NERA
ECONOMIC CONSULTING

Cost of Capital for SPT in RIIO-T2

Report for Scottish Power Transmission plc

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Executive Summary

Scottish Power Transmission (SPT) commissioned NERA Economic Consulting (NERA) to review Ofgem's cost of capital assessment as published in its Draft Determination (DD) for RIIO T2, and set out our own market based assessment of SPT's cost of capital.

This report follows on from our two previous cost of capital reports for SPT prepared in April and November 2019 which informed SPT's business plan submissions and responded to Ofgem's sector specific methodology consultation and decision (SSMC and SSMD).[1] In preparing this report, we respond to updated evidence in the DD, notably in relation to Ofgem's beta assessment, but otherwise extensively refer to analysis in our previous reports.

Cost of Equity

Ofgem proposes a cost of equity of 3.70 per cent (real, CPIH), a reduction relative to the estimate in the SSMD published in May 2019.[2] Compared to the SSMD, the decline in the proposed allowed return on equity reflects a lower risk-free rate and a reduction in notional equity beta from 0.75 to 0.72 whereas Ofgem has maintained its earlier TMR assumption.

We estimate a TMR of 6.9 to 7.8 per cent (real, CPIH), drawing on long-run historical data

As per our earlier reports, we estimate the TMR based on long-run realised market returns for UK from the 2020 Dimson, Marsh and Staunton (DMS) database, which provides long time series data on returns going back to 1900 and is the standard reference point for UK regulators and the CMA.

As a first step, we estimate updated historical returns for the UK market in RPI-real deflated terms, as RPI is the only available and reliable measure of UK historical inflation going back to 1900. We estimate an historical RPI-deflated TMR using established estimators which provide an unbiased measure of expected returns for different investment horizons, developed by Blume and JKM. We use two alternative sources of historical RPI inflation: i) DMS/ONS RPI data and ii) Bank of England Millennium RPI data.

Table 1: Long-run TMR estimates (real, RPI deflated)

RPI index based on DMS (up to 1949) and ONS (1950 onwards) data

	Simple	Overlapping	Blume	JKM
1Y Holding	7.0	7.0	7.0	7.1
2Y Holding	6.5	6.9	7.0	7.0
5Y Holding	6.8	6.8	7.0	6.9
10Y Holding	6.8	6.7	6.9	6.6
20Y Holding	7.2	6.7	6.7	6.2

Source: NERA calculations using DMS (February 2020), Credit Suisse Global Investment Returns Yearbook 2020 (DMS data since 1949 converted to real RPI-deflated figures using ONS data).

[1] NERA (April 2019) Cost of Equity for SPT in RIIO-2; NERA (November 2019) Cost of Capital for SPT in RIIO-2

[2] Note: both after step 1 and step 2 adjustment. Ofgem (July 2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance

RPI index based on Bank of England Millennium dataset

	Simple	Overlapping	Blume	JKM
1Y Holding	6.7	6.7	6.7	6.7
2Y Holding	6.2	6.6	6.7	6.7
5Y Holding	6.4	6.4	6.6	6.5
10Y Holding	6.5	6.3	6.5	6.3
20Y Holding	6.8	6.4	6.4	5.9

Source: NERA calculations using DMS (February 2020), Credit Suisse Global Investment Returns Yearbook 2020 (DMS nominal data converted to real RPI-deflated figures using BoE RPI Millennium data).

Assuming holding periods of up to 5 years, in line with evidence on typical investor holding periods, we estimate an historical real TMR (RPI-deflated) of 6.4 to 7.1 per cent, as per the highlighted cells in Table 1. (This corresponds closely to our estimate of 6.4 to 7.0 per cent as per our previous November 2019 report with the slight change reflecting the additional year of data.[3])

As a second step, we convert the historical RPI-deflated returns to a CPI equivalent using updated estimates for the historical RPI-CPI wedge of 46 to 72 bps, measured over the period where historical CPI data (actual or back-casted) are available. This supports a real CPI-deflated TMR of between 6.9 and 7.8 per cent, as per our earlier report.

In its DD, Ofgem continues to rely on the UKRN report estimates of real CPI returns and on CEPA's DGM

In its DD, Ofgem confirmed its TMR estimate of 6.25 to 6.75 per cent (real, CPIH), drawing principally on the estimate of the TMR presented in the 2018 UKRN report of 6 to 7 per cent (real, CPIH). As explained in our earlier reports for SPT, the UKRN's TMR estimate is understated in real CPI terms for two reasons. First, the UKRN report deflates historical nominal equity returns using an inflation series which combines historical RPI and CPI inflation for different periods. This hybrid RPI/CPI index overstates historical CPI inflation, given that RPI has historically been higher than CPI, and understates historical CPI-deflated returns as a result. Second, the UKRN report applies an excessive 1 per cent downward adjustment to historical simple arithmetic returns for alleged predictability of returns at long horizons. Evidence on returns predictability is contentious and the 2018 UKRN report approach ignores more established methods developed by Blume and JKM for estimating unbiased estimators of the TMR for long investment horizons and which were also used by the CMA at recent reviews. These methods support a relatively more modest adjustment to simple arithmetic averages of at most 40bps for the UKRN preferred 10-year investment horizon.[4]

Correcting for the above issues, we estimate a real CPIH TMR of 6.9 to 7.8 per cent, higher than Ofgem's assumed range of 6.25 to 6.75 (real, CPIH).

In our earlier reports for SPT, we also explained our concerns with Ofgem's reliance on CEPA's DGM estimate of the TMR for the UK FTSE, due to CEPA understating dividend

[3] NERA (November 2019) Cost of Equity for SPT in RIIO-T2, p. 17.

[4] Or stated differently, the UKRN 1 per cent uplift to geometric returns is understated relative to established estimators from Blume and JKM.

growth by relying on UK GDP forecasts as a basis of short and long run dividend forecasts. We have previously presented estimates of the DGM from the Bank of England, which rely on analyst forecasts of dividend growth in the short run and global GDP growth forecasts in the long run, and which support TMR estimates which are higher than historical realised returns estimate (of around 8 to 9 per cent). As DDM evidence lies above the more reliable historical evidence, we recommend a TMR drawing on our historical evidence.

We update our estimate for the RFR of -1.26 per cent (real CPIH), drawing on nominal 20-year gilts deflated with OBR CPI inflation forecasts

We estimate an average RFR of -1.26 per cent (real, CPIH) over the RIIO-2 period, for comparability with Ofgem's estimate. Our forecast RFR is calculated based on current evidence on yields on 20-year nominal government bonds, increased by the expected increase in yields implied from forward rates on UK gilts and deflated into real (CPIH) terms using long-term forecast of CPI inflation from the OBR. By contrast, Ofgem's estimate of -1.48 per cent relies on real gilts, but we do not find that these are reliable measure of the RFR because of structural imbalances in the supply-demand for long-dated bonds.

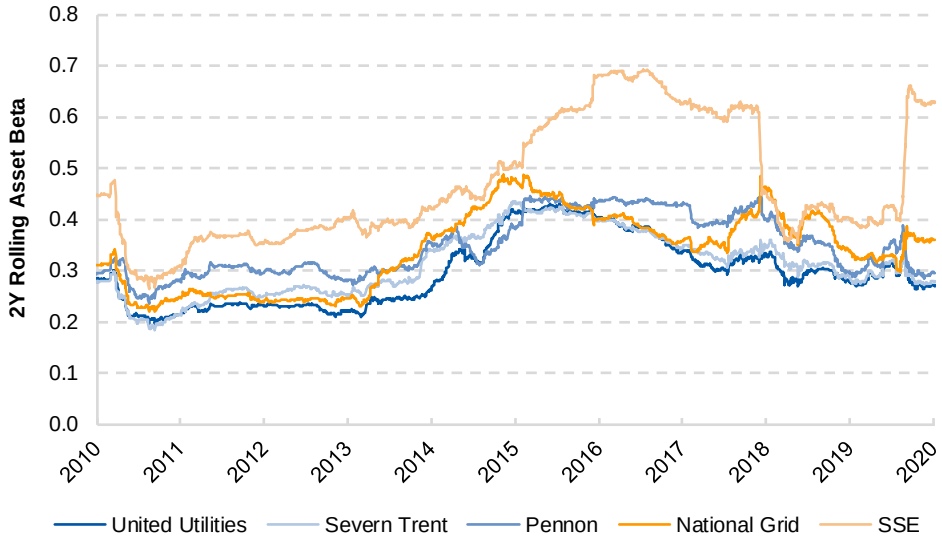
Ofgem's beta analysis emphasises GB water networks rather than focussing on energy networks

Drawing on GB water and energy networks and a sample of European energy networks, in its DD Ofgem concludes on an asset beta range of 0.34 to 0.39, with a point estimate of 0.365, using a debt beta of 0.125.[5]

We consider NG is the most natural comparator for SPT for measuring beta risk, as opposed to Ofgem's equal reliance on GB water networks. As we have previously set out, energy networks face greater risks than water networks because of the relative complexity of the investment programme, as acknowledged by Ofgem at previous reviews, competition risks from Ofgem's on-short competition models as confirmed in the DD, and uncertainty over the future role of TOs due to embedded generation. Indeed, Ofgem's own consultants, CEPA, concluded at DD that water and energy networks are not perfect substitutes and investors in energy networks face greater risks than water networks. Moreover, the empirical evidence over a sustained period shows higher beta risk for NG and SSE relative to water networks (see Figure 1), and energy and water network betas have diverged during the recent crisis evidence of an inherent difference in risk.

[5] Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.43, para 3.48.

Figure 1: We draw on NG beta evidence, the most natural comparator for SPT



Source: NERA analysis

In terms of estimation methodology, we focus on 2 and 5 year estimation periods for the regression, and 2 and 5 year averaging periods, and daily estimates – consistent with the range of estimation approaches employed by the CMA. Our approach ensures that we do not place undue weight on the most recent periods where betas have been downwardly biased because of political and regulatory risk, as we have explained in recent reports (although offsetting this, SSE and NG betas have increased in the COVID-19 crisis). Unlike Ofgem/CEPA, we also do not draw on 10-year estimation periods as these are unreliable estimates of forward looking beta risk, given changes in business and regulatory risks. Ofgem/CEPA's reliance on long-term horizons is contrary to the CMA's approach at previous network price control appeals, including CMA's provisional findings for NERL.

We also consider CEPA is wrong to reject the decomposition analysis which supports a far higher beta for NG's GB energy networks relative to NG's Group beta. CEPA concludes incorrectly that NG's inferred beta is more volatile than GB water and European energy comparators. Also, CEPA's analysis of the inferred WPD beta from PPL is unreliable, as the WPD inferred beta shows a highly volatile pattern of the past five years. For example, the volatility of WPD's inferred UK network beta is more than double the volatility of NG's inferred GB beta.

Overall, the evidence supports an asset beta of at least 0.38, based on NG's Group beta (rather than the higher inferred NG GB network beta).

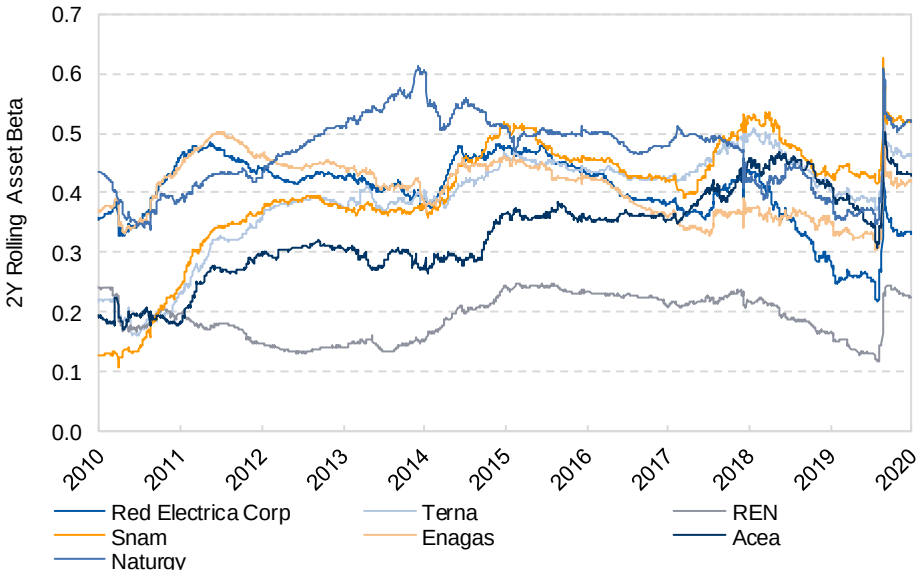
CEPA's European sample includes illiquid stocks, and incorrectly excludes close comparators

CEPA also presents evidence on betas for European networks focusing on six comparators. Relative to our own sample of six set out in our previous reports for SPT, CEPA includes two additional networks (Elia, a TO operating in Belgium and Germany, and REN, a Spanish transmission network) and excludes two (Naturgy, a Spanish gas distribution operator, and Acea, an electricity distribution operator in Italy). Otherwise, we have four comparators in common (Red Electrica, Terna Rete, Enagas and Snam).

We disagree with CEPA's inclusion of Elia, which has low transaction volumes and the likely explanation of its relative low asset beta because of illiquidity. In addition, CEPA excludes Naturgy and Acea because they have *"very low proportions of regulated activities"*.[6] However, CEPA's statement is incorrect as both Acea and Naturgy have substantial share of regulated business: Naturgy has a regulated share of EBITDA of 64 per cent in 2019; Acea's regulated share of EBITDA was 81 per cent in 2019. Both shares are also well above CEPA's own selection criteria threshold of 50 per cent of regulated activities.

Correcting for these errors in sample selection, using an estimation methodology in line with the approach used by the CMA, yet not placing weight on the recent spikes in betas related to the COVID crisis, we find empirical evidence that supports an asset beta range of 0.38 to 0.40.

Figure 2: Correcting for sample selection, we find European comparators support beta range of 0.38 to 0.40 (0.05 debt beta)



Source: NERA analysis

We conclude on an asset beta range of 0.38 to 0.40 (0.05 debt beta)

NG's asset beta is on average 0.38 drawing on a range of estimation approaches employed by the CMA. We consider that this represents a reasonable lower bound, as NG's asset beta will also reflect the risk associated with its lower risk US network operations. Our decomposition analysis supports a higher beta value for NG's GB network of at least 0.41. For our upper-bound, we draw on the upper-quartile range for the European comparators of 0.40.

On a like-for-like debt beta basis, our asset beta range is 0.38 to 0.40 (0.05 debt beta) compared to Ofgem 0.30 to 0.35 (assuming the same 0.05 debt beta).

[6] CEPA (July 2020), RIIO-2 Beta estimation issues, p.41.

We estimate an overall cost of equity of 5.91 to 7.16 per cent (real CPIH)

Overall, we estimate a cost of equity of 5.91 to 7.16 (real CPIH) based on Ofgem's information cut-off date of 11 May 2020, higher than Ofgem's CAPM cost of equity estimate of 4.3 per cent.

Table 2: Cost of Equity Summary (common 60 per cent gearing assumption)

	Ofgem (DD)			NERA	
Real CPIH	Lower bound	Central	Upper bound	Lower bound	Upper bound
Gearing	60%	60%	60%	60%	60%
RFR	-1.48%	-1.48%	-1.48%	-1.26%	-1.26%
TMR	6.25%	6.50%	6.75%	6.93%	7.84%
ERP	7.73%	7.98%	8.23%	8.11%	9.02%
Asset beta (determined)	0.34	0.37	0.39	0.38	0.40
Asset beta (zero debt beta basis)	0.27	0.30	0.32	0.35	0.37
Debt beta	0.125	0.125	0.125	0.05	0.05
Equity beta	0.60	0.66	0.71	0.875	0.925
Cost of Equity (step 1) for GD/T	3.64%	4.30%	5.00%	5.91%	7.16%
Cost of Equity (step 2) (55% gearing, SPT)		4.2 % (3.93%)			
Allowed return on equity (55% gearing, SPT)		3.95% (3.70%)			

Notes: 1) Ofgem does not calculate cost of equity under step 1 for SPT. Instead, it backs out a step 2 cost of equity and an allowed return on equity that assumes the cost of capital is identical at 60% and 55% gearing. In its DD, Ofgem uses 55% for SPT, which results in a cost of equity of 3.93% and allowed return on cost of equity of 3.70%
2) We have also estimated an updated cost of equity range taking into account the latest available data for the RFR of -1.18 per cent (i.e. as of the most recent July cut-off date). We estimate the cost of equity range to be 5.92 to 7.16 per cent (real CPIH). .
Source: Ofgem (July 2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, NERA analysis

To its CAPM cost of equity, Ofgem then applies a further reduction to reflect evidence from cross-checks, including evidence from market-to-asset ratios (MARs); OFTO IRRs; investment managers TMR; and infrastructure fund equity IRRs. Notably, Ofgem relies on CEPA's estimated MAR premia of around 20 per cent for UK water companies at 31 December 2019 (post Ofwat's PR19 final determination), to conclude that the cost of equity must be no greater than Ofwat's allowed return of 4.2 per cent. However, we show that CEPA fails to make a number of adjustments to raw MAR values – for non-wholesale regulated activities, pension deficits etc. – and once these are taken into account, there is no evidence that the water companies' corrected MARs are greater than 1. We also disagree with Ofgem's assertion that investors view water and energy network assets as similar risk, for reasons set out above. Overall, we conclude that the set of cross-checks provide no evidence to reduce an already understated CAPM cost of equity.

Following step 2, Ofgem determines an allowed return of 3.95 per cent (60 per cent gearing), allowing for its view on the expected level of outperformance. We have not addressed this step explicitly in this report but this is addressed in a separate report for SPT.

We consider an alternative case where we adopt a TMR based on arithmetic averages (as proposed by Cooper), and higher RFR of between 50 and 100 bps to reflect the gap between sovereign and corporate highly rated debt

In its recent submissions to the CMA, the ENA notes that Ofwat at PR19 (and by implication Ofgem at RIIO-2) has set an erroneously low RFR by failing to uplift the spot rate for ILGs to account for the unique characteristics of sovereign bonds and the gap between corporate and sovereign risk-free financing rates. Citing evidence from the academic literature and from empirical analysis the ENA provides evidence that an upward adjustment to the spot yield for ILGs of 50 to 100bps to determine the RFR for use in the CAPM.

In addition, ENA has explained that there is a rationale for using arithmetic averages in setting the TMR in a regulatory setting. The ENA submission cites a paper by Cooper[7], which demonstrated that the discount rate investors should use to give an unbiased estimate of the present value of future cash flows is based on a TMR at least as high as the arithmetic average of historical returns. Therefore, the Cooper paper provides a rationale for the use of an arithmetic average which would support values towards the top-half of Blume/JKM estimates.

In our report, we consider the implication of adopting a TMR based on arithmetic averages (as propose by Cooper), as well as adopting higher RFR of between 50 and 100 bps to reflect the gap between sovereign and corporate highly rated debt. If we were to adopt a TMR based on arithmetic means and a RFR based on corporate yields, our lower bound cost of equity would increase to 6.2 per cent (i.e. around 25 bps), whereas our upper-bound remains largely unchanged.

Cost of debt

Ofgem's proposed use of the iBoxx Utilities index imposes rating risk on companies

In its DD, Ofgem has proposed to index the cost of debt allowance with reference to the 10 to 14 year trailing average of the iBoxx Utilities 10yr+ index in place of the average of the A and BBB rated iBoxx Corporate non-Financials 10Y+ it has used to date.

The use of the iBoxx Utilities index, which does not have a defined rating other than broad investment grade, imposes a risk of under-recovery of cost of debt if the Utilities index credit rating improves over RIIO-2. Ofgem has stated that the notional package will ensure outturn ratios to be "two notches above investment grade", which means Ofgem will set revenue allowance for a notional company with credit ratios consistent with Baa1 at best. If Ofgem were to retain the iBoxx A/BBB, then companies funded for new cost of debt at the credit rating of A3/Baa1, which already results in half a notch under-funding. Using the iBoxx Utilities index compounds the problem. As we set out in our report for the ENA, if the iBoxx Utilities rating aligns with iBoxx A as it has historically, companies would under-recover by ca 15 bps relative to Ofgem's analysis.

[7] Cooper (1996) Arithmetic versus geometric mean estimators: Setting discount rates for capital budgeting, European Financial Management, 2:2, 1996, pages 156–67. Link: http://faculty.london.edu/icooper/assets/documents/ArithmeticVersusGeometric.pdf. 37 Professor Stephen M Schaefer, London Business School, Comments on CMA views

As in our previous report, we also show that the trailing average of the cost of debt indexation mechanism should be at least 15 years, in order to match the average tenor at issuance of network companies' debt.

Ofgem's halo analysis is imprecise, and as a consequence it fails to correctly allow for a NIP

Ofgem's rationale for adopting the iBoxx Utilities as the reference benchmark relies on its assessment that companies' debt financing costs more closely match the iBoxx Utilities index than the iBoxx A/BBB, based on its comparison of benchmark and company spreads.

As at SSMD, Ofgem has compared company spreads relative to the candidate iBoxx benchmarks, and identified a halo of 11 or 4 bps using the iBoxx A/BBB and iBoxx Utilities indices respectively.[8] As we have previously set out, Ofgem's measure of the relative spread is imprecise as it uses the closest benchmark gilt in calculating spreads for bonds and the iBoxx indices, and there are very few benchmark gilts at long tenors. By contrast, we draw on the Bank of England nominal yield curve, which is built based on a smoothed function over observed benchmark gilt yields, and allows us to match tenor precisely. Ofgem criticised our earlier analysis for not taking into account the duration of the bonds: we find that duration matching we calculate a halo of between -4 and -14 bps for the iBoxx A/BBB and iBoxx Utilities indices respectively, a similar order of magnitude to our earlier estimate of 13 bps. Ofgem has also stated that its approach to calculating is the market conventions; however, we show that our approach is consistent with other empirical studies that measure NIP, and other recent studies derive premium of similar order of magnitude.

We conclude that the networks' additional cost of borrowing should include a NIP of 9 bps (mid-point 4bps and 14bps) to compensate for companies' cost of debt issuances.

Ofgem's use of company data to calculate cost-of-carry is unreliable

For the cost of carry, Ofgem has relied on company RFPR and group level data to calculate cash-holding costs. We find that Ofgem's approach is unreliable, as companies adopt very different approaches to the location of Treasury functions: some networks undertake this entirely at the network level, and others at the midCo or indeed ultimate parent. Ofgem's analysis also fails to reflect the expected substantive increase in debt issuance over RIIO-2 which will necessitate an increase cash-holdings relative to historical levels at RIIO-1. We update our analysis – taking into account Ofgem's view that pre-financing needs could also be met by liquidity provisions – estimating a cost of capital of between 11 to 23 bps.

Ofgem incorrectly disallows CPI indexation costs

In relation to the CPI indexation switching costs, Ofgem incorrectly states that companies do not need to be compensated for this cost because CPI indexation brings forward revenues relative to RPI. However, Ofgem incorrectly ignores basis risk – i.e. risk that RPI-CPI wedge diverges from that assumed at review – which could lead to under-recovery of RPI ILD costs and a deterioration in credit metrics. Drawing on recent market evidence on the costs of using CPI ILD, from Oersted and Cambridge University bonds, and updating for Ofgem's

[8] Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 179

assumed 30 per cent notional ILD, we estimate CPI indexation costs of 15 bps, slightly higher than our earlier estimate of 12 bps.

Overall, we estimate additional cost of borrowing of 53 bps, with a range of 47 to 59 bps, compared to Ofgem's DD of 17 bps

As set out in Table 3, retaining our earlier estimates for transaction costs and liquidity costs and updating for NIP, cost of carry and CPI indexation, we estimate an overall additional cost of borrowing of between 47 and 59 bps (and mid-point 53 bps) compared to Ofgem's estimate of 17 bps.

Ofgem's own analysis - which shows TOs plus GDNs recover costs with a margin of 12 bps in its central scenario - would decline by 36 bps (i.e. 53 bps less 17 bps) to negative 24 bps under our revised additional cost of borrowing estimate. Our analysis therefore supports a higher additional cost of borrowing or alternatively a longer trailing average closer to the conceptually correct value of 15 years.

Table 3: Our updated additional cost of borrowing is between 47 to 59 bps over RIIO-2

	Ofgem DD (Jul 2020)	**NERA (Sep 2019)**	**NERA (Aug 2020)**	**Note**
Transaction Costs	6 bps	7 bps	7 bps	Ofgem draws on company data but excludes apparent outlier
				NERAs analysis includes all companies within sample
Liquidity/RCF cost	3 - 5.5 bps	4.5 bps	4.5 bps	Both Ofgem and NERA draw on companies' assumptions on RCF size and cost
Cost of carry	1.5 – 11 bps	16 – 45 bps	11 – 23 bps	Ofgem assumptions on cash at OpCo and Group unreliable
				NERA approach assumes 12-24 mth pre-financing, half met by RCF
New Issue Premium (NIP)	-	13 bps	9 bps	Ofgem's analysis does not draw on precise measures of spread and therefore estimate of halo/NIP is unreliable
				NERAs spreads calculation duration matched and support range 4 -14bps
CPI indexation costs	-	12 bps	15 bps	Ofgem assumes that companies do not require compensation for basis risk
				NERA's analysis based on recent cost of CPI issuance and CPI swaps
Total	**17 bps**	**53-82 bps (68bps)**	**47 – 59 (53bps)**	Ofgem: mid-point of its range

Source: Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, NERA analysis

1. Introduction

Scottish Power Transmission (SPT) commissioned NERA Economic Consulting (NERA) to undertake a study to review Ofgem's proposed cost of capital for RIIO-21 as published in its Draft Determination which will run for the period April 2021 to March 2026.

In this report, we examine the analysis that Ofgem and CEPA, its consultant, have undertaken, and set out our concerns with their approach. This is an update of our previous October 2019 cost of capital report for SPT. We update our earlier report for the latest market evidence as per Ofgem's Draft Determination information cut-off date (of 11 May 2020), and we respond to any new evidence provided by Ofgem relative to its earlier sector specific methodology consultation (SSMC) and decision (SSMD). In particular, for the cost of equity, we provide a critique of Ofgem's updated evidence on beta and cost of equity cross-checks for RIIO-T2 price control period.

For the cost of debt, we respond to Ofgem's proposed use of the iBoxx Utilities Index, its proposed 10-14 year trailing average, and additional cost of borrowing. Where Ofgem has not changed its approach relative to SSMD (e.g. its approach to TMR and RFR), we make extensive reference to arguments that we have set out in our earlier reports in responding to Ofgem's proposals.

The rest of the report is structured as follows:

- Section 2 sets out our estimate of the Total Market Return (TMR) and its constituent elements, the RFR and the ERP, based on latest market evidence
- Section 3 sets out our estimate of the asset beta for SPT
- Section 4 reviews Ofgem's cross-checks on its CAPM cost of equity
- Section 5 draws conclusions on the cost of equity for SPT during RIIO-T2
- Section 6 reviews Ofgem's proposed approach to the cost of debt

There are also a number of appendices:

- Appendix A provides a cost of equity estimate where we assume a RFR based on corporate bonds and a TMR based on arithmetic means
- Appendix B summarises CMA's approach to beta estimation at the recent NERL appeal
- Appendix C provides evidence on the decomposition of National Grid plc's asset beta
- Appendix D sets out CEPA's and Ofgem's MAR analysis as well as our updated evidence on MAR
- Appendix E sets out our review of evidence on CPI premium based on Cambridge University bonds

2. Total Market Return, Risk-free Rate and Equity Risk Premium

In this section, we set out our estimate of the total market return (TMR) for RIIO-T2 and its constituent elements, the risk-free rate (RFR) and the equity risk premium (ERP).

We estimate a TMR of 6.9 to 7.8 per cent (real, CPIH), drawing on realised historical returns, unchanged relative to our earlier report, and a real RFR of -1.26 per cent based on nominal gilts less forecast for CPI inflation. By contrast, Ofgem's retains its TMR range of 6.25 to 6.75 per cent (real, CPIH) from SSMD, based principally on the 2018 UKRN report, and a RFR of -1.48 per cent based on real gilts.[9]

2.1. Summary of Ofgem's RIIO-2 Sector Specific Consultation and Decision

2.1.1. May 2019 Sector Specific Decision

Step 1: CAPM evidence

In its May 2019 Sector Specific Decision, Ofgem confirmed its proposed TMR of 6.25 to 6.75 (real CPIH) from the December 2018 consultation, drawing principally on: [10]

- The 2018 UKRN report which recommends a TMR between 6 and 7 per cent (real CPIH).
- The DGM cross-check based on the analysis by CEPA, which supports an 8 per cent nominal (6 per cent real CPIH) TMR.
- The cross-check based on investment managers' forecasts, which support a TMR figure below Ofgem's estimated range, albeit higher than presented in the consultation (7.65 per cent nominal or 5.5 per cent real CPIH).

Ofgem also confirmed that it would apply RFR indexation, updating the cost of equity allowance based on the change in the RFR keeping the TMR and beta constant. However, Ofgem noted it would present an updated view of the exact methodology for how the updated RFR will be calculated (i.e. derivation real CPIH values, averaging period and tenor) at Draft Determinations.[11]

Step 2: Cross-checking of CAPM results

Ofgem also confirmed that it will continue to use the cross-checks on the CAPM-based cost of equity estimates, including evidence from: i) OFTO IRRs, ii) investment managers, iii) infrastructure funds, and iv) CAPM with investment managers' value for TMR. Ofgem noted that the cross-checks support its revised CAPM estimates, in particular around 5 per cent (real CPIH), ultimately concluding on a 4.8 per cent (real CPIH) cost of equity estimate as a mid-point.[12]

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9 Wright, Burns, Mason, Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update on Mason, Miles and Wright (2003).

10 Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, p.31-42.

11 Ofgem (May 2019), RIIO-2 Sector Specific Methodology Decision – Finance, p.25-30.

12 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.58-66.

Step 3: Expected versus allowed returns

Ofgem proposed to apply a distinction between Expected Return (ER) and Allowed Return (AR) for RIIO-2 in light of companies' outperformance in previous price controls, applying a 50bps downward adjustment to its cost of equity estimate (resulting in the equity allowance lying towards the lower end of Ofgem's CAPM range). Ofgem noted that it would consider the appropriate assumption of out- (under-)performance as part of calibrating the overall RIIO-2 package.[13]

2.1.2. Summary of Ofgem's Draft Determination

In its Draft Determination, Ofgem has retained its three step approach to estimating the cost of equity.

Under step 1, it proposes to use RFR indexation over RIIO-2 and has published a model alongside the DD. It proposes to use a one-month averaging period to set the RFR rather than a longer 6-or 12-month period, noting that this will ensure the cost of equity allowance more quickly reflects changes in market rates.[14]

In estimating the RFR, it continues to propose to use real rather than nominal gilts. It acknowledges that the Government is consulting on potential changes to the definition of RPI, and therefore the required adjustment to real gilts (which are deflated by RPI) to derive a measure deflated by CPI is uncertain over RIIO-2. To address this uncertainty, it proposes to publish an updated model as part of the Annual Iteration Process.[15]

For the TMR, it has retained its SSMD range of 6.25 to 6.75 per cent. Ofgem observes that CMA is considering the same issues over the determination of the TMR (namely, the relevant historical inflation series and averaging methods) as part of the NERL price control appeal. It has therefore decided that it will consider CMA's decision alongside stakeholder responses to the Draft Determination prior to making its final decision for RIIO-2.[16]

Ofgem's proposed CAPM-based cost of equity parameters for RIIO-2 presented are summarised in Table 2.1. (We discuss Ofgem's beta estimates in Section 3.)

[13] Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.66-78.

[14] Ofgem (July 2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, p. 32

[15] Ofgem (July 2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, p. 33

[16] Ofgem (July 2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, p. 37

Table 2.1: CAPM-implied Cost of Equity for SPT (CPIH-deflated)

	Low	High
Notional equity beta	0.66	0.79
Total Market Return (TMR)	6.25%	6.75%
Risk-free rate (RFR)	-1.48%	-1.48%
CAPM-implied cost of equity	**3.64%**	**5.00%**

Source: Ofgem (July 2020), RIIO-2 Draft Decision – Finance, Table 17, p. 49.

2.1.3. Our Review of Ofgem's Approach to Estimating the TMR

We agree with Ofgem's proposed methodology to estimate the TMR based on long-run historical averages as the best available evidence on investors' future expectations, using forward-looking approaches as a cross-check. This is also the approach we use in estimating the TMR in this report, as discussed in the following sections.

However, we do not agree with Ofgem's specific TMR estimates, drawing on historical realised returns from the 2018 UKRN report and the DGM-based TMR estimates from CEPA. As explained in our previous reports for SPT,[17] there are two important issues which lead to the UKRN report understating real CPI returns, namely:

- the use of the Bank of England hybrid CPI/RPI index for deriving historical CPI-deflated returns, and
- the adjustment to historical data for alleged predictability of returns at long horizons which forms the basis of the UKRN's lower bound estimate.

As also explained in our previous reports for SPT,[18] CEPA's DDM model understates the expected TMR due to implausibly low assumptions around dividend growth, a critical assumption in the determination of a DDM TMR. As we have shown, CEPAs growth assumptions are far lower than independent analyst forecasts used by the BoE DDM, our preferred DDM model.

In relation to step 2 of Ofgem's methodology, in our previous reports[19], we also explained that Ofgem's cross-checks do not support a lower cost of equity compared to the CAPM-based estimate and indeed in some cases support an upward adjustment to Ofgem's estimates. In this report, we have updated our analysis to address further evidence provided by Ofgem. As with our previous reports, we show that the cross-checks (and notably Ofgem's updated MAR analysis) do not provide evidence that the CAPM-based range overstates the cost of equity.

We do not address Ofgem's step 3 – the reduction from the allowed return to accommodate outperformance – in this report as this is addressed in an earlier industry wide study.[20] We

[17] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix C.

[18] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix A3.

[19] NERA (April 2019), Cost of Equity for SPT in RIIO-2, Appendix B.

[20] Frontier Economics (March 2019) Adjusting Baseline Returns for Anticipated Outperformance

also do not specifically address Ofgem's proposed RFR indexation in this report, which is addressed as a separate NERA study on behalf of the wider industry.[21]

2.2. Updated evidence on the TMR

As explained in detail in our previous reports for SPT[22] and in line with Ofgem's approach as we describe in Section 2.1, we estimate the cost of equity using a TMR approach, which estimates the TMR and RFR directly and calculates the ERP as the difference between the TMR less the RFR.

In this section, we present updated evidence on the TMR, drawing on long run historical evidence. In our previous reports for SPT, we also presented forward-looking estimates based on the Bank of England's dividend growth model, published in 2017. As there has been no update of the Bank of England's DGM, we continue to rely on the evidence presented in our November 2019 report which supports a real CPI-deflated TMR of 8.4 to 9.3 per cent.[23] As we set out below, the forward-looking estimates are higher than our preferred historical TMR estimates.

2.2.1. Long-run historical data support a TMR of 6.9 to 7.8 per cent (real CPIH)

As with our previous reports for SPT[24], we present long-run historical estimates of the TMR based on UK data from Dimson, Marsh and Staunton (DMS) database, which provides long-term time series data on returns on stocks, bonds, bills over the period since 1900 up to 2019, i.e. including 120 years of data in the latest publication.[25] The DMS database is the standard reference point for UK regulators including the CMA as well as financial practitioners.[26]

There are two methodological issues associated with estimating the TMR based on historical data: i) the appropriate inflation to use when deflating historical returns into real terms, given recent changes in the measurement of RPI and ii) the appropriate averaging method (arithmetic versus geometric), as we discuss below.

Appropriate inflation index for estimating historical real returns

We deflate the historical realised returns into real terms using historical RPI inflation, given RPI inflation series is the only historical series available as a measure of UK inflation going back to 1900. Indeed RPI inflation has been the official measure of inflation in the UK until 2003,[27] i.e. for the majority of the historical period since 1900. Our approach of using RPI

21 NERA (March 2019), Cost of equity indexation using RFR, A report for the ENA.

22 NERA (April 2019), Cost of Equity for SPT in RIIO-2, Section 2.2.

23 NERA (November 2019) Cost of Equity for SPT in RIIO-T2, p. 18.

24 NERA (November 2019) Cost of Equity for SPT in RIIO-T2, p. 13.

25 DMS (February 2020), Credit Suisse Global Investment Returns Yearbook 2020.

26 See e.g. CMA (March 2020), NATS (En Route) Plc provisional findings, para 12.185.

27 Until 2003, the Bank of England used RPI for the purpose of inflation targeting, replacing it with CPI from 2003 onwards. Since 2003, RPI has been replaced by CPI. From 2011, RPI has also been replaced by CPI for the purpose of indexation of pensions for public sector employees. (Sources: HM Treasury (10 December 2003), Remit for the Monetary Policy Committee of the Bank of England and the New Inflation Target; Department for

inflation as a basis of analysing historical real realised returns is consistent with the view presented in the ONS paper by O'Donoghue et. al. (2004), which concludes that RPI inflation series represents the appropriate historical inflation to be used for making *"long-run comparisons […] of consumer price inflation and the purchasing power of the pound"*.[28] In addition, the ONS recently published a "Long term indicator of prices of consumer goods and services" which also uses RPI data as a measure of historical inflation.[29]

However, given Ofgem's decision to switch to CPI indexation for RIIO-2 we need to make an adjustment to RPI deflated real historical returns to estimate a TMR in real CPI terms. We calculate historical real returns for the purpose of estimating the TMR for RIIO-2 as follows:

- We start with historical returns deflated with historical RPI inflation, as the only available and reliable measure of historical UK inflation going back to 1900.
- We then convert the historical real RPI returns into equivalent CPIH returns using the estimate of the historical RPI-CPI wedge (using CPI as a proxy for CPIH).

Consistent with our previous approach in our November 2019 report for SPT[30], we estimate an updated historical RPI-CPI wedge of between 46 bps (calculated over the full historical period since 1950 when *some* CPI data is available) and 72 bps (calculated over the most recent period since 1988 when official CPI data is available). Applying this historical RPI-CPI wedge to historical returns deflated using RPI index provides an estimate of CPI-deflated returns required for RIIO-2.

Arithmetic versus geometric averages

The second key question in estimating the TMR based on historical data is whether the expected return should be estimated based on arithmetic or geometric averages of historical realised returns.[31] As explained in our previous reports for SPT,[32] we draw on arithmetic, Blume and JKM estimators to provide an unbiased estimate of expected returns over the price control period. The Blume and JKM estimators are both weighted averages of the geometric and arithmetic means, with greater weight placed on the arithmetic mean the longer the historical period used to estimate the TMR compared to the investment horizon.

In the context of CMA PR19 water price control appeals[33], the Energy Network Association (ENA) has explained that there is a rationale for using arithmetic averages in setting the TMR in a regulatory setting. The ENA submission notes that the JKM and Blume estimators can

Work and Pensions and the Rt Hon Steve Webb (12 July 2010), Statement on moving to CPI as the measure of price inflation.)

28 O'Donoghue, Goulding, Allen (March 2004), Consumer price inflation since 1750, p.39.

29 Available at ONS website: https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/cdko/mm23.

30 NERA (November 2019) Cost of Equity for SPT in RIIO-T2, p. 15.

31 The arithmetic average is calculated as the sum of the historical annual returns divided by the number of years in the historical period, while the geometric average corresponds to a constant rate of return that an investor would receive each year to achieve the same asset value as generated by the variable annual returns by the end of the period.

32 NERA (April 2019), Cost of Equity for SPT in RIIO-2, Section 2.3.1.

33 ENA (2020) Ofwat Price Determinations: Further submission by Energy Networks Association. Link: https://assets.publishing.service.gov.uk/media/5eeb57fae90e07644fae4218/Energy_Networks_Association__3_.pdf

be used to answer the question "what return do investors require for investing in equities?", and correctly provide estimates that are slightly lower than the arithmetic average. However, the ENA submission considers that the relevant question for setting a price control is "what rate do investors use to discount future cash flows?"[34] In other words, JKM provides an unbiased estimator of the growth rate to forecast the future value of an investment whereas we require an unbiased estimator of the rate for discounting future cash flows. As set out by the ENA, Cooper[35] demonstrated that the discount rate investors should use to give an unbiased estimate of the present value of future cash flows is based on a TMR at least as high as the arithmetic average of historical returns. Indeed, as the horizon for investment appraisal extends, the TMR must be further increased above the arithmetic average. Therefore, the Cooper paper provides a rationale for the use of an arithmetic average which would support values towards the top-half of Blume/JKM estimates, as we show below.

Empirical evidence

Table 2.2 below shows historical realised returns (RPI-deflated) using the different methods (arithmetic, Blume and JKM) which account for different holding periods using data over the period 1900-2019 from the latest DMS 2020 publication. As per our previous reports[36], we estimate historical returns in RPI-deflated terms using two alternative sources of historical RPI inflation[37]:

- The RPI inflation reported in the DMS publication for the period 1900-1949 and official ONS RPI historical data for the period 1950 onwards; and
- The RPI inflation included in the Bank of England's Millennium Dataset.

Table 2.2: Long-run TMR estimates (real, RPI deflated)

RPI index based on DMS (up to 1949) and ONS (1950 onwards) data

	Simple	Overlapping	Blume	JKM
1Y Holding	7.0	7.0	7.0	7.1
2Y Holding	6.5	6.9	7.0	7.0
5Y Holding	6.8	6.8	7.0	6.9
10Y Holding	6.8	6.7	6.9	6.6
20Y Holding	7.2	6.7	6.7	6.2

Source: NERA calculations using DMS (February 2020), Credit Suisse Global Investment Returns Yearbook 2020 (DMS data since 1949 converted to real RPI-deflated figures using ONS data).

34 ENA (2020) Ofwat Price Determinations: Further submission by Energy Networks Association, p. 9

35 Cooper (1996) Arithmetic versus geometric mean estimators: Setting discount rates for capital budgeting, European Financial Management, 2:2, 1996, pages 156–67. Link: http://faculty.london.edu/icooper/assets/documents/ArithmeticVersusGeometric.pdf. 37 Professor Stephen M Schaefer, London Business School, Comments on CMA views

36 NERA (November 2019) Cost of Equity for SPT in RIIO-T2, pp. 15-16.

37 The two alternative sources of historical RPI from the BoE and the DMS are both based on official RPI data from the ONS for the period after 1950, while for the period prior to 1950, they rely on different sources of historical RPI inflation. The BoE relies on the study: O'Donoghue, Goulding, Allen (March 2004), Consumer price inflation since 1750. The DMS uses an index of retail prices prior to 1950, but the source for the specific inflation index is unclear from the publications.

RPI index based on Bank of England Millennium dataset

	Simple	Overlapping	Blume	JKM
1Y Holding	6.7	6.7	6.7	6.7
2Y Holding	6.2	6.6	6.7	6.7
5Y Holding	6.4	6.4	6.6	6.5
10Y Holding	6.5	6.3	6.5	6.3
20Y Holding	6.8	6.4	6.4	5.9

Source: NERA calculations using DMS (February 2020), Credit Suisse Global Investment Returns Yearbook 2020 (DMS nominal data converted to real RPI-deflated figures using BoE RPI Millennium data).

Table 2.2 shows that the assumed holding period is an important factor in estimating the historical TMR. As explained in our April 2019 report for SPT,[38] evidence from financial literature supports the use of relatively short holding periods of up to 5 years, which we use as a basis of estimating the TMR. However, we do not place weight on the simple averaging method, as the number of observations is relatively limited for holding periods of 2 to 5 years (e.g. for 5 years, the TMR is based on around 20 or so observations) and the estimates are not stable over time as a result.[39]

Taking into account the above considerations, we estimate an historical real TMR (RPI-deflated) of 6.4 to 7.1 per cent, as per the highlighted cells in Table 2.2. (This corresponds to our estimate of 6.4 to 7.0 per cent as per our previous November 2019 report.[40]) By contrast, if we were to use the arithmetic mean only as recently proposed by the ENA in its submission to CMA, as opposed to the Blume/JKM estimators, this would support a value of 6.7 to 7.0 per cent. The range relates to the annual arithmetic averages for the respective historical inflation series, i.e. towards the top-half of our TMR range.

In Table 2.3 below, we convert the historical RPI-deflated range of 6.4 to 7.1 per cent to a CPI equivalent using our estimate of RPI-CPI wedge of 46 to 72 bps discussed above. This supports a historical CPI-deflated return of between 6.9 and 7.8 per cent, as per our previous report for SPT. Again, focussing on arithmetic averages would support values towards the top-half of our range (i.e. approximately 7.2. to 7.8 per cent).

Table 2.3: NERA Estimate of Historical Real TMR (CPI)

	Lower bound	Upper bound
Historical RPI TMR	6.44%	7.07%
RPI-CPI historical wedge	0.46%	0.72%
Historical CPI TMR	**6.93%**	**7.84%**

Note: Inflation adjustments calculated using the Fisher equation
Source: NERA analysis.

38 NERA (April 2019), Cost of Equity for SPT in RIIO-2, Section 2.3.1.

39 For example, using the DMS 2018 dataset and DMS RPI inflation results in 2-year and 5-year simple average TMR estimates of 6.6 and 6.7 per cent (using data up to 2017), while the DMS 2019 dataset (using data up to 2018) shows estimates of 7.3 and 6.5 per cent respectively, a difference of 20-70 bps by adding just one year of data. We therefore conclude that these estimates are not reliable for estimating the TMR for RIIO-T2.

40 NERA (November 2019) Cost of Equity for SPT in RIIO-T2, p. 17.

Our estimate of the historical real TMR (CPI) of 6.9 to 7.8 per cent is higher than the equivalent range from the 2018 UKRN report of 6 to 7 per cent that Ofgem relies on, due to i) UKRN report understating the historical CPI returns by relying on a BoE hybrid CPI/RPI inflation series which overstates historical CPI and ii) UKRN report applying an excessive adjustment for long holding periods compared to established methods used by the CMA. We have set out our concerns with UKRN approach in detail in our previous reports.[41]

In drawing conclusions, we rely on long-run historical averages as the primary source of evidence, with forward looking estimates based on the DGM used only as a cross-check. We consider forward looking evidence should be treated with caution, given the relative sensitivity of the results to the long-term dividend growth assumption, for which there are no independent analyst forecasts. As we explained above, the Bank of England DDM provides an estimate of the TMR of 8.4 to 9.3 per cent (CPI deflated). As this lies above the more reliable historical evidence, we recommend a TMR in the range between 6.9 and 7.8 per cent real (CPIH-deflated) for RIIO-T2, using CPI as a proxy for CPIH.

2.1. Updated Evidence on the RFR

For RIIO-2, Ofgem is proposing to introduce RFR indexation, with the RFR and allowed equity return updated each year during the RIIO-2 period.

Table 2.4 shows our estimate of the RFR based on current market evidence, using the same information date of 11 May 2020 as Ofgem's Draft Determination. In deriving our current market estimates, we use nominal gilt yield with 20-year tenor deflated using CPI forecast, because long-term nominal gilts provide the most stable and objective measure of RFR.[42] By contrast, as we explained above, Ofgem retains its approach from SSMD to use real as opposed to nominal gilts in determining the RFR, as it considers that this avoids the need to adjust for an inflation risk premium.[43] As we have set out in our previous reports[44], nominal gilts provide a more objective measure than real gilts, as real gilts, especially with long maturities, may provide a distorted measure because of the excess demand or "structural imbalances" driven by pension funds demand.[45] Historically, longer term nominal gilt yields have also been less volatile than yields of shorter maturity gilts, which suggests that it could provide the more stable measure of RFR going forward. In addition, nominal gilts are also widely used by financial practitioners and by UK and European energy regulators.[46]

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41 For a summary of our concerns with UKRN TMR estimates, see NERA (November 2019) Cost of Equity for SPT in RIIO-T2, Appendix A. For a more detailed discussion, see NERA (April 2019) Cost of Equity for SPT in RIIO-2, Appendix C

42 More detailed evidence can be found in the NERA report commissioned by the ENA, source: NERA (March 2019) Cost of equity indexation using RFR, a report for ENA.

43 Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, pp.31-32.

44 NERA (March 2019) Cost of equity indexation using RFR, a report for ENA

45 See, e.g. Schroders (June 2016), Pension funds and index-linked gilts – A supply/demand mis-match made in hell, "UK private sector defined benefit schemes already own an estimated 80% of the long-dated index-linked gilt market and potential demand is almost five times the size of the market. Supply is expected to remain high, and is likely to increase the market by around a third over the next five years, but this will not come close to matching demand. Pension funds waiting for index-linked gilt yields to rise to "attractive" levels are fighting a losing battle. The imbalance is structural and yields are likely to remain depressed relative to economic fundamentals for the foreseeable future."

46 NERA (March 2019) Cost of equity indexation using RFR, a report for ENA, slide 12

Table 2.4: Short-run Evidence on the RFR and Expected Increase from Forward Curves (as at 11 May 2020)

FYE ending in March	2022	2023	2024	2025	2026	Average
BOE nominal spot rate	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%
RFR forward uplift	0.01%	0.06%	0.10%	0.14%	0.15%	0.09%
RFR forward forecast	0.64%	0.69%	0.73%	0.77%	0.78%	0.72%
CPI	1.87%	2.06%	2.04%	2.02%	2.02%	2.00%
Real RFR (CPI)	**-1.21%**	**-1.34%**	**-1.29%**	**-1.23%**	**-1.22%**	**-1.26%**

Source: NERA analysis

We conclude on an RFR of -1.26 in real CPIH terms for RIIO-T2 based on the spot rate of the 20-year nominal government bonds on 11 May 2020, Ofgem's information date for the Draft Determination, plus the average forward curve uplift over RIIO-2, deflated with expected CPI from OBR forecasts.

Table 2.5 below shows the result of updating the RFR evidence to the most recent data. Using a cut-off date of 21 July 2020, the average RFR would be -1.18 per cent in real CPIH terms for RIIO-T2, higher than the -1.26 per cent that we estimate using Ofgem's cut-off date.

Table 2.5: Short-run Evidence on RFR and Expected Increase from Forward Curves (as at 21 July 2020)

FYE ending in March	2022	2023	2024	2025	2026	Average
BOE nominal spot rate	0.67%	0.67%	0.67%	0.67%	0.67%	0.67%
RFR forward uplift	0.00%	0.07%	0.13%	0.20%	0.23%	0.13%
RFR forward forecast	0.67%	0.74%	0.80%	0.87%	0.90%	0.79%
CPI	1.87%	2.06%	2.04%	2.02%	2.02%	2.00%
Real RFR (CPI)	**-1.17%**	**-1.29%**	**-1.22%**	**-1.13%**	**-1.10%**	**-1.18%**

Source: NERA analysis

2.1.1. The use of corporate yield instead of a sovereign yield as a proxy RFR

In its recent submissions to the CMA, the ENA notes that Ofwat at PR19 (and by implication Ofgem at RIIO-2) has set an erroneously low RFR by failing to uplift the spot rate for ILGs to account for the unique characteristics of sovereign bonds and the gap between corporate and sovereign risk-free financing rates. The ENA notes that the CAPM assumes that investors can borrow at the RFR but this is not the case for non-government investors who cannot issue debt at the spot rate of ILGs. Therefore, the spot ILG should be adjusted to reflect the gap between corporate and sovereign debt yields. Citing evidence from the academic literature and from empirical analysis the ENA provides evidence that an upward adjustment to the spot yield for ILGs of 50 to 100bps to determine the RFR for use in the CAPM.[47]

[47] ENA (2020) Ofwat Price Determinations: Submission by Energy Networks Association, para. 2.7 Link: https://assets.publishing.service.gov.uk/media/5ed0f2b3d3bf7f45fb321450/Energy_Networks_Association_submission.pdf

As explained in the ENA submission, the need for a detailed examination of whether the RFR has been underestimated has not arisen in any recent previous price controls, as the regulatory allowance for the RFR was set historically at a level above the spot yields on ILGs. As we have explained in previous NERA reports, UK regulators have in the past set the RFR based on long-term averages as opposed to (low) current rates.[48] However, as we describe above, Ofgem (along with other economic regulators) proposes to set the RFR based solely on spot yields of ILGs, which has highlighted a contradiction: with Ofgem's proposed use of RFR the estimate of the WACC increases with gearing contrary to finance theory that the WACC should be broadly independent of capital structure or the "Miller Modigliani irrelevancy proposition".[49,50] The adoption of a higher RFR adjusted for the gap between sovereign and corporate debt also corrects for this problem. (See also section 4.2.1. for a discussion of Ofgem's proposals and capital structure.)

2.2. Conclusions on TMR and decomposition into RFR and ERP

This section summarises our recommendations on the TMR and how this should be decomposed between the RFR and ERP components.

Table below also shows the implication of adopting a TMR based on arithmetic averages (as proposed by Cooper), as well as adopting higher RFR of between 50 and 100 bps to reflect the gap between sovereign and corporate highly rated debt, based on Ofgem's information date.

Table 2.6: We recommend a TMR of 6.9 to 7.8 per cent, with an RFR of -1.26 per cent and an implied ERP of 8.2 to 9.1 per cent for May 2020 information date (real, CPIH)

	Ofgem DD (July 2020)		NERA (May 2020, Ofgem DD info. date)		NERA (July 2020, updated info. date)		NERA (May 2020,Ofgem DD info. date) – incl. Cooper adjustment and RfR based on corporate yield	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
TMR	6.25	6.75	6.93	7.84	6.93	7.84	7.16%	7.84%
RfR	-1.48	-1.48	-1.26	-1.26	-1.18	-1.18	-0.76%	-0.26%
ERP	7.73	8.23	8.19	9.10	8.11	9.02	7.92%	8.10%

Source: NERA calculations and Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, pp.32-34.

48 NERA (April 2019), Cost of Equity for SPT in RIIO-2

49 Modigliani, F., and M. Miller, (1958), "The Cost of Capital, Corporation Finance and the Theory of Investment", American Economic Review 48, p261–297

50 The CMA highlighted the contradiction of using a low current market RFR in its examination of the optimal capital structure for NERL. Competition and Markets Authority (2020), 'NATS (En Route) Plc /CAA Regulatory Appeal: Provisional findings report', 24 March (CMA NERL Provisional Findings), Appendix D para 4. We note that CMA should have considered whether the Miller Modigliani held based on an analysis of the marginal cost of debt. However, if we correct for this, there remains a contradiction between the use of current market yields as basis for RFR and economic and financial theory on optimal capital structure.

We estimate a TMR of 6.9 to 7.8 per cent (CPI deflated) based on Blume/JKM, and towards the top half of this range if the TMR is based on arithmetic means only. By contrast, Ofgem retains its TMR range of 6.25 to 6.75 per cent from SSMD, based principally on the 2018 UKRN report, which proposes a TMR of 6 to 7 per cent (CPI real). As we explain in our previous reports for SPT[51], we consider that the UKRN's TMR estimate is understated in real CPI terms, due to relying on historical RPI/CPI series which overstates historical CPI inflation and applying an excessive downward adjustment to historical returns data for alleged predictability at long horizons.

[51] NERA (April 20109) Cost of Equity for SPT in RIIO-2, Appendix C.

3. Beta

In this section, we set out updated estimate for beta risk of SPT at RIIO-T2. We first present a summary of Ofgem's sector consultation and decision before setting out our own evidence for beta risk.

We recommend an asset beta of 0.38 to 0.40 on our preferred debt beta of 0.05. Our range is equivalent to 0.35 to 0.37 compared to Ofgem's 0.26 to 0.34, both on zero debt beta basis for comparison. Our range draws on up-to-date evidence for the set of UK network comparators, with NG as the lower bound, and upper bound based on European energy network betas.

3.1. Summary of Ofgem's RIIO-2 Sector Specific Consultation and Decision

3.1.1. May 2019 Sector Specific Methodology Decision

In its SSMD, Ofgem determined that it will estimate raw equity betas focussing on outturn data of at least 5 years, primarily using OLS but with GARCH as a cross-check. Specifically, Ofgem high case beta was based on an estimation timeframe of 5 years, and its lower case based on a 17.5 year period. Ofgem used high frequency daily data for its regression analysis which addresses our earlier concerns around use of low frequency quarterly data.[52]

Ofgem confirmed the use of a comparator set of five companies – SSE, NG, UU, SVT and PNN – but stated that it will consider at Draft Determination the weighting attached to each, including an assessment of relative systematic risk for the different sectors. [53] It determined a debt beta range of 0.1 to 0.15.[54] Additionally, Ofgem propose to adjust book values of debt for a market-to-book value of 1.03 to 1.06.[55]

3.1.2. Summary of Ofgem's Draft Determination

In its DD[56], Ofgem updates its cut-off date to 11th May 2020 and determines an asset beta in the range 0.34 to 0.39, with a debt beta of 0.125. Ofgem's beta range is based on the following new evidence presented at the Draft Determination:

- Ofgem's own OLS analysis of the empirical beta of GB energy and water comparators, including SSE, NG, UU, SVT and PNN[57];
- Robertson's update on the beta study using GARCH and OLS[58]; and

52 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 152

53 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 55

54 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, pp. 51-52

55 Ofgem (May 2019) RIIO-2 Sector Specific Methodology Decision, Finance, p. 57

56 Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.39-48.

57 Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.45.

58 Donald Robertson (29 June 2020), Re-Estimating Beta

- CEPA's report on relative risk analysis, de-composition analysis, and European energy network betas.[59]

Based on its own analysis, Ofgem estimates raw equity betas with OLS, using an estimation window of 2, 5, and 10 years, and an averaging period of spot, 2, 5, and 10 years. Ofgem finds that the majority of its estimated raw equity beta values between 0.55 and 0.70, and argues that SSE is an outlier compared to other companies due to its greater exposure to retail and generation businesses, and therefore higher demand risk. To calculate asset betas, Ofgem presents asset beta estimates derived using both market value of debt and book value of debt.[60]

To crosscheck its beta estimates, Ofgem refers to Robertson's beta estimates using the GARCH method, and concludes that the GARCH asset beta estimates are materially lower compared to OLS.[61]

Ofgem further refers to CEPA's report on beta estimation, and draws the following conclusions:

- GB pure-play water networks (UU and SVT) share similar risk characteristics as GB pure-play energy networks, and should be used as primary evidence to inform GB energy network betas. CEPA estimates GB water networks' asset beta range to be 0.34-0.39[62];
- Using its preferred sample of comparators, CEPA/Ofgem find European energy networks' asset betas lie in the range 0.35-0.40, consistent with GB water networks[63];
- CEPA considers beta decomposition has strong theoretical foundations and has been used in practice in UK regulatory proceedings, but there are practical issues in decomposing NG and SSE's group betas. CEPA concludes that translating the evidence from SVT and UU is less challenging than translating from decomposition of NG or SSE's group beta, when estimating the risk of a pure-play GB energy network.[64]

Based on the above evidence, Ofgem finds that asset betas of the four companies (NG, UU, SVT, PNN) are in the range 0.32 to 0.43, given 5-year and 10-year estimation windows, while CEPA's report supports a narrower range of 0.34 to 0.39. Ofgem concludes on an asset beta range of 0.34 to 0.39, with a point estimate of 0.365, using a debt beta of 0.125.[65]

3.1.2.1. Our primary concern with Ofgem

We have the following substantive concerns with Ofgem's approach in its DD:

- **GB utilities beta estimation:** we disagree with Ofgem's use of long-term time horizons and averaging periods, i.e. 10 year window, to estimate beta risk. This is contrary to the CMA's approach in its provisional findings for NERL, where the CMA draws on 2- and

59 CEPA (9 July 2020), RIIO-2: Beta estimation issues

60 Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.43, para 3.41-3.45.

61 Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.43, para 3.46.

62 CEPA (9 July 2020), RIIO-2: Beta estimation issues, p.5.

63 CEPA (9 July 2020), RIIO-2: Beta estimation issues, p.6.

64 CEPA (9 July 2020), RIIO-2: Beta estimation issues, p.7.

65 Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.43, para 3.48.

5-year daily and weekly beta estimates, using spot, 1-year, 2-year, and 5-year average betas.[66]

- **European energy networks comparators:** we disagree with Ofgem and CEPA's estimation method for European comparators, as well as CEPA's comparator selection. In particular, one of CEPA's comparators, Elia, has low transaction volumes, is illiquid and provides unreliable beta estimates. Also, CEPA neglects comparators that meet its own selection criteria, such as Acea and Naturgy. Using a comprehensive comparator set that includes liquid listed European energy networks, as well as the correct estimation methodology, the empirical evidence supports a beta range of 0.38 to 0.40 (with 0.05 debt beta).
- **Relative risk between energy and water networks:** we disagree with Ofgem and CEPA's conclusion that GB pure-play water networks (UU and SVT) should be used as the primary evidence for GB energy networks beta. In particular, Ofgem's consultant CEPA acknowledges that there are sector specific drivers of risk that imply higher risks for energy networks, and our comparative risk analysis shows that investors in SPT face higher risk than investors in water networks. Water networks are likely to understate SPT's beta risk, and SPT is likely to have a similar level of beta risk to NG.
- **De-composition analysis:** Ofgem has not taken into account the evidence from de-composition analysis of the inferred NG GB beta, which is theoretically sound and has been accepted in regulatory proceedings. We also disagree with Ofgem and CEPA's conclusion that the challenges in applying de-composition analysis outweighs the merits of this approach. Our inferred estimates for NG's GB networks beta, based on decomposition analysis, provide a beta range of 0.45 to 0.52, above NG's group beta.

In the following sections, we present our estimate for the asset beta of SPT:

- Section 3.2 discusses our empirical beta estimation methodology;
- Section 3.3 sets out our updated beta evidence on GB energy and water networks;
- Section 3.4 sets out updated beta evidence from European energy networks;
- Section 3.5 explains the relative risk between energy and water networks
- Section 3.6 reviews and presents the evidence on decomposition of group betas

3.2. Empirical beta methodology

3.2.1. Our estimation methodology

Our overall approach is to use ordinary least squares (OLS) statistical techniques, and to draw on relatively high frequency data (e.g. daily or weekly) and the estimation and averaging periods employed by CMA, namely 2 to 5 year estimation periods, and 1, 2 and 5 year averaging periods.

We do not rely on long timeframes, e.g. Ofgem's 10 years, for reasons described in an earlier report, namely that changes in regulatory risk, changes in the listed company activities; and

[66] CMA (March 2020), NATS provisional findings, para.12.78, p.147.

changes to the composition of the market portfolio make long run estimates unreliable as a measure of forward-looking risk.[67] In addition, we show in our November 2019 report that we should not rely on the most recent 1 or 2 year period, given that this is affected by political risks, namely the nationalisation debate, and regulatory risks around the price control, which have emerged as increasingly important risk factors since our earlier April 2019 report.[68]

Along with time-frames, the main other methodological issue relates to de-leveraging and re-leveraging. While Ofgem no longer adjusts the comparators gearing for MAR (which unjustifiably overstated gearing and understated asset betas)[69], it still proposes to use the market value of debt when de-levering the equity betas, which is the equivalent of its market value factor (MVF) adjustment in the SSMD. As we explained in our earlier report[70], the adjustment is not conceptually correct in the context of a regulated entity, because the prior claim by debtholders does not increase proportionately where debt interest costs decline as Ofgem continues to allow companies to recover historical debt coupon costs on average. However, we note that asset beta estimates are relatively insensitive to the MVF adjustment.[71]

In de-levering and re-levering the beta, we use book debt to market asset values, and the so-called Miller formula[72] which is the standard approach in GB regulation, i.e. used by the CMA in its previous determinations and the recent provisional findings for NATS.[73]

Overall, our beta estimation methodology is consistent with the approach used by the CMA in its provisional findings for NERL appeal in 2020.[74] In line with the CMA, we consider daily and weekly betas, with an estimation window of two-year and five-year.[75] In terms of

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67 NERA (2018), Review of UKRN report recommendations on beta estimation.

68 NERA (November 2019) Cost of Capital for SPT, Appendix B, link: https://www.spenergynetworks.co.uk/userfiles/file/RIIO-T2_Annex_9_SPT_WACC_report.pdf

69 See: NERA (2019) Cost of Capital for SPT, section 3.1.2 for a discussion of Ofgem's approach, pp. 27-28

70 NERA (2019) Cost of Capital for SPT, section 3.1.2 for a discussion of Ofgem's approach, p. 30

71 Application of the MVF has the effect of reducing the value by around 0.01. In assessing the magnitude of the MVF adjustment, we multiply the gearing ratio measured with book value of debt i.e. book value of net debt / (book value of net debt + market capitalisation) by the average of Ofgem's MVF lower and upper range, i.e. average of 1.03 and 1.06, and unlever the re-lever the equity betas of all comparators using the MVF-adjusted gearing ratio, assuming a debt beta of 0.05. For NG, the MVF-adjusted asset betas decline by around 0.01 relative to the asset beta calculated using the gearing ratio measured with book value of debt.

72 Also known as the "Harris-Pringle" formula

73 CMA (2015), Bristol Water plc - A reference under section 12(3)(a) of the Water Industry Act 1991, p.333; CMA (2014), Northern Ireland Electricity Limited price determination - A reference under Article 15 of the Electricity (Northern Ireland) Order 1992, p.13-40. CMA (March 2020), NATS provisional findings, para.12.105, p.157.

74 CMA (March 2020), NATS provisional findings, para.12.82, p.148-151.

75 The CMA notes that the use of 2-year and 5-year periods for beta measurement is consistent with normal practice, i.e. betas calculated based on share prices over a 2-year period or a 5-year period. When using weekly data, it gives the most weight to the five-year weekly betas, because of high standard errors around 2-year weekly betas, and also because some of these 2-year weekly betas appeared to be outliers. CMA (March 2020), NATS provisional findings, para.12.82, p.148.

the averaging period, we consider the current betas and averaging period of 1-year, 2-year and 5-year.[76]

3.2.2. Debt beta

In its Draft determination, [77] Ofgem continues to adopt a debt beta between 0.1 and 0.15, citing the evidence presented in the SSMD, and a UKRN study prepared by CEPA.[78]

We disagree with Ofgem's conclusion. As we explain in our earlier report, the academic evidence and regulatory decisions cited by Ofgem do not support its determination of a debt beta of 0.1 to 0.15, and we assumed a debt beta of 0.05.[79]

In addition to the evidence set out in our previous reports, the CMA has determined a debt beta of 0.05 in its recent NERL's provisional findings, consistent with our approach.[80] In particular, the CMA considers that the CAA's estimate of debt beta of 0.1 was not well-founded, and there was significant uncertainty over the ability to measure debt betas using the CAA's approach. The CMA uses a lower debt beta of 0.05, considering the low risk of NERL's debt, and a low gearing ratio. As we set out in our previous reports, the debt beta is likely to be higher the higher systematic risk, and therefore energy sector debt betas should be no higher than for NERL.[81] As with our previous report, we assume a debt beta of 0.05.

However, as noted by the CMA in its past decisions, the assumed debt beta has a negligible impact on the equity beta and cost of capital, assuming de-leveraging and leveraging is undertaken correctly.[82,83]

3.3. Updated empirical evidence from GB networks

Figure 3.1 shows the evolution of asset betas for listed GB networks comparators – National Grid, SSE, UU, Severn Trent and Pennon – over the past 10 years.

As discussed in our November 2019 report[84], the asset betas for the GB networks comparators have increased since the financial crisis in Europe (2011-2012) and the RIIO-T1 determination (2013), although they have declined again as we approach the re-setting of the price control.

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76 the CMA considers It notes that, given the uncertainty over measuring beta, this approach reduces the risk of error, and allows to take into account whether betas have been stable when interpreting the current beta estimates. CMA (March 2020), NATS provisional findings, para.12.89, pp.150-151.

77 Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.43, para 3.39.

78 CEPA (2 December 2019), Considerations for UK regulators setting the value of debt beta

79 NERA (2019) Cost of Capital for SPT, section 3.1.2 for a discussion of Ofgem's approach, p. 30

81 NERA (2019) Cost of Capital for SPT, section 3.1.2 for a discussion of Ofgem's approach, p. 30 and footnote 71

82 The assumed debt beta affects the notional cost of equity only to the extent that leverage for the comparators differs from the notional assumption. If empirical leverage is the same as notional and consistent debt betas are used for un-levering and re-levering, there is no impact on the re-levered cost of equity.

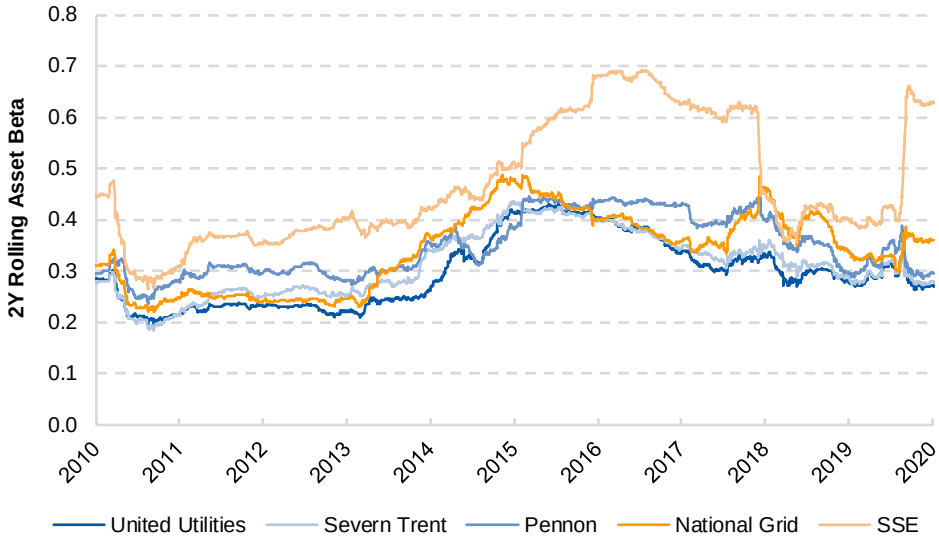
83 For example, at the BW 2015 appeal, the CMA assumed a debt beta of zero, noting that debt beta has very little impact on the overall cost of capital as BW's notional gearing level was similar to the comparators.

84 NERA (November 2019) Cost of Capital for SPT, p19, link: https://www.spenergynetworks.co.uk/userfiles/file/RIIO-T2_Annex_9_SPT_WACC_report.pdf

Around June 2018, where the Brexit referendum effect falls out of our sample, there is noticeable movement in companies' beta estimates. This effect is particularly pronounced for SSE, which shows a steep decline in its asset beta at this date. However, since June 2018, SSE's asset beta has behaved broadly in line with National Grid and the other comparators. We do not consider Ofgem's conclusion that SSE is not a relevant comparator based on revenue shares is valid. EBITDA is the more relevant measure of SSE's exposure to regulated business[85], and as per our previous report, we find that SSE's regulated network currently accounts for a significant portion of its group's business, up to three-quarters by operating profit, following the intended sale of its GB household retail business.[86] Therefore, we consider SSE as a relevant comparator, consistent with the CMA's approach in the 2014 NIE determination.[87]

More recently, SSE's asset beta increased sharply in March 2020, when the COVID-19 pandemic and associated economic lock-down led to a significant decline of stock prices across the world and an increase in stock volatilities. We observe a similar but less substantive increase in NG's beta during the COVID-period, whereas the water sector comparators' betas (UU, SVT, PNN) have all decreased after the initial uptick.

Figure 3.1: 2Y rolling asset betas for GB networks



Source: NERA analysis, cut-off: 21 July 2020, daily data, reference index: FTSE All Share. Debt beta is 0.05.

85 As we set out in a separate report, the relevant measure is a measure of the present value of future cash-flows and this is more adequately captured by EBITDA than revenue. See: NERA (13 March 2019) Review of Indepen reports recommendations on beta, A report for National Grid, section 3.2

86 SSE's 2019 annual account shows the network business account for 73 per cent of the adjusted operating profit and 58 per cent of adjusted EBITDA in FY2019, excluding discontinued activities (namely, sale of retail activities). Equity analysts estimate that SSE's regulated network business represents around 45 per cent of the group's enterprise value. Source: SSE (2019) Annual report, segmental accounts, p. 156: JP Morgan Cazenove, 13 September 2019, SSE plc, p.7; SSE plc 2019 Annual report, p.38-39, https://sse.com/investors/reportsandresults/media/0zva4vg0/sse-31464-annual-report-2019-web.pdf.

87 CMA (26 March 2014) Northern Ireland Electricity Limited price determination, A reference under Article 15 of the Electricity (Northern Ireland) Order 1992, Final determination, p 13-36.

As explain in Section 3.2, we apply the CMA approach to estimate the GB companies' betas, as shown in Table below.

Table 3.1: UK water and energy network betas: NG asset beta is around 0.38 (0.05 debt beta) on average over our preferred estimation periods, higher than water networks

	Averaging period			
Estimation period	**Today/Spot**	**Last Year**	**Last 2 Years**	**Last 5 Years**
All comparators				
2-year daily	0.37	0.34	0.35	0.40
5-year daily	0.39	0.40	0.41	0.39
2-year weekly	0.37	0.34	0.36	0.42
5-year weekly	0.40	0.40	0.41	0.39
Pennon				
2-year daily	0.30	0.31	0.33	0.39
5-year daily	0.35	0.38	0.39	0.38
2-year weekly	0.29	0.34	0.39	0.44
5-year weekly	0.36	0.41	0.43	0.41
UU				
2-year daily	0.27	0.29	0.29	0.34
5-year daily	0.30	0.33	0.34	0.33
2-year weekly	0.30	0.29	0.31	0.36
5-year weekly	0.33	0.35	0.36	0.35
SVT				
2-year daily	0.28	0.29	0.30	0.35
5-year daily	0.31	0.34	0.35	0.35
2-year weekly	0.29	0.29	0.33	0.38
5-year weekly	0.33	0.36	0.37	0.37
NG				
2-year daily	0.36	0.34	0.36	0.39
5-year daily	0.37	0.38	0.38	0.37
2-year weekly	0.35	0.33	0.37	0.40
5-year weekly	0.37	0.38	0.39	0.36
SSE				
2-year daily	0.63	0.48	0.44	0.55
5-year daily	0.64	0.58	0.57	0.54
2-year weekly	0.61	0.44	0.42	0.50
5-year weekly	0.61	0.52	0.51	0.47

Source: NERA analysis, including Pennon, UU, SVT, NG and SSE. We assume 0.05 debt beta. Information date is 21 July 2020 (weekly returns we used 17 July 2020). Asset beta is calculated using gearing based on book value of net debt.

In interpreting the data for SPT, we do not focus on very short-term estimates, i.e. those estimates that are based on spot or an averaging period over the last year, as there is evidence that increased political and regulatory risk has depressed asset betas over the most recent time periods, notably for water stocks. As explained in our previous report, increased political and regulatory risk tends to decrease beta estimate, since political and regulatory risks are less correlated with the market.[88] However, the political risk surrounding networks will

[88] NERA (November 2019) Cost of Capital for SPT in RIIO-2, Appendix B.

eventually be resolved, when the new price control come into effect in April 2021. Therefore, our recommendation is to not place undue emphasis on these transitory factors, and place less weight on these most recent periods. In addition, the very short-term estimates are heavily influenced by the financial market turmoil as a result of the COVID-19 pandemic. The effects on beta is pronounced and positive for SSE and to a lesser degree for NG. By contrast, betas for the water comparators appear to have declined marginally since March 2020 potentially because they are viewed as defensive stocks. The empirical evidence implies that energy companies face higher systematic risk than water comparators during the COVID-19 period, although the period of observation is too short to draw firm conclusions.

In terms of data frequency, we focus on estimates using high frequency data, i.e. estimated using daily data, as these provide estimates with the lowest standard errors.

Therefore, of the evidence presented in Table 3.1 we therefore propose to focus on those areas identified in highlighted squares, i.e. 2 and 5-year daily estimates (i.e. high frequency) based on 2 year and 5 year averaging periods to avoid placing undue weight on periods affected by i) political and regulatory events, and ii) short-term impact of COVID-19. For NG, the evidence supports an asset beta range of 0.36 to 0.39, with an average of 0.38 (0.05 debt beta).

3.4. European energy network asset betas

In this section, we set out updated estimate of betas of European energy networks to inform SPT's asset beta at RIIO-T2. We first present a summary of CEPA's analysis of European comparators before setting out our updated empirical beta evidence for listed European networks.

3.4.1. Summary of CEPA's methodology

To inform its asset beta range at Draft Determination, Ofgem commissioned a report from CEPA. As part of its review, CEPA draws on evidence from European energy networks which it considers may more closely reflect sector-specific risks that GB energy networks are exposed to than UK water networks.[89]

It applies four criteria in selecting suitable comparators:[90]

- Regulated share of value: the percentage of value (defined with reference to profits, assets or revenue) accounted for by pure play regulated energy network assets;
- Regime similarity: the high-level comparability of the regulatory regime to the UK (though it has not carried out a detailed relative risk analysis of each country's regimes);
- Liquidity: the trading liquidity of each comparator, in order to filter out those that may not have robust pricing data; and
- Data robustness: the reliability and robustness of the resulting beta estimates, including their volatility over time and sensitivity to modelling choices such as the reference index.

89 CEPA (July 2020), RIIO-2 Beta estimation issues, p.38.

90 CEPA (July 2020), RIIO-2 Beta estimation issues, p.40.

Based on above selection criteria, CEPA identifies a long list of 12 comparators, which also includes comparators proposed by network companies' advisers, and a short list of 6 comparators that it views match above criteria best and thus form its preferred sample.

Table 3.2 below sets out CEPA's long list of 12 comparators, and compares them to the samples of the network advisers (Oxera, Frontier and NERA).

Table 3.2: NERA's sample includes four of CEPA's comparators

Company	CEPA	Included in Oxera sample?	Included in Frontier sample?	Included in NERA sample?
Elia	Preferred list			
Red Electrica	Preferred list	Yes		Yes
Terna Rete	Preferred list	Yes		Yes
REN	Preferred list		Yes	
Enagas	Preferred list	Yes	Yes	Yes
Snam	Preferred list	Yes	Yes	Yes
Enel			Yes	
Endesa			Yes	
HERA			Yes	
A2A				
Fluxys				
Transelectrica			Yes	

Source: CEPA (July 2020), RIIO-2 Beta estimation issues, p.49.

CEPA excludes the six companies that are not on its preferred list due to low ratings in at least one selection criteria. However, it also shows asset beta estimates for its full list in order to illustrate the overall sensitivity.[91]

For its asset beta estimation, CEPA draws on daily estimates using a 2-year estimation window and long-term averaging periods of 5- and 10-years. Consistent with Ofgem's SSMD assumption, CEPA uses a 0.125 debt beta, but also shows estimates using a 0.05 debt beta.[92] CEPA draws on the Eurostoxx TMI as well as local indices as reference indices. It appears that CEPA uses an information cut-off date of 11th May 2020, consistent with Ofgem's DD.

CEPA estimates an asset beta range of 0.32 to 0.37 drawing on its preferred sample, based on 5-year and 10-year averages as well as against local indices and the EuroStoxx TMI (see Table 3.3).

Table 3.3: CEPA estimates an asset beta range of 0.32 to 0.37 (preferred sample, 0.125 debt beta)

	Local index		Eurostoxx TMI	
Sample	5-year average	10-year average	5-year average	10-year average
CEPA preferred	0.36	0.32	0.37	0.34
Full list	0.40	0.37	0.39	0.36

Source: CEPA (July 2020), RIIO-2 Beta estimation issues.

91 CEPA (July 2020), RIIO-2 Beta estimation issues, p.48.

92 CEPA (July 2020), RIIO-2 Beta estimation issues, p.50.

Based on its preferred set of comparators, CEPA concludes that its evidence appears broadly consistent with Ofgem's SSMD asset beta range of 0.35 to 0.40. It also appears to place more weight on the 5-year averaging period to guard against lower historical data for some comparators and higher bid-ask spreads over the longer 10-year horizon.[93]

3.4.2. Critique of CEPA's analysis

We have a number of concerns with CEPA's approach to the selection of the European comparators and its approach to estimation, which have the effect of understating betas for European comparators.

3.4.2.1. CEPA's comparators selection is flawed and underestimates beta

As discussed in section 3.4.1 above, CEPA applies four selection criteria to identify a list of six preferred comparators. However, there are two main issues with CEPA's comparator set that leads to an understatement of the asset beta range:

- CEPA includes one company that is illiquid, and does not provide a reliable beta estimate: Elia, a Belgian and German electricity transmission network operator.
- CEPA excludes two relevant comparators, which are valid energy networks that have similar risk profiles as SPT as shown in our previous reports: Acea and Naturgy.

CEPA, in its report to Ofgem, conducts a liquidity screening based only on the quoted bid-ask spread, but academic studies consider that bid-ask spread alone is not sufficient to determine the liquidity.[94] The criteria for a liquid market requires meeting criteria on five characteristics: (i) tightness; (ii) immediacy; (iii) depth; (iv) breath; and (v) resilience. While bid-ask spreads can be used to measure the tightness of the market in terms of transaction costs, trading volumes provide a measure of stock liquidity based on the market breadth and depth, which can equally be used to assess the robustness of the beta estimate.[95] We have further analysed the liquidity of the European comparators based on the associated trading volume, as shown in Table 3.4.

Table 3.4 presents the average trading volume of CEPA's preferred list of 6 comparators as well as Acea and Naturgy. Elia has the lowest trading volume of all EU comparators, followed by Acea, and REN. Acea and REN also have relatively low trading volumes, but our beta estimates are higher if we were to exclude Acea and REN from our sample, as shown in Table 3.7.

93 CEPA (July 2020), RIIO-2 Beta estimation issues, p.51.

94 K. Baker (1996), Trading Location and Liquidity: An Analysis of U.S. Dealer and Agency Markets for Common Stocks. Financial Markets, Institutions, and Instruments, Vol. 5, No. 4.

95 See, for example: A. Sarr and T. Lybek (2002), Measuring Liquidity in Financial Markets. IMF Working Paper, WP/02/232. Petersen and Fialkowski (1994), Posted versus effective spreads. Good prices or bad quotes? Journal of Financial Economics.

Table 3.4: Elia has the lowest trading volume of all EU comparators

Trading volume (in ths.)	2Y Average	5Y Average	10Y Average
Red Electrica	2,092	2,347	3,372
Terna	6,228	6,669	7,613
Elia	51	42	39
REN	740	816	604
Snam	10,637	11,416	10,780
Enagas	1,324	1,504	1,849
Acea	144	132	149
Naturgy	1,599	1,994	2,547

Source: NERA analysis.

In addition, CEPA excludes Naturgy and Acea because they have *"very low proportions of regulated activities and so we consider them unlikely to improve the overall robustness of Ofgem's asset beta judgement."*[96] However, CEPA's statement is incorrect as both Acea and Naturgy have substantial share of regulated business: Naturgy has a regulated share of EBITDA of 64 per cent in 2019, based on its Annual report; Acea's regulated share of EBITDA was 81 per cent in 2019, and consistently above 76 per cent for the last 6 six years. Both shares are also well above CEPA's own selection criteria threshold of 50 per cent of regulated activities.[97]

Moreover, as set out in our November 2019 report, relative risk assessment shows that Acea, an electricity distribution operator in Italy, as well as Naturgy, a Spanish gas distribution operator, bear similar risks as SPT.[98] Hence, Acea and Naturgy should be included in the sample as reasonable references for GB regulated network, and they improve the overall robustness of the asset beta assessment.[99]

3.4.2.2. CEPA's estimation methodology is inconsistent with CMA and understates beta

As discussed in Section 3.4.1, Ofgem draws on evidence from 5- and 10-year averaging periods, placing more weight on the 5-year averaging period. However, we do not consider it appropriate to place weight on an average period of 10 years, given that changes in the regulatory risk, changes in the listed company activities and changes in the composition of the market portfolio make long-run averages unreliable as a measure of forward-looking risk. The CMA agrees with our view in NERL provisional findings, and does not take into account evidence from 10-year averaging period and instead focuses on averaging periods of 2 and 5 years.[100] Also, CEPA only relies on 2-year daily beta estimates, as our replication of CEPA's

96 CEPA (July 2020), RIIO-2 Beta estimation issues, p.41.

97 *"Arguably any comparators with a lower share of regulated energy networks would be unlikely to materially improve the overall robustness of the analysis and so we seek to focus on businesses that are at least 50% regulated energy networks by value."* CEPA (July 2020), RIIO-2 Beta estimation issues, p.41.

98 NERA (November 2019), Cost of Equity for SPT in RIIO-T2, pp.49-50.

99 CEPA (July 2020), RIIO-2 Beta estimation issues, p.41.

100 CMA (March 2020), Nats provisional findings, p.150.

asset beta ranges indicates.[101] In contrast, the CMA estimated its asset beta range based on 2-year and 5-year daily as well as 2-year and 5-year weekly estimates.

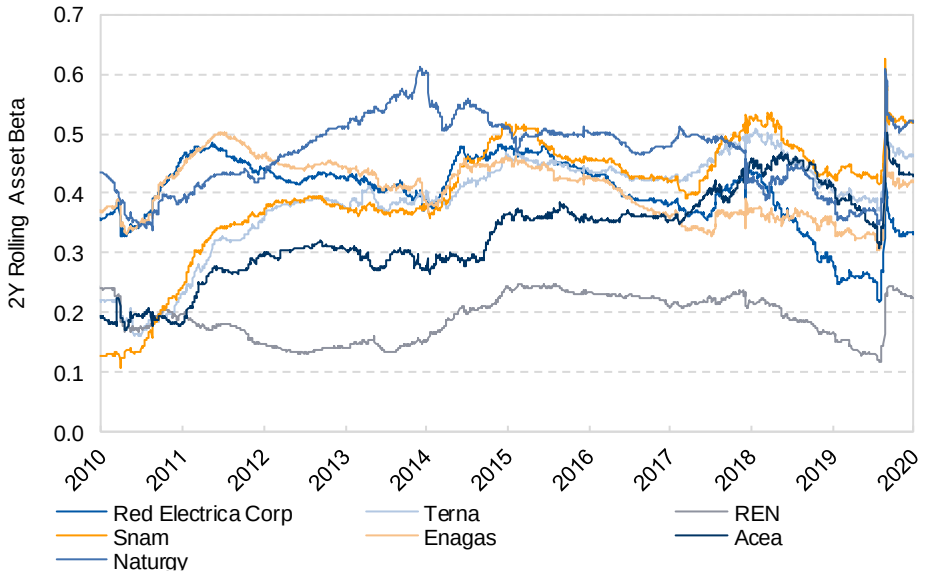
In addition, CEPA draws on local indices and the EuroStoxx TMI as benchmark indices for its EU beta estimation. However, both indices are inconsistent with the CMA's approach for the NERL provisional findings. The CMA, in its recent provisional findings on NERL, considers the EuroStoxx 600 as the appropriate benchmark for European market index, and argues that estimates using the local index are less accurate.[102]

Consistent with the CMA's approach, we use 2-year and 5-year averaging periods and 2-year and 5-year daily/weekly beta estimates, based on the EuroStoxx 600 as the benchmark index. We present out estimates in the next section.

3.4.3. Updated beta evidence from EU comparators

Figure 3.2 shows the evolution of asset betas of our EU network sample – Red Electrica, Terna, REN, Snam, Enagas, Acea and Naturgy - over the past 10 years. The asset betas for the EU network comparators have remained at a similar level between 2012 and 2018, followed by a gradual decline in 2019. We observe a sharp increase in asset betas in March 2020, reflecting equity market turmoil after Covid-19. Asset betas have remained at an elevated level for most comparators since then.

Figure 3.2: 2-year rolling asset betas of EU comparators have recently increased



Source: NERA analysis, cut-off: 21 July 2020, daily data, reference index: EuroStoxx 600. Debt beta is 0.05.

Table 3.5 shows updated beta estimates for the full set of 8 EU comparators, including (i) the common set of 4 comparators, (ii) NERA's additional comparators Acea and Naturgy, and (iii) CEPA's additional comparators Elia and REN, using the most recent cut-off date.

101 CEPA states that it uses daily asset betas but not the estimation period (CEPA (2020), RIIO-2 Beta estimation issues, p.39). However, our replication shows that CEPA uses a 2Y estimation window , as other estimation windows do not allow us to replicate its results. This is also consistent with its UK beta estimation, where CEPA indicates that it used 2Y daily asset betas (CEPA (2020) RIIO-2 Beta estimation issues p.37)

102 CMA (March 2020), Nats provisional findings, p.150 & p.154.

Consistent with our asset beta methodology for GB comparators, we follow the CMA approach of calculating asset betas for 2- to 5-year estimation windows and averaging them over different time periods.

Table 3.5: EU comparator betas based on CMA approach

	Averaging period			
Estimation period	**Today/Spot**	**Last Year**	**Last 2 Years**	**Last 5 Years**
Red Electrica				
2-year daily	0.33	0.29	0.32	0.38
5-year daily	0.36	0.38	0.39	0.41
2-year weekly	0.39	0.31	0.37	0.43
5-year weekly	0.42	0.41	0.43	0.45
Terna				
2-year daily	0.46	0.42	0.44	0.44
5-year daily	0.45	0.44	0.45	0.43
2-year weekly	0.45	0.36	0.38	0.36
5-year weekly	0.39	0.35	0.35	0.35
Enagas				
2-year daily	0.42	0.37	0.36	0.38
5-year daily	0.39	0.38	0.38	0.40
2-year weekly	0.46	0.36	0.39	0.40
5-year weekly	0.44	0.39	0.40	0.42
Snam				
2-year daily	0.52	0.47	0.47	0.46
5-year daily	0.47	0.46	0.46	0.44
2-year weekly	0.49	0.40	0.43	0.39
5-year weekly	0.43	0.38	0.38	0.37
Acea				
2-year daily	0.43	0.40	0.42	0.39
5-year daily	0.40	0.39	0.38	0.35
2-year weekly	0.55	0.43	0.44	0.41
5-year weekly	0.48	0.42	0.41	0.36
Naturgy				
2-year daily	0.52	0.42	0.42	0.46
5-year daily	0.49	0.48	0.48	0.49
2-year weekly	0.52	0.45	0.49	0.54
5-year weekly	0.54	0.53	0.55	0.56
Elia				
2-year daily	0.35	0.23	0.22	0.22
5-year daily	0.28	0.23	0.22	0.2
2-year weekly	0.32	0.24	0.24	0.22
5-year weekly	0.27	0.23	0.22	0.2
REN				
2-year daily	0.22	0.17	0.18	0.21
5-year daily	0.22	0.22	0.22	0.21
2-year weekly	0.28	0.21	0.23	0.22
5-year weekly	0.24	0.21	0.22	0.2

Source: NERA analysis. We assume 0.05 debt beta. Information date is 21 July 2020 (weekly returns we used 17 July 2020). Asset beta is calculated using gearing based on book value of net debt.

As discussed in section above, we exclude Elia from our EU comparator set due to its exceptionally low transaction volume, which may explain its low beta estimate. We estimate an interquartile asset beta range of 0.38 to 0.40, based on the set of 7 EU comparators - Red Electrica, Terna, REN, Snam, Enagas, Acea and Naturgy (see Table 3.6 below).

Table 3.6: We estimate an asset beta range of 0.38-0.40 based on EU comparators

	Averaging period			
Estimation period	**Today/Spot**	**Last Year**	**Last 2 Years**	**Last 5 Years**
All comparators				
2-year daily	0.41	0.36	0.37	0.39
5-year daily	0.40	0.39	0.39	0.39
2-year weekly	0.45	0.36	0.39	0.39
5-year weekly	0.42	0.38	0.39	0.39

Source: NERA analysis. We assume 0.05 debt beta. Information date is 21 July 2020 (weekly returns we used 17 July 2020). Asset beta is calculated using gearing based on book value of net debt. Comparators: Red Electrica, Terna, Enagas, Snam, Acea, Naturgy and REN.

Table 3.7 below shows that if we were to remove Acea and REN (which have the second and third lowest transaction volume, after Elia) from our comparator set, our interquartile asset beta range of 0.38-0.40 would increase to 0.41-0.44.

Table 3.7: We estimate an asset beta range of 0.41-0.44 based on EU comparators, excluding Elia, Acea and REN

	Averaging period			
Estimation period	**Today/Spot**	**Last Year**	**Last 2 Years**	**Last 5 Years**
All comparators				
2-year daily	0.45	0.39	0.40	0.43
5-year daily	0.43	0.43	0.43	0.44
2-year weekly	0.46	0.38	0.41	0.42
5-year weekly	0.44	0.41	0.42	0.43

Source: NERA analysis. We assume 0.05 debt beta. Information date is 21 July 2020 (weekly returns we used 17 July 2020). Asset beta is calculated using gearing based on book value of net debt. Comparators: Red Electrica, Terna, Enagas, Snam, Naturgy .

3.5. Relative risk analysis between energy and water networks

3.5.1. CEPA acknowledges factors that mean energy and water not substitutes

In the DD, Ofgem cites CEPA's relative risk analysis, and argues that pure-play energy networks in GB have several similar risk characteristics as pure-play GB water networks, suggesting that SVT and UU are appropriate comparators for estimating betas for pure play GB energy networks.[103]

[103] Ofgem (9 July 2020), RIIO-2 Draft Determinations – Finance Annex, p.39-48. CEPA (9 July 2020), RIIO-2: Beta estimation issues, p.13-38.

However, CEPA in its own report acknowledges that there are some different sector specific drivers of risk that could imply a higher risks for energy networks.

For example, CEPA states that "*In light of the similarities, we consider that a suitable starting hypothesis is that GB water networks would be considered by many investors to be a reasonable investment substitute for GB regulated energy networks and hence informative as to the latter's asset beta. Within this, however, there are aspects of risk exposure that are difficult to conclude on decisively and they cannot be considered perfect substitutes.*

However, depending on the weight placed on different components of risk we recognise that energy networks may be judged riskier than water networks (though the converse may also be also true in relation to some sources of uncertainty such as climate change and resulting water resource pressure). Investment in energy networks will be driven by factors such as the expected long-term use of gas and electricity networks (e.g. in supply of heating or power generation). Equity holders in energy networks are invested in long-lived assets and so their expected returns in the sector may be sensitive to these long-term drivers and the cashflow risks they may create, to the extent they are cyclical and systematic.

As a consequence, European energy networks as a comparator group and investment substitute to a GB energy network may more closely reflect these sector-specific risks that GB energy networks are exposed to."[104]

3.5.2. TOs face greater system, capex, competition, and net zero risks

As we described in our earlier report for SPT, while the regulatory regimes in energy and water are closely aligned, our comparative risk analysis suggests that investors in SPT face higher risk than investors in water networks (and indeed other energy networks) for the following reasons:

- Greater system operability risks associated with TOs;
- Greater uncertainty over the future role of SPT in a decarbonised energy sector with prospects for decentralised generation

In relation to the latter, the government's decarbonisation agenda is driving significant changes in the energy supply market with traditional sources of energy supply replaced with divergent mix, with material yet uncertain implications for TOs. The potential for increased levels of embedded generation and storage at the distribution level may lead to changes in the use of transmission networks at T2 and beyond.

Complexity and size of investment

We also considered that TOs face greater risk from the complexity of investment. At RIIO-T1, Ofgem considered both the scale and complexity of investment as risk factors. Ofgem took into account factors such as the size of the project, the number of projects, interlinkages with other projects and the projects' bespoke nature when assessing the complexity of networks' investments.[105]

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104 CEPA (9 July 2020), RIIO-2: Beta estimation issues, p.38.

105 Ofgem (2012), RIIO-T1: Final proposals for National Grid Electricity Transmission and National Grid Gas – Finance support document, Table 3.3

Table below compares the capex/RAV ratios of SPT, GDN's and UK water companies at the most recent price controls. As shown in the Table, SPT has higher capex/RAV ratio than GDNs and water companies, implying greater relative capex size and higher investment risks for SPT compared to GDNs and water networks.

Table 3.8: SPT faces higher capex risk than UK GD and Water

	SPT		Gas Distribution		Water	
	RIIO-1	RIIO-2	RIIO-1	RIIO-2	PR14	PR19
Capex/opening RAV	15%	7-12%	6%	5-7%	6-8%	6-7%

Note: For SPT and GDN's, the RIIO-2 range is based on baseline totex (lower bound) and illustrative totex (upper bound). For Water companies, the PR19 range is based on WaSC average (lower bound) and WOC average (upper bound).
Source: NERA Analysis.

In the RIIO-1 determination, Ofgem noted that companies with a higher capex to RAV ratio to be more exposed to cash flow risks and thus higher risk than those with smaller capex programmes: "*We consider the ratio of capex to RAV to be a better indicator of the riskiness of an investment programme than simply looking at absolute capex levels. This approach is also consistent with the considerations of the major credit rating agencies. Where this ratio is higher, we consider the company to be potentially exposed to higher cash flow risk, and vice versa.*"[106,107]

Competition risks

We also noted that TO faces greater competition risks, given DECC's (now BEIS) proposal "extending competitive tendering in the GB electricity transmission network" (CATO), which is intended to follow a similar framework to the Offshore Transmission Owner (OFTO) regime.[108] Ofgem has also published proposals to introduce a competition proxy model (CPM) and a special purpose vehicle (SPV) model, which can proceed ahead of CATO[109], and has identified a number of projects which it expects to subject to CPM or SPV approach. These models are likely to expose TOs to greater risk, given the greater

106 Ofgem (2012), RIIO-GD1: Final Proposals - Finance and uncertainty supporting document, para. 3.17.

107 Ofgem further states that capex plays a particularly important role in determining a company's cashflow position, noting that "*…the main factor [that potentially influences cash flow risk] is the way the regulatory framework interacts with the company's expenditure. This manifests itself in two key ways: the scale of allowed investment during the price control period, and the extent to which the company is exposed to cash flow implications of actual expenditure differing from the allowance.*" Surce: Ofgem (2012), RIIO-GD1: Final Proposals - Finance and uncertainty supporting document, para. 3.14.

108 DECC (January 2016), Extending competitive tendering in the GB electricity transmission network, IA No: DECC 3088(1)

109 Ofgem (2018), Impact Assessment on applying the PSV and CPM to future new, separable and high value projects, p. 14

construction[110] and operational risks.[111] In its DD, Ofgem has committed to increasing early and late competition models over RIIO-2.[112]

3.5.3. Empirical data shows that investors perceive energy faces higher systematic risk

As shown in Figure 3.1 and Table 3.1, the empirical data also supports persistently higher betas for energy networks (NG, SSE) compared to the water companies (UU, SVT, PNN), suggesting higher risks for energy networks than water companies. We therefore consider that water networks are likely to understate SPT's beta risk, and SPT is likely to have a similar level of beta risk to NG.

3.5.4. RIIO-2 framework has deteriorated from a risk perspective

We also consider that investors face greater risks under RIIO-2 rather than RIIO-1 regime, and this is supported by rating agency comments on the riskiness to the regime. Although Moody's maintain its Aaa sub-rating for the stability and predictability of the regime, Moody's note that the framework has deteriorated from a risk perspective, notably given Ofgem's reduction to the allowed return for assumed outperformance:

- *Social risks have ... become evident, with the regulator diverging at the margin from established practice following criticism. Ofgem's new outperformance wedge for the forthcoming RIIO-2 price controls will reduce allowed equity returns and weaken adjusted interest coverage ratios.* [113]
- *the inclusion of an 'assumed outperformance wedge' in the cost of capital calculation represents the largest shift from precedents. […] The change represents a departure from established regulatory practice, adherence to which has supported widespread confidence in the stability and predictability of the regime. As such, it is credit negative.*[114]
- *Assuming no outperformance and in the absence of measures to protect credit quality, the regulator's wedge will lead to even weaker adjusted interest coverage ratios. This is*

110 Ofgem states that construction and delivery risk will remain largely with the TO but with "*sharing factor for underspend and efficient overspend*". Thus, Ofgem intends to subject over-spends to efficiency test, which increases regulatory risk relative to the RIIO counterfactual where there is no such qualification. Ofgem (July 2018) Hinkley-Seabank project: decision on delivery model, Appendix 3.

111 TOs are exposed to a higher level of risk under these competition models as operational and maintenance cost allowance set over the contract period as opposed to subject to periodic review. The CPM/SPV approach thereby exposes the TO greater risk from asset failure that increase cost, and unexpected increases in the cost itself. Ofgem (July 2018) Hinkley-Seabank project: decision on delivery model, Appendix 3

112 Ofgem (2020) Consultation - RIIO-2 Draft Determinations - Core Document, p. 108

113 Moody's (3 August 2020) Regulated Energy Networks – UK: RIIO-2 proposals support sector's business risk profile, but legitimacy in greater focus, p. 1

114 Moody's (3 August 2020) Regulated Energy Networks – UK: RIIO-2 proposals support sector's business risk profile, but legitimacy in greater focus, p. 2

because allowed equity returns will be roughly halved on a like-for-like basis from those in the RIIO-1 controls that started in April 2013. [115]

Moody's has also put National Grid and its subsidiaries on negative outlook, in part citing the forthcoming price control and materially reduced scope for financial outperformance compared to the current control.[116]

3.6. NG group beta decomposition

As per our earlier report for SPT, we consider how NG's non-UK regulated businesses affect its asset beta. In our earlier reports[117], we explained that NG's US business has been less risky than its UK business for the following reasons :

- Shorter regulatory periods for National Grid's US business (mostly 3-4 years, except gas businesses in Massachusetts), reducing within-period volatility of returns with more frequent updating of revenues in line with costs;
- Greater use of cost pass-through or true ups, e.g. for commodity prices and mandated capex;
- Greater objectivity in setting allowed costs, in most cases set based on outturn costs for a base year and projected forward, without explicit efficiency factors that reduce allowances over time. By contrast, RIIO draws on more subjective comparative efficiency analysis and technical review of costs; and,
- US regulatory regimes are determined with reference to case law which has been tested in the courts. The nature of the proceedings offers greater investor security relative to the more subjective approach, and weaker appeals mechanisms, associated with GB price controls.

We update National Grid's asset beta decomposition into a UK and US asset beta from our November 2019 report.

The decomposition of NG plc's beta is done through the following equation:

$$\beta_{National\ Grid} = \frac{Regulated\ assets\ in\ UK}{Total\ regulated\ assets} * \beta_{UK} + \frac{Regulated\ assets\ in\ US}{Total\ regulated\ assets} * \beta_{US}$$

$$\beta_{National\ Grid} = 50\% * \beta_{UK} + 50\% * \beta_{US}$$

As we explained in our earlier report, to estimate the US beta, we rely on a set of 20 US network comparators, who mainly engage in regulatory energy network, retail, or generation activities. Furthermore, we consider that 3 of these comparators provide a more accurate representation of the risk to which NG's US assets are exposed, given that they operate in the same states and hence are exposed to similar regulatory regimes. These companies are

115 Moody's (3 August 2020) Regulated Energy Networks – UK: RIIO-2 proposals support sector's business risk profile, but legitimacy in greater focus, p. 3

116 Moody's (24 August 2020) Moody's changes outlook on National Grid plc and most subsidiaries to negative; affirms ratings

117 NERA (November 2019) Cost of Capital for SPT; NERA (April 2019) Cost of Equity for SPT in RIIO-2, Appendix G.4.

Consolidated Edison, Unitil Corp and Eversource Energy. Table 3.9 below shows the implied NG UK energy network asset betas based on the reduced comparator set (we present the results using our full comparator set in Table C.1).

As shown in Figure 3.3, NG's inferred GB asset beta has fallen recently as a result of market volatility during the COVID-19 period, explained by a sharp increase in US energy network comparator betas. This is potentially explained by short-term COVID impacts.[118] However, over the longer period since 2015, NG's inferred asset beta has been stable and no lower than 0.40. Consistent with our GB evidence, we do not place weight on short-term beta estimates due to the heightened market volatility during the COVID-19 period.

Overall, it supports a range 2-year and 5-year asset beta range of 0.45 to 0.52, higher than our preferred asset beta estimates for NG Group plc (0.36 to 0.39).

Table 3.9: We estimate NG's UK beta of 0.45 to 0.52 based on three most direct comparators operating in same/similar states

	NG overall		US		UK	
Share of regulated assets			50%		50%	
	Averaging period					
Estimation period	last 2 years	last 5 years	last 2 years	last 5 years	last 2 years	last 5 years
2-year	0.36	0.39	0.22	0.25	0.51	0.52
5-year	0.38	0.37	0.26	0.30	0.51	0.45

Source: NERA analysis.

Overall, we consider decomposition of NG's group beta to be the most reliable analysis, because we could identify US comparators that provide an accurate representation of the risk to which NG's US assets are exposed.

We have not decomposed SSE's asset beta, as we lack pure play generation and retail businesses to robustly estimate the beta risk associated with these other business activities, as 35 per cent from relatively low risk renewable contracted generation. Nevertheless, CEPA's own estimate of SSE's inferred GB beta shows an average above 0.4 over the past five years, which is consistent with our analysis of NG group beta decomposition.[119]

3.6.1. Critique of CEPA's decomposition analysis

In its report, CEPA presented evidence of decomposition analysis of NG's and SSE's group betas. In general, CEPA argues that there are several sources of uncertainty that could make the inferred GB beta volatile.[120] In particular, CEPA argues that decomposed results are more volatile than either GB water or European energy comparators.[121] In addition, CEPA presents evidence of inferred GB network beta by decomposing US listed PPL, which owns Western Power Distribution (WPD). CEPA's estimated inferred GB beta based on PPL is

118 For example, Moody's states that "Regulatory protections around recovery of incremental bad debt and coronavirus related costs are less comprehensive for National Grid's US operations". See Moody's (14 August 2020) Moody's changes outlook on National Grid plc and most subsidiaries to negative; affirms ratings

119 [Reference]

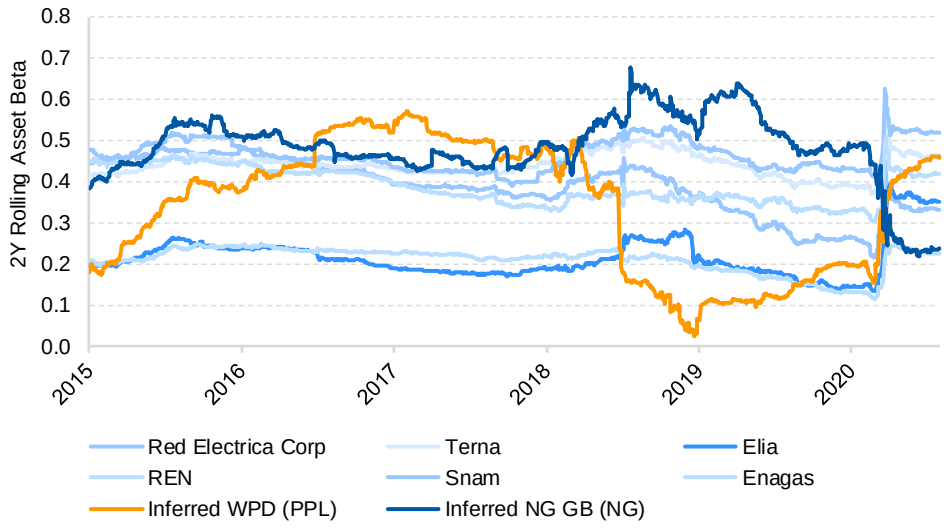
120 CEPA (9 July 2020), RIIO-2: Beta estimation issues, p.52-65

121 CEPA (9 July 2020), RIIO-2: Beta estimation issues, p.57

significantly lower than the inferred GB beta based on NG and SSE, as well as GB water network comparators.

We identify two major issues with CEPA's decomposition analysis. First, CEPA's comparison of the volatility of NG's inferred beta and GB water and European energy comparators is misleading, as it compares the volatilities of individual inferred betas with the average of multiple water and European energy comparator betas, which are smoothed and less volatile as a result of the averaging. Therefore, the relative volatility comparison of the inferred beta in CEPA's report is visually exaggerated. In fact, as shown in Figure 3.3 and Table 3.10 the volatility of NG's inferred GB beta is within the range of CEPA's own European energy comparator set, demonstrating that NG's inferred beta is no more volatile than the European energy networks.

Figure 3.3: NG's inferred GB beta shows similar trend with CEPA's own European comparators, but inferred WPD beta from PPL shows a highly volatile trend



Source: NERA analysis

Table 3.10: Volatility of NG's inferred GB beta is similar to those of the European comparators, but inferred GB beta from PPL is much more volatile

	Inferred NG GB (NG)	Inferred WPD (PPL)	CEPA EU comparator set
Coefficient of Variation (std.dev / mean)	0.17	0.46	0.07 - 0.24

Source: NERA analysis

In addition, as shown in Table 3.10, the volatility of inferred WPD beta from PPL is more than double of NG's volatility and also clearly above the upper bounds of the European energy comparators' volatility range. Also, as shown in Figure 3.3, the evolution of the inferred WPD beta from PPL is inconsistent with the European energy comparators as well as the inferred NG GB beta, suggesting that the inferred WPD beta may reflect idiosyncratic elements that only affects PPL or WPD, but not for other energy networks.

3.7. Conclusion on Beta

In its DD, Ofgem determines an asset beta in the range 0.34 to 0.39, with a debt beta of 0.125 drawing on evidence of UK water and energy networks and European comparators, supported by its consultants CEPA. We have identified errors in CEPA's analysis which means that Ofgem' proposed range understates SPT's beta risk.

For European energy networks, CEPA's comparator selection includes Elia, which has low transaction volumes and is likely to explain its low beta estimate. CEPA also wrongly excludes Acea and Naturgy for apparent low proportions of regulated activities, and yet both have sufficiently high regulated business share to meet CEPA's own criteria.

In terms of its beta estimation methodology, it draws on 2-year daily beta estimates only (averaged over 2- and 5-years), which is inconsistent with the CMA's approach at NERL provisional findings, where the CMA estimated asset betas based on 2-year and 5-year daily as well as 2-year and 5-year weekly estimates. Furthermore, CEPA draws on a 10-year average period to inform its beta range which provides an unreliable measure of forward-looking risk. CEPA also estimates betas against local indices as well as the EuroStoxx TMI, whereas the CMA employs the EuroStoxx 600 as the best available market benchmark.

Correcting for these errors, namely, extending CEPA's European sample set to include Acea and Naturgy and excluding Elia, and employing estimation periods consistent with the CMA, we estimate an asset beta range of between 0.38 and 0.40 (0.05 debt beta).

We also consider CEPA is wrong to reject the decomposition analysis which supports a far higher beta for NG's GB energy networks. CEPA concludes incorrectly that NG's inferred beta is more volatile than GB water and European energy comparators. Also, CEPA's analysis of the inferred WPD beta from PPL is unreliable, as the WPD inferred beta shows highly volatile trend of the past five years. For example, the volatility of WPD's inferred UK network beta is more than double the volatility of NG's inferred GB beta.

Of the set of UK networks, we consider that NG provides the most reasonable estimate of SPT's beta risk given, as a comparable UK energy network. CEPA's own relative risk analysis acknowledges that investors in energy networks face greater risks than water networks. In previous reports, we have identified risks in relation to the decarbonisation and competition agendas that are likely to explain higher beta risk and provide updated evidence on capex risks, as evidenced by higher capex:RAV ratios for SPT relative to other networks. Moreover, the empirical evidence over a sustained period shows higher beta risk for NG and SSE relative to water networks.

For our lower bound beta estimate, we assume NG's average beta of 0.38 – based on 2 and 5 year estimation periods, and 2 and 5 year averaging periods, and daily estimates – consistent with the range of estimation approaches employed by the CMA. We consider that this represents a reasonable lower bound, as NG's asset beta will also reflect the risk associated with its lower risk US network operations. Our decomposition analysis supports a higher beta value for NG's GB network of at least 0.45. For our upper-bound, we draw on the upper-quartile range for the European comparators of 0.40.

On a like-for-like basis, our asset beta range is 0.38 to 0.40 (0.05 debt beta) compared to Ofgem 0.30 to 0.35 (assuming the same 0.05 debt beta).

4. Cross-Checks on CAPM Cost of Equity

In its DD, Ofgem has provided a series of cross-check on its CAPM-implied cost of equity ("step 2").[122] Ofgem has provided updated evidence on MARs, which we respond to below (Appendix D contains a detailed discussion of the evidence on MARs). Otherwise, Ofgem's cross-checks largely relative to evidence from OFTO, investment funds, and investment managers, where we summarise our concerns with reference to our previous reports for SPT.

4.1. Updated MAR Analysis

Ofgem draws on CEPA's MAR analysis to justify downward adjustments to its cost of equity estimate

In its recent report for Ofgem, CEPA estimated MARs for listed UK water and energy companies to infer investor views of the cost of equity for the energy sector at RIIO-2. It estimates positive MAR premia of between c. 10 and 40 per cent for UK water and energy companies. [123]

As set out in more detail in Appendix D.1, Ofgem draws on CEPA's MAR analysis in step 2 as well as step 3 of its cost of equity cross-checks, justifying downward adjustments to its cost of equity estimate. Specifically, in step 2, Ofgem draws on CEPA's estimated MAR premia of around 20 per cent for UK water companies at 31 December 2019 (post Ofwat's PR19 final determination), to justify an allowed return on equity of 4.2 per cent, a 10 bps downward adjustment of its CAPM cost of equity.[124] Ofgem's allowed return on equity in step 3 is informed by CEPA's estimated MAR premia for NG and SSE of 10 to 20 percent at 29 May 2020, supporting a further deduction from its cost of equity estimation of 25 bps.[125]

The above two adjustments result in a baseline allowed return on equity of 3.95 per cent over RIIO-2, 35 bps below Ofgem's initial cost of equity estimate, based on 60 per cent notional gearing. However, given the uncertainties around the expected outperformance analysis, Ofgem proposes an ex-post top-up of up to 25 bps if outperformance does not materialise as expected.[126]

There is no strong evidence that MARs are different from 1

In Appendix D we present our analysis on MAR evidence for NG and two water companies (UU and SVT). For NG, a key issue in the estimation of MAR for its GB network businesses involves the adjustment of market value for its substantive US operations. We find that the

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122 Ofgem (2020) RIIO-2 Draft Determinations – Finance Annex, p. 53

123 CEPA (July 2020), RIIO-2: Use of market evidence, pp.21-22.

124 "The MARs cross-check is persuasive. As noted at paragraphs 3.67 to 3.74, market reactions to Ofwat's allowed return on equity of 4.19% (appointee level) is, we expect, priced into MAR values for UU, SVT and PNN. Compared to other cross-checks there are fewer comparison issues, given the consistent notional gearing of 60% and the view that systematic risk is similar for energy and water networks." Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, p.66.

125 "We accept that estimating and interpreting MAR premiums is subject to uncertainty, and are mindful that inferences reflect assumptions and periods chosen. However, in the context of RIIO-2, expected outperformance of 0.25% is, using the stylised model presented above, equal to a MAR of approximately 1.0135. Clearly, an implied premium of 1.35% is a cautious interpretation of market evidence indicating premiums of 10% or greater. Therefore, we believe that expected outperformance of 0.25% is a fraction of the outperformance that is reasonably derived from MAR evidence." Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, p.78.

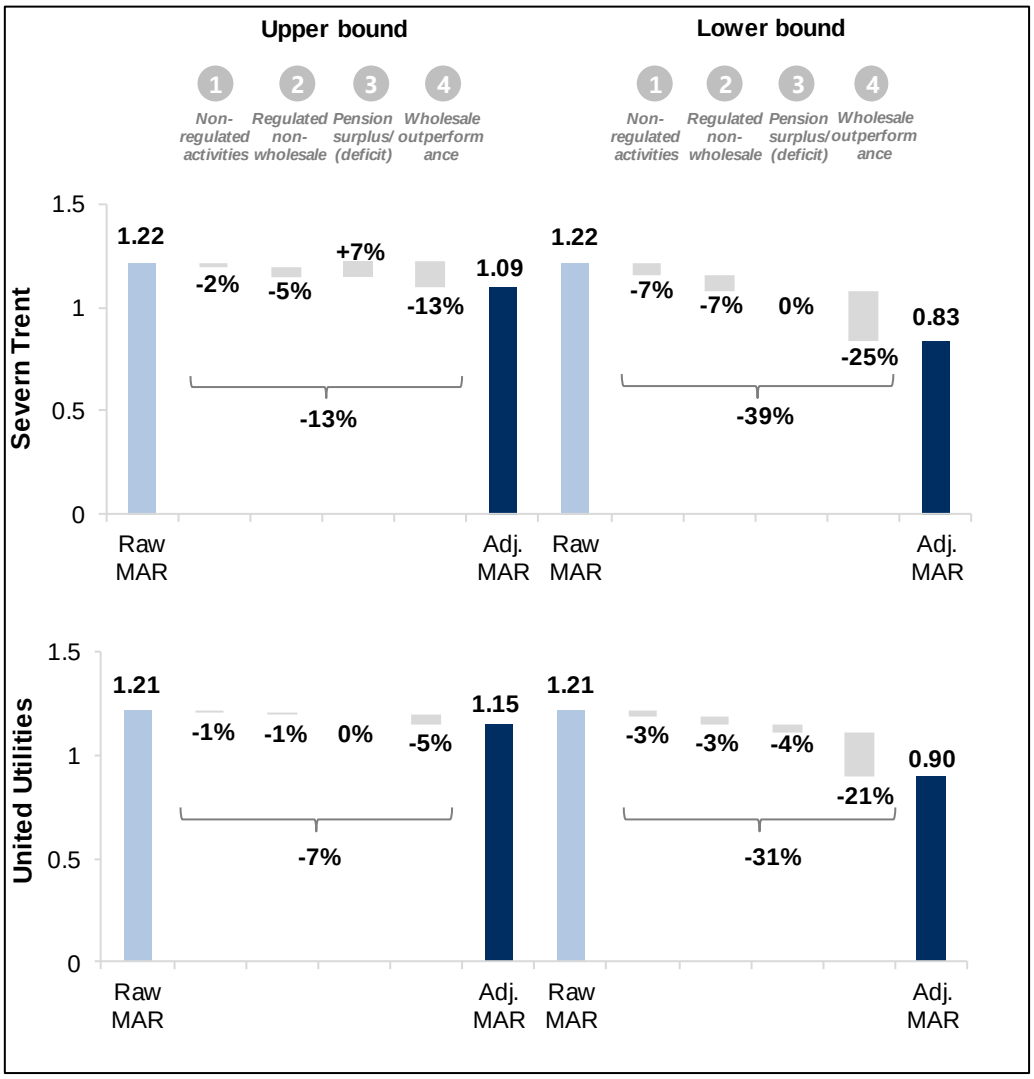
126 Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, p.83.

scale and uncertainty of the value of NG US operations, which represent around half of its asset value but where analyst estimates vary, makes it difficult to draw any meaningful conclusions on MARs for its GB networks. Drawing on analyst estimates of the value of US regulated activities and non-regulated activities, the estimated MAR lies in a very wide range between 0.33 and 1.37, which does not allow us to draw any reasonable inferences regarding the cost of equity. Notably, this range is derived prior to making any adjustments for expected outperformance over the remaining years of RIIO-1, and subsequent reviews. Therefore, our MAR estimates for NG are overstated.

Similar to NG, the enterprise value of water companies is driven by a number of factors which are unrelated to the cost of capital and which need to be removed from the raw MAR estimates to calculate an adjusted MAR for the wholesale business. It appears CEPA's analysis only adjusts the observed MARs to account for non-UK and non-regulated businesses. CEPA fails to take into account the other adjustments for non-wholesale regulated activities, pension deficits and future expected outperformance of water companies, which explain part of CEPA's residual RAB premium (see Appendix D for a detailed discussion).

We adjust the water companies' raw MAR for (i) non-regulated activities, (ii) non-wholesale regulated activities, (iii) pension deficit/surplus, and (iv) outperformance for wholesale businesses. Similar to NG, we find that analyst estimates of the value of the adjustments are uncertain, albeit to a lesser extent than NG. The sum of all the adjustments (13 to 39 per cent for SVT and 7 to 31 per cent for UU) is able to explain the observed RAB premium of 22 and 21 per cent for SVT and UU respectively.

Table 4.1: The required adjustments more than explain observed RAB premium for water companies



Note: Ranges for adjustments for each of the factors based on min and max of all analyst estimates.
Source: NERA analysis based on equity analyst reports. See Appendix D.3 for detail.

In summary, we conclude that MAR evidence is not a reliable method for backing out the cost of equity for NG's and the water companies' UK regulated business, given the magnitude and variation of the required adjustments. Nevertheless, once the raw MAR for water and energy companies is adjusted to take into account all the relevant factors that explain company valuations, we find no evidence to conclude that the adjusted MAR for the UK water wholesale and energy businesses is above 1 and therefore that the allowed return on equity exceeds investors' expected cost of equity.

4.2. Other Cross-Checks

4.2.1. Overall WACC Cross Check

Ofgem calculates the cost of capital for each of the five comparators, drawing on observed raw equity betas at observed gearing levels, Ofgem's TMR and RFR assumptions, and a cost

of debt of 1.74 per cent.[127] The implied real cost of capital lies in the range of 2.4 per cent (for UU and SVT) to 4.6 per cent (for SSE).

Ofgem then derives a "*cost of equity inference at 60 per cent gearing based on flat WACC hypotheses*", which provides a cost of equity of 3.3 per cent (SVT) to 9.0 per cent (SSE). Ofgem's own cost of equity at notional level is 3.6 to 5.0 per cent.

Ofgem invites stakeholders' views on whether it should place more weight on "*raw equity betas for UU and PNN such that the notional equity beta remains in line with the most applicable market data*".[128] To supplement this, Ofgem asks whether it should align its notional gearing with observed gearing for the preferred comparators.

We do not believe Ofgem should align notional gearing with its preferred comparators. We observe a relatively wide range of gearing decisions for the water and energy comparators – from 36 per cent (SSE) to 58 per cent (UU), on a five-year basis. Even if we were to exclude SSE (which we do not agree with), the range is 44 per cent to 58 per cent (UU).[129] Thus, it is not clear how Ofgem could align its notional gearing, given the range. Inevitably, Ofgem would need to determine a point in the range, and will need to re-lever/de-lever comparator betas accordingly. Moreover, Ofgem's use of four comparators to determine notional gearing – including only one energy network – places a great deal of emphasis on capital structure decisions of a small number of firms that may not be relevant to energy networks.

The motivation for this cross-check appears to be to address concerns around the positive relationship that is observed between gearing and the cost of capital, which violates the standard (Miller-Modigliani) theory that the cost of capital is invariant with capital structure. By contrast, under Ofgem's set of CAPM-WACC assumptions, the cost of capital increases by 10bps for each 5 percentage points increase in gearing.[130]

As noted by Ofgem, the CMA NERL inquiry has considered the relationship between capital structure and WACC[131], itself citing analysis by the UKRN report.[132] The UKRN report (and CMA NERL) set out the condition under which the M-M proposition would hold. For M-M to hold, using Wright's terms we have:

Condition for MM: $RP_D = \beta_D * RP_M$

Where RP_D is the risk premium on debt; RP_M is the market or equity risk premium (more often denoted ERP); and, β_D is the debt beta.

This shows that where the risk premium on debt (cost of debt less RFR) is greater than the premium on debt implied by the CAPM (β_D*ERP), an increase in leverage, will increase the cost of capital. This is the case at RIIO-2. However, it is not surprising that the condition for

127 Ofgem (2020) RIIO-2 Draft Determinations – Finance Annex, p. 55. Link: https://www.ofgem.gov.uk/system/files/docs/2020/07/draft_determinations_-_finance.pdf

128 Ofgem (2020) Consultation – RIIO-2 Draft Determinations – Finance Annex, para. 3.75, p. 55.

129 Based on Ofgem's measure of gearing, using its market value of debt. Ofgem (2020) Consultation – RIIO-2 Draft Determinations – Finance Annex, Table 13, p. 42.

130 Ofgem (2020) Consultation – RIIO-2 Draft Determinations – Finance Annex, p. 54.

131 See section 2.1.1 for a discussion of CMA NERL comments on capital structure.

132 Wright, S. et al (2019) Estimating the cost of capital for implementation of price controls by UK Regulators, pp. 23-24

M-M does not hold at RIIO-2 given that the allowed cost of debt (and the premium on debt) in part reflects the relatively high embedded cost of debt. The allowed cost of debt is always likely to exceed the CAPM derived cost of debt which is a measure of the marginal cost. Ofgem appears to suggest that the solution is to adopt a notional gearing in line with the gearing of its comparators to avoid re-leveraging/de-leveraging.

However, we note that the apparent inconsistency of Ofgem's CAPM parameters with capital structure theory still holds if we correctly use the marginal cost of debt in this analysis, as opposed to the allowed cost of debt. As we explain in section 2.1.1, the ENA in its submissions to the CMA has set out the case for setting the RFR based on corporate rather than sovereign yields which will address the inconsistency with Ofgem's CAPM parameters and financial theory. There is no case to use raw equity betas and observed gearing.

Otherwise, Ofgem's cross-check does not supports its proposed cost of equity. It has taken the raw equity betas for the five comparators, along with its other CAPM assumptions to show that the implied cost of equity is consistent with its proposed CAPM cost of equity at a notional level. However, the raw equity betas for the water companies do not reflect beta risk faced by SPT/TOs, for the reasons set out in section 3.5. NG (4.1 per cent inferred cost of equity) and SSE (9 per cent inferred cost of equity) – with relevant adjustments as per our decomposition – provide the most viable and direct beta risk comparisons, and these figures do not support Ofgem's assumption of 4.2 per cent cost of equity at the notional level.

4.2.2. OFTO bids

Ofgem presents updated evidence on OFTO bids which shows an average nominal post-tax return of 7 per cent for the most recent tender rounds, with a reduction of 3.2 per cent over time. Ofgem acknowledges that these structures are associated with gearing of 80-90 per cent and therefore drawing inferences for the notional energy network is problematic. Nonetheless, Ofgem concludes that the evidence supports a real CPIH post-tax return of 4.9 per cent[133] and beta of between 0.2 and 0.3.[134] Indeed, Ofgem concludes that if it were to adjust for gearing, the OFTO evidence would support the mid-point or the low-end of the CAPM range.[135]

As we have already set out in separate reports for Scottish Power[136], OFTO IRRs are an unreliable estimator for cost of equity. Bidders for OFTO projects bid and are evaluated based on their proposed revenue stream over the OFTO licence period. [137] Even where equity IRRs targeted by investors for OFTO projects are stated in the bidding documents, the equity IRR is likely to understate the expected return given potential cost outperformance, tax, and financing outperformance over the operational life. In addition, the risk profile of the OFTO

133 Ofgem (2020) Consultation – RIIO-2 Draft Determinations – Finance Annex, p. 64

134 Ofgem (2020) Consultation – RIIO-2 Draft Determinations – Finance Annex, p. 60

135 Ofgem (2020) Consultation – RIIO-2 Draft Determinations – Finance Annex, p. 66

136 NERA (March 2018), Review of Ofgem proposed WACC for Competition Proxy Model of delivering new onshore capacity investments

137 The bidding criteria place a 60 per cent weight on the bidders proposed revenue stream and a 40 per cent weight on quality of the underlying assumptions. See e.g. Ofgem (October 2014), Invitation to Tender Document for Tender Round 3 (TR3): Westermost Rough, p.60-62.

operational phase (under these late competition models) is lower than the risks faced by a TO undertaking a portfolio of capital projects.

Furthermore, we also note that we have no detailed evidence from Ofgem on the derivation of the equity IRRs, and therefore it is difficult for us to verify the OFTO evidence and the relevance to on-shore networks.

4.2.3. Investor managers' forecasts

Ofgem provides a selective small sample of asset managers' estimated returns, which it claims support an average nominal TMR of 7.10 per cent.[138]

As we have set out in previous reports, survey evidence is unreliable to inform investors' expected returns given issues around respondents' understanding of the question being asked.[139] The response to the survey is highly sensitive to the framing of the question and whether the required returns are intended to be nominal or real. For similar reasons, the CMA criticised the use of survey evidence in its 2014 NIE determination and in the most recent NERL Provisional Findings and instead the CMA focusses on historical data.[140] At NERL, CMA states:

"[…] the results of such surveys tend to depend on the identity and outlook of the respondents and how they interpret the questions being asked. Some surveys do not clarify the time frame over which the parameters are to be estimated (the long-term equilibrium ERP or a shorter-term estimate); whether an arithmetic or geometric averaging approach should be used."[141]

Ofgem has accepted that the investor managers' forecasts are based on geometric returns, and appears to have added 0.82 per cent to derive arithmetic averages required for setting the price control.[142] However, as Ofgem acknowledges, the required adjustment is uncertain. There has been substantive discussion of the determination of a TMR that provides an unbiased estimate of the expected return over the price control. For example, the JKM estimator shows the unbiased estimate will weight the arithmetic and geometric mean, and is closer to the arithmetic mean for short investment horizons. In turn, Wright et al report a difference in geometric and arithmetic means of between 1 and 2 per cent, suggesting that Ofgem's evidence may understate the unbiased TMR.[143]

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138 This is the mean excluding two outliers, WTW and Vanguard, which Ofgem itself has noted are not relevant. Vanguard's estimate of the market return appears to relate to investment portfolio that is 40 per cent bonds, and WTW are based on hedged returns. Sources: Ofgem (2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, Table 23, p.62; Ofgem (2019) Decision - RIIO-2 Sector Specific Methodology Decision – Finance, para 3.92, p. 40.

139 NERA (20 November 2018) Further Evidence on the TMR, section 2.3

140 CMA (2020) NATS (En Route) Plc/ CAA Regulatory Appeal, p. 189 para 12.231

141 CMA (2020) NATS (En Route) Plc/ CAA Regulatory Appeal, p. 189 para 12.230. Link: https://assets.publishing.service.gov.uk/media/5e7a2644d3bf7f52f7c871f3/Provisional_Findings_Report_-_NATS_-_CAA.pdf

142 Ofgem (2019) Decision - RIIO-2 Sector Specific Methodology Decision – Finance, Figure 6, p. 39.

143 Wright, S. et al (2018) Estimating the cost of capital for implementation of price controls by UK Regulators, E-125. Link: https://www.ukrn.org.uk/wp-content/uploads/2018/06/2018-CoE-Study.pdf

In terms of sampling issues, the CMA reports survey evidence for the UK TMR of 8.3 per cent nominal, apparently based on the Fernandez survey and more than 100 bps higher than Ofgem's own survey evidence. [144] The TMR range reported in the survey for the UK is between 4.3 and 20 per cent and a standard deviation of 2.4 per cent, further highlighting the sensitivity of the results to the sample size and framing issues. [145]

4.2.4. Infrastructure funds

In its Draft Determination, Ofgem presents evidence from fourteen infrastructure funds. Drawing on time-series data for discount rates and premium to NAV, Ofgem infers an Internal Rate of Return (IRR).

Ofgem notes that the equity IRR is 6.3 per cent (on a simple average) or 6.5 per cent (weighted average), implying a real equity IRR of around 4.2 to 4.4. However, these are equity IRRs as opposed to the fund discount rates, and reflect the potential discount or premium of the funds relative to the net asset value (NAV).[146] Ofgem implicitly assumes that the NAV premium or discount reflects a difference in the market view of the discount rate that should be applied to these funds and the assumed fund discount rate. However, the discount/premium can also reflect differences around other assumptions used to form the NAV, such as assumed future cash-flows. Assuming an overall premium to NAV, the fund discount rates which will be higher than equity IRRs.

In addition, as Ofgem acknowledges, it has not adjusted the IRRs for any difference in business or financial risk (i.e. leverage) that impairs the comparability of these discount rates or equity IRRs to energy networks.[147] For example, HICL's overall portfolio risk is likely to be lower than energy networks, primarily due to a large proportion of the portfolio investments in PPP contracts which stood at 70 per cent according to its 2018 accounts.[148]

4.3. Summary of cross-checks

Table 4.2 summarises the reasons why Ofgem's cross-checks do not provide a reliable check on its CAPM cost of equity estimate. In particular, Ofgem relies on CEPA's water MAR evidence to determine an allowed return on equity of 4.2 per cent, a 10 bps downward adjustment of its CAPM cost of equity at step 1. As set out, there is no evidence that the MAR is greater than 1 once we consider those adjustments omitted by CEPA, e.g. regulated non-wholesale, pension adjustments.

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144 CMA (2020) NATS (En Route) Plc/ CAA Regulatory Appeal, p. 176 para 12.177. Link: https://assets.publishing.service.gov.uk/media/5e7a2644d3bf7f52f7c871f3/Provisional_Findings_Report_-_NATS_-_CAA.pdf

145 Fernandez, P. (2019) Market risk premium, and risk-free rate used for 69 countries in 2019: a survey Table 4, p. 13-6. Link: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3358901

146 As Ofgem notes, under certain assumptions the relationship between the implied equity IRR and the fund discount rate is as follows:

$$\textbf{Equity IRR} = \frac{\boldsymbol{FundDiscountRate}}{\boldsymbol{FundSharePrice}/\boldsymbol{FundNAVpershare}}$$

147 Ofgem (2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, para 3.96. p. 63.

148 HICL (2018) Interim Report for the six months ended 30 September 2018

Table 4.2: Ofgem's Cross-Checks do not Provide Reliable Evidence for its CAPM cost of equity

Source of evidence	Ofgem view (CPIH real)	Reasons for divergence
MAR	<=4.2%	Based on: (i) CEPA/Ofgem fail to take into account all relevant adjustments that affect the company valuation; (ii) Analyst valuations produce a wide range of adjusted MAR.
M-M cost of equity inference	3.2-4.1%	Relies on: i) CMA/Ofgem make an error in consideration of capital structure and MM; ii) Ofgem's TMR and RFR, and therefore not reasonable cross-check; iii) relies on water sector comparators that understate energy network risk for reasons set out in section 3.5
OFTO implied IRR	4.9%	Equity IRR unverified Unreliable as reflects outperformance opportunities
Investment managers TMR	5.0%	Insufficient adjustment to geometric averages Other UK survey evidence suggests +100 bps
Infrastructure fund equity IRRs	4.2%	Fund discount rates likely to be greater than equity IRRs Sample includes lower risk portfolios, e.g. HICL
CAPM with 0.9 equity beta and investment manager TMR	4.3%	As above, investment manager TMR survey unreliable

Source: NERA Analysis

5. Summary on the Cost of Equity

Table 5.1 sets out our updated cost of equity for SPT at RIIO-2. This shows accost of equity estimate that lies in the range of 5.9 to 7.2 per cent (real post-tax), relative to Ofgem's estimate of 4.3 per cent (at step 1) or 3.95 per cent (step 3) on a common 60 per cent gearing basis.

If we were to adopt a TMR based on arithmetic means and a RFR based on corporate yields, as submitted by the ENA to the on-going CMA PR19 appeals, our lower bound cost of equity would increase to 6.2 per cent, i.e. around 25 bps, whereas our upper-bound remains largely unchanged. We show full calculations in Appendix A.

Table 5.1: Updated Cost of Equity (real, post-tax, common 60 per cent gearing)

	Ofgem (DD)			**NERA**	
Real CPIH	Lower bound	Central	Upper bound	Lower bound	Upper bound
Gearing	60%	60%	60%	60%	60%
RFR	-1.48%	-1.48%	-1.48%	-1.26%	-1.26%
TMR	6.25%	6.50%	6.75%	6.93%	7.84%
ERP	7.73%	7.98%	8.23%	8.11%	9.02%
Asset beta (determined)	0.34	0.37	0.39	0.38	0.40
Asset beta (zero debt beta basis)	0.27	0.30	0.32	0.35	0.37
Debt beta	0.125	0.125	0.125	0.05	0.05
Equity beta	0.60	0.66	0.71	0.875	0.925
Cost of Equity (step 1) for GD/T	3.64%	4.30%	5.00%	5.91%	7.16%
Cost of Equity (step 2) (@55% gearing, SPT)		4.2 % (3.93%)			
Allowed return on equity (@55% gearing, SPT)		3.95% (3.70%)			

Note: Ofgem does not calculate cost of equity under step 1 for SPT. Instead, it backs out a step 2 cost of equity and an allowed return on equity that assumes the cost of capital is identical at 60% and 55% gearing. In its DD, Ofgem assumes 55% gearing for SPT, which results in a cost of equity of 3.93% at step 2 and allowed return on cost of equity of 3.70% at step 3.

6. Evaluation of Options for Cost of Debt Indexation

6.1. Ofgem's DD Consultation

At RIIO-1, Ofgem introduced cost of debt indexation for energy networks, designing three separate mechanisms. For RIIO-T1 and GD1, Ofgem adopted a cost of debt indexation mechanism based on average of the A and BBB iBoxx indexes of the yields on GBP non-financial corporate debt of 10 years + remaining maturity, and a trailing average of 10 years. The nominal iBoxx index is deflated using the break-even inflation implied by the difference between nominal and index linked 10 year gilt yields for the relevant index date.[149]

In its DD, Ofgem has proposed to:[150]

- To index the cost of debt allowance with reference to the yield of the iBoxx Utilities 10yr+ index
- To add 0.17 per cent to the index above for additional borrowing costs
- To calculate the allowance using an extending 10 to 14-year trailing average
- To deflate the result of the above nominal 'all in' yields to CPIH real allowances using the 5-year OBR forecast for CPI, using the Fisher equation

Ofgem's rationale for adopting the iBoxx Utilities as the reference benchmark relies on its assessment that companies' debt financing costs more closely match the iBoxx Utilities index than the iBoxx A/BBB, as employed by Ofgem at RIIO-1. (See Section 6.2.)

Ofgem determined an overall additional cost of borrowing of 17 bps, comprising transaction costs of 6 bps, liquidity costs of between 3 and 5.5 bps, and cost of carry of between 1.5 and 11 bps.[151] Ofgem has not allowed any costs associated with the switch to CPI indexation or new issue premium (NIP), the latter informed by its assessment of companies' bond spreads relative to the iBoxx Utilities index. (See Section 6.3.)

Ofgem determined a trailing average of 10 to 14 years plus a 17 bps additional costs of borrowing based on its modelling that suggested this calibration would allow the sector to recover debt costs over RIIO-2. Specifically, Ofgem expects the sector to have a small over-recovery of 12 bps, and a range of -17 to +38 bps depending on the scenario.[152] Ofgem has included GDNs and TOs together in calibrating the index, on the basis that this provides the broadest evidence of sector debt costs, but with the exclusion of SHET. For SHET, Ofgem has proposed a continuation of its bespoke RAV weighted approach put in place at RIIO-1 and which Ofgem considers reflects its specific growth profile.[153] Ofgem has also taken into

149 Ofgem (2014) RIIO-ED1: Draft determinations for the slow-track electricity distribution companies Financial Issues, p. 11. Link: https://www.ofgem.gov.uk/sites/default/files/docs/2014/07/riio-ed1_draft_determination_financial_issues.pdf

150 Ofgem (2020) Consultation - RIIO-2 Draft Determinations – Finance Annex, p. 13.

151 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 17

152 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 27

153 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 18

account the costs due to the restructuring of debt that National Grid undertook ahead of the sale of its four gas distribution networks to Cadent in 2016.[154]

Ofgem has also excluded intercompany loans from our analysis of embedded debt costs because it is not satisfied that these loans represent terms and conditions that would be generally available to a notionally efficient operator if borrowing from an external third party.[155]

To deflate the nominal iBoxx yield, Ofgem has proposed to use the OBR 5-yr forecast of CPI but will switch to use OBR 5 year CPIH forecasts if these become available.[156]

6.2. The Conceptually Correct Trailing Average at Least 15 years

In determining the trailing average of the cost of debt indexation mechanism, the trailing average should match the average tenor at issuance of network companies' debt. By doing so, an energy network that issues a bond in line with the average tenor of, say 20 years, will receive an allowance equal to the efficient cost of the bond in each year of the lifetime of the bond, thus creating a reasonable prospect of recovering its debt costs.

We have updated our analysis of the tenor of energy networks' debt average.[157] As well as energy sector debt, we also consider evidence from outside of the energy sector given the potential impact of the regulatory framework on companies' debt issuance. For example, at GD1 and T1, Ofgem determined a 10 year trailing average as the relevant iBoxx indices were only available from 1998-99[158], which placed a limit on the trailing average at that time.[159] There is a risk that companies sought to match the index trailing average used by Ofgem which may have led to a shorter tenor for energy networks than the efficient tenor.

We have examined updated evidence from both the water and aviation sector, where regulatory rules have not provided incentives to issue shorter 10-year debt instruments.[160] We find that average tenor at issuance is around 25 years for water companies and around 20 years for London Heathrow Airport (LHR).

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154 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 19

155 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 22

156 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 29

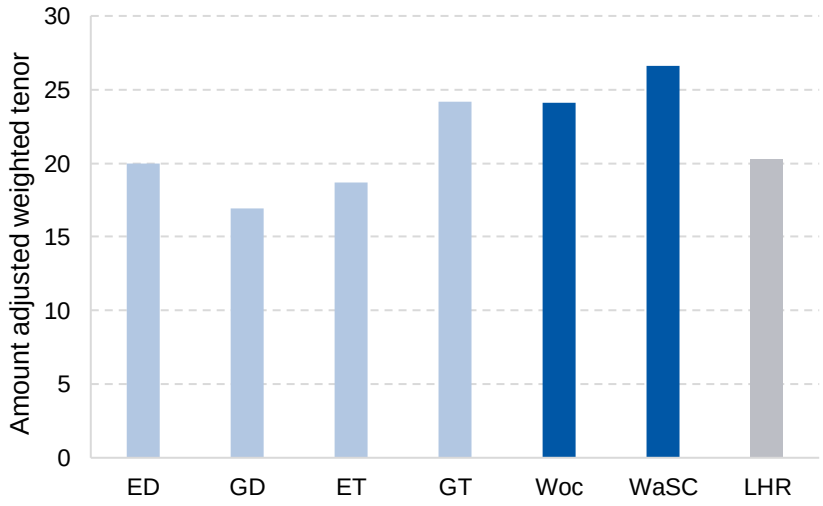
157 In calculating the energy sector tenor, we have taken into account the 14 per cent or so debt that is floating rate, and our analysis suggests that the average tenor remains largely unaffected, e.g. the average tenor declines to around 18 years (range of 15 to 24 years) if we assume a tenor of 0.5 years for such debt (irrespective of the actual tenor of the debt)

158 The iBoxx GBP Benchmark Index was published on 1997/12/31, and the yield on the index start on 1998/1/1. See IHS Markit iBoxx GBP benchmark documentation, p.18.

159 In addition, for GDNs, a substantive element of industry debt was issued post distribution network (DN) sales in 2005, and therefore the then 10Y trailing average captured the period of debt GDN debt issuance.

160 In both its 2009 and 2014 determinations, Ofwat did not index its cost of debt to any benchmark (Source: Ofwat (2009), Future water and sewerage charges 2010-2015: Final determinations, section 5.4.4, pp.130-131; Ofwat (December 2014), Setting price controls for 2015-20: Final price control determination notice: policy chapter A7 – risk and reward, section A7.4, pp.36-40). The Civil Aviation Authority (CAA) also did not index the cost of debt in either the Q5 or Q6 reviews (Source: CAA (11 March 2018), Economic Regulation of Heathrow and Gatwick Airports 2008-2013, section 10, para 10.18 to 10.32; CAA (2013), Estimating the cost of capital: a technical appendix to the CAA's Final Proposal for economic regulation of Heathrow and Gatwick after April 2014, CAP1115, section 6, paras 6.12 to 6.82).

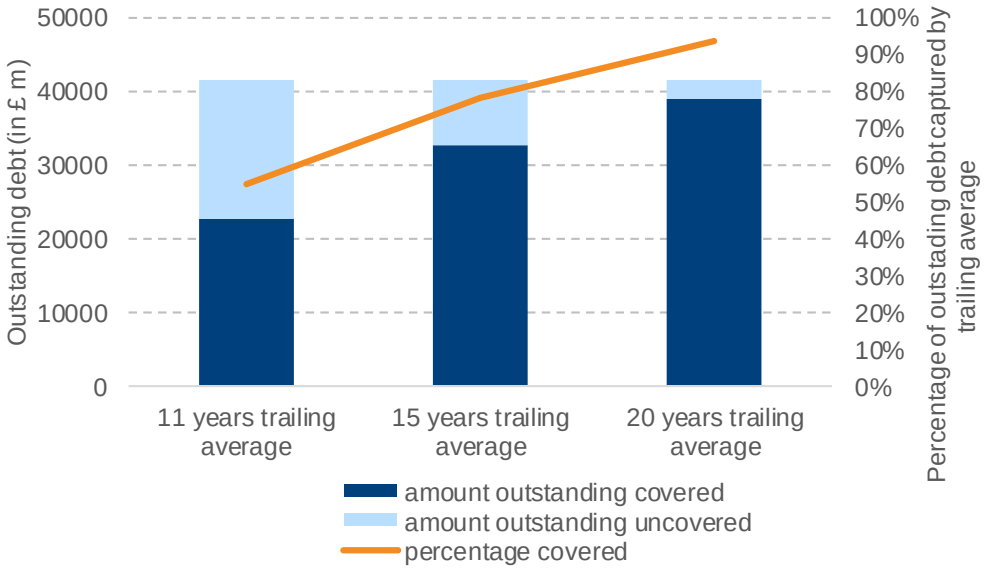
Figure 6.1: The average tenor at issuance for energy networks is 19 years, and longer for water and LHR



Source: NERA analysis

We have also updated our analysis of the profile of issuance. We find that Ofgem's starting 10 year trailing average includes around 50 per cent of company debt, whereas a 15 year starting trailing average would include around 80 per cent of energy network debt.

Figure 6.2: A trailing average of 11 years excludes half of all debt; 15 years includes ca 80 per cent of debt (energy sector debt)



Source: NERA analysis

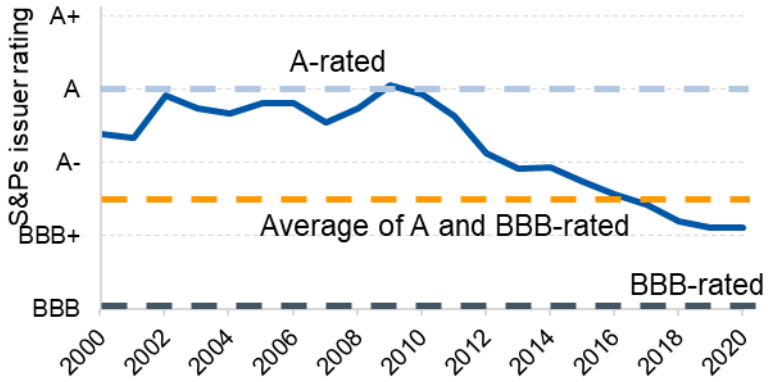
We therefore conclude that the cost of debt indexation should be based on a starting trailing average of *a minimum* 15 years, and more reasonably 20 years.

Ofgem's shows that TOs plus GDNs recover costs with a margin of 12 bps under a 10-14 year trialing average, as support for a trailing average shorter than the conceptually correct approach. However, as we show in the following sections, the apparent outperformance of 12 bps would decline to negative 24 bps under our revised additional cost of borrowing estimate of 53 bps (i.e. decline by 36 bps, or 53 less 17 bps). Our analysis therefore supports an increase to Ofgem's 17 bps additional cost of borrowing, or alternatively a longer trailing average closer to the conceptually correct value of 15 years.[161]

6.3. Ofgem's use of Utilities Index

In its DD, Ofgem updates its cost of debt index using the iBoxx Utilities 10yr+ index, instead of the average A and BBB 10yr+ iBoxx non-financial indices used in RIIO-1.[162] Compared to iBoxx A/BBB, iBoxx Utilities is sector specific and does not have a defined rating (other than investment grade), whereas iBoxx A or BBB indices are regularly updated to include only A or BBB bonds respectively. As shown in Figure 6.3, iBoxx Utilities index had an average credit rating close to A before 2011, but has declined to A/BBB, in line with deteriorating credit quality of regulated utility sectors.

Figure 6.3: iBoxx Utilities index average credit rating



Source: NERA analysis

However, the use of Utilities index which does not have a defined rating imposes a risk of under-recovery of cost of debt if the Utilities index credit rating improves over RIIO-2. Ofgem has stated that the notional package will ensure outturn ratios to be "two notches above investment grade", which means Ofgem will set revenue allowance for a notional company with credit ratios consistent with Baa1 at best.[163] If Ofgem adopts iBoxx A/BBB, then companies funded for new cost of debt at the credit rating of A3/Baa1, which already results in half a notch under-funding. Using Utilities index compounds the problem, since if rating of Utilities iBoxx strengthens over RIIO-1, then this exacerbates the mismatch between rating for the notional company and the (new) cost of debt allowance. For example, if iBoxx

161 Ofgem RIIO-2 Draft Determinations – Finance Annex, page 15, p. 27, Table 8

162 Ofgem RIIO-2 Draft Determinations – Finance Annex, page 15, para 2.14

163 Ofgem RIIO-2 Draft Determinations – Finance Annex, page 96, para 5.10

Utilities aligns with a single A rating (Moody's A2), as it had been before 2010, this could make new cost of debt allowance another 1.5 notches higher than expected at review (i.e. under-funding by 1.5 notches relative to A/BBB, or A3/Baa1). As we set out in our report for the ENA, we have quantified the impact on new cost of debt allowance where iBoxx Utilities aligns with iBoxx A rating as it has historically, and this results in under-funding of 15 bps relative to Ofgem's assumed performance.[164]

6.4. Halo: Evidence of outperformance supports a NIP of 10 bps

At SSMD and DD, Ofgem considered companies' performance against iBoxx benchmark indices by comparing the difference between the relevant iBoxx benchmark indices' spread and companies' bond spreads ("halo effect"), i.e.

Halo effect = iBoxx index spread – company's bond spread

At SSMD, Ofgem concluded that the halo effect was 7bps when using iBoxx A/BBB and when controlling for rating at issue, i.e. comparing network BBB rated bond spreads to the iBoxx BBB index spread.[165] Updating for DD, Ofgem found a halo effect of 11 bps.[166]

In our previous report for ENA[167], we noted Ofgem's spreads do not control for tenor precisely. The spread for the iBoxx index and company bond is calculated relative to a specific benchmark gilt, which faces the practical limitation that there may not be a benchmark gilt that exactly matches the tenor of the bond issue. Notably, there tend to be fewer long-dated benchmark gilts available to match the long tenor of the iBoxx bonds and companies' bonds. As a result, Ofgem's supposed halo also reflects the tenor mismatch between the network bonds and iBoxx index and the relevant benchmark gilt.

Contrary to Ofgem's approach, we calculated credit spreads that match precisely the tenor of the iBoxx index and the company bonds by drawing on the Bank of England nominal yield curve, which is based on a smoothed function over observed benchmark gilt yields, and allows us to match tenor precisely, and provides a more reliable measure of spread. Using this approach, we estimated a negative "halo effect" of -13bps (compared to Ofgem's 7bps).[168] The negative halo is explained by networks facing a new issue premium (NIP), which exists because company's yield at issue in the primary market is higher than secondary traded yields, as represented by the iBoxx index, since issuers are required to incentivise participation in primary market.

At DD, Ofgem has retained the approach it employed at SSMD, and also compared company spreads relative to iBoxx Utilities, and identified a halo of only 4 bps.[169] Ofgem noted that network bond spreads compared to iBoxx Utilities are lower at times of financial distress (relative to iBoxx A/BBB). It concluded that this is not surprising as regulated networks (which have a greater weighting in iBoxx Utilities) may be better insulated from shocks than

164 NERA (August 2020) Review of Ofgem's DD Additional costs of borrowing, and deflating nominal iBoxx

165 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.20, para 2.72

166 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 14

167 NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, A report for ENA

168 NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, A report for ENA

169 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 179

wider markets. Ofgem concludes that iBoxx Utilities provides a closer match to expected network debt costs, and proposed to use this as the benchmark index with no adjustment (i.e. no reduction for a supposed halo effect).

Ofgem also disagrees with our proposed calculation of spread, and claims that BoE nominal spot curve is a zero coupon curve, whereas the bonds issues by companies are not zero coupon, and therefore there is a duration mismatch in our calculation of the relative spread. Ofgem also argues that the convention in the market is to price a corporate bond over the nearest benchmark gilt, not over the exact tenor of an interpolated curve.[170]

As set out in our report for the ENA[171], Ofgem's approach does not control for tenor correctly, and therefore is not a reliable measure of network bonds' performance. In response to Ofgem's comment that our approach does not match duration, we have modified our approach slightly to calculate spreads based on duration matching, where duration is defined as the weighted average of the times that cash-flows are received.[172] Specifically, we calculate the duration of the network bond and iBoxx index, and for each identify the relevant BoE zero coupon bond. We calculate a negative halo of -4 bps based on iBoxx A/BBB spread less company bond spread (compared to Ofgem's +11 bps), and -14 bps when we use iBoxx Utilities (compared to Ofgem's +4 bps), respectively. [173]

As we have set out in previous studies for ENA[174], a negative halo is not surprising, as it reflects the cost of incentivising investors in the primary market relative to the secondary traded market yields. Indeed, our NIP mid-point estimate of 9bps is in line with recent studies.[175]

Ofgem has stated that its approach follows the "convention in the market is to price a corporate bond over the nearest benchmark gilt". However, in an efficient financial market, the market would adjust bond prices to reflect any mis-match in tenor of the bond to the benchmark gilt, and effectively match to the interpolated yield curve. In addition, empirical studies that seek to measure NIP (or halo) do not use Ofgem's "market convention" approach, and studies use variety of approaches including our approach to duration matching.[176]

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170 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, p. 179

171 NERA (August 2020) Review of Ofgem's DD Additional costs of borrowing, and deflating nominal iBoxx

172 We use the standard Macaulay duration as follows: $Macaulay\ Duration = \sum_{t=0}^{n} \frac{PV(CF_t) \times t}{Bond\ Price}$. Zero coupon bonds have a duration equal to their tenor, as the investor must wait to maturity to receive the value of the bond.

173 Our sample includes all outstanding energy network bonds, including those of short tenor as we account for tenor precisely through duration matching. We exclude the most recent five bonds issued during COVID-19 crisis given high levels of market volatility

174 NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, A report for ENA

175 For example, Maitra and Salt (2018) estimates an average NIP of 14bps for European corporate bond since 2009, and Rischen and Theissen (2018) estimates the NIP to be 10bps, measured as the under-pricing in the primary issues of European corporate bonds. See footnote 176 for full references.

176 Maitra and Salt (May 2018) New issuance premium in European corporate bonds, Lombard Odier Asset Management; Rischen and Theissen (2018), Underpricing in the euro area corporate bond market: New evidence from post-crisis regulation and quantitative easing, CFR Working Paper, No. 18-03, University of Cologne, Centre for Financial Research; Adams and Smith (2019), "Fixed Income Analysis", John Wiley & Sons, p. 839, Leake (2003), Credit spreads on sterling corporate bonds and the term structure of UK interest rates,

Overall, we find evidence of a NIP of between 4 and 14 bps (average 9bps) by precisely matching the duration of network bonds and iBoxx index, and our result is consistent with empirical studies. We conclude the additional cost of borrowing should include a NIP of around 10 bps to compensate for companies' cost of debt issuances.

6.5. Estimating the Additional Costs of Borrowing

In our previous report for the ENA, we estimate additional costs of borrowing over RIIO-2 to be in the range of 53 to 82 bps, which includes i) transaction costs of 7 bps, drawing on company public bond issuance, ii) liquidity costs of 4.5 bps, assuming no draw-down to avoid any potential double-count with cost-of-carry, iii) cost-of-carry of 16-45 bps, based on companies meeting sufficiency of resource and rating agency requirements to meet obligations for 12 to 24 month period, iv) new issue premium of 13 bps, based on our halo analysis, and v) the costs arising from the switch to CPI indexation (12 bps).[177]

In its DD, Ofgem estimate the additional costs of borrowing to be 17bps, where its estimate of transaction costs and liquidity costs are broadly in line with our estimate, but allows for a substantially lower cost of carry, and does not allow for NIP and CPI indexation costs.[178]

In this section, we set out our updated estimates in response to Ofgem's comment, drawing on our study for ENA.[179] As show in Table 6.1, based on updated evidence, we estimate additional cost of borrowing of 53 bps, with a range of 47 to 59 bps, compared to Ofgem's DD of 17 bps.

In its cost of debt analysis, Ofgem shows that the sector will have a margin of 12 bps under its 10-14 year trailing average plus an assumed 17 bps additional cost of borrowing.[180] Our revised mid-point additional cost of borrowing means that Ofgem should allow for a greater uplift to the iBoxx index value in setting the cost of debt allowance, or extend the trailing average period to closer to the conceptually correct 15 years.

We set out our updated evidence in Section 6.5.1 and Section 6.5.2.

177 NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, A report for ENA

178 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, Annex 2, pp, 179

179 NERA (September 2020) Review of Ofgem's DD Additional costs of borrowing, and deflating nominal iBoxx

180 Ofgem RIIO-2 Draft Determinations – Finance Annex, page 15, para 2.14

Table 6.1: Our updated additional cost of borrowing is between 47 to 59 bps over RIIO-2

	Ofgem DD (Jul 2020)	NERA (Sep 2019)	NERA (Aug 2020)	Note
Transaction Costs	6 bps	7 bps	7 bps	Ofgem draws on company data but excludes apparent outlier
				NERAs analysis includes all companies within sample
Liquidity/RCF cost	3 - 5.5 bps	4.5 bps	4.5 bps	Both Ofgem and NERA draw on companies' assumptions on RCF size and cost
Cost of carry	1.5 – 11 bps	16 – 45 bps	11 – 23 bps	Ofgem assumptions on cash at OpCo and Group unreliable
				NERA approach assumes 12-24 mth pre-financing, half met by RCF
New Issue Premium (NIP)	-	13 bps	9 bps	Ofgem's analysis does not draw on precise measures of spread and therefore estimate of halo/NIP is unreliable
				NERAs spreads calculation duration matched and support range 4 -14bps
CPI indexation costs	-	12 bps	15 bps	Ofgem assumes that companies do not require compensation for basis risk
				NERA's analysis based on recent cost of CPI issuance and CPI swaps
Total	**17 bps**	**53-82 bps (68bps)**	**47 – 59 (53bps)**	**Ofgem: mid-point of its range**

Source: Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, NERA analysis

6.5.1. Cost of Carry

As we set out in our previous report, cost-of-carry is defined as the requirement to issue debt ahead of maturity to meet sufficiency of resources requirement, rating agency and debt covenant requirements etc. In our previous report, we estimated cost-of-carry range from 16 to 45 bps, assuming pre-financing period between 12 to 24 months in line with license requirement and rating criteria, debt tenor to be between 15 and 20 years (refinancing 1/15 or 1/20 of debt each year), and net carry cost of A/BBB iBoxx less Libor on cash-deposits, based on 5-year average interest rate differentials.[181]

In the DD, Ofgem argues that the licence requirements of having sufficient liquidity to meet obligations over the following 12 months does not translate into a requirement to hold cash for 12 months ahead of upcoming maturities, and assuming 12-24 months' cash is held and revolving credit facilities sized at 10 per cent of debt double counts costs. Ofgem also consider the net cost of carry should be less than differential between LIBOR and the cost of debt. In response, Ofgem estimates the cost of carry to be 1.5-11bps, based on a range of 0.6-4.1 per cent cash on balance sheet drawing on companies' RFPR data, and a differential between iBoxx and 3-month deposit rates.[182]

[181] NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, A report for ENA

[182] Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, Annex 2, pp, 182

In estimating its cost of carry, Ofgem examined networks' RFPR and BPDT submissions and group company accounts for evidence of actual cash holdings, which suggests a range of i) 0.6 per cent RCV cash-holdings based on median of network company data, and ii) 4.1 per cent based on mean of a combination of network company data and group company data on cash held on balance sheet (with 75 per cent weighting given to network company opco data and 25 per cent weighting given to group company data).[183]

Ofgem's analysis is flawed in the following ways, which leads to understatement of the network's cash positions:

- Ofgem's analysis does not reflect divergent approaches taken by companies to location of Treasury functions. For some networks, the Treasury functions are undertaken entirely at either ultimate parent company or the midCo group level, whereas other networks have all Treasury functions conducted at the OpCo level. Thus, Ofgem's estimated median of 0.6 per cent based on OpCo understates the actual cash holdings, since some networks do not operate Treasury at the OpCo level. Also, Ofgem's 75:25 respective weights on the OpCo and Group level cash are arbitrary, and it is unclear whether Ofgem has considered midCo or parent
- Ofgem only relies on end-year snap-shot in the RFPR/BPBT where cash-positions are managed down, whereas the networks' within-year average cash holdings are substantively higher
- Ofgem appears to have solely relied on RIIO-1 average cash holding in its analysis, but companies cash requirements vary substantively depending on refinancing, and RIIO-1 data may not be representative of RIIO-2 for many networks. As NERA shows in its report, debt falling due is almost double over RIIO-2 relative to RIIO-1.[184]

In addition, Ofgem argues that we have double-counted and overestimated the cost of carry, by assuming 12-24 months' cash is held and revolving credit facilities sized at 10 per cent of the debt book. To address Ofgem's concerns around double-counting[185], in our revised analysis we assume that on average half of the pre-financing requirement will be met by using liquidity facilities, resulting in a revised cost-of-carry range from 11 to 23 bps (compared to our earlier estimate of 16 to 45 bps).[186]

183 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, Annex 2, pp, 182

184 NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, A report for ENA, slide 19

185 As we note in our revised report, as with our earlier estimates, we have excluded the draw down costs associated with LCF also to address any potential concerns around double-counting of costs with the cost-of-carry. Therefore, our approach is conservative in relation to carry costs, Source: NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, slide 20

186 Assuming pre-financing period to be between 12 to 24 months in line with licence requirement and rating criteria debt tenor to be 15 years (refinancing 1/15 of debt each year) consistent with Ofgem's assumption in DD Net carry cost of iBoxx less overnight LIBOR on cash-deposits.

6.5.2. Costs associated with CPI indexation

In our earlier report for ENA[187], we estimated 12bps premium to issue CPI ILD and to mitigate basis risk of existing RPI ILD, based on a swap cost of 50 bps (range 15bp to 80bp) and 25 per cent of ILD.

In its DD, Ofgem argues that the impact of the inflation wedge means if liability remains in RPI (rather than swapped to CPIH), this improves cash flow metrics in near term, and the premium for CPI swaps compared to RPI swaps is limited to 'low single digit basis points', which, when applied to 25 per cent of the portfolio, may indicate 1-2bps.[188] Ofgem concludes that the CPI indexation associated costs should not be remunerated in the cost of debt allowance, as not required for notional company. In addition, Ofgem assumes 30 per cent of the networks' debt to be CPIH-linked, which is an increase from SSMD working assumption of 25 per cent.[189] Ofgem states that this is based on BP submissions, which indicate that 37 per cent of externally raised GD&T company debt (pre-derivatives) is inflation linked as at FYE 2019, and this is closer to the assumption of 33 per cent used by Ofwat.

Ofgem ignores the basis risk in asserting companies do not need to be compensated for the switch to CPI. The existing framework for indexing the RAV with outturn RPI provides a natural hedge for companies financed with RPI index linked-debt, where both the allowed return and actual cost of debt grow in line with outturn RPI inflation, leaving equity returns unchanged. This natural link will be broken under the CPI indexation, since ex-post variation in the outturn RPI-CPI wedge exposes companies to additional risks. This risk exists even if investors are compensated for expected difference between RPI and CPI inflation ex-ante.

The impact on risk is illustrated in the following example:

- Assume Ofgem estimates at the review that CPI inflation will be 2 per cent and RPI inflation 2.8 per cent, allowing a 80bps increase in the real cost of capital to reflect the *expected wedge* between RPI and CPI inflation.
- Assume in reality, CPI is 2.0 per cent but RPI increases to 3.8 per cent, i.e. the *outturn wedge* is 180bps.
- Allowed revenues include an ex-ante allowance for the expected RPI - CPI wedge of 80 bps. Allowed revenues are also indexed with outturn CPI of 2 per cent. In total, allowed revenues therefore provide compensation for inflation of 2.8 per cent. This is lower than outturn RPI of 3.8 per cent, which reflects the company's increase in RPI ILD costs.

To illustrate the impact of basis risk on outturn credit metrics, Table 6.2 shows the impact on financial ratios assuming RPI-CPI wedge increases by 100bps above Ofgem ex-ante allowance. This would increase the ILD portion of "cash" cost of debt by the same amount, thus reducing AICR by around 0.1 (equivalent to half a notch).

187 NERA (September 2019) Halo effect and additional costs of borrowing at RIIO-2, A report for ENA, section 3

188 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, Annex 2, pp, 183-184

189 Ofgem (July 2020) Consultation – RIIO-2 Draft Determination – Finance Annex, Annex 2, p. 99

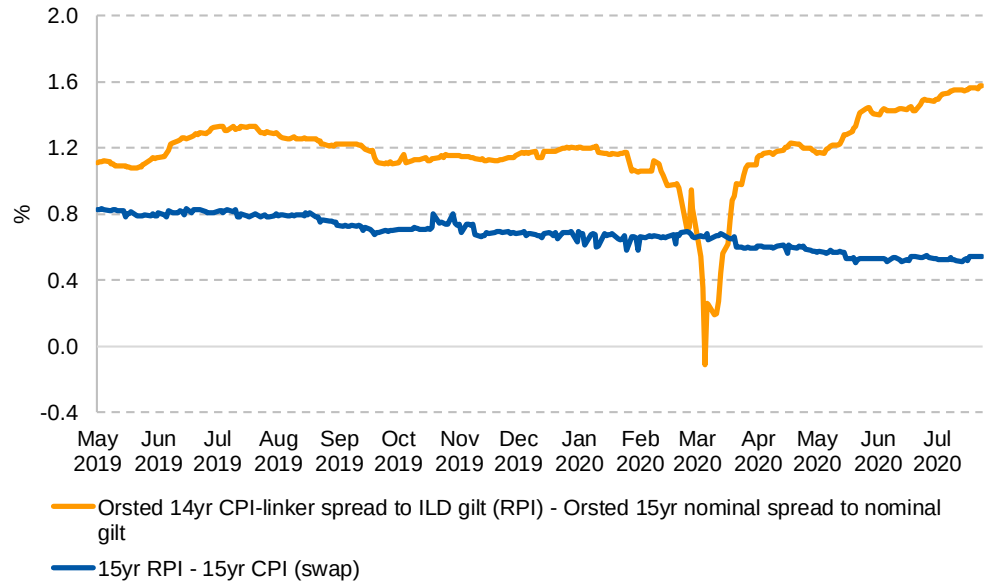
Table 6.2: A 100bps increase in RPI-CPI wedge above expected reduces AICR by 0.1 (equivalent to half a notch downgrade)

		Ex-ante RPI-CPI wedge	+100bps increase in RPI-CPI wedge
Real allowed rate of return (CPIH)	a	2.63%	2.63%
Notional gearing	b	60%	60%
Proportion of ILD	c	30%	30%
Cost of ILD (CPIH)	d	1.74%	2.74%
Nominal cost of debt	e	3.80%	3.80%
AICR = a / [b*(c*d+(1-c)*e)]		1.37	1.26

Note: Note: Calculated based on Ofgem DD ARoR for GD2 assuming Moody's recognises only CPI accretion for ILD in cash interest calc. Ofgem reports higher AICR values in the DD of 1.4-1.5 for GD2 (Table 34 Finance annex). The reason for the difference is unclear.
Source: NERA analysis

As shown above, the mis-match between RPI ILD and CPI(H) linked RAV creates basis risk, and the networks will need to consider issuing CPI(H) ILD. Our review of updated market evidence supports a CPI premium of between 30 and 100 bps, which is supportive of our original estimate of 50 bps. Oersted, a renewable energy company (formerly Dong), issued two bonds in May 2019: i) a nominal bond with yield equal to nominal UK Treasury benchmark plus 128bps, and ii) a CPI-linked bond yield (but priced to RPI ILG) with yield equal to ILG (RPI) + 238 bps, which is the real cost of debt relative to CPI. Since these two bonds are almost identical in maturity (term risk) and issuer (credit risk), the spread between the nominal yield and real yield must reflect: a) expected CPI inflation plus any b) "CPI premium", as shown in Figure 6.4.

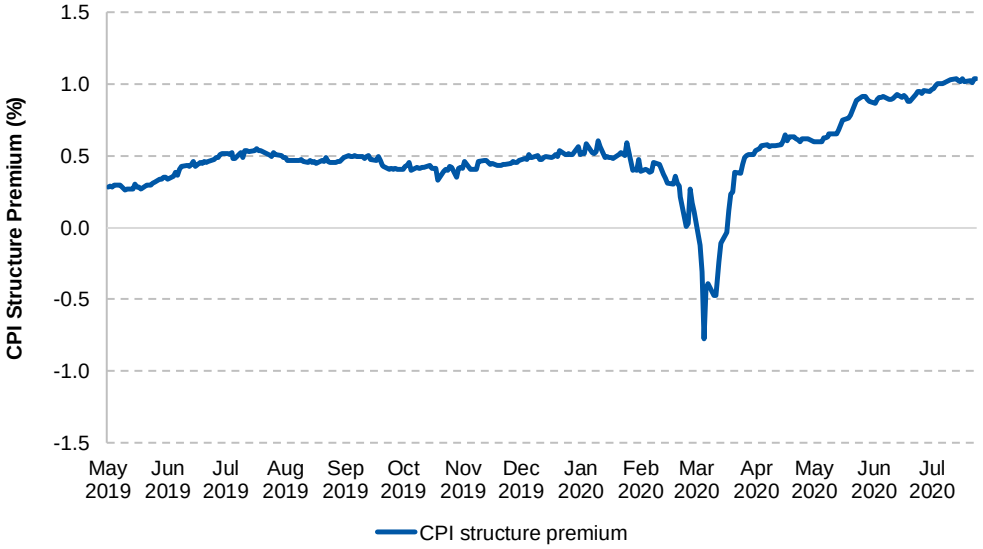
Figure 6.4: The spread between CPI linker and nominal bond is ca 110 bps at issuance, which is explained by RPI-CPI wedge and CPI



Source: NERA analysis

Drawing on RPI-CPI 15 year swaps, RPI-CPI wedge was ca 80 bps at issuance, which implies a premium of 30 bps.[190] As shown in Figure 6.5, our analysis of the bonds over time shows that the spread has widened, and RPI-CPI wedge has fallen, providing an implied CPI premium of ca 100 bps by July 2020

Figure 6.5: Implied CPI premium is ca 30 bps but has increased to ca 100



Source: NERA analysis

190 Nominal UKT + 128 bps + CPI-premium = real ILG (RPI) + 238 bps + CPI. Rewrite real ILG(RPI) as nominal UKT – RPI, and rearrange, we have: [RPI – CPI] + CPI-premium = 110 bps at issuance

We derive very similar results comparing nominal and CPI issuances by Cambridge University as shown in Appendix E.

Overall, our updated estimates for the cost associated with CPI indexation based on comparison of nominal and CPI ILD issued by Oersted and Cambridge University broadly support our initial assessment of 50 bps issuance costs. i.e. taking approximate mid-points between cost at issuance and today's implied premium.[191] We also understand from discussion with Banks that swapping a nominal debt liability to CPI ILD costs ca 40 to 60 bps, depending on the level of collateral posted by the Bank. Therefore, assuming 50 bps CPI premium, and Ofgem's CPI ILD assumption of 30 per cent, we calculate an updated CPI premium of 15 bps (compared to our estimate of 12 bps in our earlier report).

6.6. Deflating Nominal iBoxx Index Costs

At RIIO-2, Ofgem will draw on a forecast of CPI(H) to derive a real cost of debt allowance from nominal iBoxx index values. In its SSMD, Ofgem identified two broad methods to derive a real cost of debt allowance in CPI terms from a nominal iBoxx index[192]:

a. Retain RIIO-1 breakeven approach but include an expected RPI-CPIH wedge when deflating the nominal iBoxx yields

b. Use an expected value for CPIH directly, e.g. Office for Budget Responsibility's (OBR's) longest-term CPI forecast as a proxy or Bank of England inflation target of 2 per cent

In its DD, Ofgem notes that none of the respondents supported the use of breakeven inflation, and all of the all respondents preferred simplicity of deflating nominal iBoxx in one step (option b), using a single measure of inflation.[193] Ofgem further notes that the BoE target is not an inflation forecast (but rather a target), and therefore proposes to use 5-year OBR forecast for CPI. It also states that if OBR publishes CPIH forecasts, it proposes to switch to CPIH forecasts.

As per Ofgem's DD, we do not support use of break-even inflation (BEI), because breakeven inflation reflects not only expected inflation, but also inflation risk premium, and liquidity premium, both of which are difficult to estimate and may vary over time. As we explain in our report for the ENA[194], the use of a 20-year breakeven inflation (e.g. to align with the average remaining tenor of the iBoxx index) is even more problematic, given the well documented distortions in the index-linked gilt market for long maturities.

In addition, the adoption of CPIH indexation further complicates the use of gilt BEI given the need to adjust BEI for RPI-CPIH wedge. There are market measures of RPI-CPI wedge from swap based inflation, but swap-based measures of long-term RPI-CPI wedge have declined from around 100 bps in 2017/18 to around 50 bps today, as shown in Figure 6.6. The recent

191 Oersted bonds support 30 bps at issuance increasing to 100 bps, and Cambridge University bonds support 26 bps at issuance increasing to 90 bps. These bonds broadly support our initial assessment of 50 bps issuance costs, i.e. taking approximate mid-points between cost at issuance and today's implied premium.

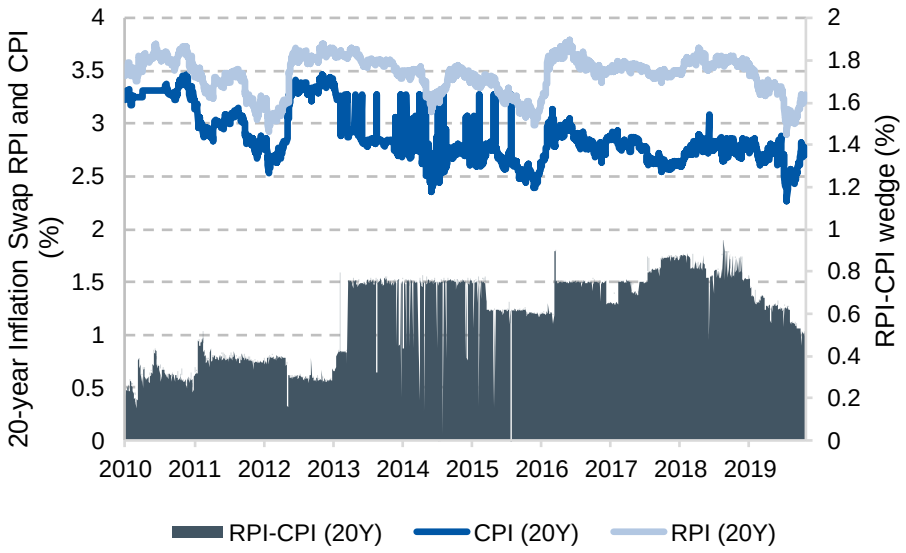
192 Ofgem (24th May 2019) RIIO-2 Sector Specific Methodology Decision – Finance, p.9

193 Ofgem (July 2020) Consultation – RIIO-2 Draft Determinations – Finance Annex, p. 29

194 NERA (September 2020) Review of Ofgem's DD Additional costs of borrowing, and deflating nominal iBoxx

decline in marked based measures of RPI-CPI may be explained by UKSA's proposal to bring the methods of CPIH into RPI between 2025 and 2030.[195]

Figure 6.6: Swap based measures of RPI-CPI wedge over 20 year period have declined sharply over the past year

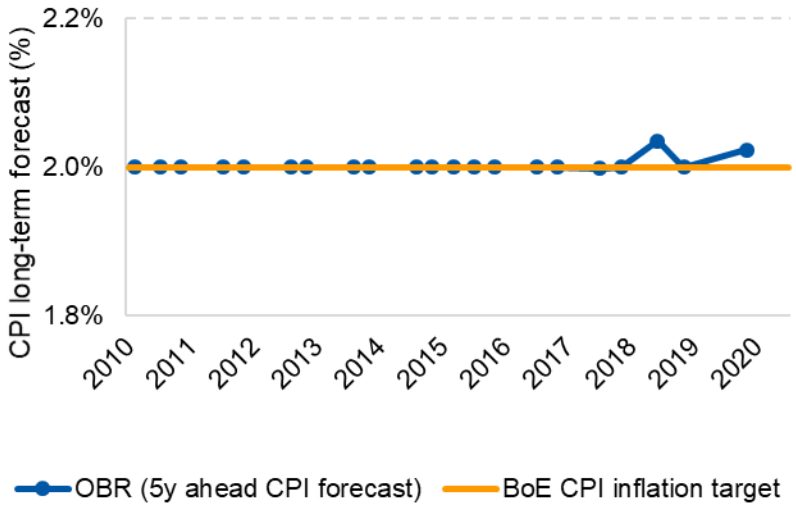


Sources: NERA analysis

In terms of a direct measure of CPI(H), Ofgem considers the direct measures of CPI(H) could be based on: OBR CPI 5 yr forecast as a proxy for CPIH, or Bank of England CPI inflation target of 2 per cent. OBR publishes five-year forecasts on an bi-annual basis, generally in March and October/November. As shown in Figure 6.7, OBR's long-term inflation forecast of CPI has been closely aligned with BoE's inflation target of 2 per cent. As with Ofgem, we do not support use of BoE target as inflation could systematically deviate from target.

195 In March 2019, UKSA proposed to address RPI's shortcomings by aligning RPI calculation with that of the CPIH. UKSA (2019) UK Statistics Authority Statement on the future of the RPI; In March 2020, the UK government announced a consultation on the UKSA proposal and on the issue of timing, i.e. whether to implement the proposal between 2025 and 2030. UK government (2020) A consultation on the Reform to Retail Prices Index (RPI) Methodology

Figure 6.7: OBR's long-term inflation forecast of CPI has been closely aligned with BoE's inflation target of 2 per cent

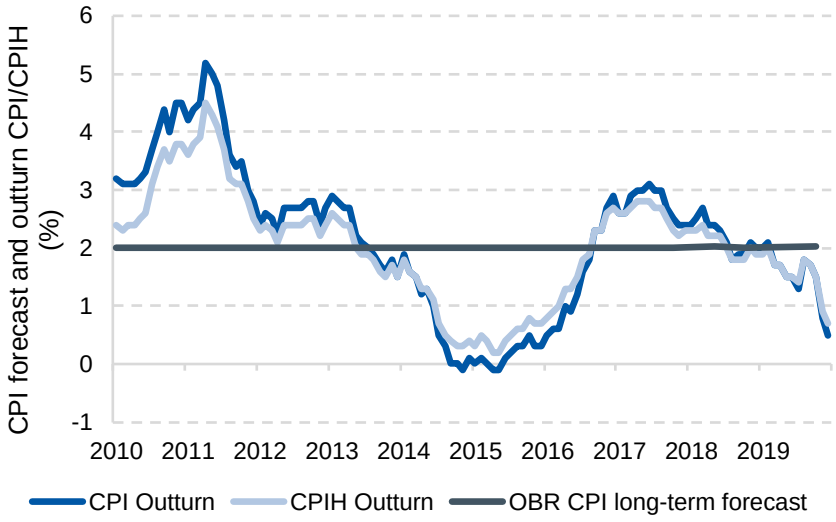


Source: OBR Economic and fiscal outlook, BoE

An alternative potential approach is to derive the real cost of debt allowance based on the inflation measure used to index energy networks' RAVs. The approach has the advantage that it ensures investors recover their nominal cost of debt: the inflation element of the cost of debt is recovered as a capital gain on the RAV, and the remaining real element is recovered as a return on the RAV. By contrast, Ofgem's proposed approach of using OBR forecast (effectively 2 per cent) means that investors may not recover their costs in any one year or indeed regulatory period. However, as we set out in our report for the ENA, this could lead to greater volatility in allowed revenues if CPIH were volatile, and therefore created volatility in real cost of debt allowance, but could be managed using an expected value with an ex-post true-up over a number of years.[196]

[196] NERA (September 2020) Review of Ofgem's DD Additional costs of borrowing, and deflating nominal iBoxx

Figure 6.8: OBR forecasts deviate from outturn inflation; Ofgem's approach may not allow for investor to recover nominal debt costs



Source: NERA analysis

In conclusion, we agree with Ofgem's DD that breakeven inflation is not a reasonable approach to derive real cost of debt allowance. The OBR 5 year forecast provides one reasonable approach to deriving a real cost of debt allowance. An alternative is to use outturn inflation used to index RAV to derive real debt costs, as this would ensure investors recover nominal debt costs through allowed cost of debt+RAV indexation.

Appendix A. Alternative Cost of Equity Scenario

This appendix sets out the implication of adopting a TMR based on arithmetic averages (as propose by Cooper), as well as adopting higher RFR of between 50 and 100 bps to reflect the gap between sovereign and corporate highly rated debt. This shows that our lower-bound estimate increases by around 25 bps but our upper-bound remains practically unchanged.

Table A.1: Updated Cost of Equity with Alternative Scenarios (real, post-tax, common 60 per cent gearing)

	Ofgem (DD)			NERA		NERA	
Real CPIH	Lower bound	Central	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Gearing	60%	60%	60%	60%	60%	60%	60%
RFR	-1.48%	-1.48%	-1.48%	-1.26%	-1.26%	-0.76%	-0.26%
TMR	6.25%	6.50%	6.75%	6.93%	7.84%	7.16%	7.84%
ERP	7.73%	7.98%	8.23%	8.11%	9.02%	7.92%	8.10%
Asset beta (determined)	0.34	0.37	0.39	0.38	0.40	0.38	0.40
Asset beta (zero debt beta basis)	0.27	0.30	0.32	0.35	0.37	0.35	0.37
Debt beta	0.125	0.125	0.125	0.05	0.05	0.05	0.05
Equity beta	0.60	0.66	0.71	0.875	0.925	0.875	0.925
Cost of Equity (step 1) for GD/T	3.64%	4.30%	5.00%	5.91%	7.16%	6.17%	7.23%
Cost of Equity (step 2) (55% gearing, SPT)		4.2 % (3.93%)					
Allowed return on equity (55% gearing, SPT)		3.95% (3.70%)					

Note: Ofgem does not calculate cost of equity under step 1 for SPT. Instead, it backs out a step 2 cost of equity and an allowed return on equity that assumes the cost of capital is identical at 60% and 55% gearing. In its DD, Ofgem uses 55% for SPT, which results in a cost of equity of 3.93% and allowed return on cost of equity of 3.70%. We have used a gearing of 60% to maintain comparability with Ofgem.

Appendix B. Summary of CMA's Beta Methodology at NATS Provisional Findings

In this Appendix, we summarise the CMA's methodology to estimate beta in its provisional finding for NATS.

Comparator selection

For its beta estimation, the CMA draws on data from ENAV as well as large European airports. The CMA considers that ENAV, the only other European ANSP that is traded, is a suitable comparator that appears to be less risky than NERL, although the scale of risk is difficult to quantify.[197] It also draws on beta estimates from airports, noting that its preference is to use a wider range of comparators, and then to use its judgement in interpreting the evidence of the asset betas measured for those comparators. The CMA has considered two main factors when choosing its airport comparators:[198]

- That the beta data is reliable, i.e. no outliers.
- That the beta data is mostly based on businesses and investors which are in sufficiently comparable sectors.

Taking into account above criteria, the CMA considers that the larger airports (AENA, Fraport, and ADP) are suitable comparators.[199] Based on an analysis of operating margins, the CMA concluded that there is inconclusive evidence that airports are either more or less risky than NERL, and therefore it has used the value of the betas of the airport comparators as a direct comparator for NERL's beta. [200]

Gearing ratio

The CMA has analysed the standard practice of calculating an asset beta, and then calculating an equity beta using a notional gearing level ("re-gearing"). However, this approach has the effect of resulting in the WACC strictly increasing with gearing, which is unexpected given that the Modigliani-Miller theorems state that the cost of capital is independent of gearing.[201]

Therefore, the CMA has concluded that it is more appropriate to use a lower notional gearing that is consistent with the average airport comparator gearing of 30 per cent.[202] This approach allows the CMA to use the comparator airports to estimate the equity beta without needing to materially adjust their gearing.[203]

Beta calculation

The CMA notes that the use of 2-year and 5-year periods for beta measurement is consistent with normal practice, i.e. betas calculated based on share prices over a 2-year period or a 5-year

197 CMA (March 2020), NATS provisional findings, para.12.56, p.141.

198 CMA (March 2020), NATS provisional findings, para.12.64, pp.143-144.

199 CMA (March 2020), NATS provisional findings, para.12.66, p.144.

200 CMA (March 2020), NATS provisional findings, para.12.76, pp.147.

201 CMA (March 2020), NATS provisional findings, para.12.105, pp.157-158.

202 CMA (March 2020), NATS provisional findings, para.12.108, p.158.

203 CMA (March 2020), NATS provisional findings, para.12.110, p.159.

period. It therefore uses both 2-year and 5-year betas, where data on both was available, or 2-year betas only, where longer-term data was not available.[204]

Where data was available, the CMA has also considered both current betas and rolling betas over a 1-year, 2-year and 5-year period. It notes that, given the uncertainty over measuring beta, this approach reduces the risk of error, and allows to take into account whether betas have been stable when interpreting the current beta estimates.[205]

The CMA uses both daily and weekly beta estimates. It also cites studies that show that monthly beta estimates might be more reliable than daily estimates. Given that the choice of beta is ultimately a matter of judgement, the CMA has included both two-year and five-year weekly betas in its analysis. When using weekly data, it gave greatest weight to the five-year weekly betas, because of high standard errors around 2-year weekly betas, and also because some of these 2-year weekly betas appeared to be outliers.[206]

As reference index, the CMA uses the Eurostoxx 600 index, as the best available market benchmark.[207] It notes that the effect of systematic risk on 'shocks' to the share prices were more highly correlated to the European indices than to the domestic indices, and this in turn indicates that these are likely to be more relevant indices.[208]

Debt beta

The CMA decided on a debt beta of 0.05 for NERL, taking into account the low risk of NERL's debt and its decision to set a lower gearing ratio.[209]

Decision on NERL's beta range

In interpreting its beta evidence, the CMA considers a range of evidence and use its own judgement in determining an estimate for NERL's beta based on that evidence.[210]

The table below shows the high and low estimate for each comparator, based on the CMA's own judgement.[211]

Table B.1: CMA comparators' asset beta ranges

	Low estimate	*High estimate*	*Relative risk*
ADP	0.5	0.6	Comparable
Fraport	0.45	0.55	Comparable / marginally lower
AENA	0.55	0.65	Comparable / marginally higher
ENAV	0.45	0.55	Lower

Source: Bloomberg and CMA analysis
Note: In each case we have used a range of 0.1. reflecting the degree of uncertainty and judgement required

Based on above analysis, the CMA concludes on an asset beta range for NERL of 0.5 to 0.6 (0 debt beta).

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204 CMA (March 2020), NATS provisional findings, para.12.78, p.147.

205 CMA (March 2020), NATS provisional findings, para.12.89, pp.150-151.

206 CMA (March 2020), NATS provisional findings, para.12.82, p.148.

207 CMA (March 2020), NATS provisional findings, para.12.89, p.150.

208 CMA (March 2020), NATS provisional findings, para.12.87, p.149.

209 CMA (March 2020), NATS provisional findings, para.12.115, p.160.

210 CMA (March 2020), NATS provisional findings, para.12.93, pp.155.

211 CMA (March 2020), NATS provisional findings, table 12-10, pp.155.

Appendix C. National Grid's UK and US Asset Betas with Full US Comparator Set

In section 3.6 we presented National Grid's US and UK asset beta decomposition evidence based on the three most comparable companies for National Grid's US business (Consolidated Edison, Unitil Corp and Eversource Energy). In this appendix we present the asset beta decomposition evidence using the full comparator set. Table C.1 shows the resulting asset beta estimates, ranging from 0.39 to 0.48 for National Grid's UK asset beta.

Table C.1: We estimate NG's UK beta of 0.39 to 0.48 based on the full US comparator set

	NG overall		US		UK	
Share of regulated assets			50%		50%	
	Averaging period					
Estimation period	last 2 years	last 5 years	last 2 years	last 5 years	last 2 years	last 5 years
2-year	0.36	0.39	0.25	0.29	0.48	0.48
5-year	0.38	0.37	0.31	0.35	0.46	0.39

Source: NERA analysis.

Appendix D. Updated MAR Analysis

In this appendix, we set out CEPA's and Ofgem's MAR analysis as well as presenting our updated evidence on raw and adjusted MARs for UK water and energy companies.

D.1. CEPA's and Ofgem's MAR analysis at RIIO-2

CEPA estimates positive MAR premia for UK energy and water companies

In its recent report for Ofgem, CEPA estimated MARs for listed UK water and energy companies to infer investor views of the cost of equity for the energy sector at RIIO-2.

Specifically, CEPA draws on 5 UK regulated comparators in estimating the valuation premia, namely the three water companies Severn Trent, United Utilities and Pennon, and two energy companies National Grid and SSE. It estimates positive MAR premia of around between 10 and 40 per cent based on its spot estimates on 31 December 2019, 14 February 2020 and 29 May 2020.[212] CEPA also analyses valuation premia over time based on book value of debt, exhibiting a time series of MAR premia (the extent to which MAR is greater than one) that are generally above zero but volatile.[213]

In order to inform Ofgem's cost of equity adjustment, CEPA uses MAR analysis, combined with assumptions on the prospective level of outperformance, to make inferences about the market's view of the cost of capital. Based on its analysis, CEPA concludes that current energy sector MARs indicate a cost of equity assumption towards the lower end of Ofgem's range (step 2 of Ofgem's cost of equity methodology). It also concludes that the MARs provide forward-looking evidence to calibrate Ofgem's proposed actual return/expected return wedge (step 3 of Ofgem's cost of equity methodology).[214] Furthermore, it considers that its MAR estimates from energy comparators and time series analysis of traded GB water companies are difficult to reconcile with Ofgem's proposed CAPM cost of equity being unacceptable to investors.[215]

Ofgem draws on CEPA's MAR analysis to justify downward adjustments to its cost of equity estimate

Ofgem draws on CEPA's MAR analysis in step 2 as well as step 3 of its cost of equity cross-checks, justifying downward adjustments to its cost of equity estimate. Specifically, in step 2, Ofgem draws on CEPA's estimated MAR premia of around 20 per cent for UK water companies at 31 December 2019 (post Ofwat's PR19 final determination), to support its view that an allowed return on equity of 4.2 per cent represents an upper limit for the water sector. Given its assumption that regulated energy and water companies are of approximately equal risk, this suggests that the upper limit of 4.2 per cent also applies to GB energy networks. This corresponds to a 10 bps downward adjustment of its allowed cost of equity.[216]

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212 For its spot estimates, CEPA uses book value as well as market value of debt. CEPA (July 2020), RIIO-2: Use of market evidence, pp.21-22.

213 CEPA (July 2020), RIIO-2: Use of market evidence, pp.25-26.

214 CEPA (July 2020), RIIO-2: Use of market evidence, p.35.

215 CEPA (July 2020), RIIO-2: Use of market evidence, p.38.

216 "The MARs cross-check is persuasive. As noted at paragraphs 3.67 to 3.74, market reactions to Ofwat's allowed return on equity of 4.19% (appointee level) is, we expect, priced into MAR values for UU, SVT and PNN. Compared to other cross-checks there are fewer comparison issues, given the consistent notional gearing of 60% and the view

Ofgem's allowed return on equity in step 3 is informed by CEPA's estimated MAR premia for NG and SSE of 10 to 20 percent at 29 May 2020, supporting a further deduction from its cost of equity estimation of 25 bps. It views a 25 bps expected outperformance, equal to a MAR of approximately 1.0135, as a cautious interpretation of market evidence as it is significantly below CEPA's estimated MAR for NG and SSE, noting that estimating and interpreting MAR premiums is subject to uncertainty.[217]

The above two adjustments result in a baseline allowed return on equity of 3.95 per cent over RIIO-2, 35 bps below Ofgem's initial cost of equity estimate. However, given the uncertainties around the expected outperformance analysis, Ofgem proposes an ex-post top-up of up to 25 bps if outperformance does not materialise as expected.[218]

D.2. NERA estimate of MAR for NG and listed UK water companies

As explained above, Ofgem, drawing on CEPA's analysis, justifies a downward adjustment to its CAPM cost of equity by arguing that UK water and energy companies exhibit MARs greater than one. However, as we explain in greater detail in the next sections, once the raw MAR for water and energy companies is adjusted to take into account all the relevant factors that explain company valuations (see Figure D.1: and Figure D.2:), we find no evidence to conclude that the adjusted MAR for the UK water wholesale and energy businesses is above 1 and therefore that the allowed return on equity exceeds investors' expected cost of equity. Indeed, we find a significant volatility in the derived adjusted MAR depending on the valuation report used. CEPA acknowledges this issue, noting that *"there is a wide scope for error in the valuation of the non "GB regulated" businesses and analyst reports often have materially divergent views"* but fails to take into account this conflicting evidence.[219] CEPA presents only (upwardly bias) mid-point MAR estimates, as opposed to setting out the potential range of estimates from the materially divergent views.

In addition, it appears CEPA's analysis only adjusts the observed RAB premium to account for non-UK and non-regulated businesses. CEPA fails to take into account the other adjustments for non-wholesale regulated activities and pension deficits which explain part of CEPA's residual RAB premium. In particular, CEPA acknowledges that additional factors such as pension surplus/deficits can explain premia in the water sector but it does not adjust its MAR premia for these factors.[220] Furthermore, CEPA also fails to take into account the substantial uncertainty around its estimate of the value of future expected outperformance for water companies, which also appears understated compared to analysts' estimates (as shown in Figure D.2:).

We calculate adjusted MARs for listed UK networks, to remove the effect of factors which are unrelated to the cost of capital to calculate an adjusted MAR for the UK regulated business,

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that systematic risk is similar for energy and water networks." Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, p.66.

217 "We accept that estimating and interpreting MAR premiums is subject to uncertainty, and are mindful that inferences reflect assumptions and periods chosen. However, in the context of RIIO-2, expected outperformance of 0.25% is, using the stylised model presented above, equal to a MAR of approximately 1.0135. Clearly, an implied premium of 1.35% is a cautious interpretation of market evidence indicating premiums of 10% or greater. Therefore, we believe that expected outperformance of 0.25% is a fraction of the outperformance that is reasonably derived from MAR evidence." Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, p.78.

218 Ofgem (July 2020), RIIO-2 Draft Determinations – Finance Annex, p.83.

219 CEPA (July 2020), RIIO-2: Use of market evidence, p.18.

220 CEPA (July 2020), RIIO-2: Use of market evidence, p.34.

which is the relevant measure for assessing the relationship between the allowed rate of return and investors' cost of capital, as we discuss in the next sections.

D.2.1. Adjustments to MARs for NG are subject to substantial uncertainty, but consistent with an adjusted MAR of 1 for UK T&D business

The enterprise value of NG is driven by a number of factors which are unrelated to the cost of capital for UK regulated networks and which need to be removed from the raw MAR estimates to calculate an adjusted MAR for NG's UK T&D business. These factors include:

- **US regulated businesses:** The NG enterprise value includes the company's assets and operations in the United States, which include electricity transmission and distribution facilities, as well as gas distribution networks.[221]
- **Non-regulated activities:** The NG enterprise value also includes the impact of the company's non-regulated activities, such as interconnectors, LNG operations, UK gas metering, UK property management, and US non-regulated businesses. [222]
- **Outperformance for UK T&D businesses:** Expected outperformance of regulatory assumptions, such as totex and incentives, represents an additional source of shareholder return, which is unrelated to the cost of equity.

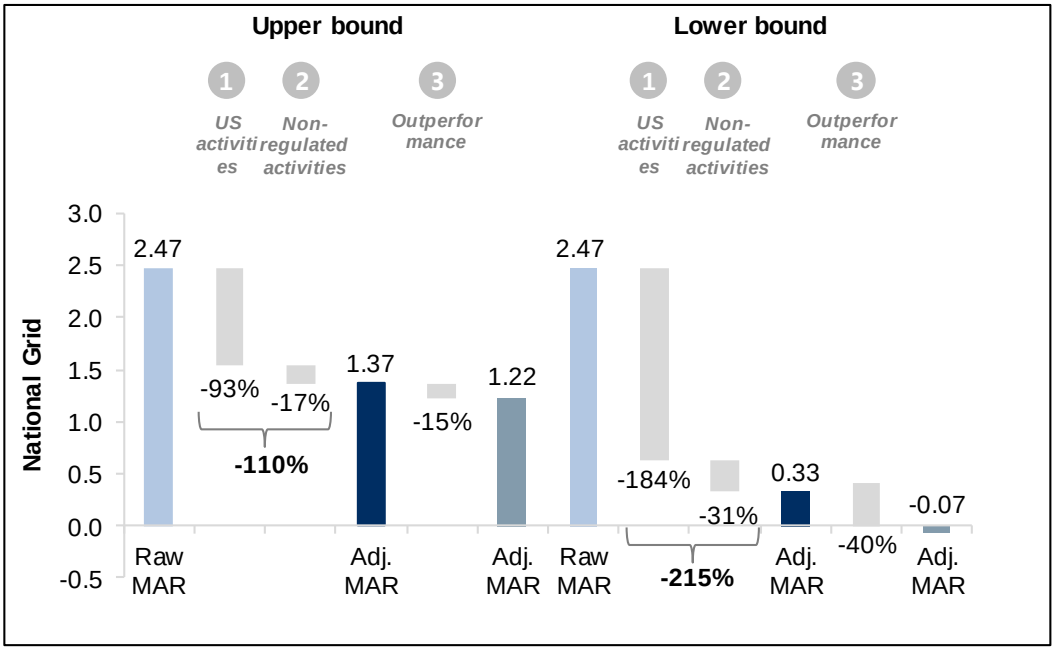
The value of the adjustments for these factors is inherently uncertain, which represents one of the key practical difficulties with estimating MARs for the purpose of gauging investor expectations of the cost of capital/equity. Nevertheless, to assess the likely value impact of the above adjustments on NG's valuation and MAR, we collected estimates for each of the above factors from independent equity analyst reports, as summarised in Figure D.1Figure D.1: below.

We use analyst valuations for each of the factors reported in £m terms and express these values as a percentage of the UK T&D RAB as reported by each analyst for comparability with the calculated MAR premium in Figure D.1. We present estimates for the value of the adjustments for the period post NG's partial sale of its gas distribution business in March 2017 only for two reasons. First, the sale of NG GDNs was a material issue and could have affected market values and MARs in the lead-up to the sale. Second, we are primarily interested in most recent market evidence so we can interpret MAR evidence relative to Ofgem (and Ofwat's) allowed return at RIIO-2 and PR19. In other words, we need to focus on the recent period in order to have a firm understanding of investors' expectations.

221 National Grid Annual Report and Accounts 2018/19, p.3.

222 National Grid Annual Report and Accounts 2018/19, p.3.

Figure D.1: Adjustments for US and Non-regulated activities more than explain the observed RAB premium for NG



Note: Ranges for adjustments for each of the factors based on min and max of all analyst estimates.
Source: NERA analysis of equity analyst reports. See Appendix D.3 for detail.

As shown in Figure D.1, analysts' estimates of the value of the adjustments are subject to a large degree of uncertainty. The wide variation in the estimates reflects the fact that a substantial portion of NG's market value is related to its US and non-regulated activities (around half post NG's GDN sale). As a result, even a small difference in the value of these activities will result in a large difference in the estimated adjustment, which is expressed as a percentage of the UK T&D RAB and which reflects only around half of NG's total business.

Figure D.1 shows that the adjusted MAR for NG's UK T&D business since March 2017, and prior to any adjustment for assumed outperformance, lies in a very wide range between 0.33 and 1.37, which does not allow us to draw any reasonable inferences regarding the cost of equity. This highlights one of the key issues with undertaking MAR analysis for companies like NG, which derive a substantial portion of earnings from activities which are unrelated to the regulated business for which the MAR is being calculated, resulting in substantial uncertainty around the value of the adjusted MAR.

If we take into account the range of expected outperformance, then the MAR lies in the range of 1.22 to -0.07. We note that a substantive element of the outperformance will relate to RIIO-GD1 rather GD2 (given that we examine the MAR since 2017), and investors' expectations formed prior to the tightening of the price control – the outperformance assumptions therefore are not indicative of future outperformance. As mentioned, the MAR lies in a wide range (and on average below 1) prior to any adjustment for outperformance.

In summary, we conclude that MAR evidence is not a reliable method for backing out the cost of equity for NG's UK T&D business, given the magnitude and variation of the required adjustments to take into account NG's non-UK regulated activities. Nevertheless, we find there is no evidence that the adjusted MAR for NG's UK T&D businesses is greater than 1 and therefore that the allowed return on equity differs from the investors' expected cost of equity.

D.2.2. Value of adjustments for UK water companies can explain their observed MAR premium in full

Similar to NG, the enterprise value of water companies is driven by a number of factors which are unrelated to the cost of capital and which need to be removed from the raw MAR estimates to calculate an adjusted MAR for the wholesale business (for which the water RAB is measured). One relevant factor is adjusting for non-regulated activities, as for NG. There are also three further material factors that we consider for water companies:

- **Non-wholesale regulated activities**: In PR14, Ofwat introduced separate wholesale and retail controls, with the RAB going forward only relating to wholesale controls. As a result, the value of all other non-wholesale regulated activities[223] needs to be removed to arrive at a market value for the wholesale regulated business only, which is relevant for making comparisons to the wholesale RAB.
- **Pension deficit:** Another important factor affecting water companies' market valuations is the value of any pension deficit/surplus. Ofwat allows companies to recover 50 per cent of the assumed pension deficit in 2009 over a 10-15 year period, with the remaining pension deficit costs borne by shareholders.[224] The value of any residual deficit/surplus represents an additional loss/revenue for shareholders, unrelated to the cost of capital, which we need to adjust for.
- **Outperformance for wholesale businesses:** Expected outperformance of regulatory assumptions, such as totex and incentives, represents an additional source of shareholder return, which is unrelated to the cost of equity. This is an important consideration for both SVT and UU. Despite the reduced scope for outperformance at PR19, both are strong performers in the water sector, notably in relation to outperformance on the industry average cost of debt.[225]

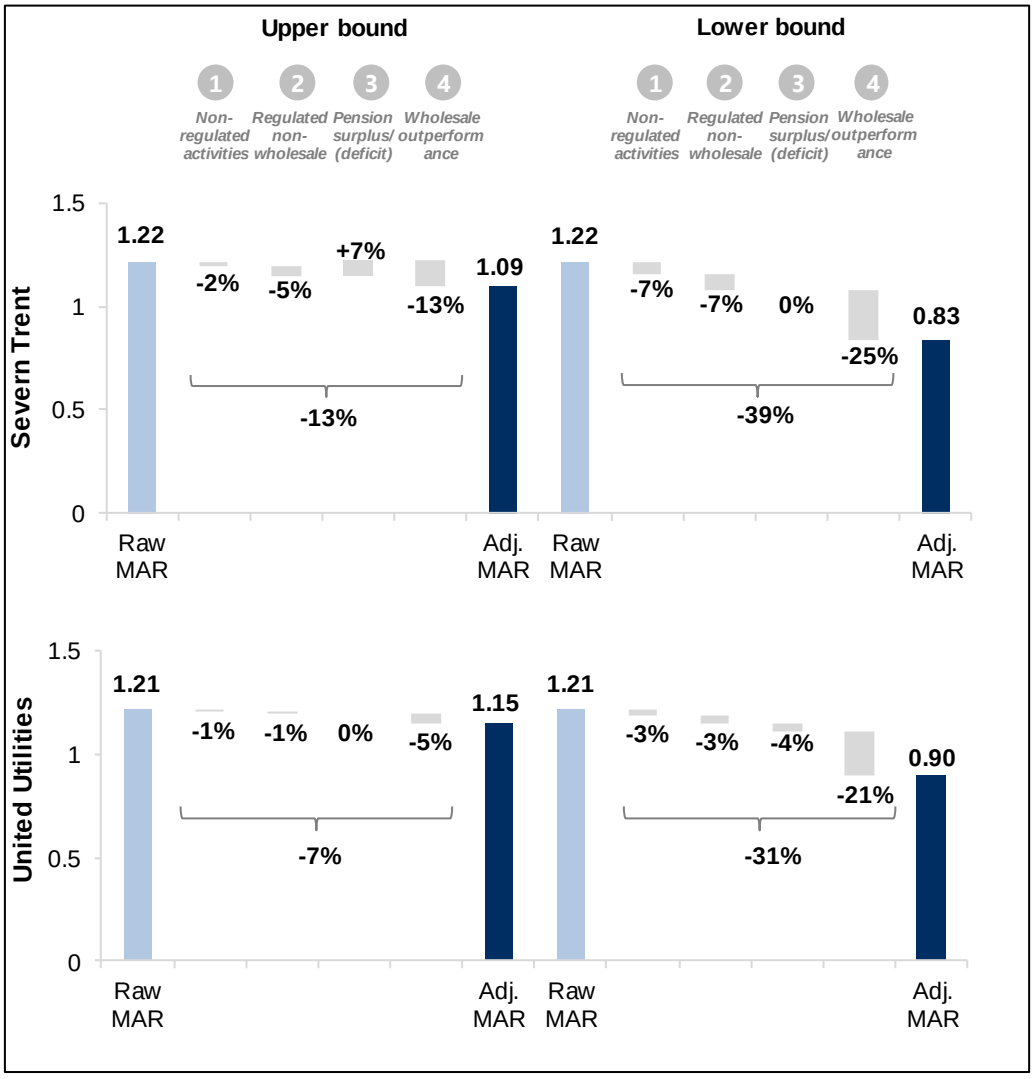
Similar to our analysis for NG, we collected estimates of the value of the adjustments from independent equity analyst reports. We estimate the adjusted MAR for water companies using the same method as for National Grid described above. We present our estimates of Severn Trent and United Utilities adjusted MARs in Figure D.2.

223 Most notably household retail, as non-household retail is typically classified by analysts as a non-regulated activity following the market opening.

224 Ofwat (October 2013), IN13/17: Treatment of companies' pension deficit repair costs at the 2014 price review.

225 For example, Ofwat's own analysis shows that it expects UU's debt costs over PR19 to be substantively lower than its cost of debt allowance, which is based on the industry average cost. See: Ofwat (2019) PR19 final determinations: Allowed return on capital appendix, p. 90. Link: https://www.ofwat.gov.uk/wp-content/uploads/2019/12/PR19-final-determinations-Allowed-return-on-capital-technical-appendix.pdf

Figure D.2: Total value of adjustments more than explains the observed RAB premium for water companies



Note: Ranges for adjustments for each of the factors based on min and max of all analyst estimates.
Source: NERA analysis based on equity analyst reports. See Appendix D.3 for detail.

As can be seen from Figure D.2 the analyst estimates of the value of the adjustments are uncertain, albeit to a lesser extent than NG, given the smaller share of non-UK regulated activities for water companies in overall market value compared to NG. Similar to NG, we find that the sum of all the adjustments (13 to 39 per cent for SVT and 7 to 31 per cent for UU) is able to explain the observed RAB premium of 22 and 21 per cent for SVT and UU respectively. As explained above, CEPA does not consider it necessary to adjust water companies' MARs for pension deficit/surplus. In contrast, our analysis shows that adjusting for pension deficits implies a reduction of up to -4 per cent, implying a material adjustment that needs to be reflected in the MAR.

As with NG, we conclude there is no evidence that the adjusted MAR for UK water wholesale businesses is greater than 1 and therefore that the allowed return on equity differs from the investors' expected cost of equity.

D.3. Analyst estimates of adjustments

D.3.1. Analyst estimates of adjustments to National Grid's raw MARs

In this appendix, we summarise data we collected on analysts' estimates of the adjustments to National Grid's raw MARs. This includes the valuation of NG' total US businesses, non-regulated activities, and the expected outperformance for the UK T&D businesses. We separately report the estimates before and after the sale of the interest in GDN, because the analysts' estimated adjustments as a percentage of the UK RAB have changed materially following the transaction.

Table D.1: Analyst estimates of value of US businesses, non-regulated activities, outperformance as % of UK RAB (post-GDN transaction)

Analyst	Report date	US activities	Non-regulated activities	UK T&D outperformance
JPMorgan	31-Mar-17	112%	19%	40%
Edison	28-Apr-17	93%	26%	27%
Edison	04-May-17	93%	26%	27%
JPMorgan	18-Aug-17	129%	22%	35%
Societe General	18-May-18	98%	24%	n/a
JPMorgan	30-May-18	126%	18%	24%
RBC	03-Aug-18	143%	29%	15%
JPMorgan	08-Nov-18	126%	18%	24%
JPMorgan	11-Dec-18	159%	20%	20%
Societe General	16-Jan-19	108%	24%	n/a
RBC	06-Feb-19	148%	27%	15%
JPMorgan	16-Apr-19	165%	20%	15%
JPMorgan	16-May-19	120%	17%	19%
Societe General	12-Sep-19	132%	21%	n/a
Societe General	30-Jan-20	112%	18%	n/a
JPMorgan	20-Apr-20	176%	23%	20%
JPMorgan	18-Jun-20	176%	23%	20%
RBC	23-Jun-20	184%	31%	24%
Range of estimates		**93% - 184%**	**17% - 31%**	**15% - 40%**

Source: JP Morgan (March 2017), p.3; Edison (April 2017), p.11; Edison (May 2017), p.11; JP Morgan (August 2017), p.4; Societe General (May 2018), p.6; JP Morgan (May 2018), p.12; RBC (August 2018), p.15; JP Morgan (November 2018), p.4; JP Morgan (December 2018), p.25; Societe General (January 2019), p.19; RBC (February 2019), p.11; JP Morgan (April 2019), p.7; JP Morgan (May 2019), p.3; Societe General (September 2019), p.18; Societe General (January 2020), p.18; JP Morgan (April 2020), p.7; JP Morgan (June 2020), p.7; RBC (June 2020), p.3.

6.6.1. Analyst estimates of adjustments to water companies' raw MARs

In this appendix, we summarise data we collected on analysts' estimates of the key adjustments to water companies' raw MARs. These include: valuation of companies' non-regulated activities (Table D.2), valuation of companies' non-wholesale regulated activities (Table D.3), valuation of companies' pension deficit/surplus (Table D.4) and valuation of expected wholesale outperformance (Table D.5).

Table D.2: Analyst estimates of value of non-regulated activities

Analyst	Report date	SVT	UU
Societe Generale	29-Mar-16	3%	1%
RBC	05-Oct-16	4%	2%
Societe Generale	13-Oct-16	7%	3%
RBC	30-Jan-17	n/a	2%
JPMorgan	23 & 25 May 2017	2%	1%
RBC	31-Jul-17	5%	2%
JPM	09-Mar-18	n/a	1%
RBC	26-Nov-18	5%	1%
JPM	11-Dec-18	n/a	1%
DB	25-Mar-19	n/a	1%
JPM	22-May-19	2%	n/a
JPM	08-Jul-19	2%	1%
JPM	19-Jul-19	2%	1%
RBC	06-Sep-19	n/a	1%
RBC	17-Jan-20	5%	n/a
JPM	18-Feb-20	2%	1%
JPM	01-Apr-20	n/a	1%
RBC	07-Apr-20	5%	1%
Range of estimates		**2% - 7%**	**1% - 3%**

Source: Societe Generale (March 2016), United Utilities, p.6; Societe Generale (March 2016), Severn Trent, p.2; RBC (October 2016), UK Water: RORE and valuations, p.12; Societe Generale (October 2016), United Utilities, p.11; RBC (January 2017), United Utilities Group, PLC, p.3; JPMorgan (May 2017), Severn Trent, p.2; JP Morgan (May 2017), United Utilities, p.2; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4; JP Morgan (March 2018), United Utilities, p.19; RBC (November 2018), United Utilities, p.3; RBC (November 2018), Severn Trent, p.3. JP Morgan (December 2018), United Utilities, p.19; Deutsche Bank (March 2019), United Utilities, p.5; JP Morgan (May 2019), Severn Trent, p.4; JP Morgan (July 2019), Severn Trent, p.12; JP Morgan (July 2019), United Utilities, p.11; JP Morgan (July 2019), Severn Trent, p.8; JP Morgan (July 2019), United Utilities, p.4; RBC (September 2019), United Utilities, p.3; RBC (January 2020), Severn Trent, p.11; JP Morgan (February 2020), Severn Trent, p.16; JP Morgan (February 2020), United Utilities, p.15; JP Morgan (April 2020), United Utilities, p.7; RBC (April 2020), United Utilities, p.3.

Table D.3: Analyst estimates of value of non-wholesale regulated activities

Analyst	Report date	SVT	UU
RBC	05-Oct-16	6%	1%
RBC	30-Jan-17	n/a	1%
RBC	31-Jul-17	7%	3%
RBC	26-Nov-18	5%	2%
RBC	06-Sep-19	n/a	2%
RBC	17-Jan-20	5%	n/a
RBC	07-Apr-20	5%	2%
Range of estimates		**5% - 7%**	**1% - 3%**

Source: RBC (October 2016), UK Water: RORE and valuations, p.12; RBC (January 2017), United Utilities Group, PLC, p.3; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4; RBC (November 2018), United Utilities, p.3; RBC (November 2018), Severn Trent, p.3; RBC (September 2019), United Utilities, p.3; RBC (January 2020), Severn Trent, p.11; RBC (April 2020), United Utilities, p.3.

Table D.4: Analyst estimates of value of pension deficit/surplus

Analyst	Report date	SVT	UU
Societe Generale	29-Mar-16	-2%	1%
RBC	05-Oct-16	-4%	3%
Societe Generale	13-Oct-16	0%	3%
RBC	30-Jan-17	n/a	3%
JPMorgan	23 & 25 May 2017	-4%	0%
RBC	31-Jul-17	-7%	3%
JPM	09-Mar-18	n/a	0%
RBC	26-Nov-18	-6%	3%
JPM	11-Dec-18	n/a	0%
DB	25-Mar-19	n/a	1%
JPM	22-May-19	-2%	n/a
JPM	08-Jul-19	-2%	1%
JPM	19-Jul-19	-2%	1%
RBC	06-Sep-19	n/a	2%
RBC	17-Jan-20	-4%	n/a
JPM	18-Feb-20	-4%	0%
JPM	01-Apr-20	n/a	0%
RBC	07-Apr-20	-4%	4%
Range of estimates		**-7% - 0%**	**0% - 4%**

Source: Societe Generale (March 2016), United Utilities, p.6; Societe Generale (March 2016), Severn Trent, p.2; RBC (October 2016), UK Water: RORE and valuations, p.12, Societe Generale (October 2016), United Utilities, p.11, RBC (January 2017), United Utilities Group, PLC, p.3; JPMorgan (May 2017), Severn Trent, p.2; JP Morgan (May 2017), United Utilities, p.2; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4; JP Morgan (March 2018), United Utilities, p.19; RBC (November 2018), United Utilities, p.3; RBC (November 2018), Severn Trent, p.3; JP Morgan (December 2018), United Utilities, p.19; Deutsche Bank (March 2019), United Utilities, p.5; JP Morgan (May 2019), Severn Trent, p.4; JP Morgan (July 2019), Severn Trent, p.12; JP Morgan (July 2019), United Utilities, p.11; JP Morgan (July 2019), Severn Trent, p.8; JP Morgan (July 2019), United Utilities, p.4; RBC (September 2019), United Utilities, p.3; RBC (January 2020), Severn Trent, p.11; JP Morgan (February 2020), Severn Trent, p.16; JP Morgan (February 2020), United Utilities, p.15; JP Morgan (April 2020), United Utilities, p.7; RBC (April 2020), United Utilities, p.3.

Table D.5: Analyst estimates of value of wholesale outperformance

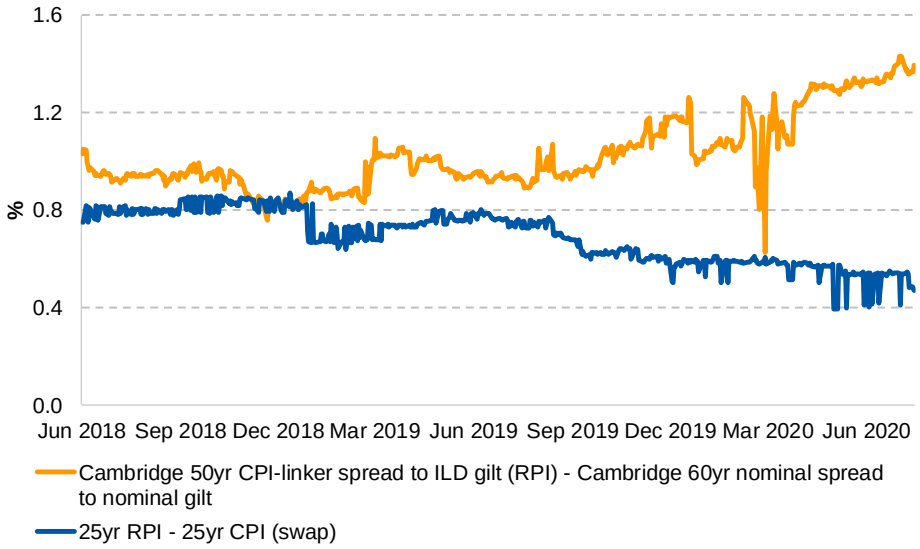
Analyst	Report date	SVT	UU
Investec	29-Jan-15	n/a	17%
RBC	05-Oct-16	21%	21%
RBC	30-Jan-17	n/a	21%
RBC	31-Jul-17	24%	16%
RBC	26-Nov-18	12%	6%
RBC	06-Sep-19	n/a	4%
RBC	17-Jan-20	25%	n/a
RBC	07-Apr-20	21%	12%
Range of estimates		**12% - 25%**	**4% - 21%**

Source: Investec (January 2015), United Utilities Group, p.3; RBC (October 2016), UK Water: RORE and valuations, p.12; RBC (January 2017), United Utilities Group, PLC, p.3; RBC (July 2017), United Utilities Group PLC, p.4; RBC (July 2017), Severn Trent PLC, p.4; RBC (November 2018), United Utilities, p.3; RBC (November 2018), Severn Trent, p.3; RBC (September 2019), United Utilities, p.3; RBC (January 2020), Severn Trent, p.11; RBC (April 2020), United Utilities, p.3.

Appendix E. Evidence from Cambridge University bonds on CPI premium

This appendix sets out our review of evidence on CPI premium based on Cambridge University bonds. Similar to Oersted, Cambridge University issued two instruments in 2018: i) a 60 year nominal bond; ii) a 50 year CPI-linked amortising bond. We are able to derive a CPI premium from these two bonds, as the difference in spreads must equal RPI-CPI wedge plus CPI premium.[226] Drawing on RPI-CPI 25 year swaps, RPI-CPI wedge at issuance was ca 75 bps, implying the CPI premium of 26 bps at issuance.[227] As shown Figure E.2, this premium increased to around 90bps by July 2020.

Figure E.1: The spread between Cambridge University CPI linker and nominal bond ca 101 bps at issuance



Source: NERA analysis

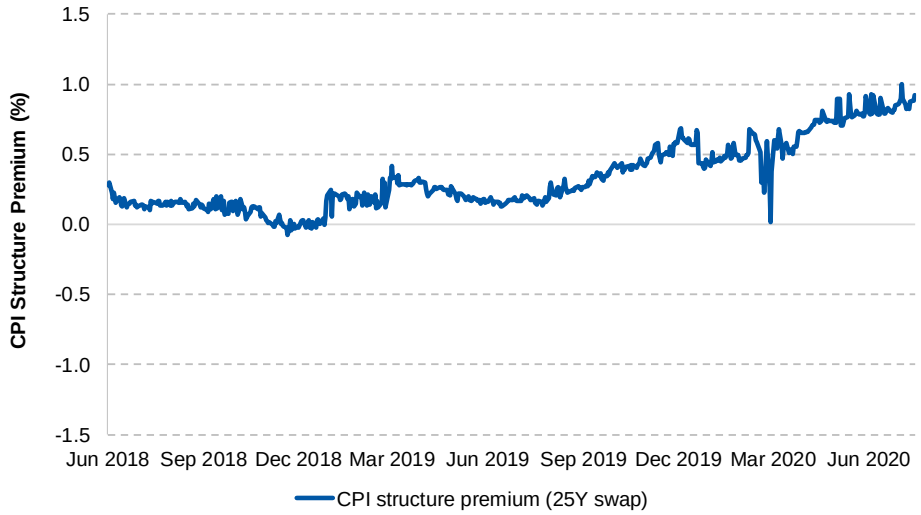
226 We derive the CPI premium as follows:

- Nominal bond yield at issue = 2.334%, and UKT benchmark =1.536%, implying 80 bps spread (using UKT with maturity 2071, i.e. closest to the maturity of the nominal bond of 2078) Real CPI yield at issue = 0.196%, and
- UKT RPI yield = -1.613%, implies 181 bps spread (using UKTI with maturity 2068 (closest to the maturity of the CPI-linked bond of 2068)
- Based on above spreads to gilts, we derive: [RPI – CPI] + CPI premium = 101bps.

Note that theoretically, there would also be a term premium given the different maturities, but given the long dated nature of the bonds, we assume term premium is zero.

227 We rely on 25y swaps as opposed to 50y swaps due to concerns over the data not showing any variation in 50y CPI swaps as of the issue date. Had we used 50y swaps, the yield at issuance would be close to 90bps.

Figure E.2: With RPI-CPI wedge of 75 bps at issuance, implied CPI premium of ca 26 bps but increased to ca 90bps



Source: NERA analysis

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