

---

# **Cost of equity in RIIO-ED2 Draft Determinations**

---

Prepared for the  
Energy Networks Association (ENA)

25 August 2022

---

[www.oxera.com](http://www.oxera.com)

## Contents

<b>Executive summary</b>	<b>1</b>
<b>1 Introduction</b>	<b>3</b>
<b>2 Errors in Ofgem's estimate of the risk-free rate</b>	<b>4</b>
2.1 Ofgem failed to account for the convenience premium on ILGs	5
2.2 RPI-CPIH wedge used to adjust ILGs RPI-real yields	8
2.3 Concluding remarks	11
<b>3 Errors in Ofgem's estimate of the total market return</b>	<b>12</b>
3.1 Ofgem relied on an outdated and incorrect measure of inflation	12
3.2 Ofgem applied the wrong averaging formula	14
<b>4 Errors in Ofgem's estimate of the asset beta</b>	<b>18</b>
4.1 Sample of comparators: Ofgem is disproportionately reliant on water companies to estimate the beta of energy networks	18
4.2 Sample of comparators: Ofgem fails to consider a broader set of evidence and to include European energy comparators in its sample	22
<b>5 Cost of equity cross-checks</b>	<b>26</b>
5.1 MARs	26
5.2 Asset risk premium and debt risk premium (ARP-DRP)	27

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; in Belgium, no. 0651 990 151, branch office: Avenue Louise 81, 1050 Brussels, Belgium; and in Italy, REA no. RM - 1530473, branch office: Via delle Quattro Fontane 15, 00184 Rome, Italy. Oxera Consulting (France) LLP, a French branch, registered office: 60 Avenue Charles de Gaulle, CS 60016, 92573 Neuilly-sur-Seine, France and registered in Nanterre, RCS no. 844 900 407 00025. Oxera Consulting (Netherlands) LLP, a Dutch branch, registered office: Strawinskylaan 3051, 1077 ZX Amsterdam, The Netherlands and registered in Amsterdam, KvK no. 72446218. Oxera Consulting GmbH is registered in Germany, no. HRB 148781 B (Local Court of Charlottenburg), registered office: Rahel-Hirsch-Straße 10, Berlin 10557, Germany.

Although every effort has been made to ensure the accuracy of the material and the integrity of the analysis presented herein, Oxera accepts no liability for any actions taken on the basis of its contents.

No Oxera entity is either authorised or regulated by any Financial Authority or Regulation within any of the countries within which it operates or provides services. Anyone considering a specific investment should consult their own broker or other investment adviser. Oxera accepts no liability for any specific investment decision, which must be at the investor's own risk.

© Oxera 2022. All rights reserved. Except for the quotation of short passages for the purposes of criticism or review, no part may be used or reproduced without permission.

---

## Figures and tables

Figure 2.1	Evolution of yield spreads of nine-year and 11-year zero-coupon REFCORP bonds strips since 2010 (bp)	7
Figure 2.2	RPI–CPI wedge, based on 20-year zero-coupon RPI and CPI swaps (bp)	10
Figure 2.3	Historical CPI–CPIH wedge (bp)	10
Figure 4.1	National Grid's two-year beta compared to the average beta of UK water companies—different cut-off dates	19
Figure 4.2	National Grid's five-year beta compared to the average beta of UK water companies—different cut-off dates	20
Figure 4.3	National Grid's ten-year beta compared to the average beta of UK water companies—different cut-off dates	20
Figure 4.4	Distribution of the asset betas of National Grid and the UK water companies (two-, five- and ten-year spot betas)	21
Table 2.1	Oxera's estimate of the RPI–CPIH wedge for 20-year gilts	11
Table 3.1	Impact of new inflation series on real-equity returns	13
Table 3.2	Summary table of the regression of the nominal and CPIH-real equity returns over the lagged equity returns	16
Table 3.3	Ljung–Box test residual test results	16
Table 4.1	T-test of the differences between the means and medians of the National Grid and UK Water betas (two-, five- and ten-year spot)	22
Table 4.2	Comparator sample after sector, geography and liquidity filtering	23
Table 4.3	Summary of the regulatory regimes risk assessment	24
Table 5.1	The ARP–DRP differentials implied by the RIIO-ED2 Draft Determinations, RIIO-ED1 Final Determinations and contemporaneous market data	28

---

## Executive summary

On 29 June 2022, Ofgem released its Draft Determinations (DDs) for the RIIO-ED2 price controls. As part of the price control review, Ofgem calculated the rate of return that investors will require in exchange for financing licence holders.

The two broad investor classes in a firm are equity holders and debt holders. The standard technique used to determine the regulatory allowed return is to (i) calculate a cost of equity (CoE) and a cost of debt (CoD), and (ii) combine them to calculate a weighted average cost of capital (WACC). This report focuses on Ofgem's estimate of the CoE and its effects on the WACC allowed for electricity distribution operators in RIIO-2.

Ofgem's estimate of the CoE for the RIIO-ED2 period is **4.75%** under certain assumptions about the proportion of debt in the capital structure (or 'gearing'), as explained further below.<sup>1</sup> The standard method for calculating the CoE uses the capital asset pricing model (CAPM), which includes the risk-free rate (RFR), total market return (TMR), and equity beta.

The formula below shows how these variables fit together in the CAPM to predict the CoE.

$$COE = RFR + \beta_{equity} * (TMR - RFR)$$

Our review of Ofgem's methodology for estimating the CoE allowance focuses on areas where there is an error in the estimation of each of these parameters, in particular with reference to academic and capital market evidence. This leads to an underestimate of the overall allowed CoE with reference to the risk-adjusted return requirement in RIIO-ED2. Ofgem has made the following errors when estimating the CoE parameters.

- **RFR:** Ofgem has erred by placing weight on the spot yields on government bonds as the sole baseline proxy for the RFR, notwithstanding the weight of evidence from academic, market and regulatory sources that gilt yields are likely to reflect a significant convenience yield. In particular, government bond yields have special properties that give rise to a convenience premium that lowers the yields, making government bond yields inappropriate for the RFR. An average of the inflation-adjusted yields on the UK 20-year ILG and the iBoxx £ Non-Gilt AAA 10+ and 10–15 indices would provide a pragmatic and simple approach to recognising the convenience yield in the estimate of the RFR.
- **RFR (RPI–CPIH wedge):** if Ofgem follows either of its suggested methods, it will underestimate the RPI–CPIH wedge. According to the Office for Budget Responsibility's (OBR's) March 2022 report, its long-term wedge forecast is 100 basis points (bp), rather than the 70bp used by Ofgem in its first method. At the same time, according to our analysis based on zero-coupon RPI and CPI swaps and the historical CPI–CPIH wedge, the RPI–CPIH wedge is expected to be around 56bp, compared with Ofgem's estimate of 20bp on average over the price control period. The balance of evidence suggests the wedge is likely to be closer to the values produced by the method already in use by Ofgem, i.e. 70bp, suggesting no strong reason to depart from the first method.

<sup>1</sup> Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', Table 19.

- **TMR (inflation):** Ofgem has relied on an outdated and incorrect measure of inflation to deflate historical nominal returns, leading to an underestimation of the real TMR of c. 25bp. The Office for National Statistics (ONS) has published a new historical series for the CPI and the CPIH for the period 1950–88, correcting the errors of the previous series. The new CPIH backcast series is more robust and reliable than its CPI predecessor and should therefore be used to deflate historical returns.
- **TMR (averaging):** Ofgem has erred by using incorrect and statistically biased averaging techniques. Ofgem estimates the historical average TMR using the geometric average plus a subjective uplift to account for the difference between the arithmetic average of returns and the geometric average. In the absence of reliable evidence on serial correlation, which is Ofgem's reason for not using an uplift that would make the estimate equivalent to the arithmetic average, the arithmetic average should be used to derive an unbiased estimation of the average TMR.
- **Beta:** Ofgem has made an error in selecting the appropriate comparator sample for energy networks. It has placed significant weight on the sample of water networks, which are characterised by a lower beta compared to energy networks, and no weight on European energy networks.
- **Cross-checks:** Ofgem has made an error of judgement by de-emphasising conceptually strong cross-checks, such as ARP–DRP, and focusing on the conceptually weaker ones.
  - In particular in relation to market-to-asset ratios (MARs), Ofgem has made an error in interpreting the evidence, having put too much weight on the two factors that in its opinion explain MARs being above 1x—i.e. the expected outperformance and the deviation of the required return on equity from the return on equity allowance. In our previous assessments, we identified a number of factors that could explain an observed level of MARs above 1x, including the winner's curse, the value of non-regulated business activities and other factors. Our new analysis suggests that a MAR above 1x may be driven by investors' persistent expectations about the MAR on the terminal value of the target network being above 1x.
  - We observe a considerable decline in the ARP–DRP differential from RIIO-ED1 to RIIO-ED2, with an ARP–DRP of 1.73% and 0.93% respectively. The majority of this reduction (52bp) is driven by the reduction from ED1 to ED2 in the allowances for the ERP and for the asset beta, which can be seen when these parameters are expressed using a calculation methodology that is consistent over time. Combined with the evidence set out in this report explaining the sources of parametric uncertainty where Ofgem has erred in the selection of point estimates within the CoE parameters, this strengthens the conclusion that an upward revision to the allowed CoE is required.

# 1 Introduction

On 29 June 2022, Ofgem published its DDs for the RIIO-ED2 price control covering the electricity distribution sector.<sup>2</sup> The Energy Networks Association (ENA) has commissioned Oxera to provide advice on issues relating to the CoE allowance in the RIIO-ED2 period.

This report presents a review of Ofgem's estimate of the CoE. The report focuses on areas where Ofgem made an error in the estimation of the CAPM parameters. The report is structured as follows.

- Section 2 reviews Ofgem's position on key issues related to RFR estimation, including convenience premium and inflation adjustments, and the summary of our responses to these issues.
- Section 3 presents a review of Ofgem's methodology for estimating the TMR. The section is divided into two sub-sections covering the choice of inflation to deflate nominal returns (sub-section 3.1) and the averaging method (sub-section 3.2); these affect the estimation of the TMR based on the historical average returns.
- Section 4 discusses Ofgem's sample selection used to estimate the asset beta of energy networks. The section presents new empirical evidence on the asset beta of energy and water networks, as well as an overview of the regulatory regimes in different European countries.
- Section 5 responds to the cross-checks presented by Ofgem, focusing on an updated estimation of the ARP–DRP and new evidence on MARs.

---

<sup>2</sup> Ofgem (2022), 'RIIO-ED2 Draft Determinations', 29 June, <https://www.ofgem.gov.uk/publications/riio-ed2-draft-determinations> (last accessed 10 August 2022).

---

## 2 Errors in Ofgem's estimate of the risk-free rate

The RFR measures the expected return on an investment free of default and systematic risk—i.e. where the realised return on the investment will be equal to the expected return. It reflects the time value of money, as it represents the compensation that investors require in order to forgo current consumption in favour of future consumption.

In the RIIO-ED2 DDs, Ofgem decided to update the CoE on an annual basis during the price control—i.e. indexation of the RFR in the CAPM framework.<sup>3</sup> Ofgem's final point estimate reflects the yield on 20-year index-linked gilts (ILGs) and forward rates, converted to CPIH-real terms using a forecast of the RPI–CPIH wedge. The average RFR forecast by Ofgem for the next control period is -0.74% CPIH-real.<sup>4</sup>

In previous submissions,<sup>5</sup> we have explained that Ofgem made an error when it benchmarked the RFR at the level of the yield of ILGs because the CAPM requires firms and investors to borrow and lend at the RFR—defined as the expected return on a 'zero beta' asset. Government bond yields are significantly below the rate at which even highly rated entities can borrow.<sup>6</sup>

In the RIIO-ED2 DDs, Ofgem acknowledged the alternative proxies for RFR proposed by Oxera and the Competition and Markets Authority (CMA) but justified its choice of ILGs by stating that:<sup>7</sup>

**we still believe that ILGs provide a sound basis for estimating the RFR, because government bonds are very low risk and because we are not persuaded there are other sources, such as AAA corporate bonds, which provide a better estimate.** As we stated in our SSMD, the yield on the UK AAA corporate bond index may not be appropriate given: the inclusion of securitised bonds; the inclusion of financial sector bonds; a lack of liquidity in the underlying securities; [Emphasis added]

We do not consider that the potential issues with the UK AAA corporate bonds that Ofgem has highlighted, even if reasonable, are a sufficient basis for rejecting evidence that spot ILG yields underestimate the RFR, as discussed in this section. We explain that, contrary to Ofgem's claim, there is a large amount of evidence from both academic literature and industry practitioners supporting the use of an RFR significantly above the yield on ILGs. As a result, Ofgem made an error by not taking a balanced approach to arrive at an RFR that in fact sits above the spot yields on ILGs.

Indeed in the PR19 redetermination, the CMA considered that the RFR should be between the yields on UK AAA corporate bonds and ILG yields.<sup>8</sup> The CMA PR19 redetermination precedent remains relevant for RIIO-ED2.

In addition, we review the methodology proposed by Ofgem to estimate the differential between future RPI inflation and CPIH inflation to convert from an RPI-real RFR to a CPIH-real RFR.

<sup>3</sup> Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', para. 3.18.

<sup>4</sup> Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', Table 9.

<sup>5</sup> See, for example, Oxera (2021), 'Cost of equity report', 1 March.

<sup>6</sup> Sharpe, W. (1964), 'Capital asset prices: A theory of market equilibrium under conditions of risk', *Journal of Finance*, 19:3, pp. 425–442.

<sup>7</sup> Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', para. 3.13.

<sup>8</sup> CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final report', 17 March, paras 9.264–5.

## 2.1 Ofgem failed to account for the convenience premium on ILGs

The CAPM assumes that all investors can borrow at the same RFR. However, in reality, even investors with the highest creditworthiness face significantly higher borrowing rates than those faced by governments with high credit ratings. That is because government bonds have special properties, as explained below, that create additional market demand. Bond yields and bond prices are inversely related, so when this additional demand pushes the price higher, the bond yield falls below a normal market-clearing price based on risk-free cash flows. These effects are collectively known as the convenience premium and push the rate of return on bonds below a true RFR. Observed government bond yields are therefore lower than the RFR relevant to the pricing of equity.

### 2.1.1 Academic evidence

There is a substantial amount of evidence from the academic literature that explicitly supports the use of an RFR for the CAPM that is higher than the yield on government bonds. For example, Krishnamurthy and Vissing-Jorgensen (2012) conclude that:<sup>9</sup>

Treasury interest rates are not an appropriate benchmark for 'riskless' rates. **Cost of capital computations using the capital asset pricing model should use a higher riskless rate than the Treasury rate;** a company with a beta of zero cannot raise funds at the Treasury rate. [Emphasis added]

Berk and DeMarzo (2013) also explain that:<sup>10</sup>

practitioners sometimes use [risk-free] rates from the **highest quality corporate bonds** in place of Treasury rates. [Emphasis added]

According to Feldhütter and Lando (2008), the magnitude of the convenience premium varies over time and can range from 30 to 90 basis points (bp).<sup>11</sup> They explain the convenience premium as follows:<sup>12</sup>

**The premium is a convenience yield on holding Treasury securities arising from,** among other things, (a) repo specialness due to the ability to borrow money at less than the GC repo rates, (b) that Treasuries are an important instrument for hedging interest rate risk, (c) that Treasury securities must be purchased by financial institutions to fulfil regulatory requirements, (d) that the amount of capital required to be held by a bank is significantly smaller to support an investment in Treasury securities relative to other securities with negligible default risk, and to a lesser extent (e) the ability to absorb a larger number of transactions without dramatically affecting the price. [Emphasis added]

Similarly, Krishnamurthy and Vissing-Jorgensen (2012) estimated the average of the liquidity component of the convenience premium to be 46bp from 1926 to 2008.<sup>13</sup>

Koijen and Yogo (2020) developed a pricing model to study sources of variation in exchange rates, long-term yields, and stock prices across 36

<sup>9</sup> Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), 'The Aggregate Demand for Treasury Debt', *Journal of Political Economy*, **120**:2, April, pp. 233–67.

<sup>10</sup> Berk, J. and DeMarzo, P. (2013), *Corporate Finance*, 3rd edn, Pearson, p. 404.

<sup>11</sup> Feldhütter, P. and Lando, D. (2008), 'Decomposing swap spreads', *Journal of Financial Economics*, **88**:2, pp. 375–405.

<sup>12</sup> *Ibid.*, p. 378.

<sup>13</sup> Krishnamurthy and Vissing-Jorgensen (2012), *op. cit.*



countries from 2002 to 2017.<sup>14</sup> Their model found that, in the absence of special-status demand for US assets by foreign investors and foreign exchange reserves, the US long-term yield would be 215bp higher. In other words, the authors find evidence consistent with a significant convenience premium for US Treasuries between 2002 and 2017.

Longstaff (2004) also examined the ‘flight to liquidity’ premium in Treasury bond prices by comparing them with prices of bonds issued by the Resolution Funding Corporation (REFCORP), a US government agency, which are guaranteed by the Treasury.<sup>15</sup> Using yield data from April 1991 to March 2001, Longstaff found a premium in Treasury bonds relating to:

- changes in consumer confidence;
- the amount of Treasury debt available to investors;
- the flows into equity and money market mutual funds.

Longstaff concluded that these features of Treasury bonds directly affect their value.

### **2.1.2 Empirical evidence**

Using a methodology that is broadly consistent with that set out in Longstaff (2004), we also estimate the size of this premium since 2010.

Figure 2.1 below shows that the long-term convenience premiums implied by the spreads of nine-year and 11-year REFCORP bonds from 2010 to date are on average 47bp and 50bp respectively.<sup>16</sup> It can be seen that the 11-year spreads reduced significantly in early 2020 when the COVID-19 pandemic began, but at the beginning of January 2022 this reversed and the spreads are currently trending upwards. These estimates are consistent with the upward adjustment of 50–100bp that we recommended in our previous submissions.<sup>17</sup>

---

<sup>14</sup> Koijen, R.S. and Yogo, M. (2020), ‘Exchange rates and asset prices in a global demand system’, No. w27342, National Bureau of Economic Research.

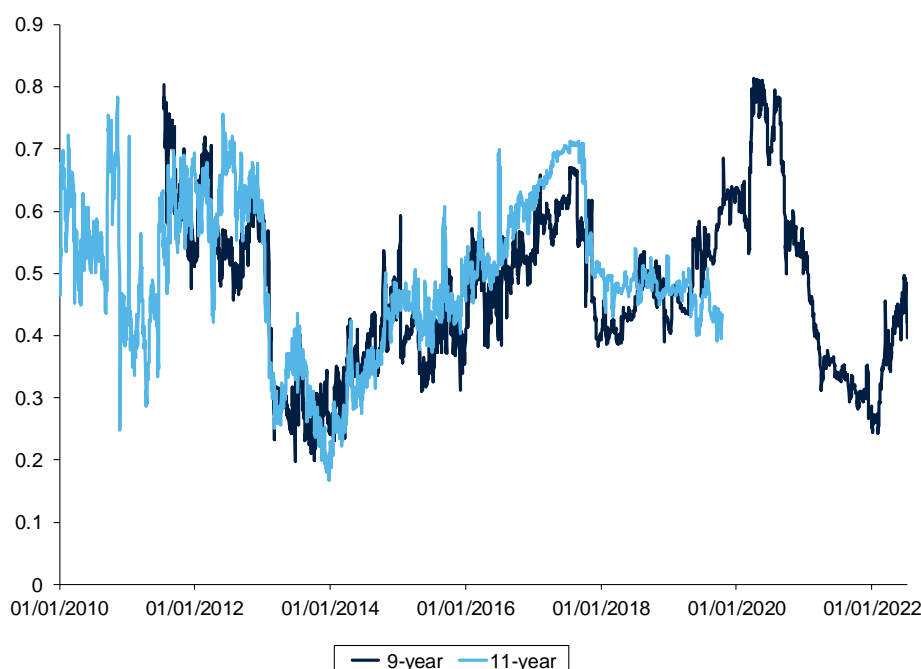
<sup>15</sup> Longstaff, F.A. (2002), ‘The flight-to-liquidity premium in US Treasury bond prices’, No. w9312, National Bureau of Economic Research.

<sup>16</sup> Due to data limitations, it is not possible to reconstruct times series of spreads for maturities longer than 11 years. For illustration, as of 1 January 2010, there were only six out of 41 outstanding REFCORP bond strips that had maturities of greater than or equal to 20 years. As of 19 October 2010, all outstanding REFCORP bond strips had maturities of less than 20 years.

<sup>17</sup> See Oxera (2020), ‘Review of the CMA PR19 provisional findings’, 26 October, p. 14; and Oxera (2020), ‘Are sovereign yields the risk-free rate for the CAPM?’, 20 May, p. 2.

---

**Figure 2.1 Evolution of yield spreads of nine-year and 11-year zero-coupon REFCORP bonds strips since 2010 (bp)**



Note: The yield spreads at a given point in time are calculated by averaging the daily spreads across all outstanding REFCORP bond strips that have maturities equal to the target maturities at that time (i.e. nine-year and 11-year). The spreads are calculated based on the USD US Treasury Bonds/Notes (FMC 82) Zero Coupon Yield curve, which has maturities available at yearly intervals between one year and ten years, and also at 15 years, 20 years and 30 years. The gaps between these maturities are linearly interpolated.

The nine-year spreads series are not available until 20 July 2011, as no REFCORP bond strips have maturities shorter than or equal to nine years before that date. The 11-year spreads series are not available after 17 October 2019, as no REFCORP bond strips have maturities longer than or equal to 11 years after that date. Due to data limitations, it is not possible to reconstruct time series of spreads for maturities longer than 11 years. For illustration, as of 1 January 2010, there are only six out of 34 outstanding REFCORP bond strips that have maturities of greater than or equal to 20 years. As of 19 October 2010, all outstanding REFCORP bond strips have maturities of less than 20 years.

Source: Oxera analysis using Bloomberg data.

### 2.1.3 Regulatory precedent

We note that some regulators and authorities have recognised the convenience premium and set the allowance above the yield on highly rated government bonds. Notably, in the PR19 redetermination, the CMA adopted an RFR between the ILGs and AAA corporate bonds, accounting for the convenience premium:<sup>18</sup>

**We note that evidence provided on both the presence of a convenience yield within ILG yields and on market RFRs with different borrowing and lending rates suggest that the appropriate RFR for our CAPM is likely to sit above the ILG yield. On this basis of this evidence, 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]**

<sup>18</sup> CMA (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.

Following the CMA precedent and advice from Oxera, ARERA (the Italian regulatory authority) set the RFR allowance for energy networks by including a convenience premium of 100bp above the yield on highly rated<sup>19</sup> EU government bonds.<sup>20</sup>

In addition, BNetzA (the German regulatory authority) issued its final determination for the fourth regulatory period for energy networks, where it recognised the need for a convenience premium and increased the cost of equity allowance.<sup>21</sup>

#### 2.1.4 Concluding remarks

Based on the collective evidence above, we consider that Ofgem erred in setting the RFR at the level of the yields on ILGs, and should have placed weight on other rates achieved by highly rated borrowers. An average of the inflation-adjusted yields on the UK 20-year ILG and the iBoxx £ Non-Gilt AAA 10+ and 10–15 indices would provide a pragmatic and simple approach to recognising the convenience yield in the estimate of the RFR.

### 2.2 RPI–CPIH wedge used to adjust ILGs RPI-real yields

In November 2020, the Chancellor announced that the UK Statistics Authority (UKSA) could introduce its RPI reforms unilaterally from 2030. These planned reforms will align the Retail Price Index (RPI) with the Consumer Price Index (CPI), including the Consumer Price Index for Housing (CPIH).<sup>22</sup>

Against this background, Ofgem is considering two methodologies for estimating the RPI–CPIH wedge in order to convert RPI-linked ILG yields into CPIH-real RFR estimates.<sup>23</sup>

- The first method is to estimate the wedge using the OBR’s fifth year ahead inflation forecast. This approach does not separately account for the RPI reform and results in an RPI–CPIH wedge of 0.7%.
- The second method is to estimate the wedge with reference to 20 years of inflation forecasts, where a 20-year geometric average forecast wedge is calculated by combining five years of OBR forecasts with assumptions for the following 15 years. Under this second method, Ofgem aims to capture the convergence between the RPI and CPIH series in the future. This results in an estimate of the RPI–CPIH wedge of 0.2–0.3% (0.12–0.3% annual estimates over the price control period or 0.2% on average, based on Ofgem’s WACC Allowance model).<sup>24</sup>

Ofgem relies on the first method to derive the RPI–CPIH wedge for the RIIO-ED2 DDs, which is set at 0.7%.

<sup>19</sup> ARERA uses a sample of European government bonds rated AAA and AA.

<sup>20</sup> ARERA (2021), ‘Delibera 23 dicembre 2021 614/2021/R/com – Allegato A’, Tabella 1.

<sup>21</sup> BNetzA (2021), ‘BK-4-21-055’, 12 October,

[https://www.bundesnetzagentur.de/DE/Beschlusskammern/1\\_GZ/BK4-GZ/2021/BK4-21-0055/BK4-21-0055\\_Beschluss\\_download\\_bf.pdf?\\_\\_blob=publicationFile&v=5](https://www.bundesnetzagentur.de/DE/Beschlusskammern/1_GZ/BK4-GZ/2021/BK4-21-0055/BK4-21-0055_Beschluss_download_bf.pdf?__blob=publicationFile&v=5) (last accessed 10 August 2022), section 2d, p. 38.

<sup>22</sup> UK Statistics Authority (2020), ‘Response to the joint consultation on reforming the methodology of the Retail Prices Index’, <https://uksa.statisticsauthority.gov.uk/news/response-to-the-joint-consultation-on-reforming-the-methodology-of-the-retail-prices-index/> (last accessed 10 August 2022).

<sup>23</sup> Ofgem (2022), ‘RIIO-ED2 Draft Determination – Finance Annex’, 29 July, para. 3.16.

<sup>24</sup> Ofgem (2022), ‘WACC Allowance Model for RIIO-ED2’, 29 June.

### 2.2.1 Ofgem's RPI–CPIH wedge based on the OBR's fifth year ahead forecast

Ofgem's first method is consistent with the approach it applies in the RIIO-GD2/T2 price controls. Ofgem's justification for this assumption was that it reflected the long-term inflation expectations, which is consistent with the maturity of the RFR.<sup>25</sup>

In line with SSMC and Sector Specific Methodology Decision (SSMD), we focus on **the longest horizon available** for our RIIO-2 proposals. [Emphasis added]

In line with Ofgem's intent to use the 'longest horizon available', we note that in its March 2022 publication, the OBR mentioned that its long-term wedge forecast was 100bp, which differs from the fifth year ahead forecast:<sup>26</sup>

Thereafter, we expect RPI inflation to rise a little as CPI inflation returns to target to reach around 2.7 per cent at the end of the forecast. This is slightly below the rate consistent with **our current estimate of the long-term wedge between CPI and RPI inflation of around 1 per cent** as the downward-sloping Bank Rate curve means we expect mortgage rates to fall slightly in the medium term. [Emphasis added]

Therefore, if Ofgem's intention is to use a long-term estimate without separately accounting for the expected RPI reform, it has underestimated the wedge by **30bp**.

The benefit of this approach is that by following it, Ofgem exercises caution until the RPI reform is confirmed and the expectation of the reform can be seen clearly in the market data, which at this stage is not the case, as discussed in the next section.

### 2.2.2 Ofgem's 20-year inflation forecast

Although Ofgem did not place weight on the second method to derive its point estimate, we note for completeness that this alternative methodology would rely on a strong assumption that the market would expect the RPI–CPIH wedge to be zero from 2030 with a 100% probability. This is unlikely to be the case given that there is still uncertainty about the reform and its timing.

Some pension funds have been granted a right for a judicial review of the RPI reform.<sup>27</sup> They challenge both the RPI reform itself and the Chancellor's decision not to compensate ILG holders for the difference between inflation indices, i.e. for the difference between the yield they could expect before the reform and the yield they can expect following the reform. If the challenge is successful and compensations are to be paid to ILG holders, ILG prices will increase, resulting in lower RPI-real ILG yields. This would consequently increase the breakeven RPI inflation, implied by the nominal gilt yields and ILG yields, leading to a wider RPI–CPIH wedge. It is also not possible to entirely rule out a scenario where the RPI reform gets delayed (or even revised) in light of the judicial review.

We have cross-checked Ofgem's estimate using zero-coupon RPI and CPI swaps. Although they could be argued to be distorted by inflation and/or liquidity risk premia, since zero-coupon CPI swaps and zero-coupon RPI

<sup>25</sup> Oxera (2020), 'Consultation - RIIO-2 Draft Determinations – Finance Annex', 9 July, para. 1.8.

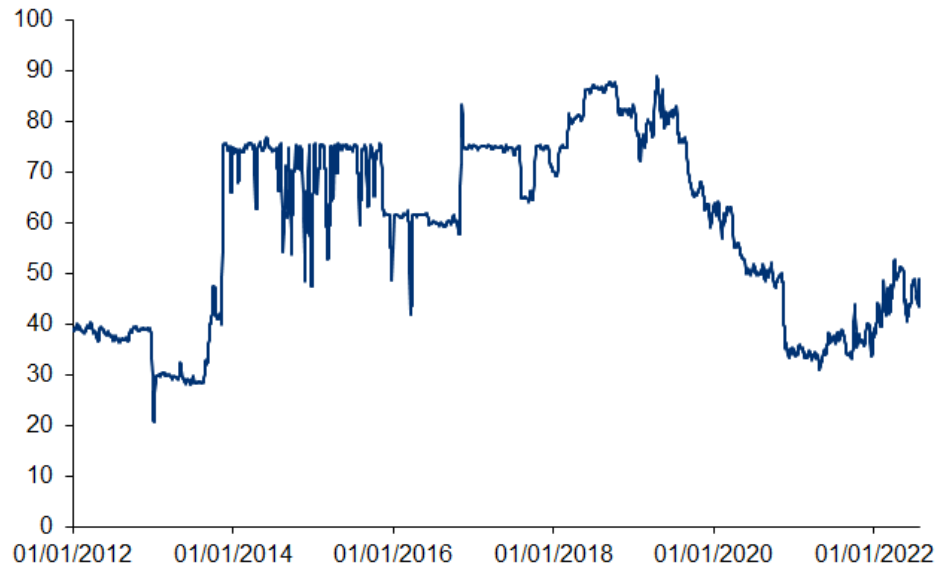
<sup>26</sup> OBR (2022), 'Economic and fiscal outlook', March, p. 40.

<sup>27</sup> UK High Court (2022), BT, M&S and Ford Pension Scheme Trustees against the UK Statistics Authority's ("UKSA"), Statement of Facts and Grounds, §3.

swaps are both affected by the premia, the levels of distortion should be reduced when the RPI–CPI wedge is estimated.

Figure 2.2 shows the RPI–CPI wedge, estimated based on zero-coupon RPI and CPI swaps. A six-month historical average as of July 2022, is 46bp.

**Figure 2.2 RPI–CPI wedge, based on 20-year zero-coupon RPI and CPI swaps (bp)**

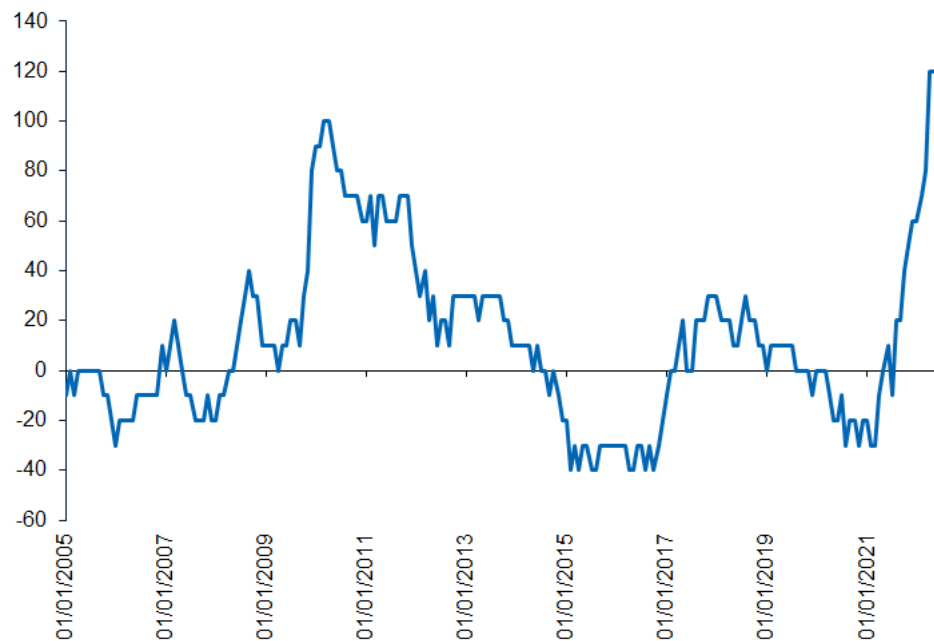


Note: Seven-day moving average.

Source: Oxera analysis using Bloomberg data.

In addition, the RPI–CPI wedge set out above needs to be adjusted for a CPI–CPIH wedge. Figure 2.3 shows the CPI–CPIH wedge, which is currently over 120bp and has already exceeded historical highs set in 2009.

**Figure 2.3 Historical CPI–CPIH wedge (bp)**



Source: Oxera analysis using data from the ONS.

The 20-year long-run average CPI–CPIH wedge from June 2002 to June 2022 is approximately 10bp. Adding this wedge to the 46bp RPI–CPI wedge implied by swap rates, we arrive at an estimate of the RPI–CPIH wedge of 56bp. This is set out in Table 2.1 below.

**Table 2.1 Oxera’s estimate of the RPI–CPIH wedge for 20-year gilts**

Component	Formula	Bp
Six-month average of the RPI–CPI wedge implied by 20-year RPI and CPI swap rates	[A]	46
20-year average CPI–CPIH wedge forecast	[B]	10
Oxera’s estimate of the RPI–CPIH wedge for 20-year gilts	[C] = [A]+[B]	56

Source: Oxera analysis.

The analysis shows the zero-coupon RPI and CPI swaps data and the historical CPI–CPIH wedge implies a higher RPI–CPIH wedge than that estimated by Ofgem in its second method.

## 2.3 Concluding remarks

In conclusion, Ofgem made an error in estimating the RFR for RIIO-ED2 because it only placed weight on ILG yields, notwithstanding the weight of evidence from academic, market and regulatory sources that gilt yields are likely to reflect a significant convenience yield. An average of the yields on the UK 20-year ILG and the iBoxx £ Non-Gilt AAA 10+ and 10–15 indices would provide a pragmatic and simple approach to recognising the convenience yield in the estimate of the RFR.

In relation to the RPI–CPIH wedge, we find that using either of its suggested methods, Ofgem underestimates the RPI–CPIH wedge.

- If Ofgem’s intention is to use the longest available forecast and not to account for the RPI reform separately, assuming there is significant uncertainty around the reform that has not yet been reflected in ILGs, it would be appropriate to use the OBR’s long-term forecast of 100bp, which is different from the OBR’s fifth year ahead forecast of 70bp as used by Ofgem.
- If Ofgem’s intention is to account for the RPI reform, assuming that the reform has been reflected in ILGs, then according to our analysis based on zero-coupon RPI and CPI swaps and the historical CPI–CPIH wedge, the wedge is 56bp. The evidence indicates that Ofgem has underestimated the wedge under this method by c. 36bp.

The balance of evidence suggests the wedge is likely to be closer to the values produced by the method already in use by Ofgem, suggesting no strong reason to depart from the first method. The benefit of this approach is that by following it, Ofgem exercises caution until the RPI reform is confirmed and the expectation of the reform can be seen clearly in the market data.

### 3 Errors in Ofgem's estimate of the total market return

The TMR is the expected return for an investor who invests in a diversified market portfolio. A 'diversified' market portfolio only bears general market risk, as all idiosyncratic risks of individual securities are diversified away. TMR is used as the baseline for determining the required return on equity for an individual company, as investors are compensated for risk relative to market risk only. Therefore, the higher the TMR, the higher the required return on equity would be for an investor in an individual company with a positive beta.

In the RIIO-ED2 DDs, Ofgem maintains the methodology and the TMR range (6.25–6.75% CPIH-real) stated in the Sector Specific Methodology Decision (SSMD) and the RIIO-GD2/T2 Determinations.<sup>28</sup> Ofgem's TMR estimates are derived by calculating the geometric average of the historical returns published by Dimson Marsh Staunton (DMS). To convert the TMR from nominal to CPIH-real, Ofgem deflates the historical returns series using the ONS CPI backcast. As a final step, Ofgem uplifts the CPIH-real geometric average TMR by 1–2% to account for the difference between the arithmetic and the geometric average. However, since Ofgem's TMR estimate was last used in its determinations, a new superior CPIH backcast has been published by the ONS.<sup>29</sup>

In a regulatory context, the regulated allowed rate of return determines annual cash flows. This is an important consideration because cash flows are not compounded over time in the regulatory model.

In the next subsections, we explain that the averaging methodology proposed by Ofgem fails to consider the non-compounding nature of the regulatory allowance and therefore should be considered an error. We also show that Ofgem made an error in not considering the most up-to-date and corrected measure of the CPIH backcast series, which led to an underestimation of the TMR.

#### 3.1 Ofgem relied on an outdated and incorrect measure of inflation

Historical data on market returns is expressed in nominal terms. However, the RIIO-2 price controls are set in real terms, meaning that the TMR is also required as a CPIH-real estimate.

As real returns are unobservable, nominal returns must be adjusted by the inflation rate. It is important to measure the appropriate inflation rate in order to accurately incentivise investors. The nominal TMR that we observe in a historical dataset is created by investors when deciding the price they are willing to pay for an asset given its expected cash flow. When considering an investment, investors take into account the expected cash flows and discount these in accordance with their required rate of return, as well as an adjustment for expected inflation. Therefore, for the purposes of calculating historical real returns to inform the estimate of future required returns, the best measure of inflation is the one that reflects investor expectations at the time of the investment.

In previous submissions, we have expressed our concerns with Ofgem's use of the ONS backcast CPI series as an input to estimating the real CoE allowance.

<sup>28</sup> Ofgem (2021), 'RIIO-ED2 Sector Specific Methodology Decision: Annex 3 Finance, 11 March. Ofgem (2021), 'RIIO-2 Final Determinations – Finance Annex (REVISED)', 3 February, para. A2.17

<sup>29</sup> Office for National Statistics (2022), 'Consumer price inflation, historical data, UK 1950 to 1988', 18 May, <https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceinflationhistoricaldatauk1950to1988> (last accessed 14 June 2022).

These concerns related to the robustness of the series—especially for the years 1950–1988 when errors were made—and the fact that the CPI and CPIH measures of inflation were not available to investors in the past and could therefore not have featured in their decision-making.

Since our last submission,<sup>30</sup> the ONS has published new historical series for the CPI and the CPIH for the period 1950–88.<sup>31</sup> We find that the new CPIH backcast series addresses the most concerning issues with the previous series and that it is therefore appropriate to be used to deflate historical returns.<sup>32</sup> For this reason, we consider it an error for Ofgem not to account for this new evidence when determining the allowed returns of energy networks for the RIIO-ED2 period.

We now present the impact of using the new CPIH backcast on the CPIH-real equity return over the period 1900–2021.<sup>33</sup>

Consistent with Ofgem’s methodology and our previous submissions, we use UK nominal returns data published by DMS to calculate the CPIH-real returns.<sup>34</sup> As shown in Table 3.1, the average CPIH-real equity return over this period is 0.24% higher than the original CPI-real equity return. Using the new (lower) inflation series published by the ONS leads to a higher estimated average real equity return over the period 1900–2021.

**Table 3.1 Impact of new inflation series on real-equity returns**

	Old CPI series	New CPI series	New CPIH series
<b>1900–2021 arithmetic average inflation</b>	3.98%	3.91%	3.74%
<i>Difference from old CPI series</i>		-0.07%	-0.24%
<b>1900–2021 arithmetic average real equity returns<sup>1</sup></b>	6.85–6.94%	6.91–7.01%	7.09–7.18%
<i>Difference from old CPI series</i>		0.07%	0.24%

Note: The update from the ONS affects only the data points between 1950 and 1988. To cover the pre-1950 period, we use Consumption Expenditure Deflator (CED) data published by the Bank of England in its Millennium database. However, we note that this is an imperfect method as the CED is theoretically and empirically a closer proxy for RPI than CPI. For details, see Oxera (2022), ‘Assessing the new ONS CPIH back-cast’, 15 July. <sup>1</sup> The range in real equity returns is driven by the range of potential values for the 2021 UK equity returns used by DMS. In particular, we have the yearly breakdown of the data used by DMS for the period 1900–2020, but not for 2021. We infer the estimates in the table from the 1900–2020 and 1900–2021 nominal average returns.

Source: Oxera analysis based on ONS and DMS data.

The long-term average of real equity returns is generally used to inform the TMR assumption. The analysis in Table 3.1 highlights that the range of CPIH-real TMR adopted by Ofgem was based on incorrect data, as it relied on

<sup>30</sup> Oxera (2021), ‘The cost of equity for RIIO-ED2’, 4 June.

<sup>31</sup> Office for National Statistics (2022), ‘Consumer price inflation, historical data, UK 1950 to 1988’, 18 May, <https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceinflationhistoricaldatauk1950to1988> (last accessed 14 June 2022).

<sup>32</sup> For details of our analysis, see Oxera (2022), ‘Assessing the new ONS CPIH back-cast’, 15 July.

<sup>33</sup> Our analysis is outlined in full in Oxera (2022), ‘Assessing the new ONS CPIH back-cast’, 15 July.

<sup>34</sup> We have the yearly breakdown of the data used by DMS for the period 1900–2020, but not for 2021. However, we know that the average UK equity return over the period 1900–2020 was 10.93%, and that over the period 1900–2021 this increased to 11.0%. From this, we can infer that the equity returns in the DMS dataset for 2021 must lie roughly between 13% and 25%. A cross-check using data from other sources suggests that the 2021 equity return was near the middle of this range.



analysis that converted nominal returns into CPI-real returns using the old backcast.

A study by the UK Regulators Network (UKRN) published in 2018 was one of the main sources used by Ofgem to inform its CPIH-real TMR range.<sup>35</sup> In the UKRN study, the authors referred to a previous study which proposed a long-run return on market equity of 5.5% (geometric average), with a range of 6.5–7.5% for the arithmetic average. The authors compared this to the geometric average of UK equity market returns between 1899 and 2016, deflated by the old CPI backcast series, which amounted to 5.23%, as well as international evidence, with returns just above 5%. They also commented that the adjustment to convert from geometric to arithmetic returns seemed high. On this basis, principally due to employing a smaller (but undefined) adjustment to convert from geometric to arithmetic returns, they proposed a revised range of 6–7% for the CPI-real TMR.<sup>36</sup>

Ofgem used this study to inform its range of CPIH-real TMR of 6.25–6.75%.<sup>37</sup> Given that the new ONS data suggests that CPIH inflation was 0.24% lower than the old estimates of CPI inflation over the period 1900–2021, the CPIH-real TMR should be corrected upwards by c. 0.25% (i.e. Ofgem's own estimated CPIH-real TMR range should be corrected to 6.50–7.00% with a mid-point of 6.75%).

### 3.2 Ofgem applied the wrong averaging formula

Ofgem estimates the TMR by calculating the geometric average of returns and applying a subjective uplift to account for the difference between the arithmetic average of returns and the geometric average. Its methodology is based on the UKRN cost of capital report. The following text summarises the position on averaging adopted from that report:<sup>38</sup>

This issue was also discussed at some length in both MMW and in Smithers and Wright (2013). In that discussion we concluded, again, that rather than calculate arithmetic averages directly (which can generate spurious differences, especially when returns are affected by exchange rate fluctuations), it is more appropriate to work from geometric (compound) average returns and add an adjustment of 1 to 2 percentage points, depending on the extent to which regulators wish to take account of serial correlation of returns.

[...]we suggest a modest downward adjustment of the original range proposed by MMW, to a range of 6-7%, primarily reflecting a smaller adjustment from geometric to arithmetic returns.<sup>39</sup>

The issues with serial correlation and the correct methodology to average historical returns have been raised previously, and were explored at length in the CMA PR19 and RIIO-GD2/T2 appeals.

In the PR19 redetermination, the CMA stated:<sup>40</sup>

**in the absence of clear modelling of the regulator's decision, the most appropriate estimate to use is the arithmetic mean.** The consequence of that would be to give no weight to the other estimators, either JKM and Blume which are lower, or Cooper, which is higher.

<sup>35</sup> See Ofgem (2019), 'RIIO-2 Sector Specific Methodology Decision – Finance', 24 May, para. 3.50.

<sup>36</sup> UKRN (2018), 'Estimating the cost of capital for implementation of price controls by UK Regulators', March, Appendix E.

<sup>37</sup> See Ofgem (2021), 'RIIO-2 Final Determinations—Finance Annex (REVISED)', 3 February, para. 3.86.

<sup>38</sup> UKRN (2018), 'Estimating the cost of capital for implementation of price controls by UK Regulators'.

<sup>39</sup> UKRN (2018), 'Estimating the cost of capital for implementation of price controls by UK Regulators'.

<sup>40</sup> CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final report', 17 March, para. 9.329.

We reasoned that there were two potential approaches that we could adopt in relation to parameter uncertainty when estimating the TMR:

- We could assume away parameter uncertainty and just use the arithmetic mean; or
- We could consider the full range of estimators, including those put forward by JKM, Blume and Cooper in deriving a TMR range.

**On balance, we consider that using the arithmetic mean is preferable due to its simplicity and transparency**, and also given that at the current time, there is no reason to conclude that one perspective, either that of the capital budgeter or of the portfolio investor, is 'correct'. [Emphasis added]

In the RIIO-GD2/T2 appeals, the CMA stated that:<sup>41</sup>

[the CMA finds] the uplift GEMA had applied to its geometric return to be consistent with the limited evidence on serial correlation in UK returns. The appellants have not provided convincing evidence to suggest that GEMA's uplift was incorrect. Therefore, we do not find that GEMA had made an error in its approach to averaging historical returns.

In the RIIO-ED2 DDs, Ofgem refers back to the CMA to say that Ofgem's preferred methodology is not wrong.

We now turn to the explanation of why Ofgem's reliance on one set of data without giving weight to more sources of evidence that have been presented should be considered an error and why its uplift should also be considered an error, absent robust evidence on the presence of serial correlation.

It is important to note that the authors of the UKRN study and Ofgem have not presented evidence of serial correlation in the equity returns series. In fact, the evidence suggests that there is no such correlation. To demonstrate this, we first run a regression on the lagged returns:

$$R_t = \beta * R_{t-1} + c + \varepsilon$$

where  $R_t$  is the annual (nominal or CPIH-real)<sup>42</sup> market return at year  $t$ ;

$R_{t-1}$  is the market return at year  $t - 1$ ;

$\beta$  is the coefficient estimated by the regression;

$c$  is the intercept of the regression;

$\varepsilon$  is the error term.

If returns are serially correlated, the  $\beta$  coefficient would be statistically different from zero. That is, the beta estimate would be different from zero and the p-value would be below 0.05 (if tested at the 10% significance level). The results of the regressions are summarised in Table 3.2 below.

<sup>41</sup> CMA (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', 28 October, para. 5.271.

<sup>42</sup> Estimated using a new ONS CPIH backcast.

**Table 3.2 Summary table of the regression of the nominal and CPIH-real equity returns over the lagged equity returns**

	$\beta$ coefficient	P-value	Significant
<b>Nominal returns</b>	-0.089	0.3263	No
<b>CPIH-real returns</b>	-0.034	0.7133	No

Note: The significance test is performed at a 10% significance level. The rejection of the significance of the beta estimate at 10% leads to an automatic rejection of significance at both 5% and 1% levels. The analysis is performed at the 1900–2021 returns data. The real equity returns is estimated using the 2021 UK nominal equity returns published by DMS, which yields a real return between 13% and 25%. We used a 21% real return in 2021 in this regression. Using a 13% real return leads to the same conclusions with a p-value of 0.6046.

Source: Oxera analysis based on Bloomberg data.

The statistical test shows that the  $\beta$  coefficient is not statistically different from zero and that equity market returns are not serially correlated.

As a second step, we test for serial correlation in the residuals of the model using the Ljung–Box test.<sup>43</sup> The results are summarised in Table 3.3.

**Table 3.3 Ljung–Box test residual test results**

	$H_0$ hypothesis	P-value	Significant
<b>Nominal returns</b>	The residuals are independently distributed	0.2954	No
<b>CPIH-real returns</b>	The residuals are independently distributed	0.3635	No

Note: The significance test is performed at a 10% significance level.

Source: Oxera analysis based on Bloomberg data.

The results of the Ljung–Box test show that the null hypothesis cannot be rejected—i.e. that the series presents no serial correlation.

The lack of statistical evidence on serial correlation of market returns was also explained in the submission by Professor Stephen Schaefer to the CMA for the NATS (2020) price control redetermination: the observed relationship between the arithmetic and geometric averages suggests that serial correlation is itself insignificant, or that the impact of serial correlation on the relationship between arithmetic and geometric average returns is insignificant. Professor Schaefer states that:<sup>44</sup>

the difference between the arithmetic and geometric mean return is given by one half of the variance. Bound up in the assumption of normality are further assumptions that both the expected return and the variance of returns are constant over time and that returns are not serially correlated.

We further note that even if serial correlation were to have a material impact on returns over holding periods of longer than one year, this could in theory be addressed by averaging returns over ten- and 20-year holding periods, using non-overlapping returns. In practice, this creates a trade-off with the precision of the estimate as the longer holding periods reduce the number of holding periods that enter the averaging calculation. We consider that Ofgem's proposed methodology is not correct because it is not substantiated by empirical evidence and it does not take into consideration the regulatory framework of setting allowed returns—that is, when setting allowed regulatory

<sup>43</sup> Ljung, G.M. and Box, G.E.P. (1978), 'On a Measure of a Lack of Fit in Time Series Models'. *Biometrika*. **65**:2, pp. 297–303.

<sup>44</sup> Schaefer, S. (2020), 'Using Average Historical Rates of Return to set Discount Rates', Appendix, contained within Oxera (2020), 'Deriving unbiased discount rates from historical returns', 14 February.

returns the regulator is setting a stream of annual cash flows (rather than cash flows that are compounded over time as a geometric averaging methodology would require). Correcting for Ofgem's errors on inflation and averaging, the real-CPIH TMR estimate would be between **7.1% and 7.2%** based on the arithmetic average of the historical yearly returns (see the last column in Table 3.1).<sup>45</sup>

---

<sup>45</sup> The range in real equity returns is driven by the range of potential values for the 2021 UK equity returns used by DMS. In particular, we have the yearly breakdown of the data used by DMS for the period 1900–2020, but not for 2021. We infer the estimates from the 1900–2020 and 1900–2021 nominal average returns.

---

## 4 Errors in Ofgem's estimate of the asset beta

In the CAPM, the equity beta measures the risk of an equity investment relative to the diversified market portfolio. The CAPM is a one-factor model which assumes that risk is measured by the standardised covariance of an asset's returns with the returns of the market as a whole.

The equity beta is affected by the level of gearing. As a result, the equity beta captures both financial risk (which depends on the company's capital structure) and business risk. The calculation of an asset beta removes the financial risk component embedded in the equity beta. The accurate calculation of an asset beta also requires an accurate estimate of the debt beta. Since the asset beta represents the hypothetical systematic risk of the firm with zero debt, the asset beta is independent of the choice of capital structure. It is therefore a more relevant measure for assessing business risk and comparing it across companies.

When assessing the asset beta of an industry, a sample of companies present in that sector should be used. Ideally, the sample would be formed by 'pure-play' comparators—i.e. companies that operate exclusively in the sector of interest. However, if there are few pure-play comparators in the sector in question, the sample of comparators may need to be widened to include companies that have a significant part of their operations in the industry of interest.

In the RIIO-ED2 DDs, Ofgem retains its beta estimate at the level of the RIIO-GD2/T2 Final Determinations, commenting that it sees no reason to deviate from a level that the CMA has not found to be wrong. In setting its beta, Ofgem relies on a comparator sample with one energy network company (National Grid) and three water companies (Pennon, Severn Trent and United Utilities). Ofgem argues that the estimated beta is aligned with National Grid's ten-year beta and 'all of the data with a 70 per cent weight on the pool of National Grid betas and 30 per cent weight on the pool of water betas'.<sup>46</sup>

In the next sub-sections, we explain why Ofgem has erred in selecting its sample of comparators by giving too much weight to some comparators, and not enough (or no) weight to others that should have been included in the sample to reflect the systematic risk of GB energy networks more accurately.

### 4.1 Sample of comparators: Ofgem is disproportionately reliant on water companies to estimate the beta of energy networks

We recognise that a certain degree of judgement is required when estimating the betas, e.g. in selecting comparators, estimation windows and averages. However, we present evidence demonstrating that Ofgem has erred by placing too much weight on a sample of comparators that is not representative of the risk associated with energy networks.

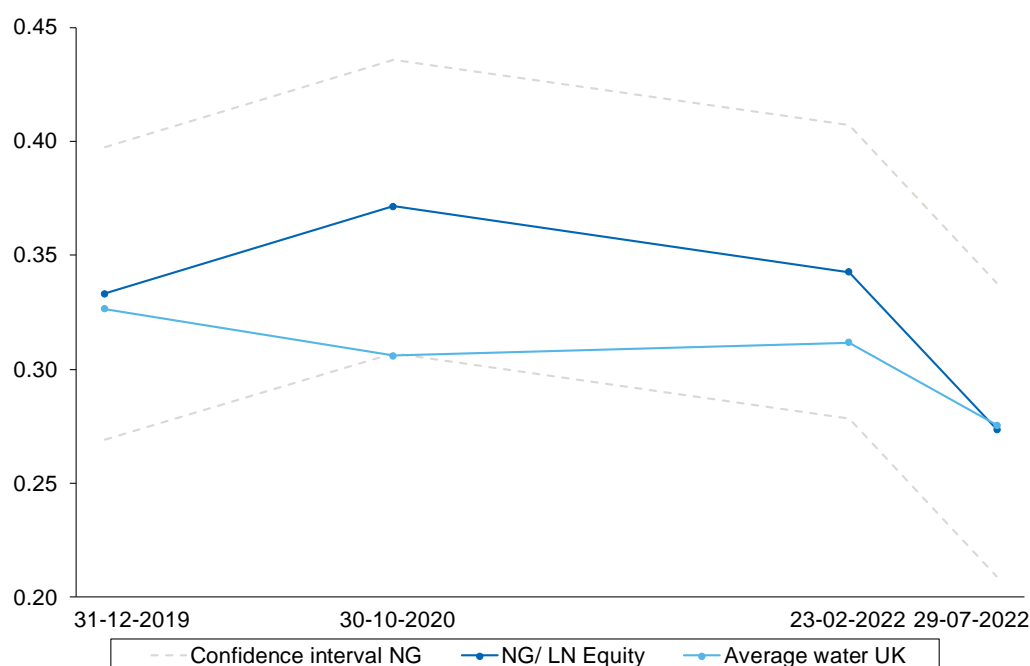
It is important to note that the risks associated with the regulatory regime of the water sector in the UK differ from those affecting energy networks, notwithstanding that there are similarities in the models of economic regulation and regimes for the two sectors. One important difference is that in the water sector, there is a process for redeterminations (by the CMA) rather than an appellate regime. The experience of the PR19 redetermination relative to the

<sup>46</sup> CMA (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', 28 October, para. 5.338.

RIIO-GD2/T2 appeals suggests that there is more regulatory discretion (due to the margin of appreciation that is accorded by the CMA to the regulator) in the exercise of the appellate regime in energy. Higher regulatory discretion tends to imply higher risk to energy networks.

Figure 4.1 to Figure 4.3 below show the two-, five- and ten-year asset betas of National Grid and the simple average of the betas for the sample of UK water companies (Severn Trent, Pennon, and United Utilities) respectively. They also show the confidence interval (of one standard deviation) around National Grid's beta estimation.

**Figure 4.1 National Grid's two-year beta compared to the average beta of UK water companies—different cut-off dates**

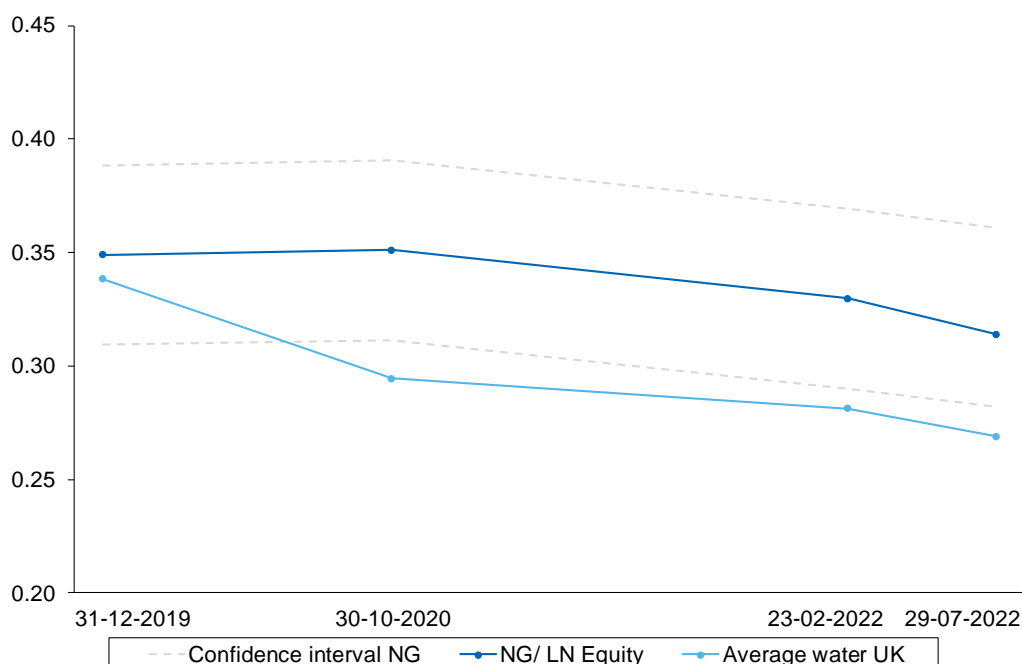


Note: UK water companies include Severn Trent, Pennon, and United Utilities. UK company equity betas are estimated relative to the FTSE All-Share index, using daily data. A debt beta of 0.05 is assumed. A confidence interval of one standard deviation is used. The standard deviation is estimated based on data from 1 January 2007.

We present estimates for four dates: 31 December 2019, which is a pre-COVID-19 date used in previous Oxera analysis; 30 October 2020, which is approximately the date that Ofgem relied on for its RIIO-GD2/T2 Final Determinations; 23 February 2022, which is the date before the Ukraine war; and 29 July 2022 as the most recent cut-off date.

Source: Oxera analysis based on Bloomberg data.

**Figure 4.2 National Grid's five-year beta compared to the average beta of UK water companies—different cut-off dates**

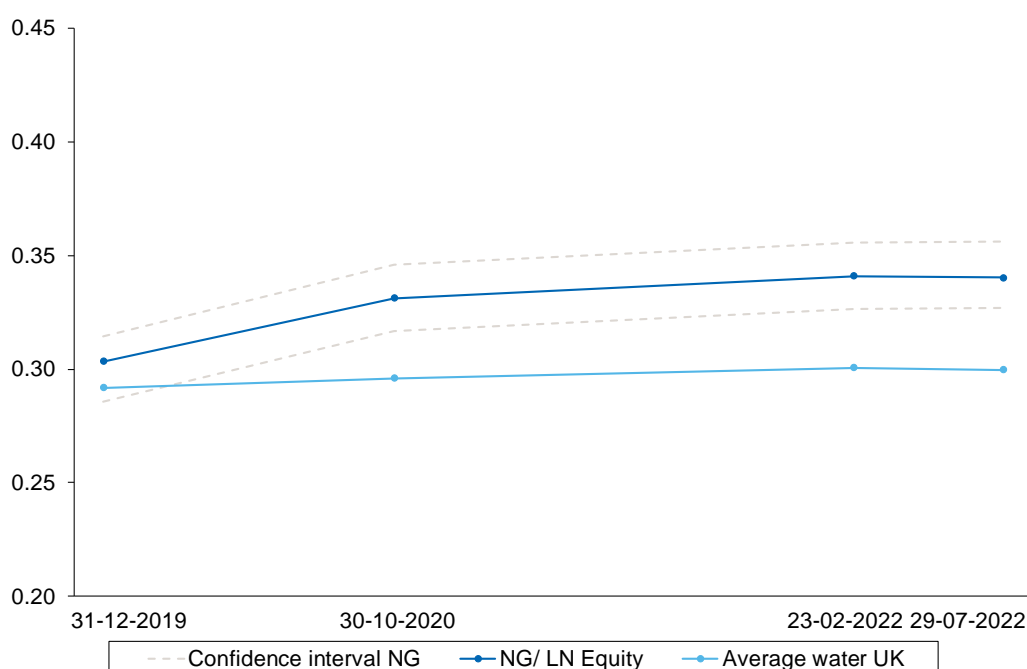


Note: UK water companies include Severn Trent, Pennon, and United Utilities. UK company equity betas are estimated relative to the FTSE All-Share index, using daily data. A debt beta of 0.05 is assumed. A confidence interval of one standard deviation is used. The standard deviation is estimated based on data from 1 January 2010.

We present estimates for four dates: 31 December 2019, which is a pre-COVID-19 date used in previous Oxera analysis; 30 October 2020, which is approximately the date that Ofgem relied on for its RIIO-GD2/T2 Final Determinations; 23 February 2022, which is the date before the Ukraine war; and 29 July 2022 as the most recent cut-off date.

Source: Oxera analysis based on Bloomberg data.

**Figure 4.3 National Grid's ten-year beta compared to the average beta of UK water companies—different cut-off dates**



Note: UK water companies include Severn Trent, Pennon, and United Utilities. UK company equity betas are estimated relative to the FTSE All-Share index, using daily data. A debt beta of 0.05 is assumed. A confidence interval of one standard deviation is used. The standard deviation is estimated based on data from 1 January 2015.

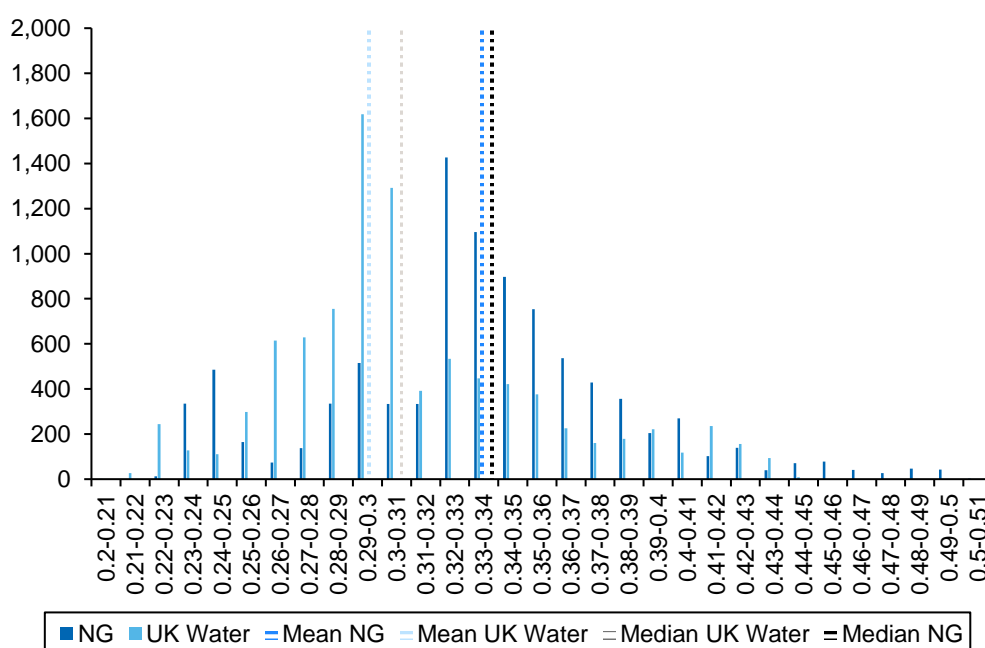
We present estimates for four dates: 31 December 2019, which is a pre-COVID-19 date used in previous Oxera analysis; 30 October 2020, which is approximately the date that Ofgem relied on for its RIIO-GD2/T2 Final Determinations; 23 February 2022, which is the date before the Ukraine war; and 29 July 2022 as the most recent cut-off date.

Source: Oxera analysis based on Bloomberg data.

The analysis shows that National Grid's asset beta has been consistently higher than the average asset beta of the water comparators. We note also that the asset beta of the average of the water companies has, in some of the regressions (e.g. see Figure 4.2 for five-year betas and Figure 4.3 for ten-year betas), fallen below the lower bound of the confidence interval for the NG beta estimate. This is supportive of a difference in the systematic risk of the UK listed water companies and National Grid.

Figure 4.4 presents the distribution of the betas of National Grid and the sample of UK water companies.

**Figure 4.4** Distribution of the asset betas of National Grid and the UK water companies (two-, five- and ten-year spot betas)



Source: Oxera analysis based on Bloomberg data.

We observe that the distribution of the asset beta of water companies also presents a mean and a median below the distribution of National Grid betas, with a 0.02 and 0.03 difference in betas. The differences between the two series is confirmed at a 99% confidence level by a t-test, as presented below.



**Table 4.1 T-test of the differences between the means and medians of the National Grid and UK Water betas (two-, five- and ten-year spot)**

	Difference	Standard deviation	t stat	P-value	Significant
<b>Test of the means</b>	0.023	0.00071	32.51	0.00	Yes
<b>Test of the medians</b>	0.031	0.00071	43.95	0.00	Yes

Note: The significance test is performed at a 99% confidence level, i.e. using 2.58 as the critical value.

Source: Oxera analysis based on Bloomberg data.

The decision to give significant weight to the sample of water betas tends to anchor the allowed asset beta for energy networks to the low end of the distribution of National Grid's asset beta. We recognise that there are good reasons for not relying on the beta of National Grid as the sole source of data on betas for UK energy networks. However, Ofgem's choice to place significant weight on the betas of the water companies—notwithstanding differences in the risks associated with the two sectors—while disregarding other potential comparators, such as European energy networks, is not robust.

In the next subsection, we explain the merits of also considering a sample of regulated European energy networks. Indeed, we show that their underlying business risk is closely aligned to that of the UK energy networks.

#### **4.2 Sample of comparators: Ofgem fails to consider a broader set of evidence and to include European energy comparators in its sample**

In previous submissions,<sup>47</sup> we used four listed European energy network comparators in our sample: Enagás, Red Eléctrica, Snam, and Terna. This sample was the result of a filtering process that excluded companies based on a range of factors, such as percentage of regulated activities, data availability and liquidity.

Since our last submission, we have undertaken an assessment of the risk exposure of the UK energy network companies relative to regulated European energy networks.<sup>48</sup> This assessment constitutes new evidence not previously presented to Ofgem or the CMA. We summarise our study below and demonstrate the similarities in the regulatory risk exposure of the European networks relative to the UK energy networks and differences between UK water and energy networks. This contextualises why it is an error to give weight, in the exercise of regulatory judgement, to UK water beta comparators (notwithstanding their difference from UK energy) while giving no weight to European energy beta comparators (notwithstanding their similarity to UK energy).

To identify an appropriate comparator set for the RIIO-2 beta estimates, we structured our assessment in three steps.

- Step 1: companies are filtered by sector, geography and liquidity factors.

<sup>47</sup> Oxera (2021), 'The cost of equity for RIIO-ED2', 4 June, Table 5.4.

<sup>48</sup> Oxera (2022), 'Assessing the risks of GB energy networks', 22 March.

- Step 2: the appropriateness of the initial sample is assessed by comparing the systematic risks of the regulatory regimes under which the companies in this initial sample operate.
- Step 3: the assessment is then cross-checked using the cost of traded debt (data on the traded yield spreads) of the companies in the sample as a measure of relative risk.

At step 1, i.e. following the sector, geography and liquidity filtering, we identified a sample of ten European energy networks, as shown in Table 4.2 below. Elia and REN are the least liquid of the ten companies, which implies that their market betas are likely to be underestimated and may require upwards adjustment to reflect their risks appropriately. Indeed, as described by Cloete, Jongh and de Wet (2001) and Bradfield (2003), OLS beta estimations on thinly traded stocks (i.e. illiquid stocks) suffer from significant bias problems. This is because there is a mismatch between the recorded price on the market and the recorded price of the stock, and this mismatch affects the covariance between the market and the stock, leading to a downwards estimate of the covariance and therefore the beta.<sup>49</sup>

**Table 4.2**      **Comparator sample after sector, geography and liquidity filtering**

Elia Group <sup>1</sup> (energy, Belgium and Germany)	REN <sup>1</sup> (energy, Portugal)
Enagás (energy, Spain)	Severn Trent (water, the UK)
Italgas (energy, Italy)	Snam (energy, Italy)
National Grid (energy, the UK)	Terna (energy, Italy)
Red Eléctrica (energy, Spain)	United Utilities (water, the UK)

Note: <sup>1</sup> Elia and REN are the least liquid of the companies, which implies that their market betas are likely to be underestimated and may require upwards adjustment to reflect their risks appropriately. However, they have been left in the sample at this stage, to be conservative.

Source: Oxera analysis.

In the case of regulated networks, the regulatory regime is a key driver of systematic risk exposure. While regulation may, to some extent, mitigate underlying business risks (e.g. by making profits less sensitive to the short-term upside and downside deviations in demand), the degree to which these risks are mitigated may vary across different regimes. Furthermore, the risk of changes in regulatory approach is a factor to which regulated utility companies are exposed to varying degrees. Given that Ofgem was particularly concerned about the differences in regulatory regimes of various networks proposed for the comparator sample and that this area is relatively under-researched, our assessment focused on comparing the systematic risk associated with companies' regulatory frameworks with RIIO-2.

The results of our assessment are summarised in Table 4.3 below.

<sup>49</sup> Cloete, G., Jongh, P. and de Wet, T. (2001), 'Combining vasicek and robust estimator for forecasting systematic risk', *Investment Analysts Journal*, **55**, pp. 37–44. Bradfield, D.J. (2003), 'Investment basics XLVI. On estimating the beta coefficient', *Investment Analysts Journal*, **57**, pp. 47–53.

**Table 4.3 Summary of the regulatory regimes risk assessment**

Company	Regime <sup>1</sup>	Risk compared to RIIO-2	Comment
<b>National Grid</b>	UK energy	n/a	n/a
<b>REN</b>	Portugal (focused on ET)	Lower	Regulator's consistency over time in applied methodologies and parameters; lower-powered cost-efficiency incentives
<b>Italgas</b>	Italy, GD	Similar (towards lower risk)	Framework similar to UK energy with lower-powered CAPEX incentives
<b>Snam</b>	Italy, GT	Similar (towards lower risk)	
<b>Terna</b>	Italy, ET	Similar (towards lower risk)	
<b>Enagás</b>	Spain, GT	Similar (towards higher risk)	Framework similar to UK energy, with slightly higher risk for GT due to CAPEX incentives being associated with greater regulatory discretion
<b>Red Eléctrica</b>	Spain, ET	Similar	
<b>Elia</b>	Belgium, ET and Germany, ET	Lower	High degree of regulatory consistency over time in applied methodologies and lower risk on financing costs in both regulatory regimes
<b>UK water comparators</b>			
<b>United Utilities</b>	UK water	Lower	Lower regulatory discretion due to the redetermination process, albeit with similarities to GB energy in how the individual elements of the regime operate
<b>Severn Trent</b>	UK water	Lower	

Note: ET, electricity transmission; GD, gas distribution; GT, gas transmission. <sup>1</sup> Covering the majority of business activities.

Source: Oxera analysis.

We found that the regulatory regimes under which Elia and REN operated were associated with lower risk than RIIO-2. We gave more weight to factors that characterise the regulatory process overall (e.g. the appeals regime) rather than factors that characterise individual elements of the framework (e.g. incentive rates).

The Italian and Spanish regulatory regimes had broadly similar risks to RIIO-2, although:

- the regulatory framework of the Italian networks is slightly lower risk due to lower-powered CAPEX incentives;
- the regulatory framework of the Spanish gas transmission networks is slightly higher risk due to CAPEX incentives being associated with greater regulatory discretion.

For completeness, we also cross-checked the conclusion of section 4.2 that Ofgem has erred in its reliance on UK water networks as the only comparators to UK energy. As summarised in the table above, we assessed that the risks associated with the regulatory regime of the water sector in England and Wales were lower than those of the GB energy networks, notwithstanding that there are similarities in the models of economic regulation and regimes for the two sectors. One important difference is that in the water sector, there is a

process for redeterminations (by the CMA) rather than an appellate regime. The experience of the PR19 redetermination relative to the RIIO-GD2/T2 appeals suggests that there has been more regulatory discretion and thereby regulatory risk to networks in energy appeals, due to the margin of appreciation that is accorded by the CMA to the regulator.

As a final step, the results were cross-checked against data on traded debt yield spreads for the utility networks in the initial comparator sample. Wider yield spreads, when controlling for differences in gearing and maturity, indicate a higher asset risk premium and therefore higher asset risk. As such, traded debt yield spreads can be used as a cross-check on the information contained in market asset betas and on the qualitative assessment of risks.

We observed that the yield spreads for REN and Elia, when controlling for gearing and maturity, are narrower than those of the rest of the European networks, suggesting a lower asset risk, as explained above. We observed the same pattern in the market asset betas of these companies and our qualitative assessment—their asset betas and the risks of their regulatory frameworks were lower than those of other European comparator networks. Therefore, overall, our cross-check supports the exclusion of REN and Elia.

We also observed that National Grid Electricity Transmission, despite having lower gearing, had yield spreads that were similar to, or wider than, those of Severn Trent and United Utilities (i.e. UK water networks). This implies that NGET had higher credit risk (when controlling for differences in gearing and maturity) and was likely to have higher asset risk than the water networks. This observation is consistent with our assessment of the regulatory regime for UK water networks being associated with lower risk than RIIO-2.

As a result, we identified six networks that could be considered as having systematic risks comparable to those of the UK energy networks: Enagás, Italgas, National Grid, Red Eléctrica, Snam, and Terna.<sup>50</sup> We found the regulatory frameworks of these networks to be sufficiently comparable to RIIO-2.

Therefore, on the basis of the empirical evidence and the review of regulatory regimes, we consider that Ofgem has erred in placing weight on the sample of water companies and no weight on the sample of European energy networks companies.

---

<sup>50</sup> The primary reason that Italgas was not in the sample in our previous submissions is that it did not have sufficiently long traded data history for us to estimate five-year betas.

## 5 Cost of equity cross-checks

This section considers the cross-checks to the CAPM-implied CoE presented by Ofgem. The use of cross-checks to adjust the CAPM-implied CoE was discussed at length during the RIIO-GD2/T2 consultations and appeals.

In the RIIO-ED2 DDs, Ofgem presented the same set of cross-checks as the SSMD and RIIO-GD2/T2 decisions. We have explained the issues with Ofgem's set of cross-checks in our RIIO-2 CoE report.<sup>51</sup> In this report, we therefore do not cite the methodological and empirical issues in relation to the following cross-checks: Modigliani–Miller, infrastructure fund discount rates, OFTO returns, or investment managers' forecasts. Instead, we focus on new evidence in relation to the MARs cross-check (section 5.1) and the asset risk premium–debt risk premium (ARP–DRP) framework (section 5.2). In brief, the error in Ofgem's methodology and application of the cross-checks is that it gives weight to a set of cross-checks where there is a weak conceptual underpinning and/or limitations in the evidence base, while failing to give weight to the ARP–DRP framework cross-check, which has robust economic underpinnings and a large dataset of regulatory and market evidence to apply the framework.

### 5.1 MARs

Ofgem explains that it observes companies being traded at a premium to the regulatory asset value (RAV) and suggests that the premium must be driven by a combination of two factors: the expected outperformance and the deviation of the required return on equity from the return on equity allowance.<sup>52</sup> In our previous assessments,<sup>53</sup> we identified a number of factors that can explain an observed level of MARs above 1x without assuming that the investors' required CoE is below the regulatory allowed CAPM-based estimate. These include the company-specific outperformance, the value of non-regulated business activities, the winner's curse, the control premium, and other factors.

While in the RIIO-GD2/T2 appeals, the CMA has not agreed with the appellants that 'little to no inference could be taken from MAR premiums', we consider that insufficient attention has been paid to the topic of the terminal value or exit multiple, which we have assessed in a separate report on behalf of the ENA.<sup>54</sup> This assessment constitutes new evidence not previously presented to Ofgem or the CMA.

In summary, as long as investors have sticky expectations and believe that MARs will stay approximately at the current level (i.e. above 1x), they can assume a terminal value of above 1x MAR. A terminal value of above 1x explains a significant proportion of the premium paid above RAV at investment and reduces the weight that Ofgem should put on the potential outperformance or the difference between required and allowed return on equity as the explanation of the premium to MAR.

To test this hypothesis, we assessed the sensitivity of MARs to regulatory determinations and recent outperformance using MARs estimated with reference to the equity data for the UK pure-play regulated networks (i.e. water networks United Utilities and Severn Trent), as well as energy and water

<sup>51</sup> Oxera (2020), 'Cost of Equity for RIIO-2 – prepared for the Energy Networks Association', June, Appendix 2.

<sup>52</sup> Ofgem (2021), 'Decision - RIIO-2 Final Determinations – Finance Annex (REVISED)', 3 February, 3.119.

<sup>53</sup> Oxera (2021), 'National Grid's acquisition of WPD from PPL and the simultaneous sale of NECO to PPL', 10 May. Oxera (2020), 'What explains the equity market valuations of listed water companies?', 20 May.

<sup>54</sup> Oxera (2022), 'Market-to-asset ratios as a cost of equity cross-check', August.

transactions data. We used the headroom between the allowed RFR and ILGs and the headroom between the allowed CoE and ILGs as a proxy for whether the CoE allowance is set at a challenging level. To measure performance, we use return on regulated equity (RoRE).

While Ofgem's cross-check assumes a causal link between returns and MARs, our assessment shows no clear link between them. Instead, we find investors' expectations to be sticky, i.e. fluctuating within and around the same range of MARs over an extended period of time.

These findings show that the MARs evidence should not be used to inform Ofgem on whether the level of the COE allowance is set too high or too low. Therefore, Ofgem has made an error in interpreting the MARs evidence by putting too much weight on the two factors that, in its opinion, explain MARs being above 1x—i.e. the expected outperformance and the deviation of the required return on equity from the return on equity allowance.

## 5.2 Asset risk premium and debt risk premium (ARP–DRP)

In March 2019, Oxera submitted evidence to Ofgem on how the regulator's proposed allowance on the CoE compared with the pricing of risk for these companies in the debt markets (the first Oxera ARP–DRP report).<sup>55</sup> We explained that the ARP–DRP differential can be used as a cross-check on the appropriate level of the allowed CoE. In September 2020, Oxera submitted to Ofgem an updated ARP–DRP report (the second Oxera ARP–DRP report),<sup>56</sup> and in 2021 we presented new evidence to the CMA in the RIIO-GD2/T2 appeals.

Based on the methodology explained in our previous submissions, we set out further evidence on the ARP–DRP implied by Ofgem's RIIO-ED2 Draft Determination and compare it to the ARP–DRP differential implied by the RIIO-ED1 Final Determinations. Some methodological aspects are described below.

We estimate the ARP and the DRP with reference to market data on the RFR and yields to maturity on corporate bonds on the publication date of the regulatory determination, ensuring that the premium is aligned with the market expectation at the time.

- We do not use a regulatory debt allowance to estimate the DRP to ensure the assessment of the CoE allowance is not distorted by embedded debt and is comparable across regulatory determinations. Instead, we rely on the yields on corporate bonds, using iBoxx £ non-financials A and BBB 10+ as a proxy, adjusting them for the expected loss and the RFR.
- We estimate the RFR with reference to gilt yields plus a convenience premium. This allows the RFR to be estimated under a methodology that is consistent over time.
- We estimate the ERP based on the regulatory allowed TMR and our estimate of the RFR. This allows the ERP to be estimated under a methodology that is consistent over time.
- We undertake the calculations in nominal terms because converting the nominal yields on corporate bonds would require an additional inflation assumption.

<sup>55</sup> Oxera (2019), 'Risk premium on assets relative to debt', 25 March.

<sup>56</sup> Oxera (2020), 'Asset risk premium relative to debt risk premium', 4 September.

- We convert asset betas to a basis that is comparable over time, i.e. based on the same debt beta assumption.

Table 5.1 presents the calculations.

**Table 5.1 The ARP–DRP differentials implied by the RIIO-ED2 Draft Determinations, RIIO-ED1 Final Determinations and contemporaneous market data**

	Calculation	RIIO-ED2 DDs 29/06/2022	RIIO-ED1 FDs 28/11/2014
Cut-off date			
Spot yield on 20-year nominal gilts <sup>1</sup>	[A]	2.78%	2.66%
Convenience premium	[B]	0.50%	0.50%
Risk-free rate (nominal)	[C] = [A] + [B]	3.28%	3.16%
Total market return (nominal) <sup>2</sup>	[D]	8.63%	9.80%
Equity risk premium	[E] = [D] – [C]	5.35%	6.64%
Asset beta <sup>3</sup>	[F]	0.334	0.348
<b>ARP</b>	<b>[G] = [E] x [F]</b>	<b>1.79%</b>	<b>2.31%</b>
Yield to maturity (nominal) <sup>4</sup>	[H]	4.44%	4.04%
Expected loss <sup>5</sup>	[I]	0.30%	0.30%
<b>DRP</b>	<b>[J] = [H] – [C] – [I]</b>	<b>0.86%</b>	<b>0.58%</b>
<b>ARP–DRP differential</b>	<b>[K] = [G] – [J]</b>	<b>0.93%</b>	<b>1.73%</b>

Note: The calculations have minor discrepancies due to rounding. <sup>1</sup> As at the publication date.

<sup>2</sup> Restated in nominal terms using the regulator's inflation assumption. <sup>3</sup> Re-levered from Ofgem's asset beta using Ofgem's debt beta assumption and de-levered using a debt beta of 0.05, i.e. estimated as (Ofgem's equity beta \* (1 – notional gearing) + 0.05 \* notional gearing). <sup>4</sup> Spot yield of the iBoxx £ non-financials A and BBB 10+ indices as at the cut-off date. <sup>5</sup> We assumed an expected loss of 30bp for senior unsecured debt. See Oxera (2019), 'Risk premium on assets relative to debt', 25 March.

Source: Data from Thomson Reuters Datastream and Bank of England yield curve; and Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 July.

We observe a considerable decline in the ARP–DRP differential from RIIO-ED1 to RIIO-ED2, with an ARP–DRP of 1.73% and 0.93% respectively. The majority of this reduction (52bp) is driven by the reduction from ED1 to ED2 in the allowances for the ERP and for the asset beta, which can be seen when these parameters are expressed using a calculation methodology that is consistent over time.

Combined with the evidence set out in this report explaining the sources of parametric uncertainty where Ofgem has erred in the selection of point estimates within the CoE parameters, this strengthens the conclusion that an upward revision to the allowed CoE is required.

[www.oxera.com](http://www.oxera.com)