimated implied minimum ARP. In contrast, the ARP for the midpoint of Oxera's CoE range would exceed our implied minimum ARP by 14bps.

Lastly, in Table 6.4 we compare Ofgem's CoE proposed point estimate and Oxera's CoE midpoint with the minimum CoE derived from the debt premia cross-check.

Table 6.4 Cost of equity vs the implied minimum cost of equity (CPIH-real, 55% gearing)

Parameter	Formula	Ofgem (RIIO-3 DD)	Oxera
Implied minimum ARP (see Table 6.3)	[A]	1.93%	1.93%
RFR	[B]	2.01%	2.25%
ERP (see Table 6.2)	[C]	4.89%	5.00%
Gearing	[D]	55%	55%
Debt beta	[E]	0.075	0.075
Implied asset beta	$[F] = [A] / [C]$	0.394	0.386
Implied equity beta	$[G] = ([F] - ([D]*[E])) / (1 - [D])$	0.78	0.77
CoE to test	[H]	5.64%	6.38%

Parameter	Formula	Ofgem (RIIO-3 DD)	Oxera
Implied minimum CoE	$[I] = [B] + [G] * [C]$	5.85%	6.08%
CoE - implied minimum CoE	$[J] = [H] - [I]$	-0.21%	0.30%

Note: The cut-off date is 31 March 2025. The implied minimum CoE estimates, when the DRP is estimated based on the one-month median (rather than the average), are 5.91% based on Ofgem's RFR and ERP and 6.14% when using Oxera's RFR and ERP.

Source: Oxera analysis based on Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July.

In line with the results at ARP level, the table shows that Ofgem's RIIO-3 DD CoE allowance is below the minimum CoE implied from the debt premia cross-check. According to this specification of the debt premia cross-check, Ofgem's CoE allowance should be equal to at least 5.85% (CPIH real, 55% gearing). We note that, while the point estimate of Ofgem's RIIO-3 DD allowance falls below the implied minimum CoE, the midpoint of Oxera's CoE range exceeds it by 30bps.

The findings in the above tables are based on a DRP estimate using the one-month average yields. However, investors are potentially looking at DRPs over a historical period to understand their requirements for the next control period. Therefore, in Table 6.5 below we show the calculations for the minimum ARP and CoE implied from DRPs based on the one-month, one-year and five-year average yields of the iBoxx A and BBB GBP non-financial 10+ index and using Ofgem's RIIO-3 DD RFR and ERP. The test needs to be passed in all its specifications, given that market conditions that affect credit spreads for a given set of assets would also affect the (required return for the) equity risk of those assets, notwithstanding that some volatility in DRP may be temporary.

Table 6.5 Implied minimum ARP and cost of equity based on Ofgem's RIIO-3 DD RFR and ERP and different averaging windows (CPIH-real, 55% notional gearing)

Parameter	Formula	One-month average	One-year average	Five-year average
DRP	[A]	1.06%	1.14%	1.22%
Gearing	[B]	55%	55%	55%
Implied minimum ARP	$[C] = [A] / [B]$	1.93%	2.07%	2.21%
Ofgem's RFR	[D]	2.01%	2.01%	2.01%
Ofgem's ERP	[E]	4.89%	4.89%	4.89%

Parameter	Formula	One-month average	One-year average	Five-year average
Ofgem's debt beta	[F]	0.075	0.075	0.075
Implied asset beta	$[G] = [C] / [E]$	0.394	0.423	0.452
Implied equity beta	$[H] = ([G] - ([B] * [F])) / (1 - [B])$	0.78	0.85	0.91
Implied minimum CoE	$[I] = [D] + [H] * [E]$	5.85%	6.16%	6.47%

Note: The cut-off date is 31 March 2025. The implied minimum CoE estimates, when the DRP is estimated based on one-month, one-year, and five-year medians (rather than averages), are 5.91%, 6.18%, and 6.46% respectively.

Source: Oxera analysis based on Ofgem (2025), '[RIIO-3 Draft Determinations – Finance Annex](#)', 1 July.

The table above indicates that the implied minimum ARP (and CoE), estimated at our cut-off date increases with a longer averaging period, with the five-year average showing the highest results.

Figure 6.1 compares the implied minimum CoE calculated based on different averaging periods for the DRP with the CoE range from Ofgem's RIIO-3 DD.

Figure 6.1 The implied minimum cost of equity vs Ofgem's RIIO-3 DD cost of equity (CPIH-real, 55% gearing)

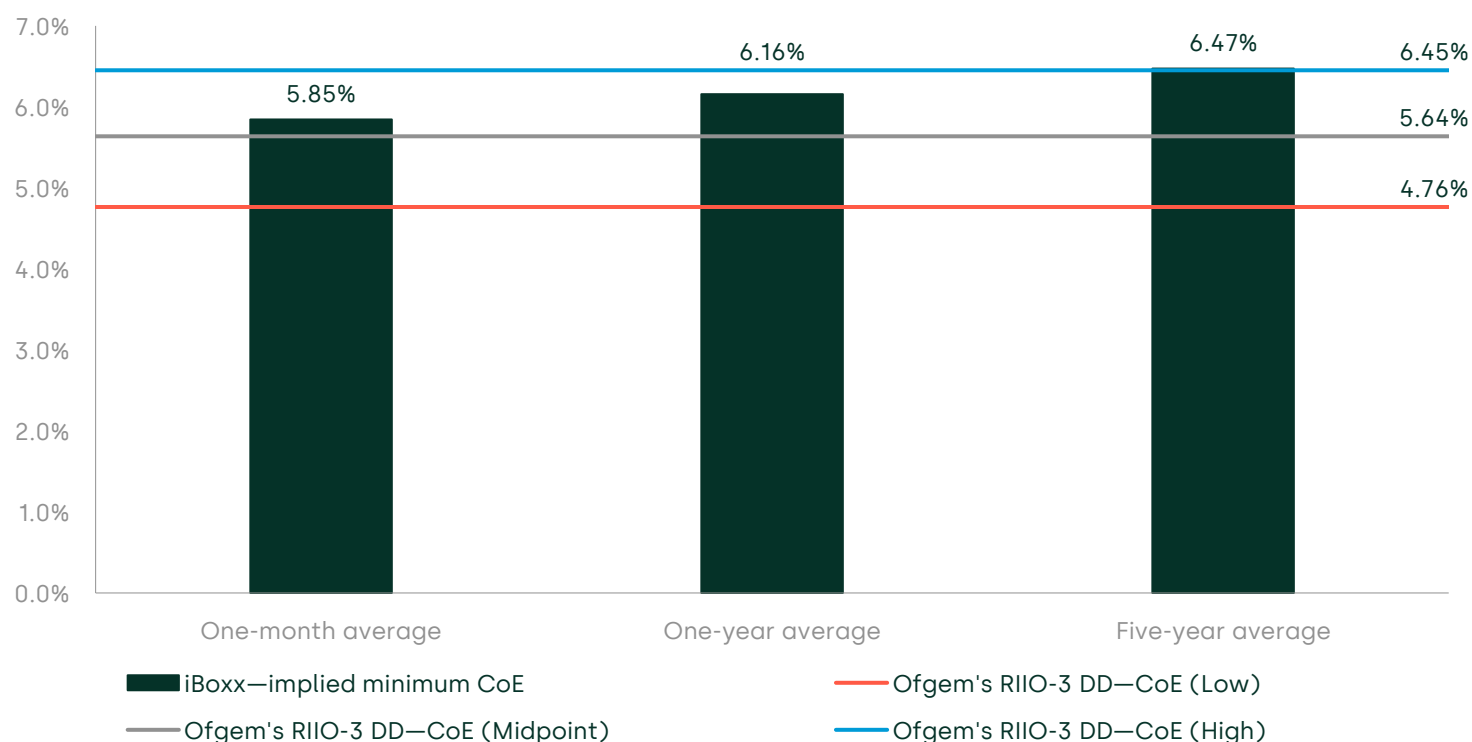
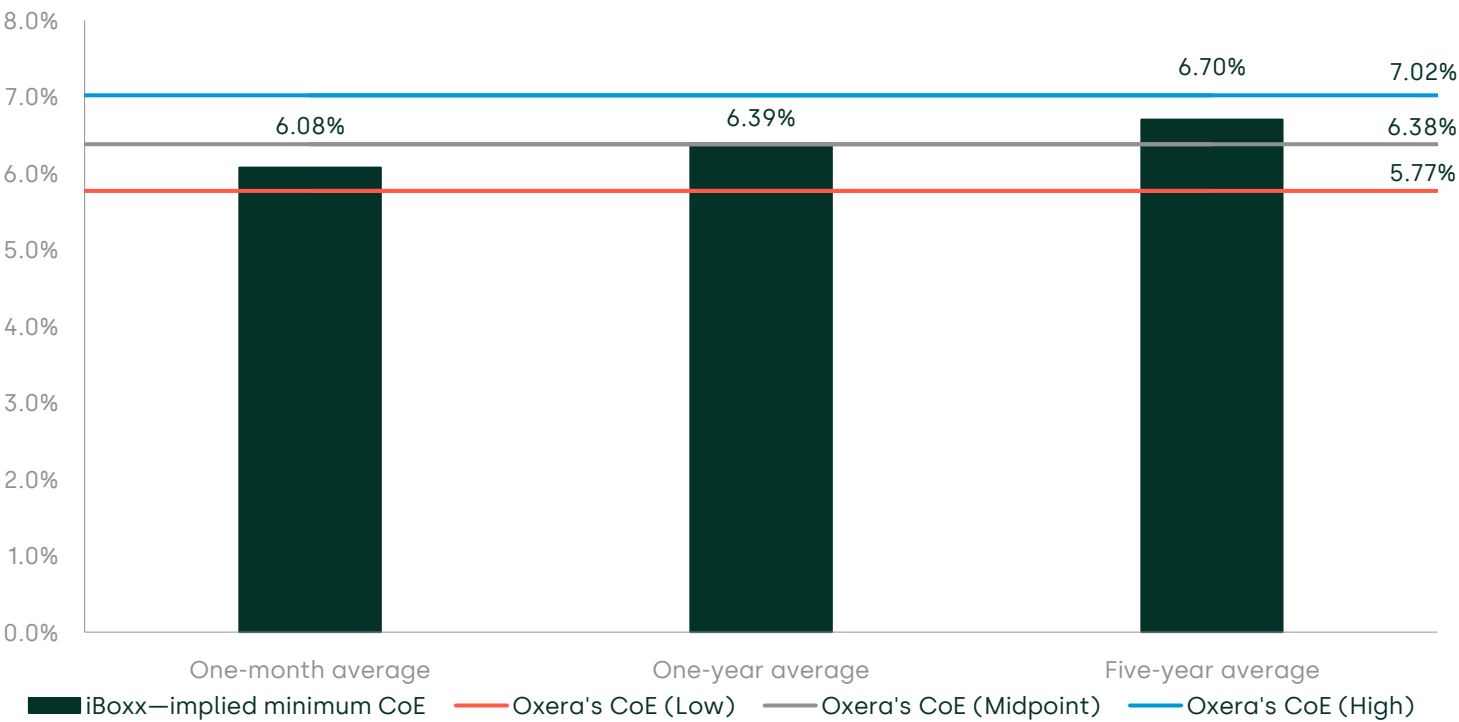


Figure 6.1 shows that Ofgem’s RIIO-3 DD CoE point estimate of 5.64% (CPIH-real, 55% gearing) falls below our implied minimum CoE, regardless of the averaging period that we use to estimate the DRP. We note that only the high end of Ofgem’s CoE range sits above the implied CoE at the one-month and one-year averages and is broadly aligned with the five-year average (6.47%).

Figure 6.2 compares the implied minimum CoE, derived using Oxera’s RFR and ERP, with Oxera’s CoE range. Appendix A1.1 shows the calculations underlying the implied minimum CoE using Oxera’s CAPM parameters.

Figure 6.2 The implied minimum cost of equity vs Oxera’s cost of equity range (CPIH-real, 55% gearing)



As for Oxera’s CoE range, we note that, while the midpoint (equal to 6.38%, CPIH-real, 55% gearing) is above our implied minimum CoE based

on the one-month average, only the high end of the Oxera CoE range (7.02%, CPIH-real, 55% gearing) is above the implied minimum CoE based on all the considered averaging measures. We therefore consider that a point estimate towards the upper end of the Oxera range would be more appropriate, to ensure that networks are investable.

Lastly, we note that using the median instead of the mean for historical figures would not affect the results of the debt premia cross-check.

6.3 Response to Ofgem's critique of the debt premia cross-check

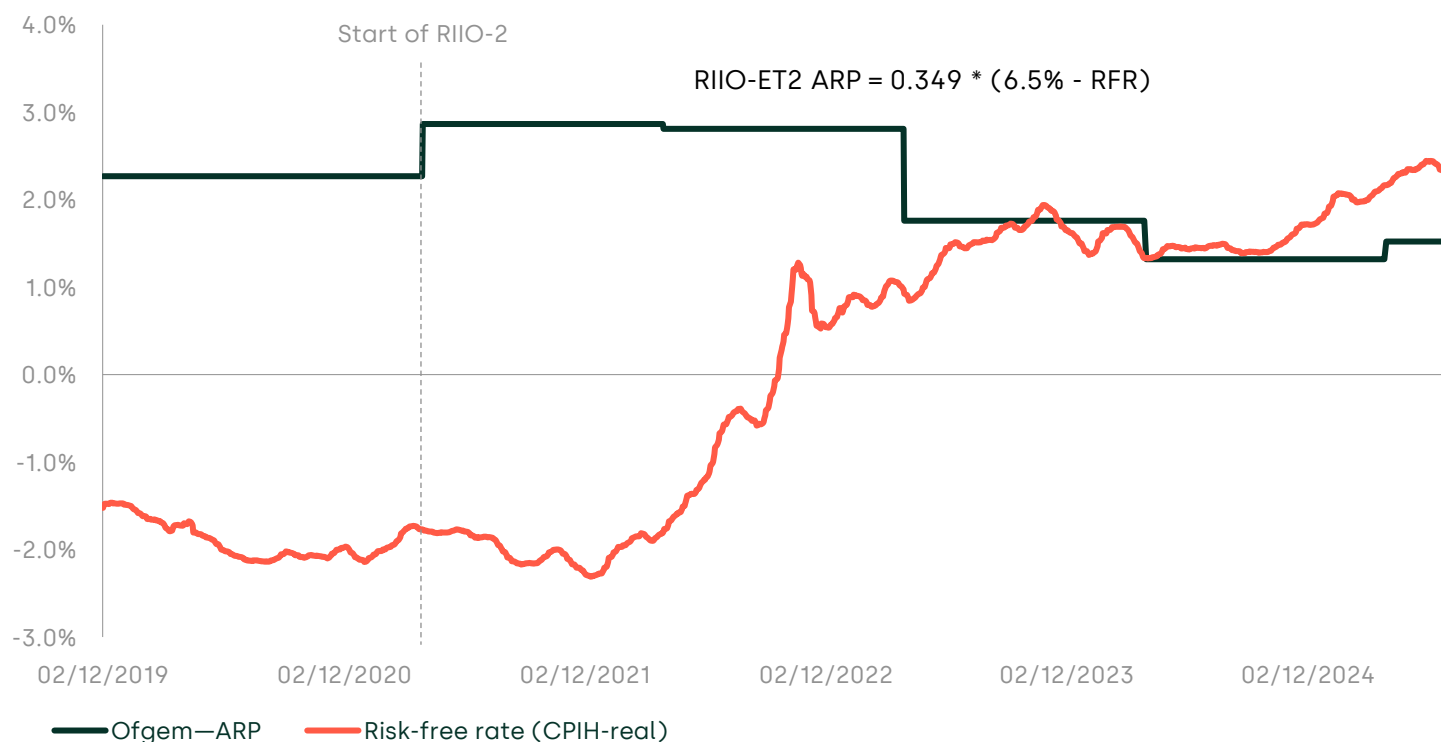
In Box 6.1 above we summarised Ofgem's view on the use of the debt premia framework for the purposes of cross-checking its CAPM-based CoE. We address Ofgem's points below.

6.3.1 Potential correlation between the ARP and the risk-free rate

Figure 6.3 compares the ARP from Ofgem's CoE allowances in RIIO-ET1 and RIIO-ET2 with the time series of the RFR, constructed based on Ofgem's RIIO-3 DD methodology.¹¹³ Appendix A1.2 outlines the methodology used to construct Ofgem's historical series of the ARPs.

¹¹³ For the RFR time series we have not fully replicated the methodology for the RPI-CPIH wedge applied to the estimates specified in the RIIO-3 DD, as the RIIO-3 DD reflect the forecast of the allowance across the five years of the RIIO-3 price control, while the time series reflects the spot data. As a result, there is a mismatch between our RFR estimates and Ofgem's RIIO-3 DD figures. Specifically, our estimates for the RFR in the time series are 15bps higher than the RIIO-3 DD estimates as at 31 March 2025.

Figure 6.3 Ofgem's ARP and risk-free rate based on Ofgem's RIIO-3 DD methodology, 2019–25



Note: Ofgem's historical ARP based on equity allowances was derived based on its yearly assumptions for the asset beta, ERP and RFR, where the RFR was converted into CPIH-real terms for the RIIO-1 period. This is further explained in Appendix A1.2. The daily series of the RFR has been converted to a one-month trailing average series for presentation purposes.

Source: Oxera analysis based on data from Ofgem, the OBR, and the Bank of England.

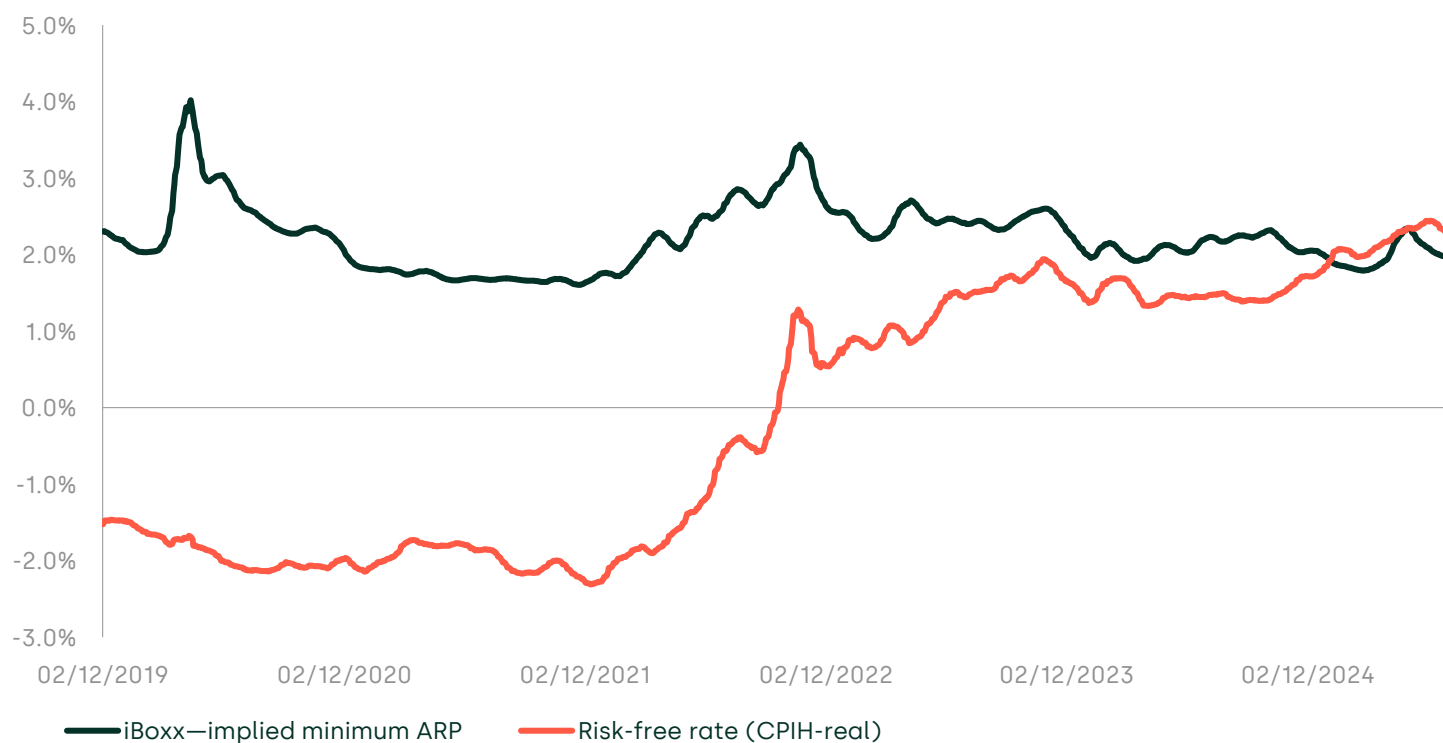
The figure shows that, in line with Ofgem's observation, when interest rates began to rise in early 2022, Ofgem's ARP began to decline in the subsequent financial years, albeit with a time lag. This relationship between interest rates and Ofgem's ARP is driven by Ofgem's decision to use the through-the-cycle assumption for the TMR in RIIO-2. However, it is unclear to us how this observation affects the effectiveness of the cross-check. It is indeed the case that, all else being equal, the lower the ARP, the harder it is to satisfy the cross-check, and as a result, it is likely that it is harder for Ofgem's allowance to pass the ARP–DRP test when interest rates are high. This is consistent with the UKRN's observation that the through-the-cycle approach to the TMR is likely to 'overstate or understate returns required by investors in a specific price

determination'.¹¹⁴ As it is a method that allows the lower bound for the appropriate CoE to be identified, the ARP–DRP cross-check is a way to identify the understated returns—i.e. the cross-check is most likely to be binding when interest rates are high. In other words, the ARP–DRP test helps to identify whether relying on the through-the-cycle approach in setting the CoE is likely to go against networks' investability in a specific price control period.

Continuing with the empirical evidence for the correlation between the ARP and the RFR, Figure 6.4 shows that, when considering the minimum ARP implied by the DRP, there is no clear evidence of such a correlation. This is because the minimum implied ARP reflects observed changes in debt spreads, which are not necessarily correlated with interest rates. Importantly, unlike Ofgem's ARP—which is derived from the CAPM—the minimum implied ARP is grounded in market data, which offers a more empirical basis for analysis.

¹¹⁴ UKRN (2023), 'UKRN guidance for regulators on the methodology for setting the cost of capital', p. 19.

Figure 6.4 Implied minimum ARP and risk-free rate, 2019–25



Note: The RFR is based on Ofgem’s RIIO-3 DD methodology. The minimum ARP is implied from the average yields of the A and BBB GBP iBoxx non-financial 10+ index, as explained further in section 6.2.2. The daily series of the RFR has been converted to a one-month trailing average series for presentation purposes.

Source: Oxera analysis based on data from HIS Markit, Ofgem, the OBR, and the Bank of England.

Lastly, on the ARP and RFR correlation, Ofgem states that the ‘relationship [between the ARP and the RFR] is unlikely to be constant as presented by Oxera’.¹¹⁵ However, it is unclear what specific analysis or conclusions Ofgem is referring to with regard to Oxera’s work. Based on the evidence presented above, the correlation between the ARP and the RFR is indeed not constant, as pointed out by Ofgem. This, however, does not detract from the validity of the cross-check.

6.3.2 The CMA’s remarks on the ARP–DRP cross-check in the RIIO-2 appeals

Ofgem refers to the CMA’s remarks from the RIIO-2 appeals, where the CMA stated that the ARP–DRP cross-check did not offer superior insight

¹¹⁵ Ofgem (2025), ‘[RIIO-3 Draft Determinations – Finance Annex](#)’, 1 July, para. 3.100 (accessed 23 July 2025).

into the appropriate cost of capital and that its inputs are not universally accepted.¹¹⁶

We note that, in the same decision, the CMA explains that no single cross-check needs to be 'disproportionately effective at identifying the "correct" cost of equity', as in that case, it would replace the CAPM.¹¹⁷ However, it is sensible to require a cross-check to offer new (in this sense, 'superior') information about the potential 'true' estimate of the CoE, and the ARP–DRP cross-check does offer that; it offers debt market evidence.

As for the inputs, the CMA explains the following:¹¹⁸

the data [...] suffers from many of the same limitations as the standard CAPM approach. In our view, given that the calibration put to us of the ARP-DRP analysis is based on values from regulators' decisions, it is also reliant on subjective assumptions

First, the CMA suggests that the limitations of the data are the same as (and, importantly, no greater than) those of the CAPM, which is indeed a standard model used, despite its limitations.

Second, the CMA points out that reliance on regulators' decisions is associated with subjective assumptions. We note that, since the ARP–DRP framework was presented to the CMA as part of the RIIO-2 appeals, it has undergone significant developments. As a result, the framework no longer relies on regulators' decisions to calibrate the threshold.¹¹⁹

Further methodological developments to the ARP–DRP framework are, in fact, something that the CMA anticipated in 2021. Indeed, the CMA states that 'ARP-DRP might ultimately gain more general acceptance as a relevant cross-check within regulatory price control processes.'¹²⁰ However, in 2021, according to the CMA, the approach was 'inadequately developed at this stage'—suggesting that the CMA expected that the framework would be developed further.¹²¹ Indeed, the

¹¹⁶ Ibid.

¹¹⁷ Competition and Markets Authority (2021), '[Cadent Gas Limited, National Grid Electricity Transmission plc, National Grid Gas plc, Northern Gas Networks Limited, Scottish Hydro Electric Transmission plc, Southern Gas Networks plc and Scotland Gas Networks plc, SP Transmission plc, Wales & West Utilities Limited vs the Gas and Electricity Markets Authority. Final determination Volume 2A: Joined Grounds: Cost of equity](#)', 28 October, para. 5.720 (a) (accessed 23 July 2025).

¹¹⁸ Ibid., para. 5.717.

¹¹⁹ For a description of the framework that used regulatory decisions for calibration see, for example, Oxera (2019), '[Risk premium on assets relative to debt](#)', Benchmarking CAPM-implied equity returns, 25 March, section 2 (accessed 29 July 2025).

¹²⁰ Ibid., para. 5.717.

¹²¹ Ibid., para. 5.717.

CMA acknowledged that the 'theoretical principles behind ARP-DRP may be valid',¹²² and that it provided a 'useful perspective'.¹²³

The key development in the ARP–DRP framework since that time has been the introduction of the internal threshold for the ARP (and hence CoE) based on the re-levered DRP, as described in section 6.2. This development means that it is no longer necessary to rely on regulatory precedents to calibrate the framework.

6.4 Conclusions on the debt-based cross-checks

Table 6.6 summarises the outcome of the different specifications of the debt-based cross-checks for Ofgem’s and Oxera’s CoE ranges for electricity transmission networks at 55% gearing. All specifications serve as a lower bound for the CoE, but some are tighter than others. The test needs to be passed in all its specifications, given that market conditions which affect credit spreads for a given set of assets would also affect the (required return for the) equity risk of those assets, notwithstanding that some volatility in DRP may be temporary.

Table 6.6 Summary of debt-based cross-checks

	Ofgem (RIIO-3 DD)			Oxera		
	Low	High	Proposed point estimate	Low	High	Midpoint
Unlevered CoE > CoND	Fail	Pass	Fail	Pass	Pass	Pass
Positive ARP–DRP	Pass	Pass	Pass	Pass	Pass	Pass
Implied CoE—one-month	Fail	Pass	Fail	Fail	Pass	Pass
Implied CoE—one-year	Fail	Pass	Fail	Fail	Pass	Fail
Implied CoE—five-year	Fail	Fail	Fail	Fail	Pass	Fail

Note: For electricity transmission networks at 55% gearing. For the implied CoE tests for Ofgem’s RIIO-3 DD and Oxera’s CoE range, we consider the implied minimum CoE estimates derived using Ofgem’s RIIO-3 DD and Oxera’s RFR and TMR respectively. Source: Oxera analysis.

The table shows that Ofgem’s proposed point estimate of the CoE allowance fails to meet most of the specifications of the debt-based

¹²² Ibid., para. 5.717.
¹²³ Ibid., para. 5.692 (a).

cross-checks discussed in this section. The one it passes (the positive ARP–DRP) is a necessary but not a sufficient condition. While the midpoint of the Oxera range passes most of the specifications, only Oxera’s high end of the range passes all of them. We therefore conclude that, in selecting a point estimate within the CoE range, a value towards the upper end of the Oxera CoE range would be appropriate, to support investability of the networks.

7 Conclusions

In this report, we have reviewed the methodology for the calculation of the CAPM parameters set out by Ofgem in the RIIO-3 DD and its proposed CoE range. Based on this, we have provided updates to the RIIO-3 SSMD Oxera report. We have provided a range for the allowed CoE, by applying the methodology that we consider to be appropriate given the developments in regulatory precedents, capital markets and the academic literature. Finally, we have assessed our and Ofgem's CoE ranges using the debt-based cross-checks.

We note that, as part of the RIIO-3 DD, Ofgem implemented some of the methodological changes that we suggested in the RIIO-3 SSMD Oxera report. Specifically, we welcome (i) the exclusion of the COLI-CED and serial correlation adjustments from the calculation of the ex ante TMR; (ii) the reintroduction of Pennon in the sample of UK water companies used to estimate the beta; and (iii) the confirmation of the inclusion of the European energy networks in the calculation of the beta.

At the same time, we consider that some of Ofgem's methodological choices continue to be in contrast with the empirical evidence, academic literature and regulatory precedents that we presented in the RIIO-3 SSMC and SSMD Oxera reports. In this report, we have focused on these specific topics, reviewing Ofgem's new considerations and evidence presented in the RIIO-3 DD and responding to Ofgem's arguments and revised estimates for these parameters.

First, in the determination of the RFR, Ofgem confirmed its decision to not account for the convenience premium embedded in government bonds. As we highlighted in the RIIO-3 SSMD report, there is extensive evidence supporting the inclusion of the convenience premium, including academic literature and recent regulatory precedents, such as those from the CMA, the CAA and the UR. As discussed in section 2.1, we have empirically shown that a large and positive convenience premium can be observed across the gilts yield curve, including at the 20-year investment horizon. While we recognise that the level of the convenience premium can fluctuate over time, depending on the underlying market conditions, in Figure 2.1 we have shown that the convenience premium has been present during periods of both calm and distressed financial markets. Therefore, we continue to consider that Ofgem's decision to not adjust for the convenience premium when setting the RFR introduces a downward bias to the estimate for a five-year control period.

Second, in the determination of the RFR, Ofgem continued not to include a CPI–CPIH wedge. However, Ofgem mentioned that it will review whether an adjustment to the inflation assumptions is warranted to reflect the long-term CPI–CPIH forecast wedge estimated by the OBR in October 2024. In section 2.2, we have identified several reasons why the OBR’s CPI–CPIH wedge should not be considered. Specifically, we note that (i) the historical evidence does not support the existence of a stable or predictable CPI–CPIH wedge; (ii) the CPI–CPIH forecast wedge estimated by the OBR lacks the track record and evidential basis needed to support regulatory application; and (iii) some of the underlying drivers of CPIH cannot be forecast reliably. Therefore, we consider that introducing a CPI–CPIH wedge into the regulatory framework would introduce unnecessary complexity and risk, and is not supported by robust and tested evidence at this stage.

Third, in the determination of the TMR, Ofgem confirmed its decision to place equal weight on ex ante and ex post approaches. As discussed in section 3.3, we continue to consider ex ante approaches to be not particularly informative and to be subject to a degree of subjective judgement about how the future will be different from the past. This includes the DMS decompositional approach considered by Ofgem, which, in reality, is closer to an ex post approach than to an ex ante one, as it does not actually attempt to predict a forward-looking TMR. Furthermore, while the UKRN guidance suggests that ex ante evidence should be considered by regulators when setting the TMR, it does not recommend placing equal weight on ex ante and ex post approaches. As such, we continue to consider that it is not correct for Ofgem to adopt a position that seeks to place equal weight on historical ex ante and ex post approaches when setting the TMR range. Instead, we consider that Ofgem should inform its TMR range predominantly on the basis of the ex post TMR, and place little to no weight on historical ex ante approaches.

Fourth, Ofgem confirmed its approach of not accounting for the higher-interest-rate environment in the estimation of the TMR. As highlighted in section 3.4, we consider Ofgem’s approach to be inconsistent with regulatory precedents. In line with the discussion in the RIIO-3 SSMD Oxera report, we maintain that following a through-the-cycle approach and placing no weight on changes in market conditions risks underestimating the TMR, which is acknowledged in the UKRN guidance, and this would not support companies in retaining and attracting capital during RIIO-3. Therefore, we consider that it is appropriate to reflect this point in the determination of the TMR.

Finally, in the determination of the beta, Ofgem discussed how it does not intend to adjust its baseline asset beta estimates to separately account for forward-looking risks, and it proposed using the midpoint of the range as its point estimate. As discussed in section 4.3, many factors in relation to net zero and transition risk are placing upward pressure on the energy networks' risk, and it is unclear whether these are fully reflected in the comparators' historical betas and thereby in Ofgem's allowed beta range. We also note that, in a previous decision, Ofgem accounted for similar risks by allowing a higher asset beta. Furthermore, the extensive evidence on the low beta anomaly suggests that the CoE estimated through the CAPM may underestimate the required returns for regulated utilities. In light of this, we consider that the lower part of Ofgem's proposed asset beta range of 0.30–0.45 neither addresses the low beta anomaly nor adequately reflects the challenges that energy networks are expected to face during RII0-3. As a result, a point estimate based on the midpoint of this range risks being too low to ensure that allowed returns are sufficient to enable companies to attract and retain capital and to support the investability of the energy sector. We therefore consider that it is more appropriate to rely on a narrower asset beta range of 0.375–0.45 when selecting the point estimate.

Based on the above, our analysis leads to a CoE estimate of **5.77–7.02% at 55% gearing** and **6.17–7.57% at 60% gearing** (both ranges in CPIH-real terms), with **midpoints of 6.38% and 6.84%**, respectively.¹²⁴ These compare with Ofgem's proposed estimate of 4.76–6.45% at 55% gearing and 5.06–6.96% at 60% gearing (both ranges in CPIH-real terms). The point estimates proposed by Ofgem (5.64% at 55% gearing and 6.04% at 60% gearing) are below the bottom of the Oxera CoE ranges, which suggests that Ofgem's point estimates are too low.

Having estimated the appropriate range for the CoE, we have cross-checked it alongside Ofgem's RII0-3 DD CoE range using the debt-based cross-checks. We have found that Ofgem's proposed point estimate of the CoE (5.64% CPIH-real at 55% gearing) does not pass the cross-check across all specifications of the cross-check except one. While the midpoint of the Oxera range (6.38% CPIH-real at 55% gearing) passes most of the specifications, only Oxera's high end of the range passes all of them.

¹²⁴ The midpoints of the Oxera CoE ranges are based on the midpoints of each of the estimated CAPM parameters. These do not equate to the midpoints of the overall CoE ranges due to rounding.

Therefore, in relation to selecting the point estimate within the CoE range, the debt-based cross-checks suggest that a point estimate towards the upper end of the Oxera CoE range would be appropriate to support investability of the networks.

A1 Supporting material for the debt premia cross-check

In this appendix, we present the calculations for the one-month, one-year, and five-year average implied CoEs derived from Oxera's CAPM parameters, and explain how the historical series of Ofgem's ARP is estimated.

A1.1 Implied minimum cost of equity based on Oxera's CoE parameters

In the table below, we show the calculations for the minimum ARP and CoE implied by the one-month, one-year, and five-year average DRPs based on the average yields of the iBoxx A and BBB GBP non-financial 10+ index and using Oxera's RFR and ERP.

Table A1.1 Implied minimum ARP and cost of equity based on Oxera's RFR and ERP and different averaging windows (CPIH-real, 55% notional gearing)

Parameter	Formula	One-month average	One-year average	Five-year average
DRP	[A]	1.06%	1.14%	1.22%
Gearing	[B]	55%	55%	55%
Implied minimum ARP	[C] = [A] / [B]	1.93%	2.07%	2.21%
Oxera's RFR	[D]	2.25%	2.25%	2.25%
Oxera's ERP	[E]	5.00%	5.00%	5.00%
Oxera's debt beta	[F]	0.075	0.075	0.075
Implied asset beta	[G] = [C] / [E]	0.386	0.414	0.442
Implied equity beta	[H] = ([G] – ([B]*[F]))/(1 – [B])	0.77	0.83	0.89
Implied minimum CoE	[I] = [D] + [H] * [E]	6.08%	6.39%	6.70%

Note: The cut-off date is 31 March 2025. The implied minimum CoE estimates, when the ARP is estimated based on one-month, one-year, and five-year medians (rather than averages), are 6.15%, 6.41%, and 6.68% respectively.

Source: Oxera analysis.

A1.2 Estimation of the historical series of Ofgem's ARP

To derive Ofgem's ARP for each year (as shown in the table below and in Figure 6.3), we multiply the asset beta by the ERP, which is defined as the TMR less the RFR, all expressed in CPIH-real terms.

For 2019/20 and 2020/21, both the TMR and the RFR were originally set in RPI-real terms by Ofgem, so we apply a 0.98% RPI–CPIH wedge to convert these values to CPIH-real terms.¹²⁵ In those years, we also derive the asset beta from NGET's equity beta of 0.95, assuming notional gearing of 55% and a debt beta of zero, as used by Ofgem in RIIO-1. From 2021/22 onwards, we use Ofgem's published RIIO-2 asset beta directly. This method yields a time series of ARPs that reflect changes in market conditions and regulatory assumptions over time.

Table A1.2 ARP for Ofgem's return on equity allowances for the electricity transmission sector

Parameter	Formula	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Asset beta	[A]	0.43	0.43	0.35	0.35	0.35	0.35	0.35
TMR (CPIH-real) [B]		8.30%	8.30%	6.50%	6.50%	6.50%	6.50%	6.50%
RFR (CPIH-real) [C]		3.00%	3.00%	-1.71%	-1.55%	1.46%	2.72%	2.14%
Ofgem's ARP	[A] * ([B]-[C])	2.27%	2.27%	2.87%	2.81%	1.76%	1.32%	1.52%

Source: Oxera analysis using Ofgem data.

¹²⁵ Historical RPI-real determinations have been converted to CPIH-real using the long-term wedge as stated by the OBR. We have reflected the changes in the long-term wedges over time. For the years before the Bank of England started targeting CPI, we use the 2.5% RPI target.



Contact

Sahar Shamsi

Partner

+44 (0) 20 7776 6624

sahar.shamsi@oxera.com

Peter Hope

Partner

+44 (0) 7776 6621

peter.hope@oxera.com

oxera.com

