PRIVATE AND CONFIDENTIAL

Ofgem
10 South Colonnade
Canary Wharf
London
E14 4PU

Tuesday 26 August 2025

Dear Director,

Inference Analysis as a Cross-check on Allowed Returns at GD&T3

We attach a copy of the above confidential report dated August 2025 (the "Final Report") prepared by KPMG LLP ("KPMG"). The Final Report was solely prepared for IGEM future Energy Networks ltd.

KPMG has agreed that we may disclose the attached Final Report to you, on the basis set out in this letter, to enable you to verify that a report has been commissioned by us and issued by KPMG in connection with the cost of equity ("CoE") set out in the RIIO-3 Draft Determinations for the Electricity Transmission, Gas Distribution and Gas Transmission sectors ("RIIO-3 DDs"), and to facilitate the discharge by you of your regulatory functions subject to the remaining paragraphs of this letter to which your attention is drawn. KPMG has also agreed that you may publish the Final Report (in full only) on your website pages.

KPMG's work was designed to meet our agreed requirements and the engagement activities were determined by our needs at the time. The Final Report should not be regarded as suitable to be used or relied on by any party other than us for any purpose or in any context.

In consenting to the disclosure of the Final Report to you, KPMG does not assume any responsibility to you in respect of its work for us or for the Final Report. To the fullest extent permitted by law, KPMG accepts no liability in respect of any such matters to you.

If you rely on the Final Report or any part of any of them, you do so at your own risk.

Yours faithfully

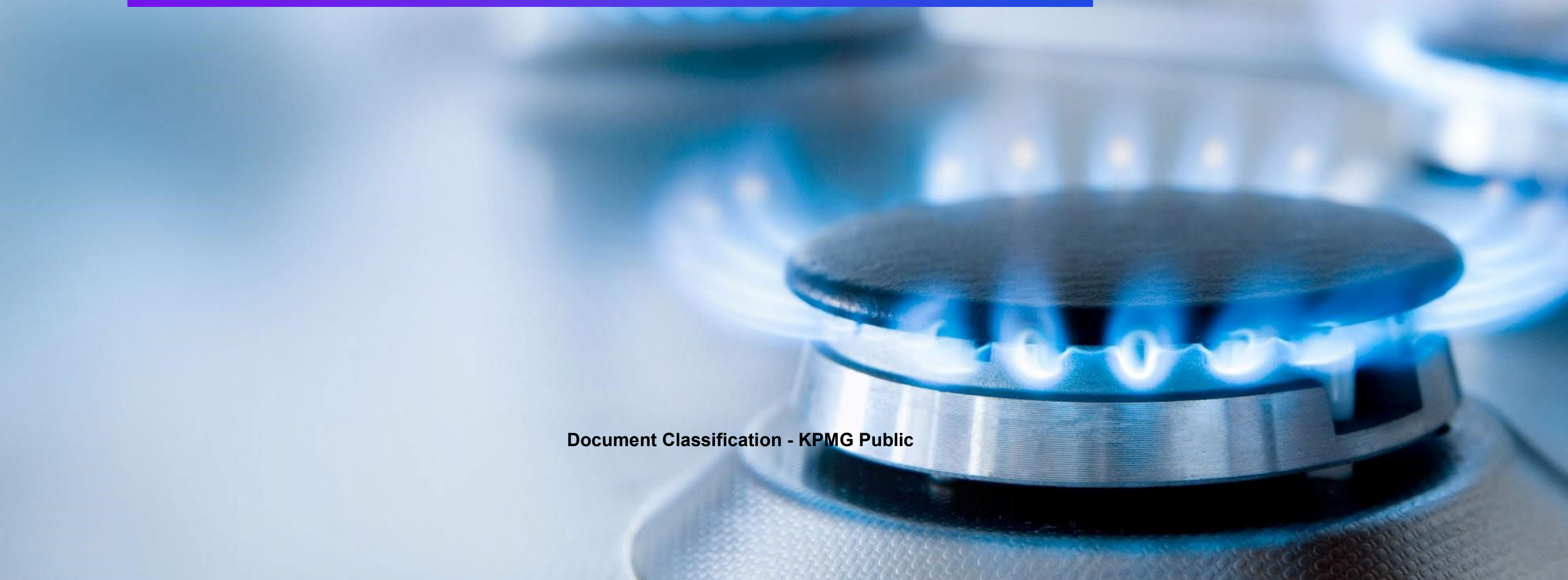
James Earl

James Earl, CEO, IGEM future Energy Networks ltd

Inference analysis as a cross-check on allowed returns at GD&T3

Prepared for Future Energy Networks

August 2025



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Important notice

This Report has been prepared by KPMG LLP ('KPMG', 'we' or 'our') for IGEM Future Energy Networks Ltd ('FEN') on the basis of an engagement contract dated August 2025 between FEN and KPMG (the "Engagement Contract").

FEN commissioned the work to assist FEN in its considerations of the Office of Gas and Electricity Markets ('Ofgem') methodology for cross-checking the allowed cost of equity, as outlined in the RIIO-3 Draft Determinations ("DDs") for the Electricity Transmission, Gas Distribution and Gas Transmission sectors published on 1 July 2025. FEN commissioned the work on its own behalf and on behalf of its members Cadent Gas Ltd, Wales and West Utilities Ltd, Southern Gas Networks plc, National Gas Transmission plc and Northern Gas Networks Ltd.

The agreed scope of work is included in section 2 of this Report. FEN should note that our findings do not constitute recommendations as to whether or not FEN should proceed with any particular course of action.

For the avoidance of doubt, it is FEN's sole responsibility to decide what should be included in their submission to Ofgem. KPMG has not made any decisions for FEN or assumed any responsibility in respect of what FEN decides, or has decided to, include in its submission.

This Report is for the benefit of FEN only. It has not been designed to be of benefit to anyone except FEN. In preparing this Report we have not taken into account the interests, needs or circumstances of anyone apart from FEN, even though we may have been aware that others might read this Report. We have prepared this Report for the benefit of FEN alone.

This Report is not suitable to be relied on by any party wishing to acquire rights against KPMG (other than FEN) for any purpose or in any context. Any party other than FEN that obtains access to this Report or a copy and chooses to rely on this Report (or any part of it) does so at its own risk. To the fullest extent permitted by law, KPMG does not assume any responsibility or liability in respect of our work or this Report to any party other than FEN.

In particular, and without limiting the general statement above, since we have prepared this Report for the benefit of FEN alone, this Report has not been prepared for the benefit of any other person or organisation who might have an interest in the matters discussed in this Report, including for example other companies or regulatory bodies.

Without prejudice to any rights that FEN may have, subject to and in accordance with the terms of engagement agreed between FEN and KPMG, no person is permitted to copy, reproduce, or disclose the whole or any part of this Report unless required to do so by law or by a competent regulatory authority.

The market information in this Report is based on financial information platforms, datasets, and publicly available sources. Our analysis is based on data available up to June 2025. The analysis in the Report reflects prevailing conditions as of this period, all of which are accordingly subject to change. We have not undertaken to update the Report for events or circumstances arising after these periods. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. Information sources and source limitations are set out in the Report. We have satisfied ourselves, where possible, that the information presented in this Report is consistent with the information sources used, but we have not sought to establish the reliability or accuracy of the information sources by reference to other evidence. We relied upon and assumed without independent verification, the accuracy and completeness of information available from these sources. KPMG does not accept any responsibility for the underlying data used in this Report.

Where our Report makes reference to 'KPMG analysis' this indicates only that we have (where specified) undertaken certain analytical activities on the underlying data to arrive at the information presented. We do not accept responsibility for the underlying data.

KPMG has not made any decisions for or assumed any responsibility in respect of what FEN, or any individual company within FEN, decides, or has decided to, include in its business plan submission.

The findings expressed in this Report are (subject to the foregoing) those of KPMG and do not necessarily align with those of FEN.

This engagement is not an assurance engagement conducted in accordance with any generally accepted assurance standards and consequently no assurance opinion is expressed.

1. Executive summary

On 1 July 2025, Ofgem published its Draft Determinations (DDs) for the RIIO-3 price control for the Gas Transmission and Gas Distribution sectors (GD&T3), covering the period from 1 April 2026 to 31 March 2031. KPMG has been engaged by FEN to develop a cross-check for the regulatory CoE based on the market pricing of debt and relationship between debt and equity implied by corporate finance theory. Notably, in the DDs, Ofgem did not attach weight to any debt-equity cross-check.

Setting an appropriate and evidence-based Cost of Equity (CoE) allowance is critical to strike the right balance between attracting and retaining equity capital in the sector and ensuring customers do not pay more than necessary for that capital. Improving the precision of the CoE estimate via robust cross-checks is particularly important at GD&T3 due to the following factors:

- **A shifting sector risk profile:** The gas sector is undergoing a notable risk shift as net zero policies and declining gas demand introduce material uncertainties, including asset stranding risk. According to credit rating agencies, gas networks no longer sit at the lower end of the utility risk spectrum [1]. Policy uncertainty surrounding the energy transition has increased business risk relative to electricity networks [2]. These changes must be reflected in allowed equity returns.
- **The need to attract and retain equity capital:** The projected decline in long-term gas demand may discourage long-term investment in the sector. Regulatory uncertainty further heightens concerns around asset stranding and cost recovery. To maintain investor confidence and support long-term investment, the CoE must be calibrated to reflect these risks, ensuring the sector remains competitive amid substantial competing infrastructure programmes.
- **A fundamentally different interest rate environment**: Since RIIO-2, the UK has transitioned from a low- to a high-interest rate environment. The resulting compression in the spread between the allowed CoE and the cost of new debt would be likely to disincentivise equity investment unless appropriately addressed.

Equity investors often face multiple investment options, each with different risk-return profiles. When making capital allocation decisions, they assess competing opportunities, including debt, which offers lower risk and more secure returns. Given the higher risk profile of equity – due to subordination in insolvency, limited control rights in the event distress, and discretionary returns – the expected return must meaningfully exceed that of debt to attract capital.

For GD&T3, the DDs reveal a disconnect between the risk reflected in the CoE and CoD. While CoD allowances vary to reflect the higher credit risk in gas networks relative to electricity transmission, CoE estimates assume no difference in sector risk profiles. To maintain equity investability, *both* CoE and CoD must accurately reflect the gas sector's evolving and comparatively higher risk profile.

In this context, inference analysis offers an empirical approach to calibrate a debt-equity cross-check, supporting a robust and investable CoE estimate. It is derived based on Merton's (1974) [3] contingent claim framework and its empirical application by Campello, Chen and Zhang (2008) [4]. The approach is based on the premise that investors compare the expected return on equity with the expected return on debt of the same company, as both provide exposure to the same underlying asset.

The key rationale for exploring inference analysis as a cross-check is as follows:

- It offers an independent estimation framework, avoiding the limitations of CAPM.
- It uses forward-looking, observable debt yields that reflect real-time market perceptions of risk.
- It links equity returns to debt returns via elasticity, recognising that the relationship between CoE and CoD is dynamic rather than fixed.

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1 S&P (July 29, 2025). Four U.K. Gas Distribution Networks Ratings Affirmed Following Regulatory Draft Determinations; Outlooks Stable.

2 Moody's (29 July 2025). Sector in-depth: Broader policy uncertainty on energy transition increases business risks.

3 Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, 29(2), 449-470.

4 Campello, M., Chen, L., & Zhang, L. (2008). Expected returns, yield spreads, and asset pricing tests. *The Review of Financial Studies*, 21(3), 1297-1338.

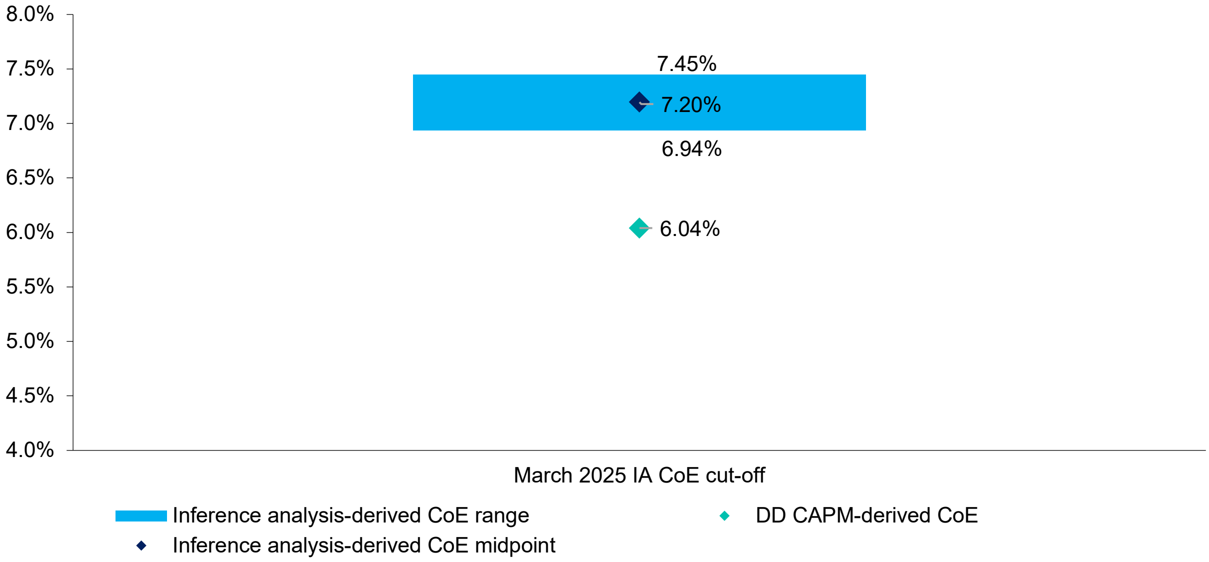
The inferred CoE calculated in this Report reflects the same 20-year investment horizon used in the DDs to ensure comparability and internal consistency with the CAPM-based CoE. This long-run horizon is appropriate given the weighted-average asset lives of gas networks and the regulatory framework for capital recovery.

To align the cost of new debt – and thus the inferred CoE – with this 20-year horizon, the Report incorporates a 45bps gas-specific premium estimated by NERA. This premium is derived from the relative spreads between gas network bonds and the iBoxx A/BBB benchmark, calculated on a like-for-like tenor basis using primary market data. As a result, the cost of new debt reflects an investment horizon close to 20 years, consistent with the DD CAPM-CoE assumption.

Using 31 March 2025 as the cut-off date, the inferred CoE range is estimated between 6.94% and 7.45%, based on averaging windows of 1, 12, and 24 months. By comparison, the DDs set the point estimate for the GD&T3 CoE at 6.04%.

As shown in the figure below, the floating bar illustrates the range implied by the inference analysis, while the green diamond denotes the allowed CoE in the DD. The RIIO-3 DD CoE lies materially below the lower bound of the inferred CoE range. All else being equal, this indicates that the CAPM-derived CoE in the DDs is not aligned with current market debt pricing and the observed relationship between debt and equity returns.

Figure 1: Comparison between the inferred CoE range and Ofgem's RIIO-3 DD allowed CoE



Source: KPMG analysis

Notably, given the absence of listed regulated gas networks in the UK, the inferred CoE reflects the elasticity[5] of National Grid (NG) and the gas-specific debt risk premium. The inferred CoE may understate the true CoE required for a notional gas network because it is based on NG's gearing, which is lower than the GD&T3 notional level, and may not fully reflect investors' higher risk perceptions for the gas sector.

The scale of the disconnect between equity and debt pricing implied by the inference analysis and the CAPM-derived CoE based on the GD&T3 DDs may be indicative of a material miscalibration of the allowed CoE. This, in turn, could mean that the cost of capital materially exceeds allowed returns for GD&T3, making investment in gas less attractive compared to gas debt.

[5] Elasticity is the percentage change in the value of equity relative to the percentage change in the value of debt.

The retention and attraction of equity capital in the gas sector is increasingly dependent on allowed returns that reflect the evolving risk landscape and shifting investment profiles associated with the energy transition. If allowed returns fail to compensate for forward-looking risks and the opportunity cost of capital in current market conditions, the retention of and the access to equity is likely to be constrained, which results in detriments to customers.

Ofgem estimates a CAPM range of 5.06 – 6.96% in the DDs. Inference analysis suggests that Ofgem should consider selecting a point estimate at the upper end of the range to ensure that investment in gas sector equity remains attractive relative to debt.

2. Context and scope

On 1 July 2025, Ofgem published its Draft Determinations (DDs) for the RIIO-3 price control for the Gas Transmission and Gas Distribution sectors (GD&T3), covering the period from 1 April 2026 to 31 March 2031. As part of the DDs, Ofgem set out its proposed approach to cross-checking its cost of equity (CoE) estimate derived using the Capital Asset Pricing Model (CAPM).

Ofgem continues to use the following cross-checks: Market-to-Asset Ratios, Offshore Transmission Owner bid-implied returns, investment managers' total market return (TMR) forecasts, and infrastructure funds' implied CoE. According to Ofgem, the use of these cross-checks is a key mechanism for addressing investability concerns, helping to ensure that its estimate remains aligned with broader assessments of investor requirements[6].

In its Sector Specific Methodology Decision (SSMD), Ofgem stated that it would consider the use of additional cross-checks proposed by network companies, including debt-equity cross-checks that estimate the CoE based on observed debt yields. However, in the DDs, Ofgem chose not to adopt any of these cross-checks.

Key factors relevant to the estimation of allowed return at GD&T3

Setting an appropriate and evidence-based Cost of Equity (CoE) allowance is critical to strike the right balance between attracting and retaining equity capital in the sector and ensuring customers do not pay more than necessary for that capital. Improving the precision of the CoE estimate via robust cross-checks is particularly important at GD&T3 due to the following factors.

First, the sector's risk profile is undergoing a notable shift. As the energy system transitions to support a net zero carbon economy by 2050, demand is projected to decline significantly – particularly from the mid-2030s onward. This downward trajectory, coupled with uncertainty surrounding future policy developments, introduces material risks. Among these is the potential for asset stranding, where existing investments may no longer be recoverable.

This shift is acknowledged by the market; for instance, credit rating agencies no longer place gas networks at the lower end of the utility risk spectrum[7], as policy uncertainty related to the energy transition has elevated their business risk relative to electricity networks. In its latest sector update in July, Moody's commented that: "we see higher business risk for gas networks than electricity because gas network use will ultimately decline, whereas electricity networks are growing in support of the energy transition. The additional uncertainty associated with the detailed pathway and timeline to net zero as well as potential risks of future policy decisions and affordability constraints means that GB gas networks will have to exhibit a stronger financial profile to maintain existing credit quality"[8].

Ofgem also recognises these challenges, noting the need to: "manage the uncertainty around the future of gas to protect current and future consumers, while also managing the perceived risk of asset stranding for investors"[9].

Second, the projected decline in long-term gas demand risks could potentially discourage sustained investment in the sector, while regulatory uncertainty exacerbates concerns over asset stranding and cost recovery. The regulatory CoE needs to be sufficient and risk-reflective to maintain investor confidence and support long-term investment.

Ensuring that existing and prospective equity holders remain committed will require competitive investment returns relative to both other forms of capital investment and other equity investment opportunities. In other words, the cost of capital (and the price control as a whole) must represent an investable proposition.

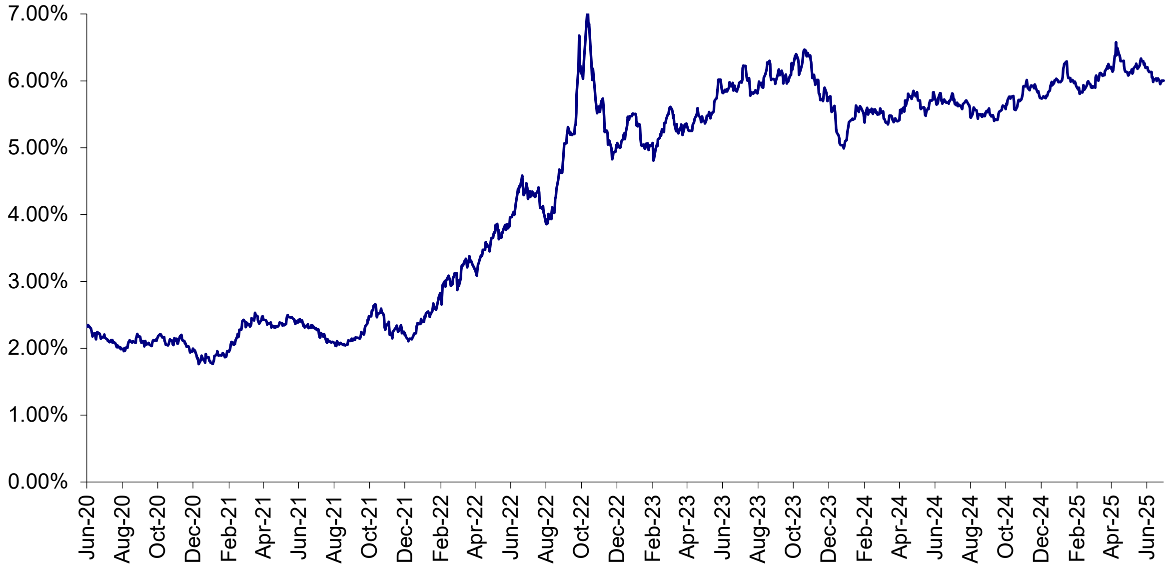
6 Ofgem (2025), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para 1.16.
7 S&P (July 29, 2025). Four U.K. Gas Distribution Networks Ratings Affirmed Following Regulatory Draft Determinations; Outlooks Stable.
8 Moody's (29 July 2025). Sector in-depth: Broader policy uncertainty on energy transition increases business risks.
9 Ofgem (2025), RIIO-3 Draft Determinations – Overview Document, para 7.3.

This is especially important given the increasingly competitive infrastructure investment landscape in the UK. Gas networks are operating in an environment where multiple high-profile infrastructure programmes are expected to proceed concurrently with GD&T3 [10]. In this context, the gas sector must be positioned as a stable and credible investment option despite uncertainties surrounding the future role of gas, including the potential scale of network repurposing for hydrogen transport and carbon capture infrastructure.

Capital can only be attracted and retained based on objective, positive forward-looking investment appraisal. In practice, this requires systematic cross-checking of allowed returns against market evidence and benchmarks to ensure that allowed returns are sufficient to attract and retain equity capital in the industry.

Third, there has been a significant shift in the macroeconomic landscape since RIIO-2, marked by higher interest rates. The figure below illustrates the step change in interest rates since 2021.

Figure 2: Evolution of yields on iBoxx A/BBB 10+



Source: KPMG analysis of LSEG Workspace data.

Direct evidence from the debt markets indicates that the allowed CoE no longer includes the same risk premium over debt as it did previously. Figure 3 shows the evolution of the differentials between allowed CoE [11] and the cost of new debt pricing [12]. The effective maturity of the iBoxx A/BBB index is close to 20 years such that the investment horizons implied in CoE and debt pricing are broadly consistent.

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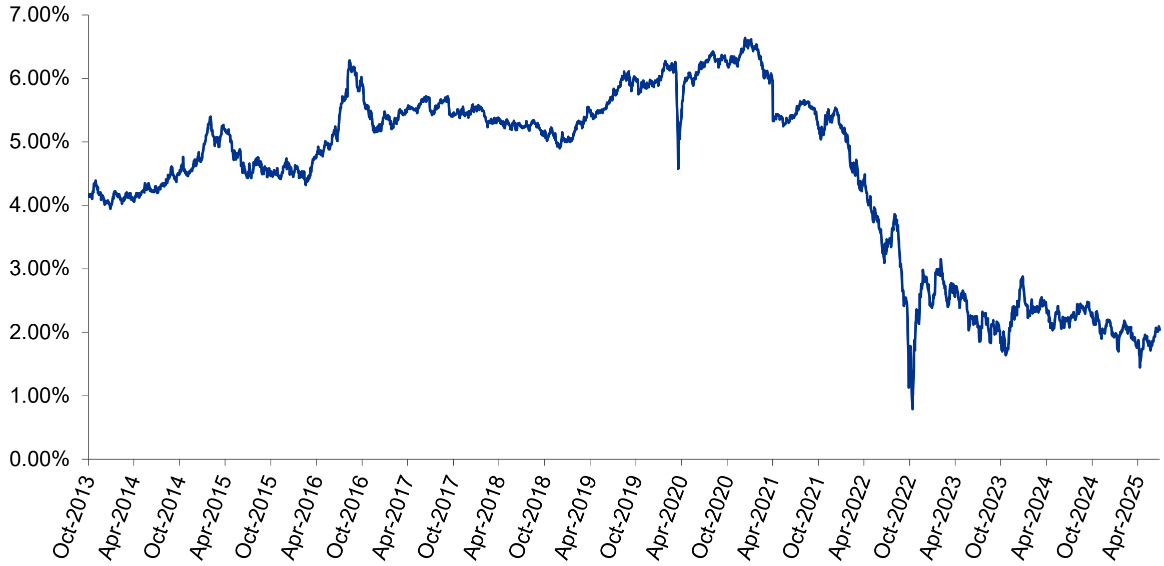
[10] Significant investment is forecast for electricity transmission, including the Accelerating Strategic Transmission Infrastructure (ASTI) programme, which is essential for preparing the country for net zero. The UK water sector enhancement programme is also set to invest £50 billion between 2025 and 2030. Additional net zero-related investments – including the development of a hydrogen network, carbon capture and storage assets, expansion of nuclear energy capacity, and other renewable energy projects – will further increase capital requirements. Hinkley Point C alone is estimated to cost £40bn. Additionally, the new hospitals programme will spend another £20bn by 2030 to build 40 new hospitals.

[11] The allowed CoE is calculated based on the proposed point estimates for Total Market Return (TMR) and equity beta outlined in the RIIO-3 DDs. The Risk-Free Rate (RFR) is derived as a one-month average of 20-year Index-Linked Gilt (ILG) yields, calculated for each respective day.

[12] The cost of new debt is calculated using different benchmarks over time. From 01/10/2013 to 31/03/2021, it is based on the unadjusted iBoxx A/BBB non-financials 10+ index. Between 01/04/2021 and 12/12/2023, it is based on the unadjusted iBoxx Utilities 10+ index. From the RIIO-3 Sector Specific Methodology Consultation date of 13 December 2023 onwards, the benchmark reverts to iBoxx A/BBB non-financials 10+ with a benchmark adjustment of 45bps (see Section 5.2) to reflect the higher issuance premium in the recent 2 years. In all cases, the cost of new debt is reduced by the expected default loss rate (as calculated in Section 5.2).

Figure 3: Evolution of the differential between allowed CoE and cost of new debt pricing



Source: KPMG analysis of the GD&T3 DD methodology and LSEG Workspace data.
Note: (1) Compares nominal cost of new debt pricing (default adjusted) to allowed CoE converted to nominal using long-term inflation assumptions.

Relationship between debt and equity pricing as a potential cross-check

Equity investors often face multiple investment options, each with different risk-return profiles. When making capital allocation decisions, investors carefully assess these options to identify the most attractive opportunities.

Equity inherently faces higher risks in relation to loss of capital and return compared to debt. This is due to, *inter alia*, the subordinated nature of equity claims in case of insolvency, more limited control rights in the event of financial difficulty or distress and differences between contractually obligated debt interest payments and more discretionary equity dividends.

Given the riskier nature of equity, the expected return on equity needs to be substantively above the expected return on debt of the same company, as otherwise an investor is unlikely to be incentivised to invest in equity. This is in line with Damodaran who considers that “there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences” [13]. This principle has also been recognised by regulators:

- In its guidance for setting the cost of capital (WACC), the UK Regulators’ Network (UKRN) highlights that returns should be “risk reflective” [14] such that “the reward will reflect the allocation of risk in the regulatory framework and sectors” [15]. The allowance for the cost of capital set by regulators should be commensurate with the risks faced by debt and equity investors.
- In its guidance, UKRN has similarly recognised “the principle that equity bears more risk than debt and so should normally receive a higher return” [16].
- At PR19 the CMA recognised that “for a regulated business with capped returns, the cost of equity used in the WACC should still be assumed to remain sufficiently above the current cost of debt to promote equity investment in the sector” [17].
- In the SSMD Ofgem noted that it agrees “with the broad principle that we would expect equity returns for an asset to be strictly higher than debt returns for the same asset” [18].

[13] Damodaran A., Equity Risk Premiums (ERP): Determinants, Estimation, and Implications – The 2023 Edition.
[14] UKRN cost of capital principles
[15] Ibid.
[16] UKRN (2023), Guidance for regulators on the methodology for setting the cost of capital, Appendix A: Guidance Consultation Issues and Taskforce Response
[17] CMA (2021), PR19 Final Determination, para. 9.1386
[18] Ofgem (2025), RIIO-3 Sector Specific Methodology Decision – Finance Annex, para 3.270.

Empirical evidence supports the existence of a positive relationship between equity and debt returns[19]. For National Grid (NG), the average correlation over the past 5 and 10 years has been 0.41 and 0.57, respectively. Notably, since the start of RIIO-2[20], the annual average correlation has consistently exceeded 0.6. This correlation suggests that equity and debt returns are influenced by common underlying risk factors – such as interest rate movements and market volatility – and underscores the importance of development of evidence on the appropriate level of the CoE based on this relationship.

It will be important to cross-check whether the allowed CoE has been set at a level which reflects risk differences between debt and equity capital. This is intended to mirror the decision-making process in a competitive setting, where investors make capital investment decisions only if they expect to earn a return equivalent to or above the investment's cost of capital, where the latter is a function of the asset's cashflow risks. In a competitive market, when the expected return is below the investment's cost of capital, the investment would not occur, as capital providers would be unwilling to accept earning an expected return that is not commensurate with the level of risk or is inconsistent with what they could achieve by deploying capital in other assets with similar risk exposure.

To attract and retain equity, the CoE must provide returns that adequately compensate for the risks and opportunity cost of capital. As an alternative asset class and competing investment opportunity, debt represents a natural and relevant benchmark for estimating CoE, and a cross-check based on debt pricing and the debt-equity relationship can help inform an investable CoE that reflects the opportunity cost of capital, investor expectations, and prevailing market dynamics. An important strength of such cross-checks is that they are based on observable, market-based debt data that is inherently forward-looking, offering additional evidence to support CoE estimation – evidence that the CAPM alone cannot provide, as it relies on historical inputs and assumptions that may not reliably reflect future market conditions.

This is particularly important for GD&T3 as based on the DDs there appears to be a disconnect between risk priced into CoE and CoD. The DDs recognise the higher financing costs of GD&T in the cost of new debt through the incorporation of a gas-specific premium over the iBoxx benchmark. All else being equal, this variation would be expected to carry through to CoE estimates to ensure the CoE remains appropriately risk-reflective. To ensure the investability of gas sector equity, the evolving risk profile for the sector must be properly reflected in the estimation of both CoE and CoD, accounting for the higher risk profile of equity relative to debt.

In this context, this Report develops an empirical approach to calibrate a debt-equity cross-check by inferring the CoE from the CoD – an inference-based analysis – to support a robust and investable CoE estimate.

19 Equity return is measured as the percentage change in the Total Return Index (TRI). Debt return is measured as the weighted average return on NG's fixed rate debt.

20 The average 1-year correlation between debt and equity returns was 0.78 in 2022, 0.66 in 2023, and 0.63 in 2024.

3. Scope and structure of the Report

This Report establishes a cross-check for the regulatory CoE grounded in debt market pricing and the debt-equity relationship from corporate finance theory, using the following approach:

- First, it establishes the conceptual framework for inferring CoE from CoD based on the established corporate finance theories (section 4).
- Second, it sets out the methodology for the estimation of expected elasticity and the inferred CoE (section 5).
- Third, it develops the empirical analysis to estimate the inferred CoE range and compares it to the allowed CoE set out in the DD. It then comments on the implication from the analysis (section 6).

4. Conceptual framework for the inference analysis

This section sets out an overall framework for inferring the CoE based on debt pricing and specification of the key drivers of the relationship between debt and equity pricing as outlined in corporate finance theory.

Merton's (1974)[21] contingent claim framework – developed as part of his work on option and derivative pricing – and its modern applications represent a potential basis for estimation of CoE based on the interrelationship between equity and debt pricing.

In Merton's framework, debt and equity are considered contingent claims over a firm's assets[22]. This framework views equity as a European call option, exercised when firm assets exceed debt value, granting shareholders the right to acquire assets. When assets fall below debt value (signifying default), shareholders forgo this option, leaving assets for debtholders. Debt is akin to risk-free debt and shorting a European put option on assets. If assets surpass debt value, equity holders repay the debt, granting debtholders the debt's value instead of firm assets.

The values of debt and equity are intrinsically related to the value of the firm's assets. When the firm's asset value rises, equity holders benefit from larger residual claims, and debt value benefits from the reduction in the firm's leverage and the lower likelihood of default. Conversely, a decline in asset value diminishes the residual claims of equity holders and heightens the risk of default. Consequently, all else equal, the expected returns on equity and debt exhibit a positive correlation, as both are sensitive to the underlying factors that affect the firm's asset value.

Campello, Chen and Zhang (2008)[23] have developed an analytical formula[24] (see Equation (1) below) to estimate the expected equity return based on the relationship between equity and debt inferred from Merton's framework. Their research is published in the top-ranking Review of Financial Studies.

The inputs into this formula are the elasticity of the changes in equity value with respect to the changes in debt value ($\frac{\partial E/E}{\partial D/D}$) and the expected cost of debt adjusted for default risk[25].

Equation (1) $E[r_E] - r_f = \frac{\partial E/E}{\partial D/D}\,(E[r_D] - r_f)$

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21 Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, 29(2), 449-470.

22 The framework views equity as a European call option, while debt is considered as a European put option.
Equity holders are effectively holding a European call option on the firm's assets, which means that they have the right, but not the obligation, to obtain the firm's assets by paying off the debt. Their net payoff is the residual value of the firm, the difference between the asset value and the debt value. They will thus exercise the option when the residual value if positive, i.e., when the firm's asset value exceeds the value of debt.
When the value of a firm's assets is lower than the value of debt (i.e., the company is in default), then the payoff from exercising the option is negative – shareholders would lose money by paying off the debt to obtain assets of lower value. They will thus allow the option to expire worthless, leaving debtholders with all of the firm's assets.
When the value of a firm's assets is higher than the value of debt, shareholders can exercise their call option to buy the assets, retaining the residual claim on the firm's assets.
Debt holders are effectively holding risk-free debt and shorting a European put option on the firm's assets. the risk-free debt reflects the money they have lent and expect to be repaid Unlike the buyer of an option which has the right, but not the obligation to exercise his option, the option seller, in this case the debtholder, gets what the option holder chooses to leave them with. When the value of the firm's assets is lower than the value of debt (i.e., the company is in default), equity holders choose not to exercise their option to buy the firm's assets; instead, they leave the firm's assets to the debtholders and do not repay the debt.
When the value of the firm's assets exceeds the value of debt, equity holders choose to repay the debt. Thus, debtholders receive the value of the debt rather than the firm's assets.

23 Campello, M., Chen, L., & Zhang, L. (2008). Expected returns, yield spreads, and asset pricing tests. *The Review of Financial Studies*, *21*(3), 1297-1338.

24 See Formula 1 in Campello et al. (2008).

25 Campello et al. (2008) explain why bond yield data could be used to represent investors' expected return on debt. Bond yields are computed in the spirit of forward-looking internal return, capturing factors such as probability of default and yield spreads that incorporate the expected risk premiums associated with default risks. Controlling for default risks, bonds with higher systematic risk should have higher yield spreads.

Elasticity ($\frac{\partial E/E}{\partial D/D}$) reflects the percentage change in the value of equity relative to the percentage change in the value of debt. If elasticity is higher (i.e. a small change in the value of debt leads to a large change in the value of equity), then equity is riskier than debt and so the equity risk premium $E[r_E] - r_f$ will be larger than the debt risk premium $E[r_D] - r_f$.

This Report uses Equation (1) to infer CoE based on the elasticity and debt pricing. Academic literature suggests two ways of decomposing elasticity into key drivers. One approach is based on Schaefer and Strebulaev (2008)[26] and the Black-Scholes-Merton option pricing model[27] and the other on Friewald, Wagner and Zechner (2013)[28].

These approaches are described in Appendix 1. The analysis undertaken in this Report follows the methodology put forward by Campello et al., in which the key drivers considered are the risk-free rate, market leverage, and equity volatility.

The relevance of the drivers used in the Campello et al. methodology to the estimation of elasticity and the theoretical basis for inclusion of these drivers in the Campello et al. methodology is as follows:

- Equity volatility: Equity is more sensitive to changes in firm value than debt, since the payoffs of debt are capped. Thus, greater volatility increases the sensitivity of equity more than the sensitivity of debt, and so shareholders require a higher compensation for volatility.
- Market leverage: As is well known from Modigliani-Miller, higher leverage increases the risk of equity as it is the residual claim, thus increasing the return required by equity holders.
- Risk-free rate: The rationale for the inclusion of risk-free rate as a key driver of elasticity stems from the linkage between Merton's framework – which views equity as a European call option – and the Black-Scholes-Merton framework for option pricing which incorporates risk-free rate as one of the inputs.

In practice, in the real world there are other drivers and complexities which could also affect elasticity and its derivation. This underpins the role of inference analysis as a cross-check, rather than a primary methodology for estimation of the CoE.

[26] Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, *90*(1), 1-19.

[27] Black-Scholes-Merton model is an option pricing model that determine the fair value of a stock option based on the price of the underlying asset, the strike price of the option, risk-free rate, time to maturity of an option, and the volatility of an asset.

[28] Friewald, N., Wagner, C., & Zechner, J. (2014). The cross-section of credit risk premia and equity returns. *The Journal of Finance*, *69*(6), 2419-2469.

5. Methodology for using inference analysis to estimate CoE

5.1. Outline of the methodology for the estimation of expected elasticity

This section sets out the approach and data used for the estimation of inferred CoE using the analytical formula developed by Campello et al. (2008).

The calculation of inferred CoE based on this formula requires an estimate of the expected elasticity as well as estimates of debt risk premia and risk-free rate.

The section first outlines the methodology for estimating the expected elasticity, including the specification of the regression, data collection, and the calculation of the expected elasticity based on regression outputs. It then sets out how the expected elasticity is combined with debt risk premia and risk-free rate to generate a range for the inferred CoE.

Figure 4: Overview of the methodology for the estimation of inferred CoE

Data collection

Data inputs based on the Campello et al. methodology include firm-level bond and stock returns – outturn elasticity, market leverage, equity volatility and risk-free rate.

Regression analysis

- Regress outturn elasticity on market leverage, equity volatility and the risk-free rate based on the regression specified by Campello et al.
- The expected elasticity is then calculated by the predicted elasticity from the regression model.

Calculation of inferred CoE

- The inferred CoE is derived based on expected elasticity, debt risk premia and risk-free rate.
- The cut-off used for the calculation is consistent with the DD cut-off.
- The range for the inferred CoE for each cut-off date is formed based on the minimum and maximum CoE implied by the 1-, 12-, 24-month averaging windows as at that date.

Source: KPMG analysis

5.1.1. Regression framework specification based on outturn elasticity

The elasticity used for estimating the expected CoE is the expected elasticity, which is a predicted value of the elasticity from the regression, reflecting the expected relationship between equity and debt returns based on the drivers suggested by Merton's framework, including market leverage, equity volatility and risk-free rate. The relationships between elasticity and its drivers are established through a regression analysis conducted over a long-term window to ensure that the derived elasticity reflects the underlying fundamental relationships, free from distortions caused by transient factors.

To derive expected elasticity, Campello et al. (2008) regress outturn elasticity ($\frac{\partial E/E}{\partial D/D}$) on historical market leverage, equity volatility and the risk-free rate based on monthly frequency bond and stock data [29].

Equation (2) $\frac{\partial E/E}{\partial D/D}_{it} = \alpha + \beta_{lev}\, Leverage_{it} + \beta_{vol}\, Volatility_{it} + \beta_{rf}\, r_{f_t} + \varepsilon_{it}$

[29] Campello et al. conduct the regression based on 1205 nonfinancial firms listed in the U.S. from January 1973 to March 1998.

Listed comparators are required to estimate the expected elasticity for the gas sector. The calibration of expected elasticity is market-specific, using a regression based on the non-financial FTSE 350 companies listed on the London Stock Exchange. By focusing the companies subject to the same macroeconomic environment in the regression, this approach ensures robust estimates of the relationship between equity and debt driven by the UK-specific factors, including the risk-free rate and market volatility.

Given the absence of listed regulated gas networks in the UK, National Grid (NG) is used as a proxy. Using NG's expected elasticity to infer CoE for a notional gas network may lead to inferred CoE estimates that understate the true CoE required for a notional gas network. This is because gas networks face higher borrowing costs than electricity networks, reflecting higher risk perceptions of the sector from the investors. Higher risk is expected to be translated to greater volatility, which is a driver of elasticity based on Merton's framework.

5.1.2. Approach to data collection

A regression period from October 2013 to June 2025 is used based on the following considerations. First, the earliest start date to draw a robust sample size based on bond returns available from Bloomberg is October 2013 [30]. Second, using a long-term window beginning in October 2013 helps to average out cyclical fluctuations in elasticity, producing stable estimates that capture long-term relationships between variables. Third, an end date of June 2025 allows the expected elasticity to be reflective of all the market data available till June and the latest market movements, which is expected to increase the robustness of the coefficient estimates.

Step 1: Obtain the list of all stocks listed in the London Stock Exchange for each year

LSPD [31] is used to obtain a list of all the stocks listed on the London Stock Exchange each year.

Step 2: Apply the filtration criteria

Filtration criteria are applied to exclude financial companies and Alternative Investment Market (AIM) listed companies. Stocks that are not excluded based on the filtration criteria below are then taken forward to the next step for data collection.

Table 1: Filtration criteria and rationale

Criterion	Treatment	Rationale
Financial firms	Exclude	The implications of high leverage are different across financial and non-financial firms (consistent with Campello et al.). Whilst high leverage is common for financial firms and not indicative of financial distress, in non-financial firms, high leverage may indicate financial distress or difficulty.
Alternative Investment Market (AIM) listed firms	Exclude	AIM-listed firms are excluded to capture the tradable and investable universe for institutional investors. AIM-listings include many small and illiquid stocks. AIM stocks have not historically been viewed as investible by many fund managers due to their high failure rates and poorer standards of reporting. Therefore, the UK studies focus on the Main Market of the London Stock Exchange and exclude AIMs.

Source: KPMG analysis

[30] Relative to the later years, the number of companies with bond data available before 2013 is less than 50 companies. This could be because Bloomberg does not have the bond data for stocks which subsequently de-listed in the earlier years, which could result in the results being affected by survivorship bias should these periods be included in the analysis.

[31] LSPD provides a comprehensive list of stocks from 1955 to date, including companies that have since de-listed and / or gone bankrupt. De-listed stocks are included in the dataset to avoid survivorship bias.

Step 3: Download firm-level bond and stock data required for the regression

The table below summarises the definitions, measurement and data sources used for independent and dependent variables in the regression.

Variables	Definition	Measurement	Data source
Outturn elasticity $\left(\frac{\partial E/E}{\partial D/D}_{it}\right)$	Ratio of realised equity return to realised debt return	Equity return: % change in Total Return Index (TRI) Debt return: Weighted average return on company's fixed rate debt	TRI: LSEG Workspace Debt return: Bloomberg
Market leverage $(Leverage_{it})$	Ratio of market value of debt to market value of equity	Market value of debt is the product of the company's book value of debt and its weighted average fixed rate bond price	Bloomberg
Volatility $(\mathrm{Volatility}_{it})$	Volatility of stock returns	The standard deviation of daily stock returns over a rolling 180-day window	LSEG workspace
Risk-free rate (r_{f_t})	Risk-free rate	20-year nominal gilt yields	LSEG workspace

Source: KPMG analysis

The methodology for deriving these variables is broadly consistent with Campello et al., with targeted exceptions as set out below.

- Risk-free rate is measured based on the yields on the 20-year nominal gilt whereas Campello et al. use the 30-day treasury bill rate. A long-term measure of risk-free rate is used to reflect the long-term investment horizon of equity investors.
- Outturn elasticity $\frac{\partial E/E}{\partial D/D}$ is calculated based on the ratio of month-on-month total return on equity to total return on debt[32]. The total return on equity $(\partial E/E)$ is measured as the month-on-month % change in TRI of equity. TRI reflects both the market price movement and dividend distributions, assuming the dividend distributions will be re-invested. The total return on debt $(\partial D/D)$ is measured as the month-on-month weighted average total return on fixed-rate bonds[33] which includes 1) price movement, 2) accrued interest, 3) coupon actually paid out during the month, and 4) interest on interest (i.e. the interest that is earned by re-investing the coupon).

5.1.3. Approach to the regression analysis

Campello et al. use a pooled Ordinary Least Square (OLS) regression, which assumes that the average elasticity is the same across firms. If the assumption of uniform average elasticity across firms does not hold, alternative models, such as the fixed effect model, should be used. The fixed effect model incorporates firm-specific, time-invariant effects, relaxing the assumption of uniform elasticity and accounting for individual heterogeneity[34] across firms that affects elasticity.

The pooled OLS regression can be expressed as follows, where the intercept term α is fixed across firms.

$$\frac{\partial E/E}{\partial D/D}_{it} = \alpha + \beta_L Leverage_{it} + \beta_V\ Volatility_{it} + \beta_r\ r_{f_t} + \varepsilon_{it}$$

32 Merton (1974) – upon which Campello et al's analysis is based – uses a simplified model that assumes that there are no coupon payments on bonds, no cash dividends, no share repurchase or new equity or debt issuance. Under these simplified assumptions, the changes in the market value of debt and equity could be used to capture investors' returns, as the only driver of returns would be the movement of market price. These simplified assumptions do not hold in practice meaning that changes in market values of debt and equity are a poor proxy for total returns received by equity and debt investors

33 i.e. the weighted average total return of all the fixed-rate bonds issued by each company.

34 Individual heterogeneity, in statistical terms, refers to differences among individuals or firms that are not completely random.

The fixed effect model can be expressed as follows, where the term α_i represents the firm-specific, time-invariant effects.

$$\frac{\partial E/E}{\partial D/D}_{it} = \alpha_i + \beta_L \; Leverage_{it} + \beta_V \; Volatility_{it} + \beta_r \, r_{f_t} + \varepsilon_{it}$$

The fixed effect model reflects the fact that the level of elasticity is expected to vary across firms depending on their business, sector, leverage and capital structure characteristics. This firm-specific, time-invariant level of elasticity is represented by the firm-specific intercept α_i in the equation.

It is standard practice for econometricians to base the selection of the panel regression model on statistical testing [35]. While Campello et al. do not mention any such tests and directly use pooled OLS regression for estimating elasticity, this Report performs statistical tests to select the appropriate panel regression models. The tests are implemented based on the practical guide by Park (2011) [36]. In particular, the F-test and Breusch-Pagan Lagrange Multiplier (LM) test are conducted to inform the selection of the appropriate model. The null hypotheses for these tests are as follows:

1) F-test: the firm-specific fixed effects (u_i) are jointly zero.
2) Breusch-Pagan Lagrange Multiplier (LM) test: random effects are insignificant.

The table below summarises the suggested approach based on the guide depending on the conclusion of the F-test and the LM test:

Table 2: Guidance on the selection of the model for panel data [37]

F-test (for fixed effect)	Breusch-Pagan LM test (for random effect)	Suggested approach
H_0 is not rejected (no fixed effect)	H_0 is not rejected (no random effect)	Pooled OLS
H_0 is rejected (fixed effect)	H_0 is not rejected (no random effect)	Fixed effect model
H_0 is not rejected (no fixed effect)	H_0 is rejected (random effect)	Random effect model
H_0 is rejected (fixed effect)	H_0 is rejected (random effect)	Conduct Hausman test to decide between fixed effect and random effect models

Source: Page 50, Park (2011).

First, applying the F-test on the fixed effect regression on elasticity yields a p-value of 0.00%, which indicates that the null hypothesis of no firm-specific fixed effects should be rejected at the 1% significance level. This suggests the presence of fixed effects. Second, applying the Breusch-Pagan LM test yields a p-value of 100%, which means the null hypothesis of no random effects cannot be rejected. Based on these results and the guidance provided in the table above, the fixed effect model is deemed the appropriate choice for the regression on elasticity.

The results of this empirical testing align with economic intuition. It is reasonable to expect that the average elasticity would vary across firms due to company-specific factors in relation to their capital structure and business risks. These characteristics are firm-specific and time-invariant, which corresponds to the firm-specific intercept term (α_i) in the fixed effect model. Indeed, firm fixed effects are used in the vast majority of corporate finance analysis and research.

5.2. Approach and methodology for estimation of the inferred CoE

This section sets out the specification of methodology and assumptions underpinning the calculation of inferred CoE, along with associated rationale.

35 See, for example, sections 10.4 and 10.5, Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

36 Park, H. M. (2011). Practical guides to panel data modelling: a step-by-step analysis using Stata. Public Management and Policy Analysis Program, Graduate School of International Relations, International University of Japan, 12, 1-52.

37 Based on the table in p. 50, Park (2011), Practical Guides To Panel Data Modelling: A Step by Step Analysis Using Stata.

The investment horizon reflected in the inferred CoE should align with the investment horizon assumed in the DDs for cost of capital estimation. This alignment between the investment horizons is critical to preserving the integrity and effectiveness of the cross-check:

- **Comparability**: To ensure the inferred CoE is comparable to the DD CAPM-CoE, both must reflect the same investment horizon.
- **Internal consistency**: For the inferred CoE to represent a true return over the assumed investment horizon, all underlying parameters must reflect that same horizon.

A 20-year investment horizon has been adopted in the DDs, as reflected in the methodology for estimating the RFR and the accompanying supporting commentary. It is appropriate for the investment horizon for estimating the forward-looking CoE in regulatory price controls to be long-run. This reflects the fact that equity investors in regulated utilities are funding infrastructure assets with long useful lives – typically 20 years or more – and are therefore exposed to risk and return over that extended period. The long asset lives influence both the pace of capital recovery (via regulatory depreciation) and the duration over which equity investors require compensation for bearing risk. A long-run investment horizon aligns with the reasonable expectation that investors will, on average, recover their efficiently incurred financing costs over the full life of the assets. Therefore, a forward-looking CoE over that same long-run horizon is necessary to attract long-term investment into these capital-intensive sectors.

Ofgem applied a 20-year investment horizon in RIIO-2, which it considered to be consistent with the long-term nature of equity investment and the then typical 45-year depreciation horizon, which implied an average asset life close to 22.5 years [38].

For RIIO-3, the weighted average asset lives of gas networks remain above 20 years under all regulatory depreciation scenarios considered by Ofgem, including Option 4 adopted in the DDs. Further, DESNEZ in its latest policy paper [39] recognises that the sector will have “a crucial part to play in supporting our energy transition” and “heat many of our homes and fuel hard-to-decarbonise industry for years ahead”.

Given this, a 20-year investment horizon assumed in the DDs appropriately reflects the nature of the underlying asset base for gas networks and supports regulatory stability and predictability, which are especially important given the significant policy uncertainties currently affecting the sector.

Consequently, the inputs into the inferred CoE calculation also reflect a 20-year investment horizon. However, the DD assumption for the cost of new debt does not align with this horizon. The DD allowance is derived by applying a 25bps benchmark adjustment to iBoxx A/BBB 10+ yields. This adjustment calculation does not explicitly control for tenor differences when comparing gas network debt yields to the iBoxx A/BBB benchmark. As a result, the allowance effectively reflects a shorter average tenor – approximately 12 years – based on the public and private issuances between 2023 and 2024 [40.]. Using this assumption as an input in the inference analysis would create a material inconsistency, as the inferred CoE would then reflect a shorter investment horizon than the DD CAPM-derived CoE, resulting in an inferred CoE that does not represent a like-for-like cross-check.

To align the cost of new debt assumption – and hence the inferred CoE – with a 20-year investment horizon, this Report instead incorporates a 45bps gas-specific premium estimated by NERA [41.]. The 45bps adjustment is derived from the relative spreads of gas network bonds versus the A/BBB iBoxx benchmark, calculated on a like-for-like tenor basis using primary market data. The resulting cost of new debt aligns with an investment horizon close to 20 years, broadly consistent with the horizon used in the DD CAPM-CoE calculation.

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38 RIIO-2 Sector Specific Methodology Annex: Finance, para. 3.33.

39 DESNEZ (June 2025), Policy paper: Midstream gas system: update to the market.

40 The 12-year average tenor is calculated as the simple average tenor of 14 private and public bonds issued between 2023 and 2024. Although the exact instruments used by Ofgem to determine the 25bps adjustment are not disclosed in the DDs, Ofgem similarly focuses on the 2023–2024 period and analyses 14 bond issuances within that timeframe.

41 [To add x-ref to NERA report]

The table below provides an overview of the methodology and assumptions underpinning the estimation of inferred CoE.

Table 3: Methodology and assumptions underpinning the estimation of inferred CoE

	Approach	Rationale
Cut-off date	31 March 2025	Consistent with the cut-off date used in the DD.
Averaging window	1-, 12- and 24-month averages	These averaging windows capture the most up-to-date data (1 month) as well as longer-term, more stable trends (24 months) in the inferred CoE. Notably, the use of the 24-month averaging window aligns with the focus on gas networks issuances during the last 2 years in Ofgem's cost of new debt assessment.
Inferred CoE	$E[r_E] = r_f + \frac{\partial E/E}{\partial D/D}\left(E[r_D] - r_f\right)$	Consistent with the formula used by Campello et al.
Debt risk premium $(E[r_D] - r_f)$	Debt risk premium is derived by subtracting the yields on the 20Y nominal gilt from default-adjusted nominal cost of new debt. This subtraction isolates the additional return required for credit risk of a notional gas company relative to the nominal gilt. The cost of new debt is calculated based on the iBoxx non-financial A/BBB 10+ benchmark plus 45bps, reduced by an expected default loss rate. The expected default loss rate is calculated based on a 0.23% [42] annualised default rate and a 37.9% [43] recovery rate for senior unsecured A/BBB bonds sourced from Moody's 2025 annual default study.	The purpose of inference analysis is to provide a cross-check to the notional company's CoE. Accordingly, the appropriate input, consistent with the regulatory construct, is the notional cost of new debt over the 20-year investment horizon assumed in the CAPM. Campello et al. apply a similar default loss rate adjustment based on Moody's data in their analysis.
Treatment of inflation [44]	Inferred CoE is derived in CPIH-deflated terms in three steps: First, an equity risk premium is calculated by multiplying expected elasticity by the debt risk premium. Then an inferred CoE is calculated as the sum of the yields on the 1-month average 20Y nominal gilt and the equity risk premium. Lastly, the nominal inferred CoE is converted into a CPIH-deflated value based on the 1-month average 20Y CPI swap rate [45].	Consistent with the approach for estimating the regulatory CoE which does not reflect compensation for the inflation risk premium (given that it is estimated using index-linked gilts and a real TMR). The deflation using the CPI-swap rate strips out both market-based inflation expectation and the inflation risk premium from nominal inferred CoE. The resulting inferred CoE is thus consistent with the regulatory methodology.

Source: KPMG analysis.

42 Moody's (2025), Annual default study: Corporate default rate to fall below its long-term average in 2025, Exhibit 41 and 42.

43 Moody's (2025), Annual default study: Corporate default rate to fall below its long-term average in 2025, Exhibit 7.

44 Consistent with the regulatory CoE, the inferred CoE estimates are derived in real terms, and are assumed to be unaffected by inflation and inflation risk premia. First, although the inputs in the elasticity regression are nominal, both the numerator and denominator of the elasticity ratio (i.e., the dependent variable) incorporate inflation which is likely to limit the extent to which inflation affects elasticity and means that elasticity can be used to underpin estimation of CoE in real terms. Second, the debt risk premium is calculated by subtracting the yield on a 20-year nominal gilt from the yield on a similarly long-term corporate benchmark. This approach isolates the impact of credit risk differences, adjusted for default, without including inflation risk premia, as inflation expectations are similar for bonds of the same maturity. Third, while the company-specific ERP is combined with a nominal risk-free rate to derive the CoE in nominal terms, the resulting nominal CoE is deflated using inflation swaps. This deflation removes any inflation risk premia introduced by the nominal risk-free rate.

45 Sourced from Bloomberg.

6. Inference analysis results and implications for the allowed CoE at GD&T3

6.1. Inference analysis as a cross-check

Inference analysis is an alternative way to estimate the CoE that does not rely on the CAPM framework and is based on a different underlying premise.

The CAPM operates on the premise that investors hold a diversified portfolio of both risk-free assets and the overall market. The investors construct a theoretical portfolio combining the risk-free asset and the market that matches the utilities stock's beta. If this theoretical portfolio offers a higher expected return, investors will sell the utilities stock, driving its price down until its expected return equals that of the portfolio. Conversely, if the theoretical portfolio offers a lower expected return, investors will buy the utilities stock, pushing its price up until its expected return matches the portfolio. This mechanism ensures that the expected return of the utilities stock is ultimately determined by its beta, the risk-free rate, and the expected return of the market, as defined by the CAPM equation.

Crucially, the expected return on the market is very difficult to estimate as it requires (i) specifying the market portfolio, (ii) specifying the historic estimation window, and (iii) assuming that historic premia are an accurate estimate of forward-looking beta or estimating an appropriate adjustment.

Further, the assumption underlying the CAPM may not hold in reality due to several factors: (1) investors may seek compensation for sources of systematic risk that are not fully captured by the market portfolios; and (2) investor are often not fully diversified and require compensation for idiosyncratic risk; and (3) financial markets are not frictionless, leading investors to consider factors beyond risk and return when choosing assets.

In contrast, inference analysis is based on the idea that investors will compare a utilities stock only not to the market, but also to the utility's bonds: both are ways of gaining exposure to the same underlying asset. Thus, what matters is the expected return on the stock compared not to the market but to the yield on debt for utilities.

The key rationale for exploring inference analysis as a cross-check is as follows:

1. It provides an independent framework in estimating the CoE, and therefore, it is not subject to the same estimation issues that affect the CAPM.
2. It uses debt yields that are directly observable and automatically forward-looking, in contrast to the historical Total Market Return (TMR) estimates used in the CAPM. These yields capture the market's real-time, forward-looking perception of credit risk for the notional gas company. By using the sector's cost of new debt as an input, inference analysis helps ensure that the allowed return on equity remains competitive and attractive relative to the returns investors could achieve from new debt issuance within the gas sector.
3. It provides an analytical method to infer the CoE based on elasticity – that is, the sensitivity of changes in equity value to changes in debt value – combined with current debt pricing. The elasticity component recognises that the relationship between equity and debt returns is dynamic and time-varying and does not assume a constant spread between the CoE and CoD over time.

Inference analysis has been submitted by water companies as a potential cross-check for the PR24 CoE and is currently under consideration as part of the PR24 re-determination process. Throughout the price review and re-determination phases, Ofwat and its advisers raised several technical comments concerning the inference analysis methodology, to which KPMG has provided detailed responses. The responses addressing material points that may also be relevant to GD&T3 are summarised in Appendix 3.

6.2. The inference analysis results and implications for GD&T3

6.2.1. Regression results on elasticity

A regression between October 2013 and June 2025 is run to get a long-term stable relationship between elasticity and the independent variables.

A 5% winsorisation[46] is applied to the outturn elasticities in the panel dataset to mitigate the impact of extreme outliers. The regression results are set out below. The F-statistic[47] for the regression yields a p-value of 2%, indicating that the independent variables, taken together, are able to jointly explain the variation of elasticity and are jointly significant at a 5% significance level. The use of the F-statistic, which assesses the overall statistical significance of the regression model, is appropriate in this context as the expected elasticity is derived based on the combined effect of all independent variables.

Table 4: Regression results

	Coefficient	Standard error	t-stat	p-value
Intercept (α_{NG})	4.12	1.15	2.11	0.04
Leverage (β_L)	0.12	0.23	0.05	0.96
Volatility (β_V)	104.53**	40.27	2.60	0.01
Risk-free rate (β_r)	-0.25	0.24	-1.03	0.30

Source: KPMG analysis.

Note: * is significant at the 10% level, ** at the 5% significance level and *** at the 1% level. α_{NG} represents the firm-specific fixed effect of NG. In this context, the statistically significant alpha term means that the average time-invariant component of elasticity for NG is positive and statistically significant.

6.2.2. The estimation of the expected elasticity

The regression coefficients (β_L, β_V, β_r) are multiplied by NG's leverage, volatilities and risk-free rate as of a given month. These, combined with NG's fixed-effect intercept, are used to calculate the expected elasticity for that month.

As illustrated in Figure 5, apart from a temporary spike during the height of the Covid19 pandemic in 2020, the expected elasticity has remained broadly stable over time. All else equal, the level and trend of expected elasticity suggest that there should continue to be a significant differential between debt and equity pricing at GD&T3. As of March 2025, the expected elasticity is equal to 4.23.

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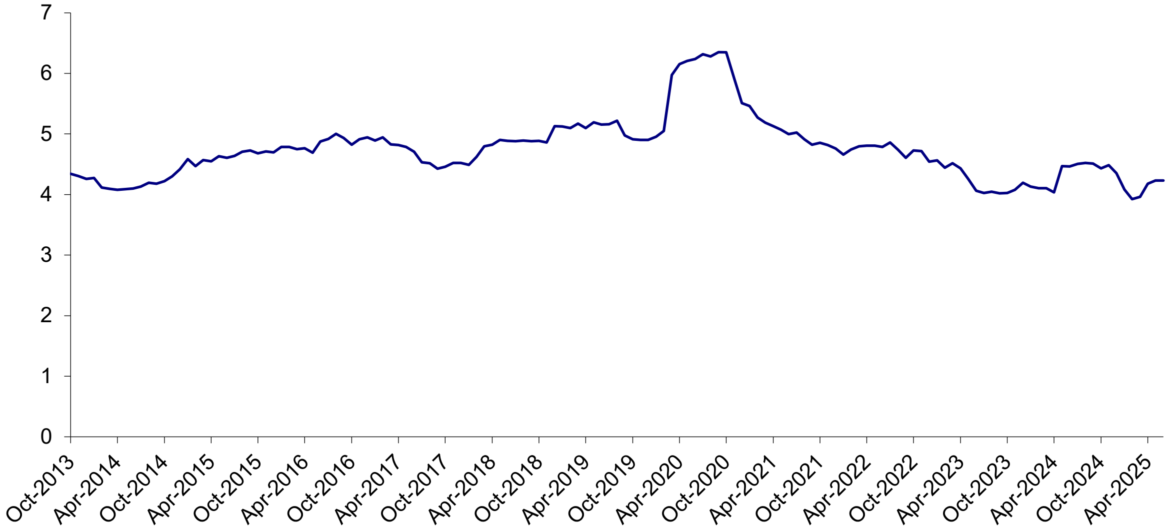
[46] Winsorisation is a data cleaning technique commonly adopted in statistics to mitigate the impact of extreme values (outliers) on the coefficient estimates of the regression, which reduces estimation bias and provides more accurate regression outputs. In this Report outliers are 'capped' meaning that they are replaced with the nearest non-outlying values within a specified range. A 5% winsorisation is applied to elasticity ($\frac{\partial E/E}{\partial D/D}_{it}$), which means that all observations greater than the 97.5th percentile are set to be equal to the 97.5th percentile, and all observations lower than 2.5th percentile are set to be equal to 2.5th percentile.

[47] The F-statistic in a regression model is a value that assesses the overall significance of the model.

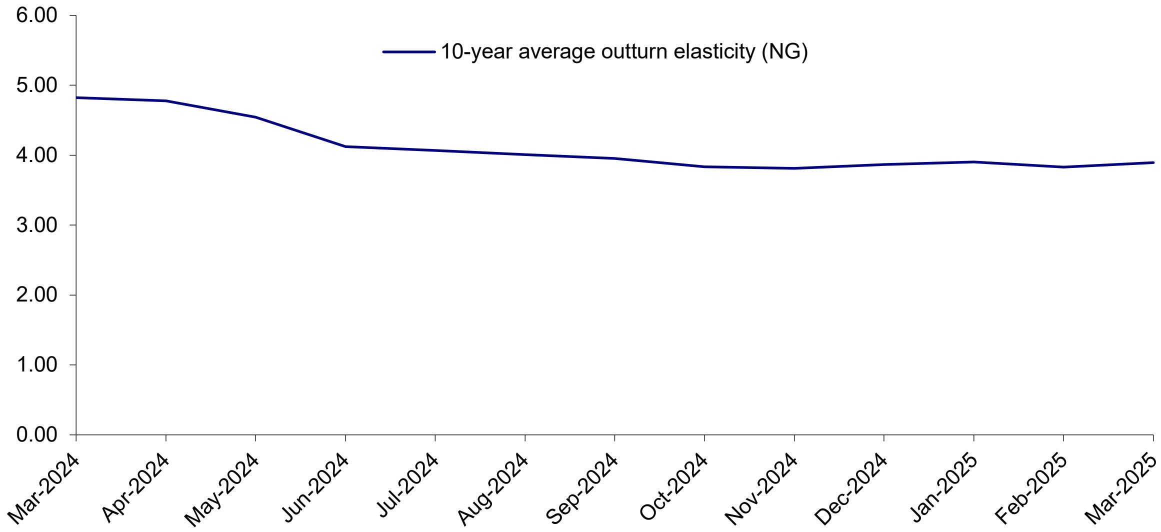
Figure 5: Expected elasticity for NG



Source: KPMG analysis

To provide a baseline sense-check of the expected elasticity derived from the regression, a long-term outturn elasticity – winsorised within the regression window – was calculated, yielding a value of 4.74 [48]. As can be seen from Figure 6, the average outturn elasticity over the 10-year period – consistent with the estimation window used in the DDs for beta – is relatively stable over time. This supports the use of the long-term regression window for estimating the expected elasticity. The close alignment between the long-term outturn elasticity and the expected elasticity suggests that the regression results are reasonable and robust.

Figure 6: The evolution of the 10-year average outturn elasticity of NG



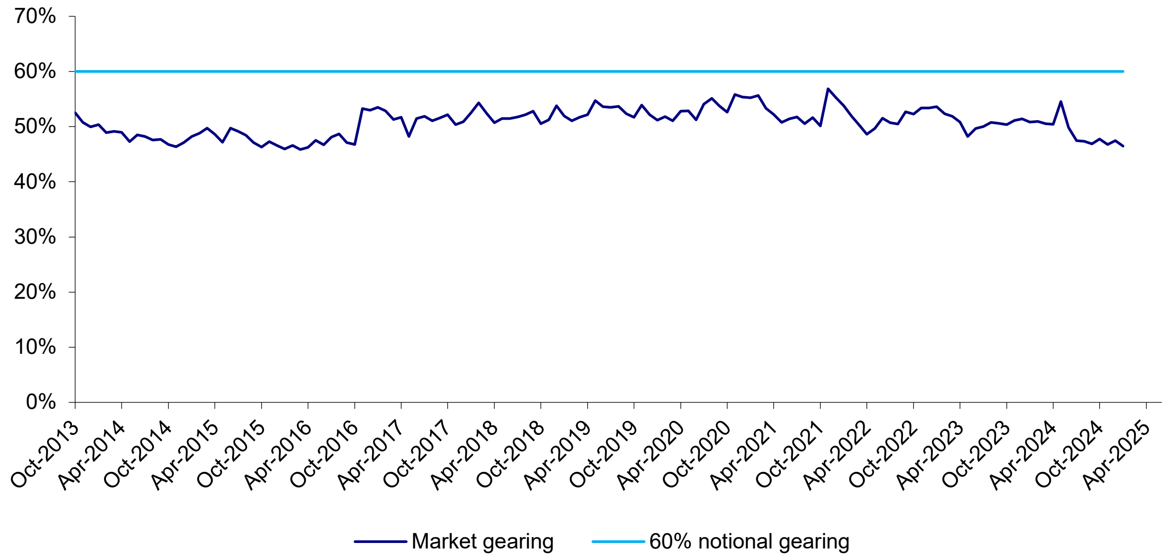
Source: KPMG analysis

The expected elasticity is derived from regression analysis based on market leverage which may differ from the 60% notional gearing assumption used in the DDs for gas networks. As illustrated in the figure below, market leverage for NG is consistently below the assumed notional gearing level. The longest averaging window used in the calculation of inferred CoE is 24 months, with expected

48 5% winsorisation is applied to the long-term average elasticity to be consistent with the winsorisation method used in the regression on elasticity. The long-term average raw elasticity of NG without winsorisation is equal to 5.41.

elasticity estimates extending back from April 2023. During this period, the average market leverage for NG was 49.2%, ranging from 45.5% to 54.5%. As a result, all else being equal, the elasticity estimates are lower than they would be if calculated using a 60% market leverage basis.

Figure 7: Evolution of market leverage (NG) relative to the GD&T3 notional gearing



Source: KPMG analysis

Given that the market leverage is below notional gearing, de- and re-levering would increase elasticity and CoE estimates. As the Report does not perform this conversion, inferred CoE estimates are likely to somewhat understate the required returns at the notional gearing level and can thus be considered conservative.

6.2.3. The results on the inference analysis-derived CoE

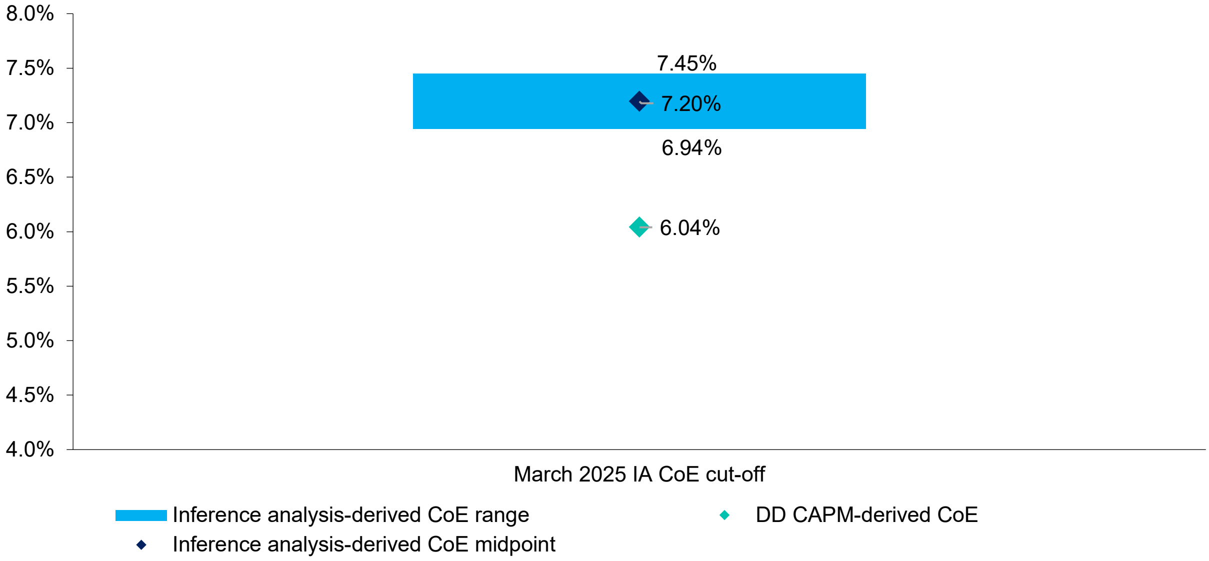
To assess the implications of inference analysis for the allowed CoE at GD&T3, the Report considers how the CAPM-derived CoE estimate from the DDs compares to inferred CoE estimate. Using 31 March 2025 as the cut-off date, the inferred CoE range is between 6.94 and 7.45% [49], based on averaging windows of 1, 12 and 24 months [50]. The DDs set the point estimate for the GD&T3 CoE at 6.04%.

In Figure 8, the floating bar represents the range implied by the inference analysis while the green diamond represents the allowed CoE in the DD. The RIIO-3 DD CoE sits materially below the lower end of the inferred Coe range. All else equal, this suggests that the CAPM-derived CoE based on the DDs is not consistent with current market pricing of debt for gas networks and the relationship between debt and equity pricing.

49 The inferred CoE range is between 6.17% and 6.63% where a 25bps benchmark adjustment is assumed.

50 The inferred CoE based on 1, 12 and 24-month average is 6.94%, 7.27% and 7.45%, respectively.

Figure 8: Comparison between the inferred CoE range and Ofgem's RIIO-3 DD allowed CoE



Source: KPMG analysis

The scale of the disconnect between equity and debt pricing implied by the inference analysis and the CAPM-derived CoE based on the GD&T3 DDs may be indicative of a material miscalibration of the allowed CoE. This, in turn, could mean that the cost of capital materially exceeds allowed returns for GD&T3, making investment in gas less attractive compared to gas debt.

The retention and attraction of equity capital in the gas sector is increasingly dependent on allowed returns that reflect the evolving risk landscape and shifting investment profiles associated with the energy transition. If allowed returns fail to compensate for forward-looking risks and the opportunity cost of capital in current market conditions, the retention of and the access to equity is likely to be constrained, which results in detriments to customers.

Ofgem estimates a CAPM range of 5.06 to 6.96% in the DDs, with a point estimate of 6.04%. The inferred CoE range of 6.94% to 7.45% exceeds the CAPM point estimate and partially overlaps with the upper bound of Ofgem's range. This suggests that Ofgem should consider selecting a point estimate at the upper end of the CAPM range to ensure that investment in gas sector equity remains attractive relative to debt.

Appendix 1: Decomposing elasticity into underlying drivers

Academic literature suggests two ways of decomposing elasticity into key drivers.

Approach 1: Decomposing elasticity into delta (Δ) and market leverage (L)

This approach is based on Schaefer and Strebulaev (2008)[51] and the Black-Scholes-Merton option pricing model[52].

Schaefer and Strebulaev (2008)[53] derive the elasticity of debt to equity – which is the inverse of elasticity of equity to debt shown in Equation (1) – as follows:

Equation (4) $\frac{\partial D/D}{\partial E/E} = (\frac{\partial E/E}{\partial D/D})^{-1} = (\frac{1}{\Delta} - 1)(\frac{1}{L} - 1)$

Where:

- Δ is the change in the equity value with respect to the change in the value of the asset[54].
- L is the market leverage, calculated as the ratio of market value of debt to the market value of firm.

Further, the Black-Scholes-Merton model implies that the call option delta (Δ) is equal to:

Equation (5) Δ = N (d_1), where $d_1 = \frac{\ln(A/D)+(r+{\sigma_A}^2/2)T}{\sigma_A \sqrt{T}}$

Where:

- r is the risk-free rate,
- A is the value of the firm's asset,
- D is the value of the firm's debt,
- T is the time to maturity of firms' debt, and
- σ_A is the volatility of the return on firm's assets.

Equation (4) and (5) imply that the underlying drivers of elasticity include the market leverage (L), risk-free rate (r), asset volatility (σ_A) and time to maturity of the firm's debt (T).

Approach 2: Decomposing elasticity into the volatility of equity (σ_E) and debt (σ_D)

Friewald, Wagner and Zechner (2013)[55] derive the following equation, where elasticity is equal to the ratio of the volatility of equity to the volatility of debt.

Equation (6) $\frac{\partial E/E}{\partial D/D} = \frac{\sigma_E}{\sigma_D}$

Therefore, Equation (6) implies that the underlying drivers of elasticity include asset and equity volatility.

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[51] Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, *90*(1), 1-19.

[52] Black-Scholes-Merton model is an option pricing model that determine the fair value of a stock option based on the price of the underlying asset, the strike price of the option, risk-free rate, time to maturity of an option, and the volatility of an asset.

[53] Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. *Journal of Financial Economics*, *90*(1), 1-19.

[54] Δ is the delta of the European call option on the firm's asset and given Merton's (1974) framework views equity as a European call option, Δ is the change in the equity value in response to the change in the asset value.

[55] Friewald, N., Wagner, C., & Zechner, J. (2014). The cross-section of credit risk premia and equity returns. *The Journal of Finance*, *69*(6), 2419-2469.

Appendix 2: Analysis of and commentary on points raised on inference analysis as part of the PR24 price review and re-determination processes

Inference analysis has been submitted by water companies as a potential cross-check for the PR24 CoE and is currently under consideration as part of the PR24 re-determination process. Throughout the price review and re-determination phases, Ofwat and its advisers raised several technical comments concerning the inference analysis methodology, to which KPMG has provided detailed responses. The responses addressing material points that may also be relevant to GD&T3 are summarised below.

The inferred CoE is only an intermediate input into another asset pricing model in Campello et al. (2008), while KPMG uses it directly as a CoE estimate

The objective of the Campello et al. paper is to derive firm-level expected equity returns to investigate whether the different factors in multi-factor models can explain the cross-sectional variation in expected returns.

Unlike traditional asset pricing models, which rely on realised stock returns, Campello et al. utilise the inferred CoE – an ex-ante expected equity return measure – to construct and test a range of asset pricing models. Their results show that the inferred CoE, based on Merton's framework, significantly improves the predictive power of these models compared to those using historical realised returns [56].

Although the purpose of using inferred CoE differs between Campello et al. and this Report, there is a shared goal of deriving a robust measure of expected CoE based on elasticity and debt pricing. The robust inference of the expected CoE demonstrated in the paper supports confidence in employing this framework as an independent cross-check against the CAPM-derived CoE.

The two independent variables in the regression on elasticity are not statistically significant. This is likely to result in a wide confidence interval.

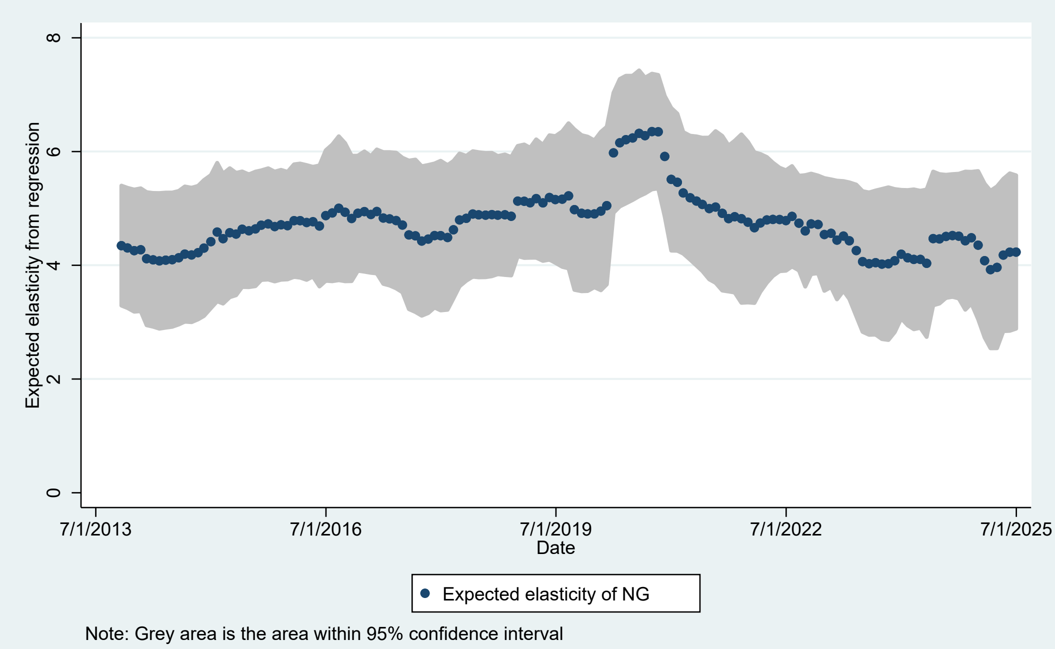
Ofwat relies on the t-statistics to examine whether the independent variables are individually statistically significant. However, in estimating the expected elasticity, the inference analysis relies on the predicted value from the regression based on the combined effects of the independent variables as a whole rather than the coefficients of the individual variables. Therefore, the more relevant test statistics in this case is the F-statistic, which confirms that the independent variables are jointly significant at the 5% level.

Confidence intervals provide a range within which the true value of a population parameter is likely to fall. Figure 9 shows that the expected elasticity generated from the regression is relatively stable and the 95% confidence interval around the expected elasticity is positive and relatively narrow. This indicates that the estimation of expected elasticity is precise and statistically significant, fulfilling the requirements of the analysis.

The selection of the three independent variables is theoretically grounded, as outlined in Campello et al.

[56] Campello et al. note that "the results suggest that our inferences are robust to the regression specification that we use to estimate the equity-bond elasticity"

Figure 9: The evolution of the expected elasticity estimated from the regression and 95% confidence interval

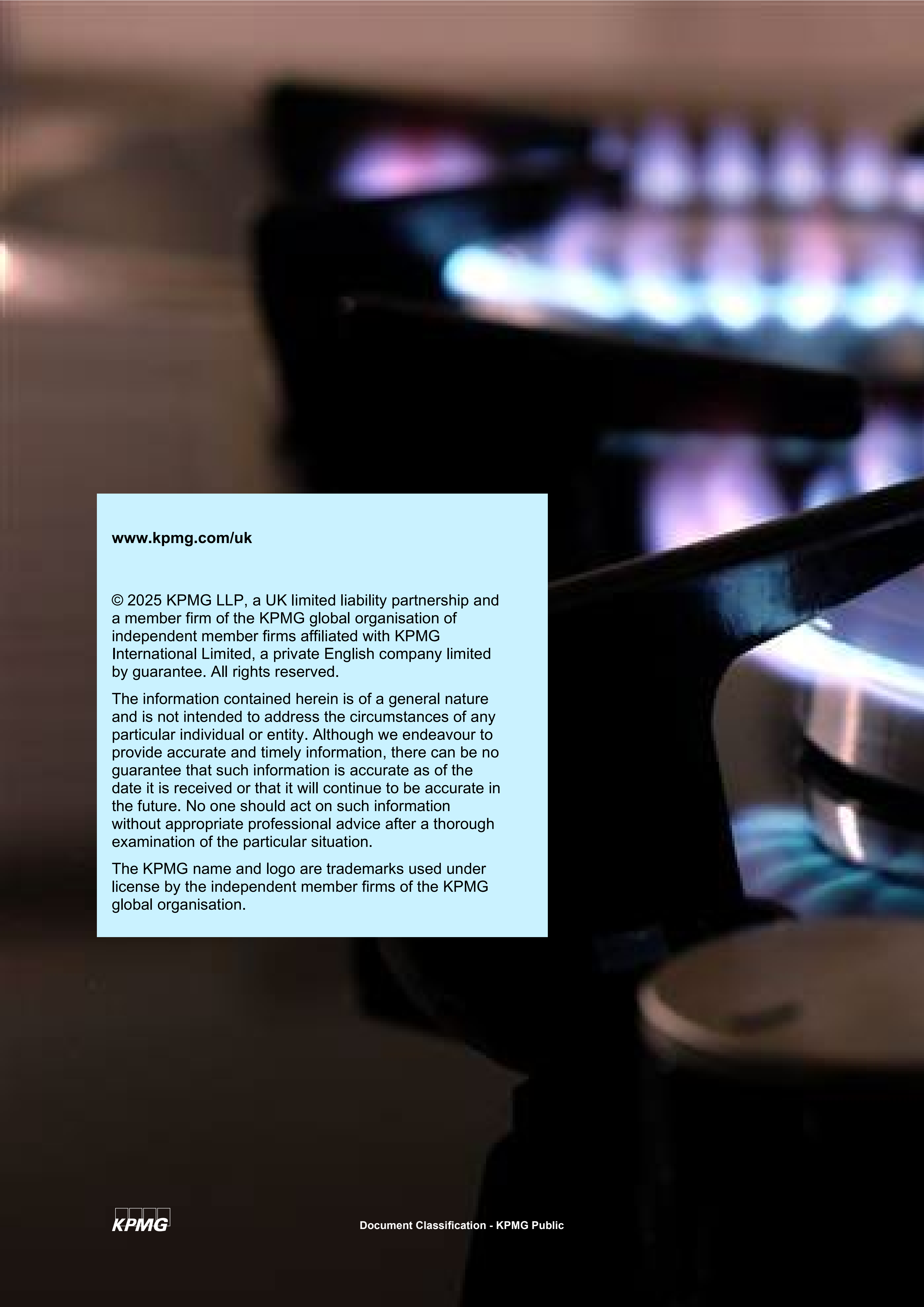


Source: KPMG analysis, output generated using Stata.

The allowed cost of capital should be relatively stable in a regulatory setting with multi-year view of investment. The inference analysis-derived CoE is less stable than the CAPM-derived CoE

A regulatory setting should take a multiyear view of investment and the cost of capital, in that the estimated forward-looking cost of capital should be applicable over the next 20 years, rather than just the next year. However, this does not mean that the estimate itself should not change over time. For example, the yield on a 20-year bond is a multi-year expected return, yet it changes whenever economic news is released.

The estimated cost of capital needs to change over time to account for the most up-to-date market conditions, to ensure that investment in utilities stock remains attractive compared to investors' outside options, such as investing in utilities bonds or other companies. This is a strength of inference analysis, not a flaw, as it ensures that equity remains an attractive investment. Under the regulatory CAPM, the estimated CoE will be relatively stable with a long-term stable TMR, which could be less reflective of the changes in the market conditions and result in uninvestable equity premia. One way to address this is through a cross-check that does not make the same assumption.



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