NERA
ECONOMIC CONSULTING

# Cost of Equity for RIIO-2

## A Report for Western Power Distribution

1 May 2018

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# Executive Summary

NERA Economic Consulting (NERA) has been engaged by Western Power Distribution (WPD) to respond to Ofgem's proposed approach to estimating the cost of equity for RIIO-2.[1]

This report reviews CEPA's, Ofgem's advisers on the cost of capital at RIIO-2, proposed approach to the cost of equity, namely its proposed total market return (TMR) and beta estimates.[2] CEPA estimates a cost of equity of between 3.1 per cent and 7.5 per cent based on a consistent 65 per cent notional gearing,[3] whereas a report commissioned by the Energy Networks Association (ENA) from Oxera recommends a range of 6.3 to 7.2 per cent (real, RPI-deflated), again based on a comparable 65 per cent gearing.[4] Our critique of CEPA's report suggests that the cost of equity at RIIO-2 should be at the upper-end of CEPA's range.

## CEPA relies on CMA's NIE TMR decision which it misinterprets as 5-6.5 per cent; updating CMA's methods supports a higher range

CEPA recommends a range for the TMR of 5 to 6.5 per cent (real RPI) which it states is in line with the CMA's NIE decision, where the CMA cited a range of methods, including historical returns, so-called ex-ante historical returns, as well as the Bank of England's Dividend Growth Model (DGM) (see Table 1).

CEPA's interpretation of the CMA NIE decision as supporting a TMR range of 5 to 6.5 per cent is erroneous. Although the CMA cited 5 per cent as a lower bound in its report, it concluded that the evidence for a TMR of 5 per cent was not well-supported, and the *weight of evidence* supported a TMR range between 5.5 and 6.5 per cent.[5] In addition, given that only the Bank of England DGM approach supported the lower bound of 5 per cent at NIE 2014, and updated studies from the Bank of England support a value of 7 to 8 per cent, CEPA's 5 per cent lower-bound does not represent a reasonable application of the CMA NIE 2014 approach for RIIO-2.

Indeed, as can be seen from Table 1, drawing on the different methods considered by the CMA in the 2014 NIE determination, the evidence supports an increase in the CMA's NIE preferred range of 5.5 to 6.5 per cent with both the historical ex post and DGM methods supporting values above the higher-bound value of 6.5 per cent. The increase in the Bank of England's DGM estimates reflect improvements in its model specification to take account of

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1 Ofgem (March 2018) RIIO-2 Framework Consultation, p. 90.

2 CEPA (February 2018): "Review of Cost of Capital Ranges for Ofgem's RIIO-2 for Onshore Networks".

3 Ofgem state the range is 3 to 5 per cent, but the upper-end is based on a 50 per cent notional gearing level. We report the range stated by CEPA on a consistent gearing basis. See CEPA, op.cit., p. 63.

4 Oxera state a range of 5.51 to 6.34 per cent based on a 60 per cent gearing level. Source: Oxera (February 2018) The cost of equity for RIIO-2, p. 6. Link: http://www.energynetworks.org/assets/files/info/Oxera%20research%20on%20the%20cost%20of%20equity_2018-02-28.pdf

5 CMA (March 2014) op. cit., para. 13.38.

changes in the expected dividend growth rate over time, share buybacks and variation in risk-free interest rate across maturities.

**Table 1**
**Updating studies used by CMA at NIE 2014 supports a higher range for the TMR than CEPA's 5 to 6.5 per cent (real RPI)**

| | CMA NIE 2014 evidence | NERA update of CMA evidence |
|---|---|---|
| DMS long run *(historical ex post)* | 6 – 7 % | 6.2 – 7.1% |
| DMS decomposition *(historical ex ante)* | 5.5 – 6 % | 5.5 – 6 % |
| Fama-French *(historial ex ante)* | 5.25 – 6.25 % | 5.27 – 6.27 % |
| Bank of England DGM *(forward looking)* | 5 – 6% | 7.2 – 8.1 % |

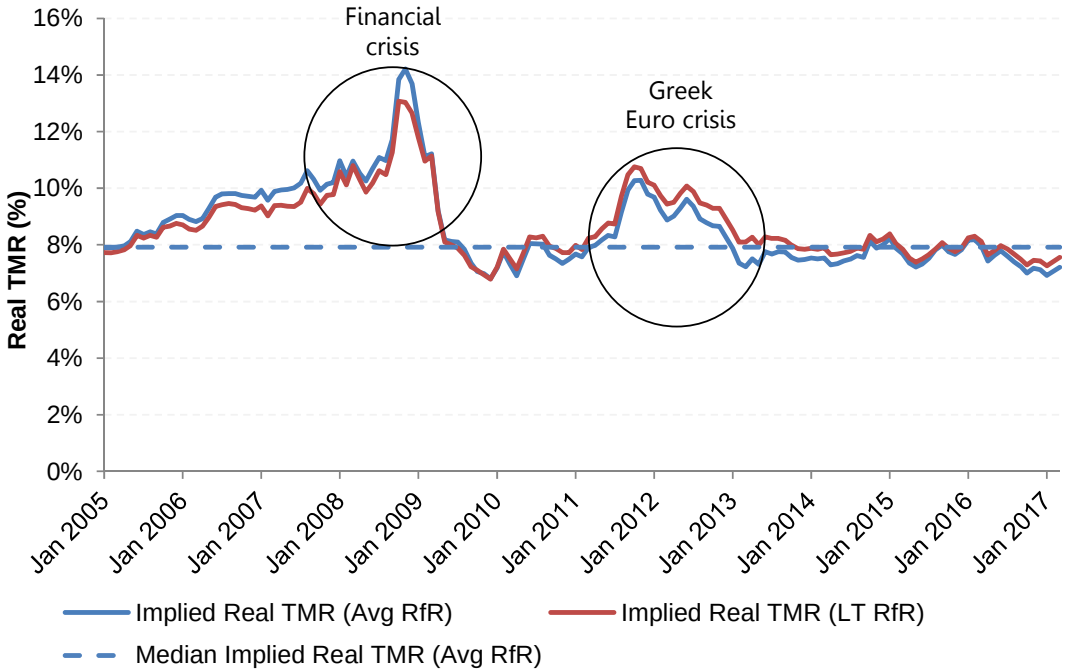
*Sources: NERA analysis of CMA (March 2014) Northern Ireland Electricity price determination. section 13; DMS (February 2018),Credit Suisse Global Investment Returns Yearbook 2018; Barclay's (March 2016), Equity Gilt Study 2016; Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2(4) and Bank of England yield curves.*

## CEPA's own DGM approach to estimating the TMR is flawed

CEPA also presents forward looking estimates on the TMR, although it does not rely on such evidence in making recommendations for its TMR. CEPA recommends a range of between 4.5 to 5 per cent based on its own DGM, and 5.3 to 5.8 per cent (real, RPI-deflated) based on PwC's DGM in a recent study commissioned by Ofwat for PR09.

Both CEPA and PwC's DGM evidence is substantially below independent estimates of the TMR from the Bank of England's DGM, which the CMA relied on in its 2014 NIE determination (as noted above). As shown in Figure 1, independent estimates of the TMR from the Bank of England support a range of around 7 to 8 per cent (real, RPI-deflated), substantially above the evidence presented by CEPA. CEPA's (and PwC's) DGM is understated, due to implausibly low assumptions around dividend growth rates, which is a key determinant of the implied TMR.

**Figure 1**
**Bank of England DGM supports a real TMR in the range of 7.2 to 8.1 per cent far higher than CEPA and PwC estimates**




*Note: (1) The implied Bank of England's TMR range of 7.2 to 8.1 per cent is based on the Bank of England's ERP estimates plus a risk-free rate estimate based on the UK 10-year index-linked gilt. The lower bound of 7.2 per cent represents the spot implied TMR whilst the upper bound of 8.1 per cent is the 5-year average. (2) The peaks in the TMR have been identified as the periods in which UK GDP growth was negative, corresponding to periods of high market volatility. UK quarterly GDP was negative in 2009 during the global financial crisis and in 2012-13 during the Euro sovereign crisis. Source: Office for National Statistics.*

We conclude that CEPA's TMR range of 5 to 6.5 per cent is based on an inappropriate update of the CMA's method for estimating the TMR at NIE 2014 and a flawed DGM approach. Our update of the CMAs analysis for NIE shows that in most cases the evidence supports a higher TMR than the value of 6.5 per cent determined by the CMA in 2014, with a marked increase in the Bank of England's DGM based TMR relative to 2014. We therefore conclude that based on the CMA NIE methodology the TMR should be at least as high as the NIE decision of 6.5 per cent.

## CEPA's beta range of 0.25 to 40 relies on market evidence during the financial crisis when betas were depressed

CEPA estimates the asset beta using four UK listed utilities, National Grid (NG) and three UK water companies. CEPA estimates asset betas over time, and calculates a range of 0.25 to 0.40 by taking the overall range in estimates from the global financial crisis onwards. In particular, CEPA places weight on asset beta estimates from the period 2011 to 2014 when UK utility asset betas were at historical lows.

We see no merit in using asset beta estimates from 2011 to 2014 to estimate the asset beta for RIIO-2. In the aftermath of the global financial crisis, the betas for regulated utilities

declined as investors became more risk-averse and reallocated their portfolios towards less risky assets. As a result of the 'flight to quality', the asset betas declined.

However, this trend has now reversed and beta estimates for UK listed utilities have returned to the pre-crisis level. Decomposing National Grid's asset beta into its constituent elements, the correlation with the market portfolio and relative volatility, we show an increase in both elements since RIIO-1 supporting higher values at RIIO-2. By contrast, CEPA's lower bound range of 0.25, which is based on outdated market evidence, is not relevant to RIIO-2.

## Updated market evidence shows assets betas in a range of 0.3 to 0.4, with NG towards the upper-end

The latest beta estimates for UK listed utilities lie in the range of 0.3 to 0.4, with NG's latest 2-year asset beta at 0.37. CEPA argues that the asset betas for the water companies are as relevant benchmarks for the RIIO-2 asset beta as NG's beta, and CEPA notes that there are certain factors, such as the treatment of pension deficit recovery under the regulatory regimes, which mean energy networks face less risk than water companies. CEPA highlights that water companies are only able to recover 50 per cent of pension deficits whereas energy networks can recover the established deficit as at 2013.

However, CEPA has not undertaken a complete relative risk analysis of UK energy networks against water companies. Aside from pension deficit recovery, there are other factors for which energy networks may face greater risk than water companies, e.g. cost of debt indexation; capex to RAB. For example, greater capex to RAB ratios increase the company's systematic risk exposure because of the greater fixed costs in the business, which results in greater variance in profits as a result of any demand shocks. Higher capex can also expose the company to greater downside asymmetric risk, as some of the investments may be stranded in the event of certain technological changes, which is not captured within a beta estimated using the CAPM. Without considering all these factors, CEPA cannot conclude that UK water companies are appropriate comparators for estimating the asset beta at RIIO-2. Moreover, the empirical asset beta evidence for NG supports a higher asset beta than for water companies as described below.

## NG's composite beta reflects lower risk US assets; the implied asset beta for UK energy networks lies in range of 0.43 to 0.47

We have also decomposed NG's group asset beta to determine the beta of its UK regulated operations, given a large segment of its business relates to US energy networks. We find that US energy network betas are lower than NG's asset beta, principally because they are subject to less high-powered incentive regimes, and lower regulatory risk due to established regulatory principles established through the courts. This implies that the asset beta for NG's UK regulated business must be higher than its group beta. Our decomposition analysis suggests that the asset beta for NG's UK regulated business is likely to be in the range of 0.43 to 0.47, above CEPA's overall beta range for RIIO-2 of 0.25 to 0.4.

# 1. Introduction

NERA Economic Consulting (NERA) has been engaged by Western Power Distribution to assist with responding to Ofgem's framework consultation on the regulatory framework for RIIO-2. In March 2018, Ofgem published its framework consultation describing its proposed approach to setting price controls for GB gas and electricity networks.[6]

A key aspect to Ofgem's framework consultation is the approach to setting the baseline allowed return to ensure investors in an efficiently run company can earn a reasonable rate of return commensurate to the risks they bear. This report reviews CEPA's, Ofgem's advisers on the cost of capital at RIIO-2, proposed approach to the cost of equity, namely its proposed total market return (TMR) and beta estimates. [7]

CEPA estimates a cost of equity of between 3.1 per cent and 7.5 per cent based on 65 per cent notional gearing,[8] whereas a report commissioned by the Energy Networks Association (ENA) from Oxera recommends a range of between 6.3 and 7.2 per cent, based on a comparable 65 per cent gearing. [9] Our critique of CEPA's report suggests that the cost of equity at RIIO-2 should be at the upper-end of CEPA's range.

This report is structured as follows:

- Section 2 discusses CEPA's approach to estimating the total market return, which is the sum of the risk-free rate and equity risk premium.
- Section 3 considers CEPA's approach to estimating the asset beta.

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6 Ofgem (March 2018): "RIIO-2 Framework Consultation".

7 CEPA (February 2018): "Review of Cost of Capital Ranges for Ofgem's RIIO-2 for Onshore Networks".

8 Ofgem state the proposed cost of equity range is 3 to 5 per cent, where the upper-end is based on a 50 per cent notional gearing level. We report the range stated by CEPA on a consistent 65per cent notional gearing basis. See CEPA, op.cit., p. 63.

9 Oxera state a range of 5.51 to 6.34 per cent based on a 60 per cent gearing level. Source: Oxera (February 2018) The cost of equity for RIIO-2, p. 6. Link: http://www.energynetworks.org/assets/files/info/Oxera%20research%20on%20the%20cost%20of%20equity_2018-02-28.pdf

# 2. Total Market Return

In this section, we review CEPA's evidence on the recommended range for the total market return (TMR). CEPA presents a number of estimates of the TMR, drawing on historical and forward looking evidence, concluding on a range for TMR of 5 to 6.5 per cent (real, RPI-deflated). CEPA states that the proposed range is in line with the CMA's Northern Ireland Electricity (NIE) TMR range.

Below, we explain that much of CEPA's TMR evidence is flawed and leads to a substantial understatement of the TMR for RIIO-2. We also show that the CMA in its NIE 2014 decision concluded that the *weight of evidence* supports a range of 5.5 to 6.5 per cent (not 5 to 6.5 per cent, as CEPA conclude), and that updating these methods supports a higher range.

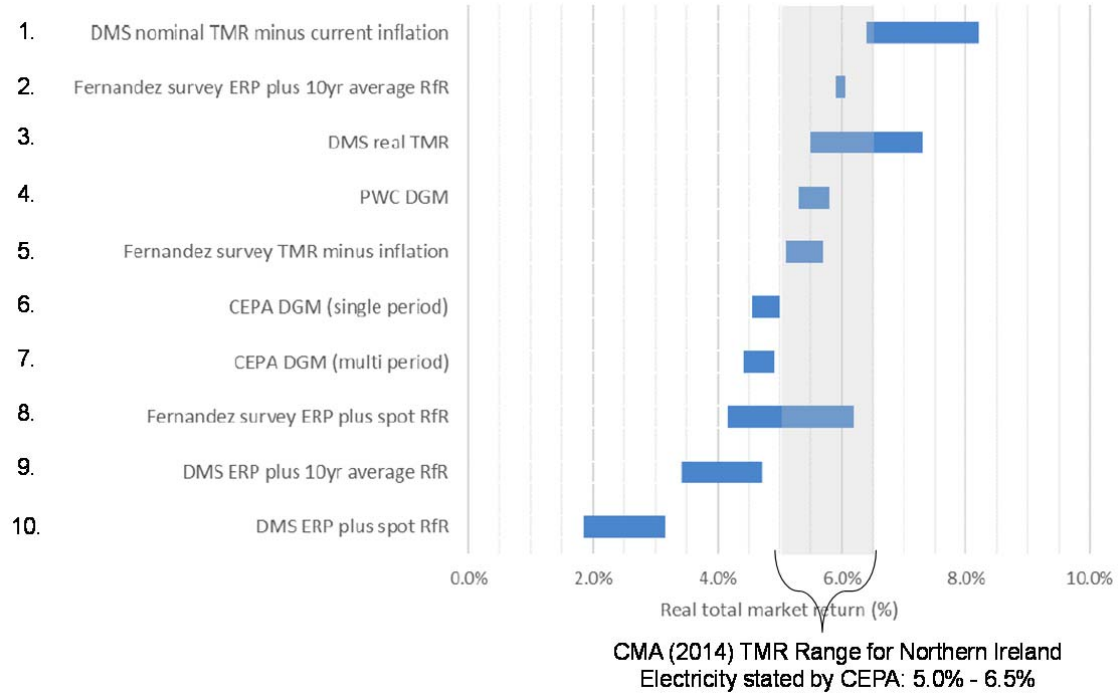
## 2.1. Summary of CEPA evidence and recommendations

CEPA recommends adopting a TMR approach to estimating the equity risk premium (ERP) and risk-free rate (RfR) parameters of the CAPM, in line with standard practice in GB utility regulation.[10]

In its report, CEPA presents a range of evidence on the TMR, including historical realised returns as well as forward looking evidence. The different estimates presented by CEPA in its report are summarised in Figure 2.1 below.

[10] CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, section E.1.2, p.101.

**Figure 2.1**
**CEPA presents a wide range of TMR estimates based on different sources and approaches (real, RPI-deflated)**




*Source: CEPA (February 2018), review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, Figure E.7, p.113.*

CEPA's evidence on the TMR can be divided into three different categories:

- **Historical TMR evidence**: This includes estimates based on historical realised returns from Dimson, Marsh and Staunton (DMS) database. CEPA presents estimates based on historical nominal returns deflated with current inflation as well as historical real returns, using geometric and arithmetic averages as a basis of generating its TMR range (approaches 1 and 3 in Figure 2.1).
- **Forward looking TMR evidence**: This includes estimates based on DGM models from PwC and CEPA's own DGM analysis as well as survey evidence on the TMR (approaches 4-7 in Figure 2.1).
- **Evidence on ERP and RfR parameters estimated separately**: This includes TMR calculated as a combination of ERP from various sources (historical and survey evidence) combined with current estimates of the RfR (spot and 10-year averages) (approaches 2, 8-10 in Figure 2.1).

CEPA also refers to a TMR range of 5 to 6.5 per cent (real, RPI-deflated), which it states is the range adopted by the CMA in its 2014 NIE determination (as indicated in grey in Figure

2.1 above). For its NIE 2014 review, the CMA relied on historical as well as forward looking evidence.[11]

CEPA concludes that it is appropriate to consider both historical and forward-looking evidence to estimate the TMR and **recommends a range of 5 to 6.5 per cent (real, RPI-deflated) for the TMR**, which it states is in line with the CMA's NIE determination. CEPA notes that it does not consider the weight of available evidence points to an estimate outside of this range (with the exception of its own DGM estimate, approaches 6 and 7 in Figure 2.1, but CEPA acknowledged that reflects only one source of evidence). CEPA further suggests that the lower end of its range is consistent with forward looking evidence and cross-checks from competitive benchmarks while historical evidence and regulatory precedent would support a TMR towards the top end of the range.

Finally, CEPA also notes that the UKRN report supports an upper bound of 6 per cent (real, RPI deflated) based on historical realised returns, due to adjustments by UKRN to historical inflation estimates relative to the DMS.

In the next sections, we explain that most of the TMR evidence presented by CEPA is flawed and leads to a substantial understatement of the TMR for RIIO-2. We also show that updating the evidence base considered by the CMA in its NIE 2014 supports a higher range than that identified by CEPA.

## 2.2. CEPA historical TMR evidence based on geometric averages understates expected TMR

CEPA presents historical estimates of the TMR in the range of 5.5 to 7.3 per cent (real, RPI deflated), based on historical real TMR figures from DMS (approach 3 in Figure 2.1), and a range of 6.4 to 8.2 per cent (real, RPI-deflated), based on historical nominal TMR figures from DMS, deflated using CEPA's current inflation forecasts (approach 1 in Figure 2.1).[12] The bottom end of CEPA's range is based on geometric averages of historical returns whereas the top end is based on arithmetic averages.

We consider that the use of geometric averages is not appropriate for estimating the expected TMR for RIIO-2, as supported by financial literature discussed below.

### 2.2.1. Academic evidence supports use of arithmetic averages

In theoretical literature, papers by Blume (1974), Cooper (1996) and Jacquier, Kane and Marcus (2003) have been quoted on the issue of the appropriate averaging method.[13]

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[11] CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, p.48.

[12] Real values calculated based on information in CEPA (February 2018), review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, Table E.4; subtracting inflation of 3 per cent from CEPA's nominal values reported (appears consistent with figures in CEPA's Figure E.7).

[13] Blume (1974), Unbiased Estimators of Long-Run Expected Rates of Returns, Journal of the American Statistical Association 69, p.634‑663.; Cooper (1996), Arithmetic versus geometric mean estimators: Setting discount rates for capital budgeting, European Financial Management, 2:2, p.157-167; Jacquier, Kane, and Marcus (2003), Geometric or Arithmetic Mean: A Reconsideration, Financial Analysts Journal 59(6), p.46‑53.

- Blume (1974) was among the first to propose an estimator of the expected return, in which the arithmetic mean gets more weight, the longer the historical averaging period compared to the investor's investment horizon. This is known as the Blume estimator:

$$TMR = [\frac{T-n}{T-1}T * (1+AM)^n + \frac{n-1}{T-1} * (1+GM)^n]^{\frac{1}{n}} - 1$$

  Where T is the historical estimation period, and n is the investment horizon typically defined as the number of years. Based on the above formula, the shorter the investment horizon relative to the historical estimation period, the greater the weight on the arithmetic mean (AM) relative to the geometric mean (GM).

- Cooper (1996) considers the use of arithmetic vs. geometric averages in the context of the CAPM applied in capital budgeting. Cooper concludes that: *"The use of arithmetic mean ignores estimation error and serial correlation in returns. Unbiased discount factors have been derived to correct for both these effects. In all cases, the corrected discount rates are closer to the arithmetic than the geometric mean".*[14]
- Jacquier, Kane and Marcus (2003) provide a set of conditions under which both the arithmetic mean and geometric mean are biased or unbiased, demonstrating that the geometric mean is downward biased when the investment horizon is shorter than the historical estimation period. They also derive an unbiased estimator (JKM) of the expected return, calculated as the weighted average of the geometric and arithmetic means, with greater weight placed on the arithmetic mean the longer the historical period compared to the investment horizon (similarly to Blume).

The above papers demonstrate that the relative weight on the AM and GM in estimating the TMR depends on the length of the investment horizon (referred to by the CMA as the "holding period")[15] for the marginal investor, relative to the historical period over which the TMR is estimated (118 years based on DMS data).

We consider that evidence as well as precedent supports the use of relatively short investment horizons for the following reasons:

- GB regulators such as Ofgem and Ofwat have typically considered the TMR for a holding period of 1 year.[16]
- The use of short-term holding periods is consistent with evidence from a survey of equity market participants by the CFA Institute UK that suggests that the average holding period is between 1-2 years.[17]

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[14] Cooper (1996), Arithmetic versus geometric mean estimators: Setting discount rates for capital budgeting, European Financial Management, 2:2, p.165.

[15] Competition Commission (26 March 2014): "Northern Ireland Electricity Limited price determination – Final determination", Appendix 13.2, paragraph 2.

[16] Ofgem set out long-run historical returns based on a 1-year holding period at RIIO-ED1. Source: Ofgem (17 February 2014): "Decision on our methodology for assessing the equity market return for the purpose of setting RIIO-ED1 price controls", p6-7. Ofwat too presented long-run historical returns based on a 1-year holding period at PR14. Source: Ofwat (January 2014): "Setting price controls for 2015-20 – risk and reward guidance", p13.

[17] Kay Review of UK Equity Markets and Long-Term Decision Making, Interim Report, Feb 2012I; CFA UK response to the Kay Review of UK Equity Markets and Long-Term Decision Making – Call for Evidence

Given the historical period from DMS data (118 years) is substantially longer than the holding period for the marginal investor (relatively short, as discussed above), academic literature supports the TMR should be estimated close to the historical arithmetic mean.

## 2.3. CEPA forward looking evidence is understated compared to independent DGM evidence from the Bank of England

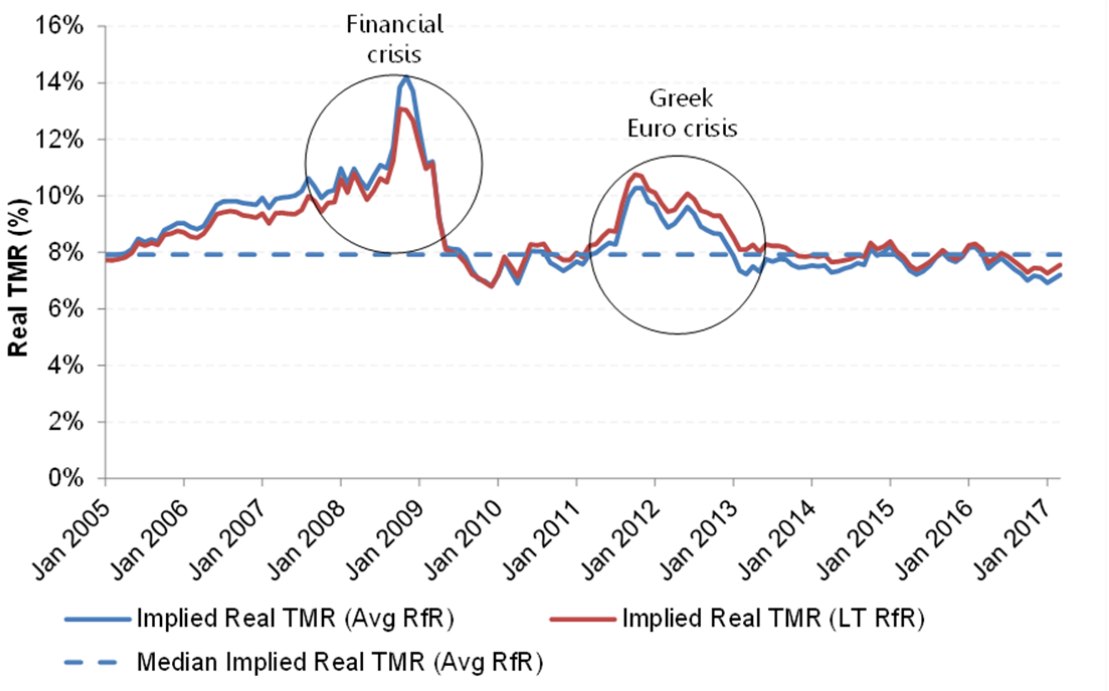
CEPA presents forward looking estimates on the TMR, drawing on its own DGM as well as PwC's DGM analysis for Ofwat for the upcoming PR19 review. CEPA's DGM estimates provide a range for the TMR of 4.5 to 5 per cent and 4.4 to 4.9 per cent (real, RPI-deflated), based on CEPA's single period and multi period models respectively (approaches 6 and 7 in Figure 2.1) and 5.3 to 5.8 per cent (real, RPI-deflated) based on PwC's DGM (approach 4 in Figure 2.1).[18]

### 2.3.1. CEPA's estimates are substantively below independent estimates from the Bank of England

CEPA's DGM evidence, based on its own as well as PwC's DGM specification is substantially below independent estimates of the TMR from the Bank of England's DGM, which the CMA relied on in its 2014 NIE determination. As shown in Figure 2.2, independent estimates of the TMR from the Bank of England support a range of around 7 to 8 per cent (real, RPI-deflated), substantially above the evidence presented by CEPA.

[18] Real values calculated based on information in CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, Table E.4; subtracting inflation of 3 per cent from CEPA's nominal values reported (appears consistent with figures in CEPA's Figure E.7).

**Figure 2.2**
**Bank of England DGM supports a real TMR in the range of 7.2 to 8.1 per cent**




*Note: (1) The implied Bank of England's TMR range of 7.2 to 8.1 per cent is based on the Bank of England's ERP estimates plus a risk-free rate estimate based on the UK 10-year index-linked gilt. The lower bound of 7.2 per cent represents the spot implied TMR whilst the upper bound of 8.1 per cent is the 5-year average. (2) The peaks in the TMR have been identified as the periods in which UK GDP growth was negative, corresponding to periods of high market volatility. UK quarterly GDP was negative in 2009 during the global financial crisis and in 2012-13 during the Euro sovereign crisis. Source: Office for National Statistics.*

| | Spot (Mar 2017) | 1Y average (Mar 2017) | 5Y Average (Mar 2017) |
|---|---|---|---|
| BoE TMR (average RfR) | 7.2 | 7.3 | 7.8 |
| BoE TMR (LT RfR) | 7.6 | 7.6 | 8.1 |

*Source: NERA analysis of Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.94 and Bank of England yield curve data using March 2017 as cut-off date (later data from BoE on the TMR not available)*
*Note: The Bank of England estimates the DGM using a time varying risk-free rate for all maturities (where available) and a long-run risk-free rate assumption. We calculate a TMR as the sum of the Bank of England's reported ERP and an i) average of the real risk-free rate for all available maturities and ii) the real risk-free rate at the longest maturity available.*

### 2.3.2. CEPA has adopted implausibly low assumptions on dividend growth

CEPA's (and PwC's) DGM is understated, due to implausibly low assumptions around dividend growth rates, a key determinant of the implied TMR. CEPA (and PwC) assume that FTSE dividends grow in line with short-term and long-term nominal growth in UK GDP, but provide no basis for the assumption that UK GDP forecast growth rates are a good proxy for

investors' expectations of dividend growth rates. This assumption is incorrect, for a number of reasons. First, FTSE All-Share companies derive over 70 per cent of their earnings from outside of the UK, which have higher forecasts of GDP growth than assumed by CEPA (and PwC) for the UK.[19] Second, short-term UK GDP forecast growth rates are somewhat depressed (e.g. due to Brexit) and are substantially lower than independent analyst forecasts of dividend growth rates for FTSE stocks, which are used by the Bank of England as a basis of forecasting short-term dividend growth in its DGM.[20]

As a result of understating dividend forecasts for both the short-term and the long-term relative to the independent estimates by the Bank of England (as summarised in Table 2.1), CEPA's and PwC's DGM substantially understate the TMR.[21]

**Table 2.1**
**CEPA's and PwC's nominal dividend growth assumptions are understated compared to Bank of England (October 2016 assumptions)**

| | Bank of England | CEPA | PWC |
|---|---|---|---|
| Short-term dividend growth (nominal) | Around 8% (analyst forecasts) | Around 4% (UK GDP growth) | 3.7% (UK GDP growth) |
| Long-term dividend growth (nominal) | Around 6% (weighted average GDP growth for countries from which FTSE companies derive earnings) | 4.5% (UK GDP growth) | 4.0% (UK GDP growth) |

*Source: Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.90-91, Chart 3 and 7, (approximate values based on BoE summary charts) ; CEPA (January 2018), Review of cost of capital ranges for new assets for Ofgem's network division, p. 77 Figure A.2 and PwC (June 2017), Refining the balance of incentives for PR19, Appendix D, Table 24, p.102*
*Note: Reflects forecasts for October 2016 DGM results.*

### 2.3.3. CEPA's investor survey evidence is unreliable

CEPA also presents survey evidence on TMR of between 5 and 6 per cent (real, RPI-deflated).[22] However, we do not recommend relying on survey evidence to estimate the TMR,

[19] For example, the weighted average long-run GDP growth rate for the different regions from which FTSE companies derive their earnings as of October 2016 is around 5.9% (nominal), while the UK long-run GDP growth rate assumed by CEPA and PwC is 4.5 and 4.0 per cent (nominal). Source: Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.91, Chart 7, CEPA (January 2018), Review of cost of capital ranges for new assets for Ofgem's network division, p. 77 and PwC (June 2017), Refining the balance of incentives for PR19, Appendix D, Table 24, p.102.

[20] Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2, p.90, Chart 3, CEPA (January 2018), Review of cost of capital ranges for new assets for Ofgem's network division, p. 76-77 and PwC (June 2017), Refining the balance of incentives for PR19, Appendix D, Table 24, p.102.

[21] The DGM estimates a discount rate which equates the forecast dividends to the current value of the FTSE all share index, which is observable. If dividend forecasts are understated, the DGM will "compensate" for this by producing a lower discount rate (i.e. TMR) to equate the lower dividend forecasts to the same observed value of the market index.

[22] Real values approximated based on CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, Figure E.7.

given issues around the respondents' understanding of the question being asked (e.g. are they supposed to provide an estimate in real or nominal terms). The CMA criticised the use of survey evidence of in its 2014 NIE determination, where it noted:

> *"[…]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; or whether the ERP is over bonds or bills or some other instrument."*[23]

## 2.4. CEPA estimates based on combining ERP and RfR over different periods is unreliable

CEPA also presents a number of estimates based on combining ERP and RfR parameters from different sources and periods. Specifically, CEPA combines historical estimates from the DMS as well as forward looking survey evidence on the ERP with spot and 10-year average risk-free rate estimates based on Bank of England data. This provides a wide range of estimates of the TMR between 2 and 6 per cent (real, RPI deflated).[24]

We do not consider that CEPA's estimates of the TMR based on combining ERP and RfR from different sources and periods represents reliable evidence on the TMR for RIIO-2. Finance literature explains there is a negative relationship between the RfR and ERP over time, which implies the two parameters should be estimated on a consistent basis to avoid biased TMR estimates. This is also supported by UK regulatory precedent of adopting a "TMR approach", which involves joint estimation of the total market return parameter first with the ERP derived as a residual. CEPA itself recommends the use of a TMR approach for RIIO-2[25] and it is therefore not clear why it combined separate estimates of ERP and RfR from different sources and time periods, contrary to its recommendations.

Finance theory explains that the negative relationship between the RfR and the ERP is associated with increased risk aversion and the so called "flight to safety" effect during periods of economic and financial crisis. At times of economic uncertainty, investors dispose of risky assets such as equity in favour of risk-free assets such as government bonds. This reduces the price of equities and increases the premia for holding risk while reducing yields on risk free assets, giving rise to the negative correlation between the ERP and the RfR.[26]

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[23] CMA (March 2014), Northern Ireland Electricity price determination, Final Determination, Para. 13.156, p.13-31 and 13.32.

[24] Real values approximated based on CEPA (February 2018), review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, Figure E.7.

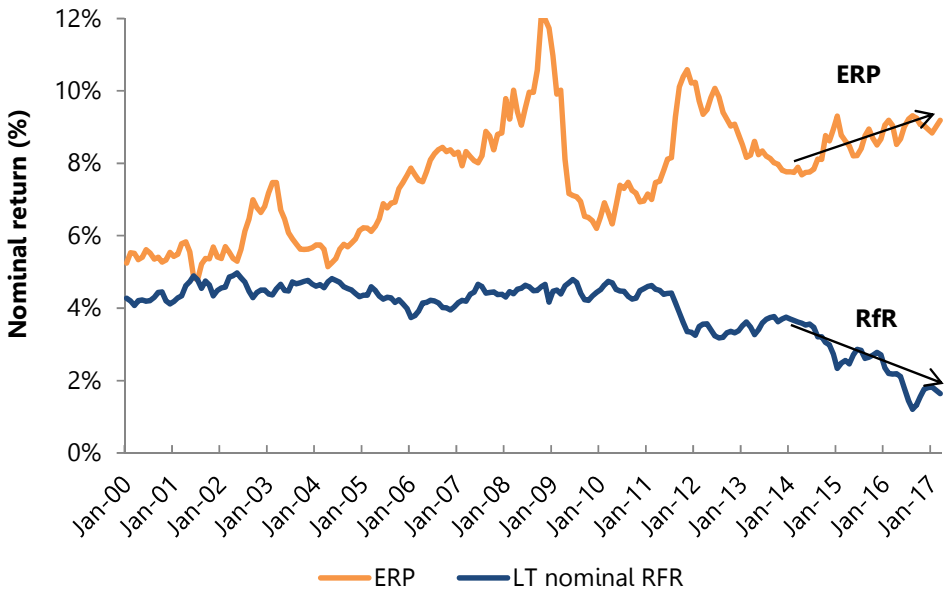
[25] CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, section E.1.2, p.101.

[26] See for example: (1) Campbell and Cochrane (1999), By force of habit: A consumption-based explanation of aggregate of stock market behaviour, Journal of Political Economy, 107, 205-51; (2) Wright, S. et al. (September 2006), Report on the Cost of Capital – provided to Ofgem, Smithers & Co Ltd; (3) Harris, Robert, and Marston, Felicia (1999) , The Market Risk Premium: Expectational Estimates Using Analysts' Forecasts, Darden Business School Working Paper No 99-08; (4) Maddox, F., D. Pippert and R. Sullivan (1995), An Empirical Study of ex ante Risk Premiums for the electric Utility Industry," Financial Management, 89-95.

Empirically, a number of studies find a positive relationship between volatility and expected equity returns and a negative relationship between the RfR and ERP while the TMR remains stable over time.[27]

Consistent with financial literature, prominent economic institutions such as the Bank of England have recognised that low interest rates and economic uncertainty have led to increased ERPs.[28] Indeed, the Bank of England's estimates of the ERP derived from its DGM have increased markedly with the recent fall in interest rates (see Figure 2.3) while the TMR remained relatively stable over time (as shown in Figure 2.2).

**Figure 2.3**
**Bank of England DGM shows reduction in RfR offset by increases in ERP over recent period**




*Source: NERA analysis of Bank of England data*

Similarly, the German Bundesbank also noted that there is a strong negative correlation between ERP and risk free rates:[29]

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[27] See for example: (1) Graham and Harvey (2010), The equity risk premium in 2010. (2) Cochrane and Piazzesi (2008), Decomposing the yield curve, Graduate School of Business, University of Chicago. Working Paper; (3) Wright, Mason, Miles (2003), A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK, Smithers & Company Limited.; (4) Scruggs (1998), Resolving the puzzling intertemporal relation between the market risk premium and conditional market variance: A two‐factor approach. The Journal of Finance, 53(2), 575-603.; (5) Siegel W(1998), Stocks for the Long Run McGraw Hill, Second Edition.

[28] See for example, Bank of England, (August 2017), Inflation Report, p.1; Bank of England, (August 2016), Inflation Report. The report states: ""*There remains, however, substantial uncertainty about the nature of the UK's future trading arrangement and the implications for competitiveness. This may have increased the risk premium required by investors to hold sterling-denominated assets.*""

[29] Deutsche Bundesbank, (Nov 2007), Monthly Report.

"*[…] the correlation between returns from stocks and long-term government bonds is a suitable measure of risk aversion... In times of heightened risk aversion, it is therefore often possible to observe that investors demand higher equity risk premiums or undertake shifts from stocks into secure government bonds (safe haven flows). The resulting contrasting price developments of stocks and government securities are accompanied by a negative correlation.*"

While CEPA does not appear to support a full 1-to-1 relationship between the RfR and ERP, it quotes estimates of the correlation which are close to 1.

> *"PwC, on behalf of Ofwat, analysed the movement in DDM estimates over two horizons to estimate this coefficient, finding for 2000-2016 that the coefficient was [-0.76] and for 2010-16 the coefficient moved to [-0.88]. Alternatively, looking at DMS evidence on TMR and the risk-free rate provides another point of evidence to utilise. A report by Harris and Marston (2013) found that the coefficient between the risk-free rate and ERP was [-0.79] based on US evidence between 1986 and 2010."* [30]

Estimating the RfR and ERP parameters separately, as CEPA does, can result in biased estimates if inconsistent sources and periods are combined together, without taking the correlation of the two parameters into account. This concern applies in particular to CEPA's estimates of the TMR based on combining long-run historical ERP from DMS with spot and 10-year averages of the risk-free rate, which ignores the negative relationship between the two parameters and leads to implausibly low estimates of the TMR of as low as 2 per cent (real, RPI-deflated).

## 2.5. Updating CMA NIE 2014 evidence supports a higher range for RIIO-2

Based on the above evidence, CEPA concludes on a TMR of 5 to 6.5 per cent (real, RPI-deflated), which it states is consistent with the CMA range considered in its 2014 NIE determination.

Below, we set out the updated evidence on the TMR considered by the CMA in its 2014 NIE determination. As we show, the updated evidence supports the conclusion that the TMR has not fallen since 2014. The CMA NIE determination of 6.5 per cent real (RPI-deflated) TMR should therefore be considered as a lower bound for the TMR for RIIO-2 controls.

In its NIE 2014 determination, the CMA considered three types of evidence for estimating the TMR: [31]

- **Historical ex-post approaches**: studies that assume that historical realised returns are equal to investors' expectations;
- **Historical ex-ante approaches**: studies that fit models of stock returns to historical data to separate out ex-ante expectations from ex-post good or bad fortune;

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[30] CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, p.59.

[31] CMA (March 2014), Northern Ireland Electricity price determination. p.13-26

- **Forward looking-evidence**: studies that use current market prices and surveys of market participants to derive current forward-looking expectations of the TMR.

On the relative weight to be placed on the evidence, the CMA noted that it used historical approaches (both ex ante and ex post) as its primary sources for estimating the equity market return, with forward-looking approaches being used as a cross-check. [32]

Historical ex-post approaches

The CMA used the DMS and Barclays capital databases as the basis for its long-run historical estimate. Drawing on a number of different averaging techniques, including those discussed in section 2.2, and using different holding periods, the CMA concluded a TMR of around 6 to 7 per cent for UK and world markets in 2014.[33]

Table 2.2 below shows an update of the CMA calculations using updated DMS data over the period 1900-2017 from the DMS 2018 publication.

[32] CMA (March 2014), Northern Ireland Electricity price determination, para 13.137, p.13-26.

[33] CMA (March 2014) op. cit. p.13-27, para 13.141.

**Table 2.2**
**The latest long-run DMS' TMR estimates lie in range of 6.2 to 7.1 per cent, a slight increase relative to evidence presented by CMA at NIE 2014**

| | Simple | Overlapping | Blume | JKM |
|---|---|---|---|---|
| 1Y holding | 7.1 (0.0) | 7.1 (0.0) | 7.1 (0.0) | 7.1 (0.1) |
| 2Y holding | 6.6 (-0.9) | 7.0 (0.0) | 7.1 (0.0) | 7.1 (0.1) |
| 5Y holding | 6.7 (0.0) | 6.8 (0.0) | 7.0 (0.0) | 7.0 (0.2) |
| 10Y holding | 6.8 (0.4) | 6.7 (-0.1) | 7.0 (0.1) | 6.7 (0.1) |
| 20Y holding | 7.1 (0.4) | 6.8 (-0.1) | 6.8 (0.0) | 6.2 (0.1) |

*Source: NERA calculations using DMS (February 2018),Credit Suisse Global Investment Returns Yearbook 2018 (DMS data since 1988 converted to real, RPI-deflated figures based on ONS data).*[34] *CMA (2014), Northern Ireland Electricity price determination, Final Determination, p. 13-27, Table 13.7.*
*Note: The figures in black in the table represent different historical estimates considered by the CMA for NIE (2014), calculated using updated DMS data up to 2016.*[35] *The figures circled in green and red represent the difference between the updated estimates and the estimates presented by the CMA in NIE (2014).*

The figures circled in green and red in Table 2.2 represent the difference between the updated estimates and the estimates presented by the CMA in the NIE 2014 determination. The updated estimates generally show a marginal increase relative to the estimates presented by the CMA in 2014.

Historical ex-post approaches

The CMA noted that an alternative approach to estimating expected returns from historical data can be made under the assumption that the dividend-price ratio is stationary, referred to as the Fama and French underlying return.[36] Under this assumption, the expected return can be estimated as the sum of the average dividend yield and the average annual dividend growth rate. Drawing on Barclay's data set up to 2009, the CMA estimated an expected market return of 4.5 to 5.5 per cent. The top end of the range was based on the CMA's application of the Fama French estimate to the historical data from Barclay's, while the

[34] We note that the 2017 DMS publication includes real returns for the UK market since 1988 which have been calculated using CPI as opposed to RPI inflation. (See DMS (February 2017), Credit Suisse Global Investment Returns Yearbook 2017, p.212.) As a result, the DMS reported historical real return for the UK market of 7.3 per cent over the period 1900-2016 should not be interpreted as a real RPI deflated measure. To ensure consistent treatment of inflation, we have re-calculated the real UK historical returns to be based on a RPI deflated basis. This provides an estimate of historical real returns of 7.1 per cent for the UK market over the period 1900-2016.

[35] The simple approach calculates the arithmetic mean for successive time periods (and therefore there are few observations for long holding periods) and the overlapping approach is identical other than it allows for overlapping time periods. For holding periods greater than 1 year, the simple approach first calculates the compounded nth period return (e.g. for a 5-year holding period, it calculates the 5-year compound return earned in the consecutive periods 1-5, 6-10, 10-15 etc.), and then takes an average of these 5-period compound returns. The overlapping approach is identical other than it allows that the compound 5-year return is calculated for periods 1-5, 2-6 etc. The Blume adjustment takes a weighted average of the arithmetic and geometric returns, and the JKM is a statistical approach that provides efficient estimates for small samples, but this adjustment also effectively produces unbiased estimates of the nth period return as a weighted average of the geometric and arithmetic averages over the observation period.

[36] Estimated based on the approach developed in Fama and French (April 2002), The Equity Premium, the Journal of Finance, Vol. 57, No. 2, p. 637-659.

bottom end of the range reflected a downward adjustment to the historical data to account for the fact that current dividend yields were about 1 per cent below historical averages.[37] The CMA also acknowledged that the application of the Fama French approach may lead to an understatement of the expected market return due to dividend growth being less volatile than equity price index growth, with the understatement being equal to half the variance of the two growth rates (as suggested by Fama and French).[38] Applying the CMA's estimate of this understatement of around 75 bps results in a market return estimate between 5.25 and 6.25 per cent.

We have updated the CMA's calculations of the Fama French underlying return for the UK market based on the updated Barclay's data set up to 2015 and found that the estimate remains broadly unchanged relative to NIE 2014.[39]

The CMA also cited the DMS estimate of the expected market return for the world index. The DMS decomposes the historical returns into four elements: dividend yield (the dominant effect), dividend growth rate, the annual expansion in the price/dividend ratio, and real exchange rate changes. The DMS then determines an expected market return based on consideration of which elements correspond to investor expectations, and elements of non-repeatable good or bad luck. Drawing on DMS forecasts, the CMA cited a value of 5.5 to 6 per cent for the world index.[40] Our review of the 2017 DMS forecast indicates that the forecast has not changed relative to NIE 2014.[41]

Forward-looking approaches

Finally, the CMA considered evidence from the Bank of England DGM which it concluded supported a market return of between 5 and 6 per cent.[42]

As we set out in section 2.3, current estimates of the total market return from the Bank of England's DGM are between 7.2 and 8.1 per cent (with the range based on a spot and 5 year average of monthly estimates ending March 2017). These estimates are higher than the equivalent Bank of England DGM estimates at NIE 2014, primarily because the Bank of England has improved its model specification to take account of changes in the expected dividend growth rate over time, share buybacks and variation in risk-free interest rate across

[37] CMA (March 2014) op. cit. p.13-27, para 13.143-13.144.

[38] CMA (March 2014) op. cit., p. A13(2)3.

[39] Based on Barclay's (March 2016), Equity Gilt Study 2016, we calculate an updated estimate of the Fama French underlying return of 6.27 per cent, using data up to 2015 (based on 4.5 per cent dividend yield, 1.1 per cent dividend growth and 70bbps volatility adjustment).

[40] CMA (March 2014) op. cit. p.13-29, para 13.145.

[41] DMS (2017), op. cit., p. 37; DMS cites an arithmetic risk premium of 4.5-5 per cent relative to bills, and an historical bill return of around 0.8 per cent.

[42] CMA (March 2014) op. cit., p.13-31, para 13.155.

maturities. The Bank of England itself states that "*These changes to the Bank's DDM should improve the accuracy of the model's decompositions and ERP estimates*".[43]

Table 2.3 summarises the CMA's estimates of the TMR for the different approaches considered in the 2014 NIE decision, and our updated estimates drawing on latest evidence from 2017, as discussed above.

**Table 2.3**
**Updating studies used by CMA at NIE 2014 does not support a reduction in the TMR**

| | CMA NIE 2014 evidence | NERA updated evidence |
|---|---|---|
| DMS long run *(historical ex post)* | 6 – 7 % | 6.2 – 7.1% |
| DMS decomposition *(historical ex ante)* | 5.5 – 6 % | 5.5 – 6 % |
| Fama-French *(historial ex ante)* | 5.25 – 6.25 % | 5.27 – 6.27 % |
| Bank of England DGM *(forward looking)* | 5 – 6% | 7.2 – 8.1 % |

*Sources: NERA analysis of CMA (March 2014) Northern Ireland Electricity price determination. section 13; DMS (February 2017),Credit Suisse Global Investment Returns Yearbook 2017; Barclay's (March 2016), Equity Gilt Study 2016; Bank of England (2017), An improved model for understanding equity prices, Quarterly Bulletin 2017Q2(4) and Bank of England yield curves.*

### 2.5.1. Conclusions on updated CMA NIE evidence

CEPA's interpretation of the CMA NIE decision is erroneous. Although the CMA determined 5 per cent as a lower bound figure, it concluded that the evidence for 5 per cent was not well-supported, and the *weight of evidence* supported a range between 5.5 and 6.5 per cent.[44] In addition, given that the only the Bank of England DGM approach supported the lower bound of 5 per cent, and updated studies from the Bank of England support a value of 7 to 8 per cent, CEPA's 5 per cent lower-bound is not a reasonable interpretation of the CMA NIE approach.

Indeed, as can be seen from Table 2.3, drawing the different methods considered by the CMA in the 2014 NIE determination, the evidence supports an increase in the CMA's NIE preferred range of 5.5 to 6.5 per cent with both the historical ex post and DGM methods supporting values above the higher-bound value of 6.5 per cent.

## 2.6. Conclusions on TMR

CEPA's presents a wide range of evidence for the TMR, although ultimately concludes that the CMA NIE 2014 range is relevant for RIIO-2 – which it interprets as 5 to 6.5 per cent. As

[43] Bank of England (2017): "Quarterly Bulletin 2017 Q2 – An improved model for understanding equity prices", p86.

[44] CMA (March 2014) op. cit., para. 13.38.

set out above, the CMA concluded the weight of evidence supported a lower-bound of 5.5 per cent, and not 5 per cent as CEPA state. In addition, our update of the CMA's analysis for NIE shows that in most cases the evidence supports a higher TMR than the value of 6.5 per cent determined by the CMA in 2014, with a marked increase in the Bank of England's DGM based TMR relative to 2014. We therefore conclude that, drawing on the CMA NIE approach, the TMR should be at least as high as the NIE decision of 6.5 per cent.

CEPA also presents historical time-series TMRs based on geometric means, which provides a downwardly biased estimate of the investors' required return as supported by academics. CEPA also presents evidence that combines RFR and ERP from time periods, although all GB regulators accept that the inverse relationship between the two parameters necessitates an approach based on estimating the TMR directly. It also presents its own DGM estimates, which are far below independent Bank of England estimates because of implausibly low assumptions on dividend growth rates. However, CEPA does not directly draw on these approaches in its overall cost of equity for RIIO-2.

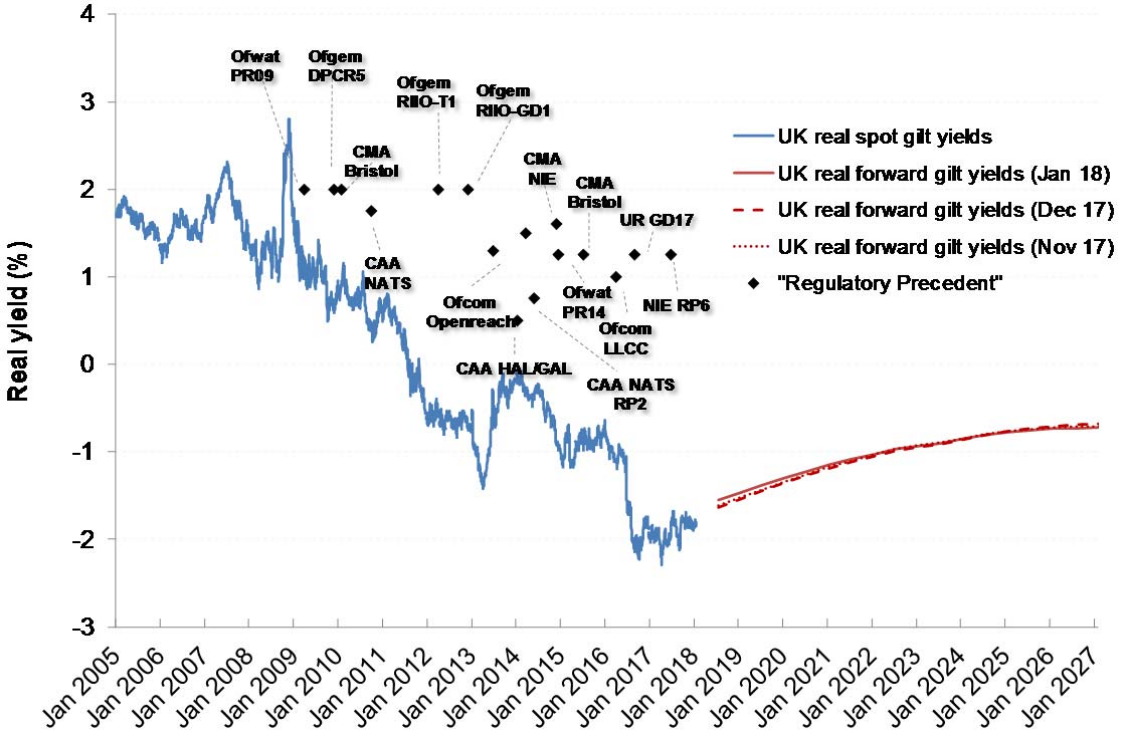
## 2.7. CEPA proposes a short-term risk-free rate

CEPA draws on short-run market evidence for the RfR proposing a RfR in the range of -1.75 per cent to -0.060 per cent, based on spot and forward 10 year gilts.[45]

There are two broad approaches used by UK regulators to indexing the RfR: i) relying on long-run historical averages or ii) relying on short-run market evidence, such as spot or forward rates. As set out by CEPA, evidence from short-run gilt rates suggests a negative real yield of between 1.5 and 2 per cent for a 10 year gilt (see Figure 2.4 below). However, the Figure also shows that the real yield is expected to increase towards zero per cent over RIIO-2 period.

[45] CEPA (February 2018) Review of Cost of Capital Ranges for Ofgem's RIIO-2 for Onshore Networks, p. 46.

**Figure 2.4**
**Spot and forward evidence supports a RfR below zero per cent (real)**




*Source: NERA analysis of Bloomberg and Bank of England data*

As can be seen from Figure 2.4, at recent reviews, UK regulators generally placed greater weight on long-run evidence on the RfR, with determinations in the range of 0.75 to 2 per cent real, reflecting long-run averages with some downward adjustment to reflect the lower spot and forward yield evidence.[46]

Not only is the use of long-run evidence consistent with previous regulatory decisions (including CMA), but it also ensures stability in the cost of equity over time and removes a source of cyclical risk, given that UK gilts tend to increase as the economy enjoys relatively high-growth and vice versa.

[46] For example, Ofwat estimated the risk-free rate at PR14 mainly with reference to long-run historical bond returns. Source: Ofwat (January 2014): "Setting price controls for 2015-20 – risk and reward guidance", p13. The Civil Aviation Authority estimated the risk-free rate at Q6 based on spot government bond yields adjusted with forward curve evidence. Source: CAA (October 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", p58-60.

# 3. Asset Beta

In this section, we assess CEPA's approach to estimating the asset beta for RIIO-2. CEPA estimates an asset beta range of 0.25 to 0.40 for energy networks at RIIO-2, where it believes the top end of the range is more appropriate for certain sectors or companies with large investment programmes relative to the size of the asset base.[47] CEPA's estimates are based on the empirical asset beta estimates for four UK listed utilities, including three listed water and sewerage companies.

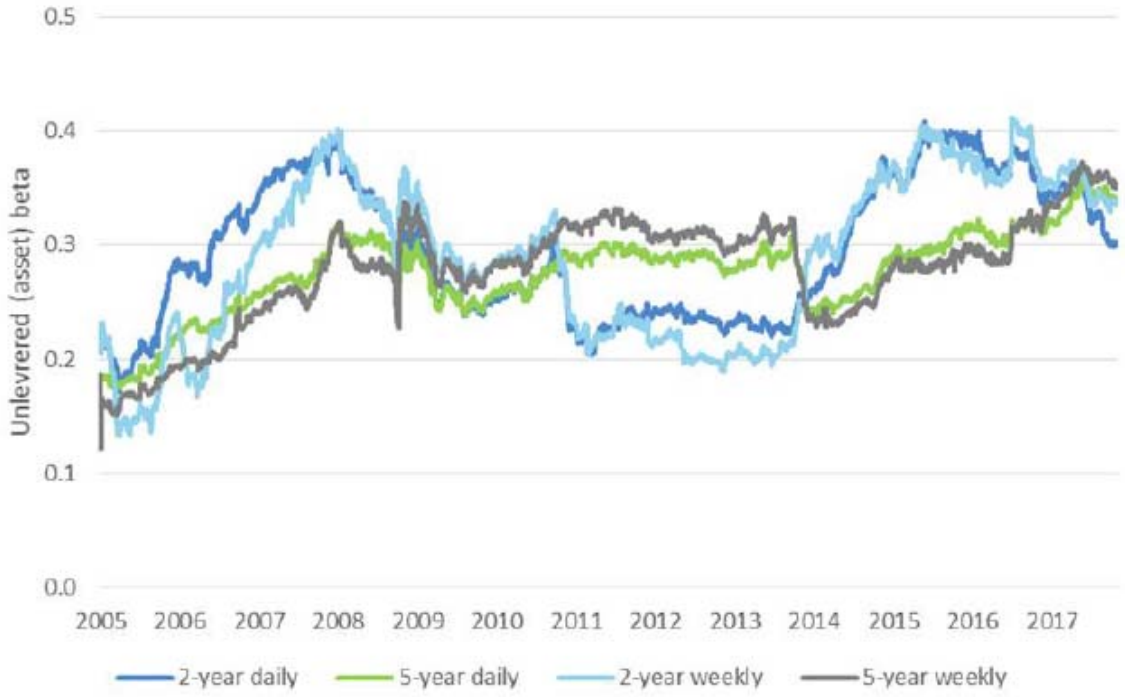
We have evaluated CEPA's method for estimating the asset beta below, in particular considering whether it is appropriate to use all four UK listed utilities to estimate the asset beta for RIIO-2. Overall, we show that CEPA's recommended range of 0.25 to 0.4 is far lower than empirical estimates for NG's UK assets, which is around 0.43 to 0.47.

## 3.1. CEPA uses outdated empirical evidence to estimate the asset beta for RIIO-2

CEPA presents analysis of the asset beta over time for National Grid, Pennon Group, Severn Trent and United Utilities, which it identifies as the four principal UK listed utilities. CEPA considers a range of different beta estimation approaches, but its final asset beta range of 0.25 to 0.40 appears to be derived from 2-year daily estimates, presented below.

[47] CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, p.54.

**Figure 3.1**
**CEPA Estimates of Asset Betas for UK Listed Utilities**



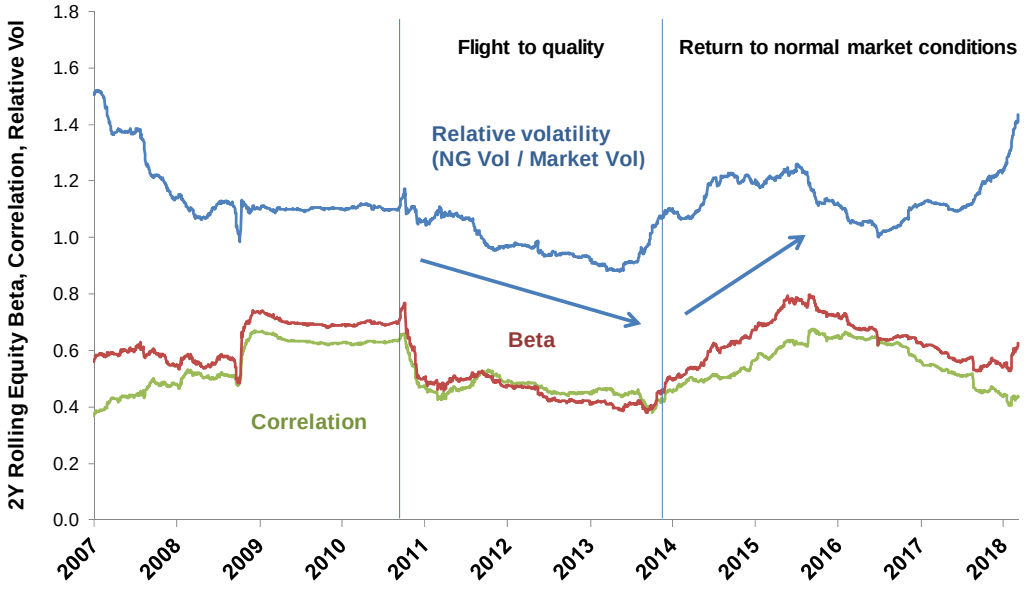

*Source: CEPA*

Figure 3.1 shows that CEPA's asset beta range of 0.25 to 0.40 is clearly not based on the latest market evidence. As shown in the chart, the asset beta was in the range 0.30 to 0.36 at the end of 2017, well above CEPA's proposed lower bound of 0.25. It appears that CEPA's lower bound places weight on asset beta estimates from the period 2011 to 2014, when asset betas for the four listed utilities were depressed relative to the more recent trend.

We see no merit in using asset beta estimates from 2011 to 2014 to estimate the asset beta for RIIO-2. These asset betas reflect the market's perception of risk facing the companies at that point in time. In the aftermath of the global financial crisis, the betas for regulated utilities declined as investors became more risk-averse and reallocated their portfolios towards less risky assets. As a result of the 'flight to quality', the asset betas declined.

However, the decline in asset betas at RIIO-1 has now reversed. For example, our decomposition of NG's asset beta into its constituent elements, and the correlation with the market portfolio and relative volatility, show an increase in both elements since RIIO-1 supporting higher values at RIIO-2 (see Figure 3.2).

**Figure 3.2**
**Increase in NG plc's beta since T1 largely explained by increase in relative volatility**




*Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.*

All macroeconomic forecasting agencies foresee sustained economic growth over the next five years,[48] and therefore we see no reason to estimate the beta for RIIO-2 based on market conditions that are highly unlikely to prevail during the period.

In conclusion, we do not consider that any weight should be placed on the asset betas from the period 2011 to 2014 as CEPA does, because the estimates from this period are depressed by the temporary flight to quality phenomenon which has since reversed.

Finally, we note that CEPA focuses on a relatively narrow UK set, and ignores potential European comparator energy networks.[49]

## 3.2. Our estimates support a beta of 0.3 to 0,4, with NG in upper-end

Table 3.1 shows the latest empirical asset betas for UK networks including SSE, using 1-year, 2-year, 5-year, and 10-year estimation windows. This evidence shows that in the most part the asset beta estimates lie in the range of 0.3 to 0.4, with the exception of SSE's beta which

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[48] None of the forecasting agencies in HM Treasury consensus forecasts are currently forecasting a recession in the next five years.

[49] For example, potentially comparable networks include: EDP-Energias de Portugal (Portugal), Red Electrica (Spain), TERNA (Italy), ACEA (Italy), Gas Natural SDG (Spain), SNAM (Italy), and Enagas (Spain). Oxera presents evidence for European energy networks in its report for ENA concluding a range of 0.38 to 0.42 (0.05 debt beta) or 0.36 to 0.40 (zero debt beta). See: Oxera (2018) Cost of capital at RIIO-2, p. 44. Link: http://www.energynetworks.org/assets/files/info/Oxera%20research%20on%20the%20cost%20of%20equity_2018-02-28.pdf

is higher, reflecting its significant share of generation and supply activities, which are more risky. National Grid's asset beta is at the top-end of the range, excluding SSE. [50]

**Table 3.1**
**With the exception of SSE, most network asset beta lies in the range of 0.3 to 0.4 with National Grid at the top end of the range**

| | 1Y | 2Y | 5Y |
|---|---|---|---|
| National Grid | 0.54 | 0.37 | 0.39 |
| SSE | 0.44 | 0.60 | 0.57 |
| United Utilities | 0.35 | 0.30 | 0.33 |
| Severn Trent | 0.37 | 0.31 | 0.35 |
| Pennon | 0.44 | 0.40 | 0.38 |
| Average | 0.43 | 0.40 | 0.40 |
| **Average (excl. SSE)** | **0.43** | **0.34** | **0.36** |

*Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.*

We now evaluate whether it is appropriate to place equal weight on all the UK listed utilities, including the UK water companies, given differences between the risks faced by UK water and energy networks.

## 3.3. CEPA does not capture differences in relative risk between UK water and energy networks

CEPA argues the "*the energy sector is broadly comparable in (systematic) risk profile to the water sector*".[51] CEPA recognises there may be some differences in the regulatory regime, but believes that these differences will only affect the beta point estimate rather than the range itself.

CEPA asserts that energy networks face less risk relative to water companies from the treatment of pensions under their respective regulatory frameworks. UK water companies were able to recover 50 per cent of deficits as at PR09[52], whereas energy networks can recover the established deficit as at 2013 with triennial revaluation to allow for changes in the

[50] Our estimates are also in line with Oxera's recent range proposed in its Report for ENA. Oxera estimate asset betas for both UK and European utility comparators, and concluded that 0.38 to 0.42 is an "appropriate assumption" for RIIO-2 based on the empirical betas of the same sample of UK and European network comparators. Oxera's range reflects a debt beta assumption of 0.05. Assuming a debt beta of zero, in line with our approach, Oxera's range would be 0.36 to 0.40. See Oxera (28 February 2018), The cost of equity for RIIO-2 - Prepared for Energy Networks Association, p42-48. We use the Miller formula to solve for the implied asset beta: $\beta_{assets}=\beta_{equity}*(1-gearing)+\beta_{debt}*gearing$.

[51] CEPA (February 2018), Review of cost of capital ranges for Ofgem's RIIO-2 for onshore networks, p.54.

[52] At PR09, Ofwat determined the price control allowance for pension deficit repair costs associated with companies defined benefit pension schemes assuming a 10- to 15-year deficit repair period starting in 2009 or 2010. Ofwat allowed companies to recover about 50 per cent of pension deficit repair costs from customers from PR09, with the rest dealt with by management action or shareholder contributions. Source: Ofwat (October 2013), IN 13/17: Treatment of companies' pension deficit repair costs at the 2014 price review. Link: https://0980a19b0bb02fe4a86d-0df48efcb31bcf2ed0366d316cab9ab8.ssl.cf3.rackcdn.com/wp-content/uploads/2015/11/prs_in1317pr14pension.pdf

value of the deficit, but face risk on post-establishment deficits.[53] This difference in the treatment of pension deficit recovery suggests energy networks face less risk relative to UK water networks on this particular factor.

However, CEPA does not undertake a systematic relative risk analysis. Focusing on the difference in treatment of pension deficit recovery does not alone justify CEPA's suggestion that UK energy networks may be less risky than water companies.

We have undertaken comparison of risks across a range of factors as set out in Table 3.2 below).

[53] Ofgem (17 December 2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas - Finance Supporting Document, Appendix 5.

## Table 3.2
## Relative risk assessment shows energy networks face different risks relative to other sectors

| | Electricity Distribution | Gas Distribution | NGET | NGGT | Water | Heathrow | NATS (air traffic control) |
|---|---|---|---|---|---|---|---|
| **Form / length of control** | • Revenue-cap<br>• 8-years | • Revenue-cap<br>• 8-years | • Revenue-cap<br>• 8-years | • Revenue-cap<br>• 8-years | • Revenue-cap<br>• 5-years | • Price-cap<br>• 5-years | • Part revenue part price-cap<br>• 5-years |
| **Setting cost allowances** | • Comparative benchmarking of totex (UQ efficiency)<br>• DB pension deficit recovery over 15yrs with 3Y re-valuation Re-openers for some costs | • Comparative benchmarking of totex (UQ efficiency)<br>• DB pension deficit recovery over 15yrs with 3Y re-valuation<br>• Re-openers for some costs | • Expert review of totex<br>• DB pension deficit recovery over 15yrs with 3Y re-valuation Re-openers for some costs | • Expert review of totex<br>• DB pension deficit recovery over 15yrs with 3Y re-valuation<br>• Re-openers for some costs | • Comparative benchmarking of totex (UQ efficiency)<br>• 50% sharing of pension deficit repair costs with customers | • Opex based on benchmarking & capex agreed with airlines<br>• Pass-through of pension deficit costs | • Opex based on benchmarking & capex agreed with airlines<br>• DB pension deficit allowance and 80% pass through of savings / overspend within period |
| **Outturn cost risk & incentives** | • TIM<br>• Uncertainty/pass-through of non-controllables<br>• Disapplication of price control | • TIM<br>• Uncertainty/pass-through of non-controllables<br>• Disapplication of price control | • TIM<br>• Uncertainty/pass-through of non-controllables<br>• Disapplication of price control | • TIM<br>• Uncertainty/pass-through of non-controllables<br>• Disapplication of price control | • Totex sharing<br>• Pass-through of non-controllables<br>• IDoK/SAE clause | • Full risk on opex and pass-through of efficient actual capex (s.t. delay penalties) | • 5-year opex roller and pass-through of efficient capex |
| **Capex/opening RAB** | • 11% | • 6% | • 16% | • 9% | • 6-8% (WaSC-WOC) | • 4% | • 10% |
| **Totex/opening RAB** | • 15% | • 13% | • 18% | • 11% | • 13-22% (WaSC-WOC) | • 11% | • 54% |
| **Ret+Dep./Rev** | • 57% | • 46% | • 83% | • 58% | • 51-38% (WaSC-WOC) | • 59% | • 42% |
| **Totex sharing factor** | • 53-58(70)% | • 62-64% | • 48% | • 45% | • 50-57% | • 100% opex, 0% capex | • 5-year opex roller, 0% capex |
| **Financing cost risk** | • COD update = 10-20Y trailing average iBoxx | • COD update = 10Y trailing average iBoxx | • COD update = 10Y trailing average iBoxx | • COD update = 10Y trailing average iBoxx | • Fixed at weighted average of industry embedded and new forecast COD | • Fixed at weighted average of HAL embedded and new forecast COD | • Fixed at weighted average of NERL embedded and new forecast COD |
| **Quality of Service/Output incentives** | • Performance incentives : +2.2/-2.8% of RORE | • Performance incentives : +1.3/-0.7% of RORE | • Performance incentives : +0.6/-1.4% of RORE | • Performance incentives : +1.7/-1.4% of RORE | • Performance incentives (SIM,ODI): +0.8/-2.1% of RORE | • Service quality: asymmetric -7% penalty.+2% reward of airport charges | • Delays: +/-1% revenue |
| **Stranding/ competition / regulatory risk** | | • Uncertainty over future gas flows (domestic heat decarbonisation) | • Uncertainty over future role and operation of system from distributed generation | • Uncertainty over future role given uncertainty of CCGT role in energy mix, and decarbonisation of heat | • Competition in NHH retail; future competition for water/ bioresources | • Competition from other London/UK and European hub airports | • No competition in immediate future |

*Source: Bloomberg, NERA analysis.*

At a high level, the regulatory regimes in energy and water are closely aligned, but there are some differences in the respective regimes that would lead to different exposures to systematic risk. UK energy networks may face greater risk from the longer regulatory review period of eight years compared to five years in the water sector, as it can increase in-period volatility in returns. However, such forecasting risk is mitigated (at least in part, if not wholly) by uncertainty mechanisms, reopeners and the mid-point review.[54] UK energy networks may also face greater risk relative to the water sector from the cost of debt indexation mechanism which increases the pro-cyclicality of returns relative to a fixed ex ante allowance.[55][56]

By contrast, UK energy networks bear somewhat lower risk than companies in the aviation sector (HAL and NATS). Whereas energy companies have higher incentives with regard to cost and output, aviation companies are exposed to material within-period volume and competition risks, given their price cap regimes.

In addition to differences in the regulatory framework, our comparative analysis suggests that investors in UK energy networks face higher risk than investors in water networks given the greater capex size (as measured by capex/RAB), and greater exposure to asset stranding risks due to government's decarbonisation plans and uncertainty over the future role of energy networks.

In summary, we consider that CEPA's beta estimates based on historical data, and during the period of the financial crisis, understate the risks faced by investors today. Our empirical analysis provides for a range of around 0.3 to 0.4; NG's asset beta is towards the top-end of the range potentially reflecting investors' perceptions of higher risk for energy networks relative to water networks

## 3.4. CEPA does not consider how National Grid's US operations affects its beta estimate

CEPA includes National Grid in its group of comparators to estimate the asset beta for RIIO-2, but notes that it is not a pure play comparator because only 36 per cent of its operating profit in 2017 was derived from UK regulated network businesses. CEPA makes no attempt to adjust National Grid's asset beta for the differences in risk in its underlying business segments. We have considered how National Grid's non UK regulated businesses affect its asset beta.

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[54] We note that there may some other benefits of a longer regulatory period including lower regulatory burden and better alignment between investment and the price control period.

[55] However, we note that Ofgem and its advisers did not accept that the cost of debt indexation method increased the procyclicality of returns. See for example, FTI (2012) A report for Ofgem (2012) Cost of capital study for the RIIO-T1 and GD1 price controls, p. 96. Link: https://www.ofgem.gov.uk/ofgem-publications/53728/riio-t1-cost-capital-study-riio-t1-and-gd1.pdf.

[56] Any changes that would create greater convergence in the regulatory regimes in the future, such as Ofwat's intention to introduce a cost of debt indexation mechanism, would increase the appropriateness of UK water companies as comparators for RIIO-2.

In 2016/17, National Grid's UK non-regulated activities accounted for 5 per cent of the group's revenues and about 6 per cent of the group's fixed assets.[57] US regulated operations accounted for 41 per cent of the group's combined regulated asset base.[58] In order to estimate the asset beta of National Grid's UK regulated business, we have decomposed its overall asset beta into a UK asset beta and a US asset beta.

In the US, National Grid's operations are subject to various regulatory regimes, depending on the state in which they operate and the business activity in question. The majority of these businesses are subject to incentive regulation (about 90 per cent of regulated assets), albeit a lower-powered incentive regime than the UK. However, around 8 per cent of assets are subject to rate of return regulation, which exposes the company to less risk in terms of potential over or underperformance. In addition, National Grid Generation, which comprises around 3 per cent of the business' regulated assets, operates under a long-term power supply agreement with the Long Island Power Authority, with very low systematic risk.[59]

### 3.4.1. US regulatory regimes are lower risk than UK

Although National Grid's US businesses that are regulated under incentive based regimes are subject to revenue caps similar to the UK regulated business, i.e. do not bear material demand or revenue risk, there are some key differences that mean the US incentive based regimes are less risky than RIIO-2:

- National Grid's US businesses are regulated under shorter regulatory periods (mostly 3-4 years, except gas businesses in Massachusetts which account for only 11 per cent of regulated assets) which reduces the within-period volatility of returns with more frequent updating of revenues in line with costs;[60]
- Greater objectivity in setting allowed costs: in most cases, cost allowances are set based on outturn costs for a base year and projected forwarded, without explicit efficiency factors that reduce allowances over time. Some are also based on historical costs (especially in Massachusetts). The prudency standard for permissible costs sets a high evidentiary bar for the disallowance of incurred costs. By contrast, RIIO draws on more subjective comparative efficiency analysis and technical review of costs;
- US regimes provide a true-up for pension and other post-employment liabilities, whereas National Grid bears the risk on its post-2012 liabilities in the UK;
- US companies generally have less stringent output and quality of service incentives (they focus mainly on reducing and preventing gas leakage and some efficiency incentives);

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[57] These activities included UK gas metering activities; the Great Britain-France Interconnector; UK property management; a UK LNG import terminal; US LNG operations; US unregulated transmission pipelines; together with corporate activities. See National Grid Annual Report 2016/17, p.95, 96.

[58] National Grid (18 May 2017), 2016/17 Full Year Results, p.14-17. This calculation only takes into account NG's remaining 39% stake in its former gas distribution business.

[59] See National Grid US Databook for 2016/17, p7,8.

[60] We note that the risks associated with a longer regulatory period can be in part mitigated by uncertainty mechanisms, reopeners and the mid-point review. Moreover there are other benefits associated with a longer price review, including lower regulatory burden and better alignment between investment and the price control period.

- The US regimes incorporate greater use of cost pass-through or true-ups, e.g. for commodity prices, commodity related bad debt, some mandated capex, and environmental remediation costs. By contrast, the true-ups or pass-through provisions for National Grid are more limited, e.g. relating to security, network development, infrastructure enhancement, strategic wider works, and some environmental costs.[61]

Overall, 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. For example, the rate cases have enshrined principles in relation to the protection of property rights, and notions of prudency standards in relation to permissible costs.[62]

### 3.4.2. Empirical asset beta evidence for US networks are lower than for NG Group

In order to obtain a measure of the systematic riskiness of National Grid's UK regulated business, we decompose its group asset beta into a UK and US asset beta, based on the equation below.

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

$$\beta_{National\ Grid} = 59\% * \beta_{UK} + 41\% * \beta_{US}$$

In order to estimate the beta associated with National Grid's US regulated businesses ($\beta_{US}$), we have identified a preliminary sample of 22 network comparators in the US.[63] We selected these comparators based on networks operating exclusively in the US, and principally engaged in regulated energy network, retail, or generation activities, as well as ensuring that the stocks met standard liquidity thresholds.[64]

Of this initial set of comparators, 3 comparators operate in the same states, and hence similar regulatory regimes, as National Grid. In particular, Consolidated Edison operates in New York (where National Grid USA has about 56 per cent of its regulated assets), and Unitil Corp and Eversource Energy have significant operations in Massachusetts, New Hampshire (and Maine), where about 30 per cent of National Grid USA's regulated assets are located.

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61 Ofgem (2012), RIIO-T1: Final proposals for National Grid Electricity Transmission and National Grid Gas – Finance support document, p89, 90.

62 The regulation of utilities in North America faces a special kind of constraint that most other nations do not exhibit. Particularly in the United States, major regulatory statutes do not become settled methods of government control over private businesses until they are tested in the courts. There are established principles in relation to property rights, and prudency standards. See for example: NERA (2015) Half a century of estimating the cost of capital, Link: http://www.nera.com/content/dam/nera/publications/2015/PUB_Cost_of_Capital_1115.pdf

63 Bloomberg, CEG (2013), Information on equity beta from US companies.

64 We look at bid-ask spreads as a proxy for the liquidity of the listing. We consider stocks with bid-ask spreads above 1 per cent to meet liquidity threshold, based on UK and European regulatory approaches. See for example, NERA (2016) Update of the Equity Beta and Asset Beta for BT, A report for Ofcom. Section A4, pp 58-59. Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0028/97039/annex_31.pdf

Table 3.3 summarises their asset betas over different estimation windows. The average two-year asset beta is 0.23, and all asset betas are below National Grid's group two-year beta of 0.37.

**Table 3.3**
**US comparators operating in same/similar states as National Grid have an average 2Y asset beta of 0.23**

| | 1Y | 2Y | 5Y | 10Y | % regulated | States |
|---|---|---|---|---|---|---|
| National Grid Plc | 0.54 | 0.37 | 0.39 | 0.32 | >95% | New York, Massachusetts, New Hampshire, Vermont, Maine, Rhode Island |
| | | | | | | |
| Consolidated Edison | 0.17 | 0.13 | 0.21 | 0.26 | 87% | New York |
| Eversource Energy | 0.22 | 0.20 | 0.31 | 0.33 | 82% | Connecticut, Massachusetts, New Hampshire |
| Unitil Corp | 0.28 | 0.35 | 0.34 | 0.18 | 99% | New Hampshire, Massachusetts, Maine |
| **Average of comparators** | **0.22** | **0.23** | **0.29** | **0.26** | **89%** | |

*Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: S&P500.*

### 3.4.3. We derive a higher NG UK asset beta of between 0.43 and 0.47

Using the average asset beta of these three comparators as a proxy of the systematic riskiness of National Grid's operations in the US, and drawing on the equation above, we calculate an implied UK asset beta of 0.47 based on a two-year estimation window, and 0.46 based on a five-year estimation window (see Table 3.4 below). Our estimate is considerably higher than the composite National Grid asset beta of 0.37 (two –year beta), and approximately mid-point of the empirical betas of UK water companies and SSE (see Table 3.1). Our estimates are also significantly higher than CEPA's estimated asset beta range of 0.25 to 0.40 for RIIO-2.

**Table 3.4**
**We estimate NG's UK beta of 0.46/0.47 based on three most direct comparators operating in same/similar states**

| | NG overall | US | UK |
|---|---|---|---|
| Share of regulated assets | | 41% | 59% |
| 2Y beta | 0.37 | 0.23 | **0.47** |
| 5Y beta | 0.39 | 0.29 | **0.46** |

*Source: Bloomberg, NERA analysis.*

To check the sensitivity of our results to the three main comparators, we also present asset betas for the full sample of 22 comparators. We obtain very similar results for the two-year

betas, which are in the range of 0.13 to 0.38, with an average of 0.26. This average is considerably lower than National Grid's two-year asset beta of 0.37.

Using the full sample, we obtain an implied asset betas for National Grid's UK operations of 0.45 (2Y) and 0.43 (5Y), only marginally lower than the betas we obtained using the most relevant comparators only.

**Table 3.5**
**Solving for NG UK beta – full set of comparators**

| | NG overall | US | UK |
|---|---|---|---|
| Share of regulated assets | | 41% | 59% |
| 2Y beta | 0.37 | 0.26 | **0.45** |
| 5Y beta | 0.39 | 0.34 | **0.43** |

*Source: Bloomberg, NERA analysis.*

This evidence supports the conclusion from our relative risk assessment: the asset beta for UK energy networks at RIIO-2 should lie above the overall National Grid asset beta, with an implied value of between 0.43 to 0.47 based on decomposing the National Grid composite beta into UK and US operations.

CEPA does not present any such analysis in evaluating the asset beta for National Grid, and as a result, we consider its approach of simply taking the National Grid group beta understates the true systematic risk faced by UK energy networks.

## 3.5. Conclusions on CEPA's asset beta

CEPA's asset beta range of 0.25 to 0.40 is clearly not based on the latest market evidence, and instead draws on evidence when betas were depressed during the financial crisis. In interpreting the evidence for RIIO-2, CEPA also fails to rely on NG, which is the most obvious comparator for energy networks, and fails to decompose NG's group asset beta into the beta associated with higher risk UK versus lower risk US operations. Undertaking this decomposition we identify a beta range for NG, and therefore RIIO-2, of between 0.43 and 0.47, far higher than CEPA's range.

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NERA
ECONOMIC CONSULTING

NERA Economic Consulting
Marble Arch House, 66 Seymour Street
London W1H 5BT
United Kingdom
Tel: 44 20 7659 8500  Fax: 44 20 7659 8501
www.nera.com