Review of the NZCC's WACC-setting methodology

Prepared for
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Executive summary

This report assesses the approach taken by the New Zealand Commerce Commission (**NZCC**) in its 2016 Input Methodology (**IM**) to estimate the weighted average cost of capital (**WACC**) for electricity lines (i.e. electricity distribution and transmission). The 2016 IM represents the most recent IM published by the NZCC, and we have reviewed it with a view to supporting the electricity distribution businesses (**EDBs**) in their engagement with the NZCC on the WACC-setting methodology for the forthcoming 2023 IM.

We note that regulatory practice differs between jurisdictions for a number of reasons, including different market conditions and different statutory duties. Our review of the NZCC's WACC-setting approach draws on regulatory precedent, academic evidence and capital market evidence, for each parameter of the cost of capital.

We begin by considering the three parameters that make up the cost of equity (**CoE**), as estimated by the simplified Brennan–Lally capital asset pricing model (**CAPM**). Under this model the CoE is estimated as the sum of: (i) the risk-free rate (**RFR**), and (ii) the product of equity beta and the tax-adjusted market risk premium (**TAMRP**). After this, we proceed by considering the cost of debt (**CoD**), and then move to the parameters that are used to combine the CoD with the CoE: leverage and tax. Finally, we discuss how the NZCC could add a financeability assessment to its IMs.

We summarise our findings on each of these issues, below.

Risk-free rate

The RFR is the parameter that compensates investors for the time value of money; the fact that, by investing money, investors sacrifice consumption in the present for consumption in the future. The NZCC currently estimates the RFR by observing the average yields on New Zealand government five-year bonds, for three months of recent available data. We have reviewed the approach of the NZCC with reference to recent evidence from other regulators (with a focus on the UK and Australia), as well as looking at other academic and capital market evidence.

We find that the key areas where the NZCC may reconsider the appropriateness of its approach in the context of the forthcoming IMs are as follows:

- whether the bond maturity considered by the NZCC should be revised to encompass yields on a range of bonds (i.e. five to 20 years);
- whether the yields on the highest-rated corporate bonds—to adjust for the convenience premium of government bonds—should be included in the calculation of the RFR;
- the extent to which the current three-month averaging period is appropriate, given the evidence on interest rate volatility in New Zealand;
- the role of (annual) indexation[1] and/or other measures in reducing investors' exposure to market movements in interest rates.

[1] By 'indexation' we mean an approach whereby some or all of the WACC parameters are updated—usually on a mechanistic basis, with reference to movements in a specified market index—during a regulatory period, rather than being calculated at the start of the regulatory period and then left unchanged.

Tax-adjusted market risk premium

Together with the equity beta, the TAMRP compensates equity investors for investing in a risky asset. The NZCC uses a range of models to calculate the total market return, and then subtracts the tax-adjusted RFR from this to get its estimate of the TAMRP. We find that the NZCC may consider adjusting its approach in the following areas:

- whether methods that assume a constant TAMRP should be used, or whether these should be deprioritised due to the existence of evidence that the TAMRP varies over time;
- the amount of weight that the NZCC should place on two specific sources that it considers as cross-checks—the dividend growth model (**DGM**) and survey data—compared with the weight it places on primary sources of estimation;
- the level of rounding that the NZCC applies to estimates of the TAMRP.

We have also reviewed the NZCC's approach to the averaging period (i.e. the longest period over which reliable data is available) and the averaging method (i.e. the arithmetic rather than geometric mean). We find that the approach taken by the NZCC is reasonable, with reference to academic evidence and regulatory precedent.

Equity beta

As we note above, the equity beta is multiplied by the TAMRP to produce an estimate of the additional compensation that investors require to invest in risky (as opposed to riskless) assets. The NZCC takes the average of the equity betas that it calculates for 72 regulated utilities. It then produces four separate equity beta calculations, each covering a consecutive five-year period (i.e. across a total of 20 years) and places more weight on the more recent equity beta estimates.

We find that the key areas where the NZCC may reconsider the appropriateness of its approach in the context of the forthcoming IMs are:

- whether the large sample of companies is sufficiently representative of New Zealand networks, or whether a smaller sample could be used instead;
- whether the current estimation period, which uses data from the past 20 years but places more weight on recent data, could be adjusted to place more focus on medium-term equity beta estimates;
- the frequency of the observations that are used for the NZCC's equity beta regressions (daily, weekly, or monthly);
- whether data from the COVID period should be included in the estimation of equity beta.

Cost of debt

The CoD compensates debt investors for lending money to a particular company, and therefore reflects both the time value of money and the cost of lending to an entity with a particular risk profile. The NZCC calculates the CoD by combining a contemporaneous RFR (calculated as the three-month average) with a five-year average of debt premia (and also adds debt issuance costs).

Based on regulatory precedent from the UK and Australia and capital market evidence, we consider that the NZCC could reconsider the appropriateness of its approach in the following areas:

- whether it is appropriate to combine a RFR that is based on a three-month average with a debt premium that is based on a five-year average;
- whether the averaging period that is currently used (between three months and five years) is sufficiently long to compensate EDBs for the costs they incurred when raising debt in time periods more than five years in the past;
- as noted in the context of the RFR, whether the NZCC could consider indexing the CoD allowance across the regulatory period in order to reduce networks' exposure to movements in market rates. This is in the context of increased market volatility in New Zealand since the last IM review, and the length of time that elapses between WACC re-sets.

Leverage

Leverage represents the proportion of a regulated utility that is financed through debt. It is used as the weighting factor that combines the CoD and CoE into the WACC. The NZCC calculates leverage by taking the mean leverage of the sample of 72 comparators that it uses to estimate equity beta across the most recent ten years of data.

Based on regulatory precedent from the UK and Australia, we consider that the NZCC could reconsider its methodology in the following areas:

- whether the sample of 72 companies is sufficiently representative of New Zealand networks, or whether a smaller sample could be used instead;
- whether a ten-year averaging period is appropriate, or whether a shorter period could be used instead.

Tax

Under the simplified Brennan–Lally CAPM, tax is used to adjust both the CoD by the corporate tax rate and the CoE by the investor tax rate. There is limited read-across from the approaches taken by other regulators to tax because the New Zealand tax regime is unlike most tax regimes, as is the use of the simplified Brennan–Lally CAPM. We therefore do not comment on whether the NZCC could adjust its methodology in respect of tax.

Financeability

Financeability refers to the ability of regulation to ensure that regulated companies can raise and repay capital in financial markets readily, and on reasonable terms. Financeability is typically tested by ensuring that certain key financial ratios, which demonstrate an ability to repay debt investors, are not violated as a result of the regulations proposed in a regulatory period. The NZCC currently does not consider financeability as part of its IMs.

Based on our review of regulatory precedent, we find three key issues that the NZCC could consider if it decided to implement a financeability assessment:

- whether to base its assessment on a notional or actual company;
- the credit rating that should be targeted;

- what metrics to use to assess the credit rating, and what benchmark to set for each of these metrics.

Most material issues

We understand that the NZCC is likely to want to prioritise the most material issues in its review of the IMs. To assist with this, we list below the four issues that we have identified as being the most material.[2]

First, we propose that the NZCC consider adjusting its methodology for the RFR to reflect the yields on a sample of Government bonds with a wider range of maturities and also assesses evidence in relation to allowing a convenience yield, for New Zealand government bonds. The rationale for using a sample of Government bonds with a wider range of maturities is informed by regulatory precedent and reflects varying time horizons for network investments. The logic behind looking into the convenience yield is that recent evidence (which we discuss further in section 2.3) has led some European energy regulators, such as ARERA and BNetzA, to uplift the RFR estimates by a convenience yield that reflects the special safety and liquidity characteristics of government bonds—which may be heightened when there is macroeconomic stability.

Second, we propose that the NZCC considers indexing (or otherwise introducing mechanisms to reduce risk exposure from market movements[3]) for some of its WACC parameters to reduce the risk to which EDBs are exposed from changes in market interest rates during a regulatory period. Since the last IM was in 2016, a lengthy period of time has elapsed since the last regulatory reset of the WACC, and there is corresponding uncertainty about market movements in the next period leading to heightened risk for networks. This could be particularly timely in the context of the upcoming regulatory periods because of increased uncertainty about interest rates in the current high-inflation environment, which appears to be reflected already in the higher volatility of New Zealand government bond yields. If the NZCC were to adopt indexation, this would be aligned with current Ofgem practice, for example, which indexes both the RFR and the CoD, and the AER, which indexes the CoD.

Third, we consider that the NZCC could add a financeability assessment to its regulatory process, as the AER and Ofgem do. Such an assessment would help the NZCC ensure that EDBs receive sufficient funding, which is likely to be particularly importance in future regulatory periods as the economy focuses on decarbonisation, including higher levels of electrification. In line with regulatory precedent, we consider that this assessment could be based on a notional company basis but informed by market evidence such as the EDBs' actual capital structures.

[2] The list is in order of where the issue appears in the report, not in order of materiality. This is because a quantitative assessment of materiality is beyond the scope of this report.
[3] For example, a number of tools—e.g. pass-through mechanisms, 'true-ups', triggers or reopeners to instigate changes to allowances within the period—can all be used to manage uncertainty about movements in the market which are beyond companies' control.

1 Introduction

In April 2021, the NZCC published an open letter[4] seeking views on the emerging issues for the regulated sectors in order to help plan its review of its Input Methodologies (**IMs)**.[5] The key industry stakeholders were invited to provide submissions in response to this open letter. One area identified by the electricity distribution businesses (**EDBs**) was that 'real (outturn) returns were not consistent with (the allowed) WACC.'[6] If the EDBs' investment needs are not met, there is a risk that the electricity distribution network in New Zealand could face underinvestment, with negative consequences for end-customers.

The question of adequate remuneration for the EDBs is particularly timely for the upcoming price control for two reasons: first, because of a recent increase that has been observed in the level of volatility in capital markets; and, second, having an efficient energy system—particularly an efficient electricity system—is becoming increasingly important because the success of decarbonisation is, to a large extent, dependent on electrifying much of the economy. To ensure this happens, the entirety of the electricity value chain, including transmission and distribution, will need to receive funding that is sufficient to cover its required investments.

In this context, Aurora, Orion, Powerco, Unison, Vector, and Wellington Electricity (together, '**the Big Six EDBs**') has commissioned Oxera to assess the approach taken by the New Zealand Commerce Commission (**NZCC**) to set the allowed WACC for energy networks. This report reviews the robustness of the WACC-setting approach taken by the NZCC with reference to current evidence, and to the approach taken by other regulators. The aim is to identify any areas where the NZCC's methodology for WACC-setting could be reviewed in line with current evidence and to facilitate effective engagement by the EDBs with the NZCC, during the determination of the IM.

The terms of reference for this report are to:

- undertake a parameter-by-parameter assessment of each component of the WACC, and to compare it to best practice from other countries. This best-practice review focuses on the approaches taken by Ofgem and the Australian Energy Regulator (**AER**) to determine the parameters of the WACC, but also contains insights from other European jurisdictions on a case-by-case basis;
- consider whether a financeability test should be introduced in New Zealand and, if so, what format it should take.

The report is structured as follows:

- sections 2, 3, and 4 discuss the approach taken by the NZCC to determine the parameters that constitute the CoE—respectively, the risk-free rate (**RFR**), the market risk premium (**MRP**) and the equity beta;
- section 5 discusses the approach taken by the NZCC to determine the CoD;

[4] NZCC (2021), 'Open letter—ensuring our energy and airports regulation is fit for purpose', 29 April, available here.
[5] NZCC (2022), '2023 Input Methodologies review', accessed 18 July 2022, available here.
[6] NZCC (2021), 'Open letter on priorities for energy networks and airports', 29 April, available here.

- section 6 discusses the approach taken by the NZCC to determine the parameters that are used to combine the CoE and the CoD (i.e. leverage and tax);
- section 7 discusses the approach that we consider appropriate for the NZCC to take in its financeability assessment.
- section 8 concludes.

We note that this report has been produced alongside a separate report that considers the percentile of the WACC distribution that the NZCC should target. We have produced two reports as they each address a separate issue. This report is exclusively concerned with the methodology for estimating the WACC, while the report on the WACC percentile considers what the point estimate within the range should be. Such an approach is consistent with the views of the NZCC, which explained in its 2016 IM that aiming up on the WACC does not replace or mitigate the need to have an accurate estimate of the midpoint of the WACC.[7]

Box 1.1 CEPA update

After the original publication of our report, we were asked by the EDBs to consider CEPA's subsequently published report 'Review of Cost of Capital 2022/2023' (henceforth 'the CEPA report').[8] We have added high-level considerations in relation to the CEPA report in relevant sections of this report, within boxes whose titles start with 'CEPA update'.

[7] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 4.26, available here.
[8] CEPA (2022), 'Review of Cost of Capital 2022/2023', available here.

2 Risk-free rate

The RFR is the rate of return that an investor would expect to earn on a riskless asset. In the context of the WACC-setting methodology adopted by the NZCC, the RFR is used to estimate: (i) the CoE under the Brennan–Lally CAPM framework; and (ii) the CoD, together with the debt premium and other adjustments (i.e. the liquidity premium and issuance costs).

This section sets out how the NZCC calculates the RFR. Where the most recent market, academic or regulatory precedent suggests that the approach adopted by the NZCC could, or should, be revised, we explain and substantiate such reasoning. The aim is to facilitate engagement between the EDBs and the NZCC as part of the forthcoming review of IMs, by providing all parties with an understanding of alternative approaches for calculating the RFR.

There are many issues that regulators can consider when estimating the RFR, but some of the key aspects, which we discuss in this section, are:

- the term of the debt instruments that are used as proxies to the RFR;
- the choice of the proxy for the RFR;
- the length of the averaging period used to estimate the RFR;
- whether the RFR should be updated annually.

2.1 The approach taken by the NZCC

In its 2016 IM review, the NZCC considered the yield on New Zealand government bonds to be the most appropriate proxy for the RFR due to the riskless nature of government bonds.[9]

The NZCC decided to continue to apply the same RFR methodology it had used in the previous control, where the RFR was proxied by the prevailing yields on government bonds. The NZCC stated that this approach enabled firms to 'achieve a normal return on their investment and promotes the potential dynamic efficiency benefits of investment',[10] as the resulting RFR would provide the EDBs with an allowance more closely aligned to the RFR that would be implicit in the debt yields that the EDBs actually have to pay.

The NZCC determined the averaging period for the RFR allowance to be three months—an increase from the one-month averaging period in the previous control. The NZCC and some stakeholders considered this change to have alleviated, at least to some degree,[11] the concerns surrounding the energy networks' ability to use the interest swap market to fully hedge movements in the RFRs (over the future regulatory period).[12]

[9] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 36, available here.
[10] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 85, available here.
[11] Notwithstanding, we understand from the Big Six EDBs that there remain concerns about the practicality of hedging across a three-month window.
[12] Several energy networks expressed concerns about the market impact of the hedging activity of regulated suppliers, including the suggestion that the swap market is subject to distortions if suppliers attempt to procure large numbers of swaps (e.g. to hedge similar positions) at the same period in time. The New Zealand Electric Network Association also expressed concerns that under the NZCC's approach to setting the allowed cost of debt, using a short averaging period does not fully compensate for the cost of embedded debt. See NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues',

The term of the government bonds used to estimate the RFR (hereafter the 'term of the RFR') has been set at five years, consistent with the term of the energy bonds used to estimate the debt premium. The NZCC has not acknowledged any stakeholder objections to this assumed term of the RFR.

The NZCC decided against updating its RFR estimate annually, stating that the benefit of annual updates would not provide sufficiently material long-term benefits to consumers to justify the administrative costs of an annual update process. In section 3.3, we show that, relative to countries where an indexation approach[13] is adopted, the EDBs in New Zealand are likely to be exposed to the interest rate risks that are likely to materialise over a multi-year price control period.

2.2 Evidence from other regulators

The AER

The AER, in its draft explanatory statement (dated June 2022) for the rate of return instrument, identified four contentious areas surrounding the RFR:

- the term of the RFR;
- the choice of the proxy for the RFR;
- the length of the averaging period;
- the length of the nomination window (which sets out the time period over which a regulated business can nominate its averaging period).

We describe in turn below the approach adopted by the AER on each of these four areas.

First, the AER sets the term of the bonds used to estimate the RFR equal to the term of the return on equity. This is because, under the AER's approach to estimating the allowed rate of return, the RFR is used only as a component for estimating the CoE under the CAPM framework, and not as a component for estimating the CoD (which we discuss in further detail in section 5).

The AER has considered switching from a ten-year term (used in the previous regulatory period) to a five-year term, although investor and network stakeholder submissions expressed strong support for maintaining the status quo. Specifically, the AER prefers a five-year to a ten-year term on the following grounds.

- Compared to a five-year term, a ten-year term is likely to introduce a term premium to compensate for the risks of locking in rates for an extra five years. As allowed returns are re-set every five years, investors do not bear the risks of locking in rates for ten years, and therefore the term premium is not justified and would not be necessary to attract investors.[14]
- The five-year term matches the length of the regulatory control period. The importance of this is highlighted by Dr Lally's (the NZCC's economic advisor's) theoretical cash-flow model, which interprets the results of an

20 December, para. 118, available here. For more discussions on the NZCC's approach to the cost of debt, see section 5.

[13] By 'indexation' we mean an approach whereby some or all of the WACC parameters are updated—usually on a mechanistic basis, with reference to movements in a specified market index—during a regulatory period, rather than being calculated at the start of the regulatory period and then left unchanged.

[14] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 100, available here.

academic paper by Professor Schmalensee (1989) to conclude that matching terms are required, to equate the market value of regulated assets at the start of the regulatory control period to the present value of future cash flows.[15]

- Although a ten-year term is considered to be a standard assumption for estimating discount rates in commercial practices, such as the valuation of commercial projects, the AER does not consider valuation in the context of commercial projects to be relevant to valuation in the context of regulatory price reviews. The AER argues that investors' required returns should be aligned to the length of the period over which these returns are expected to be recovered (which, in its view, is the five-year regulatory control period).[16]

Second, and with respect to the choice of the proxy for the RFR, the AER maintains its status quo view that the return on Commonwealth Government Securities (CGS) is the best proxy for the RFR. The AER rejects the view from stakeholders that the yield on CGS needs to be adjusted for a convenience premium, which is embedded in the yield of government bonds. (For more details on the convenience premium, see Appendix A1.) The AER gives five key reasons for maintaining the status quo:[17]

- the academic evidence on the convenience premium is unclear;
- the RFR in a CAPM framework is riskless and therefore consistent with the safety property of government bonds;
- the magnitude of the convenience premium is difficult to estimate;
- there is no direct empirical evidence on the existence of a convenience premium in Australia;
- it is common practice to use the CGS as a proxy for RFR in Australia.

Third, and with respect to the averaging period length, the AER uses an averaging period of between 20 and 60 business days. It argues that this helps mitigate any potential mis-estimation caused by short-term volatility in the CGS yields, while maintaining a dynamic and flexible approach to estimating the prevailing rates near the start of the next regulatory control period.

Finally, the AER has determined that regulated businesses can choose the averaging period over which the AER observes the CGS yields to calculate the RFR. This is referred to as the 'nomination window'.[18] Companies must start and end their nomination window between eight and four months prior to the commencement of the regulatory control period. The AER points out that this helps mitigate practical difficulties and leaves sufficient time for its final decisions on the rate of return. No stakeholders voiced objections to this approach.

[15] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, pp. 104–5, available here.
[16] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 109, available here.
[17] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 119, available here.
[18] The regulated business must indicate this nomination window before the start of the averaging period and include it in its initial proposal. The nomination window must comply with a number of requirements: it must start no earlier than eight months prior to the commencement of the regulatory period, and end no later than four months prior to the commencement of the regulatory period. The AER uses a default averaging period in case a company fails to provide a valid nomination window. See AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 93, available here.

Ofgem

Ofgem, in its Draft Determination for RIIO-ED2, determined that its RFR estimates would be based on 20-year index-linked gilts (**ILGs**), averaged over a one-month period.[19]

While the reason for using 20-year terms is not given in this Draft Determination, a justification was given in the RIIO-2 Sector Specific Methodology published in December 2018, in which Ofgem gave two reasons for using a 20-year term.[20]

- First, the yields on 20-year gilts are more stable than those on ten- or five-year gilts. In particular, Ofgem noted that during the financial crisis that began in 2008, the yields on ten- and five-year gilts both increased materially, whereas those on the 20-year gilts did not increase as sharply. Ofgem concluded that this was 'an important consideration for the stability of the CoE under any equity indexation approach [where CoE is updated using the prevailing RFR].'
- Second, the long-term nature of equity investment and the typical 45-year regulated asset value (**RAV**, or regulated asset base, **RAB**) depreciation horizon implies an asset life close to 22.5 years, which is well represented by a 20-year term.

The decision to select a one-month averaging period is consistent with the approach adopted for the RIIO-2 Final Determination, where Ofgem exercised regulatory judgement to settle the disagreements between stakeholders who do not unanimously favour one averaging period over another.[21] Ofgem acknowledged that it needed to balance the trade-off between using the most up-to-date information on the RFR under a shorter averaging period and the stability of rates under a longer averaging period. It concluded that the former was more important than the latter, without specifying its detailed reasoning.

A concern in relation to Ofgem's RFR determinations, relative to recent UK Competition and Markets Authority (CMA) precedent, is the choice of the RFR proxy. Ofgem, in its estimation of the RFR, acknowledged the role of evidence on other sources, such as yields on AAA non-government bonds, but was not persuaded to use that evidence. Ofgem pointed to the RIIO-GD&T2 regulatory period appeals, where the CMA determined that 'GEMA's [Ofgem's] methodology for estimating the RFR, specifically its reliance on UK ILGs, was **not wrong**' [emphasis added].[22] Ofgem also highlighted a few practical issues with the quality of AAA corporate bond indices,[23] which is why it considers only inflation-linked government bonds in its calculation of the RFR.

In summary, Table 2.1 below presents the key similarities and differences between the NZCC, the AER and Ofgem approaches for estimating the RFR.

[19] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, Table 9, available here.
[20] Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance', 18 December, paras 3.32–3.33, available here.
[21] Ofgem (2020), 'RIIO-2 Final Determinations – Finance Annex (REVISED)', 8 December, para. 3.8, available here.
[22] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 3.14, available here.
[23] Issues with the quality of the indices included the use of securitised bonds; the inclusion of financial sector bonds; a lack of liquidity in the underlying securities; and the inclusion of an inflation risk premium in nominal bond yields.

Table 2.1 Summary of regulators' approaches to RFR

	NZCC	AER	Ofgem
Term	Five-year, matching the length of the regulatory period	Five-year, matching the length of the regulatory period	Twenty-year, reflecting the long asset lives of energy networks
Choice of proxy	Nominal government bonds	Nominal government bonds (CGS)	ILG bonds
Averaging period	Three months	20–60 business days	One month
Annual update of RFR	No	No	Yes

Source: Oxera.

2.3 Oxera assessment of implications for the NZCC approach

Having reviewed the regulatory determinations by the NZCC, AER and Ofgem, we find that the NZCC could adjust its approach to setting the RFR in respect of the following elements:

- **the term of the RFR**—we recommend that the NZCC consider a range of evidence on yields for government bonds with maturities between five and 20 years;
- **the choice of the proxy for the RFR**—we recommend that the NZCC performs further assessment of the feasibility of using both the government bonds and the highest-quality non-government bonds as inputs to its RFR estimation in order to take into account a possible convenience premium;
- **the averaging period length**—we recommend that the NZCC maintains its current approach of using a short averaging period and that it takes account of interest rate uncertainty separately (see next point);[24]
- **annual update of RFR**—we recommend that the NZCC reassess its decision against annually updating the RFR estimate (i.e. 'indexation'), as not doing so would leave the EDBs in New Zealand exposed to the rising interest rate risks that would materialise over a multi-year price control period.

We discuss each of these elements in turn.

The term of the risk-free rate

The AER and Ofgem have considered the use of a longer term for the RFR for at least two reasons.

First, they have considered whether there is theoretical or practical evidence that a particular term should be used. This was the case with the AER's choice of a five-year term, as they based this decision on academic evidence from Dr Lally. However Professor Schmalensee, whose work Dr Lally interpreted to conclude that the term of the bonds should match the duration of the regulatory

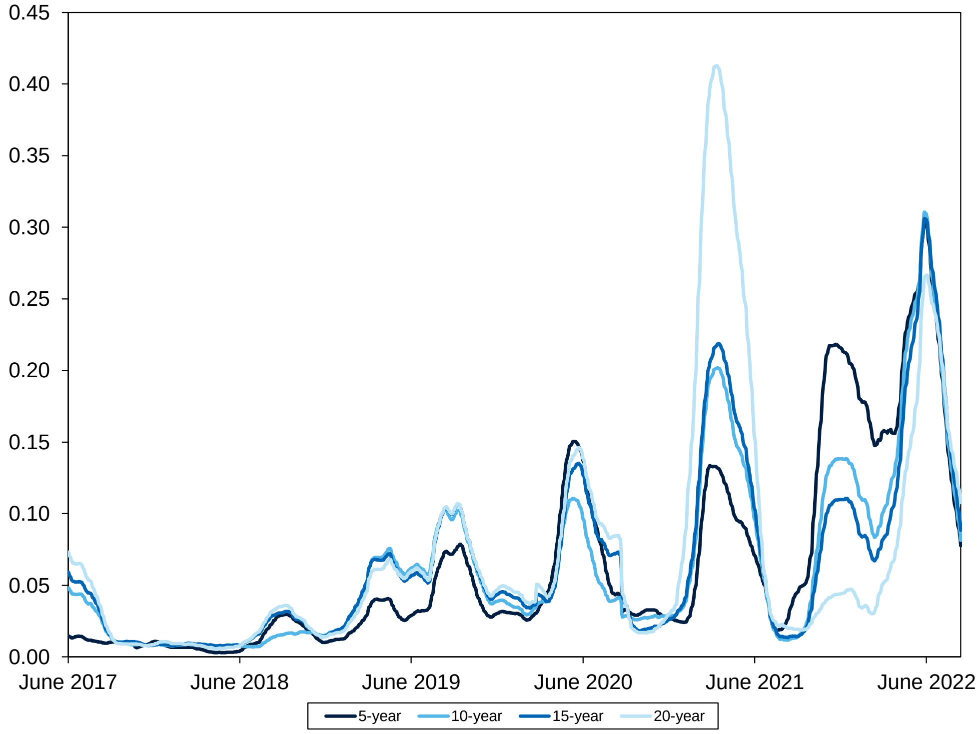
[24] We note that we come to a different conclusion in section 5 when we discuss the cost of debt, as there we suggest that the averaging period for the RFR is extended beyond the current 3 month window. The reason for recommending a longer averaging period for the RFR in the context of CoD is to match the debt premium window and to allow for a weight to historical averages since fixed-rate debt raised in the past can be 'embedded' in the current financing structure of the firm, at historical interest rates—until the debt is refinanced; this is not a consideration for the allowed cost of equity.

period, has rejected this conclusion, stating that Dr Lally has misinterpreted his paper.[25]

Ofgem has approached the question of the appropriate term from a more practical perspective, with the position that there is no clear precedent, academic or otherwise, on the term that should be used to compute the RFR. Ofgem instead selects a longer term based on: (i) placing some weight on the investment horizons of the investors being longer term; and (ii) the greater level of stability of long-term bonds. We note that the US Federal Energy Regulatory Commission also uses longer terms for government bonds.[26]

Second, Ofgem has considered that longer term government bonds could be used based on their lower levels of volatility. We have investigated whether this reasoning could apply in New Zealand and show below (see Figure 2.1) that there is no clear pattern in the volatility of yields of bonds with different maturities. As can be seen in the figure, at various points in time, short-term bonds have had the lowest volatility (e.g. 2019) and also the highest volatility (e.g. 2022). This implies that, from a yield-stability perspective, there is no clear benefit in using either short- or long-term New Zealand government bonds. It is, however, notable that across the maturities, the volatility of government bond yields in New Zealand has increased since the 2016 IM review. This is a point to which we will return, as regards its implications for managing interest rate risks, towards the end of this section.

Figure 2.1 New Zealand government bond yield variance for selected maturities



Note: Variance in daily bid yields of New Zealand government bond benchmarks calculated over six-month rolling periods.

Source: Oxera analysis based on Bloomberg data.

[25] Energy Networks Australia (2022), 'Rate of Return Instrument Review: Response to AER's Draft Instrument and Explanatory Statement', p. 4, 2 September, available here.
[26] Vector (2021), 'Vector Submission to the Commerce Commission's Open Letter on the Input Methodology Review, Gas Pipeline Business Reset and Information Disclosure Review', May, para. 41, available here.

Taking both of the above factors into account, a pragmatic approach could be for the NZCC to take into account the yields on government bonds with a range of maturities. Specifically, the NZCC could consider a range of evidence on yields for Government bonds with maturities between five and 20 years.

The choice of proxy

The RFR should be equal to the return on an asset that does not expose the investor to any systematic risk. The NZCC considers that government bonds closely match the key requirement of the RFR. The New Zealand government enjoys a strong credit rating of AA+/Aaa, and as a sovereign nation has monetary and fiscal levers to support debt repayment that are not available to commercial lenders.

In contrast to the highest-quality non-government bonds, government bonds have special properties (see Appendix A1 for more details) that create additional demand for these instruments. In other words, market participants have reasons to hold government bonds and these reasons go beyond the rate of return expected on these instruments. Bond yields and bond prices are inversely related, so when this additional demand pushes the price higher, the bond yield falls below a normal market-clearing price based solely on risk-free cash flows. These effects are collectively known as the 'convenience premium' and push the rate of return on government bonds below a 'true' RFR based on a zero beta asset.

This additional demand for government bonds has been recognised in the UK by the CMA, which referred to Oxera's submissions for the water company appeals following Ofwat's Final Determinations at the most recent water price control review in 2019, and explained that:[27]

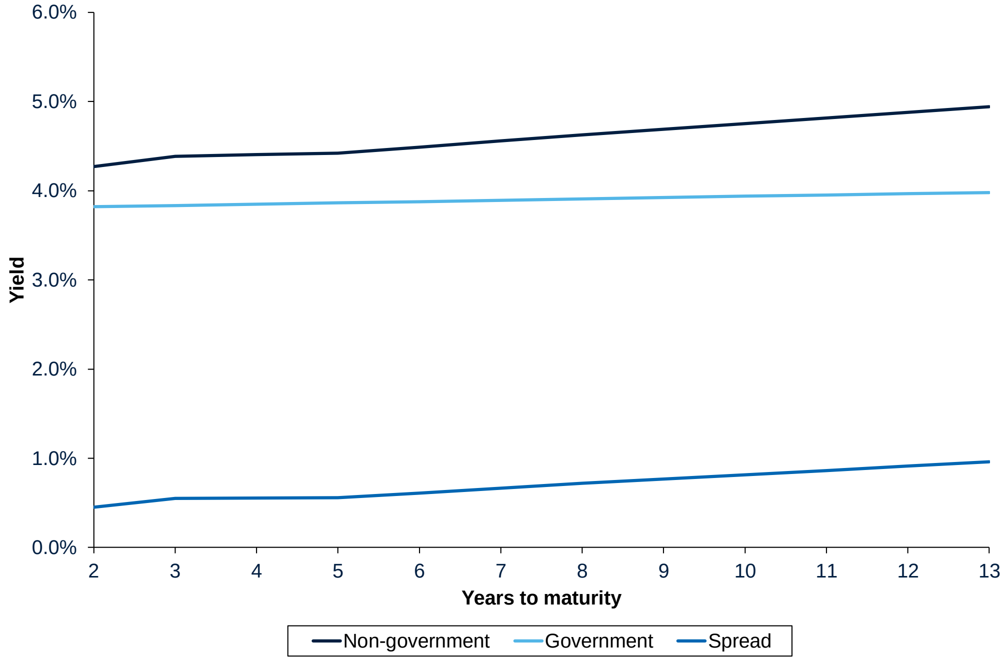
> ILGs have traditionally been considered as the best proxy for the RFR. However, analysis of the current and historic yields associated with these instruments demonstrates that the **government can borrow at rates significantly lower than would be accessible by even the highest-rated private investor**. [Emphasis added]

The concept of a convenience premium has been widely studied in academic literature and via empirical analysis. Also, we are aware of at least three separate regulators in the UK, Germany and Italy that have, in various ways, accounted for the existence of the convenience premium in regulated WACC decisions. We set out this evidence and precedents in Appendix A1.

The likely existence of a convenience premium in New Zealand could be observed from the yield spreads between the highest-quality vanilla NZD-denominated non-government bonds (Aaa rated by Moody's) and the maturity-matched NZ government bonds.

[27] CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report',17 March, para. 9.92, available here.

Figure 2.2 Yield spread between NZ government bonds and AAA-rated NZD-denominated vanilla non-government bonds as at 8 September 2022



Note: Yield curves for government and non-government bonds constructed using linear interpolation on daily yields of New Zealand government bond benchmarks and Housing New Zealand Ltd bonds respectively. Housing New Zealand Ltd operates as a residential landlord for public housing, and Bloomberg categorises its bond issuances as agency bonds.

Source: Oxera analysis based on data from Bloomberg.

These observed yield or credit spreads provide evidence for the existence of a convenience premium in the returns of government bonds. This indicates that using yields on government bonds to estimate the RFR is likely to result in an underestimation of the 'true' rate. The size of the convenience premium is likely to be smaller than the entirety of the yield spreads due to the existence of a small risk premium and a liquidity premium in the highest-quality non-government bonds. Therefore, using solely the yield on the highest-quality non-government bonds could overestimate the 'true' RFR.

We consider that the exact quantification of the convenience premium requires further analysis, for example in adjusting for any risk premium or liquidity premium,[28] within the spreads of highly rated corporate bonds relative to government bonds. However, the existence of spreads in highly rated corporate bonds relative to government bonds of around 50–100bps (Figure 2.2) suggests that it would be worthwhile for the NZCC to undertake analysis on the convenience yield in New Zealand. The NZCC could also look to the CMA's pragmatic approach in allowing for the convenience yield, whereby the RFR is estimated as an average between the yield on AAA bonds and the yield on gilts.

Length of averaging period

Finally, with respect to the averaging period length, the NZCC, AER and Ofgem all considered a short-term averaging period (one to three months) to be most appropriate. While the averaging period appears to have been far less

[28] We show data on preliminary analysis of a small liquidity premium (around 7 bp) in Appendix A4.

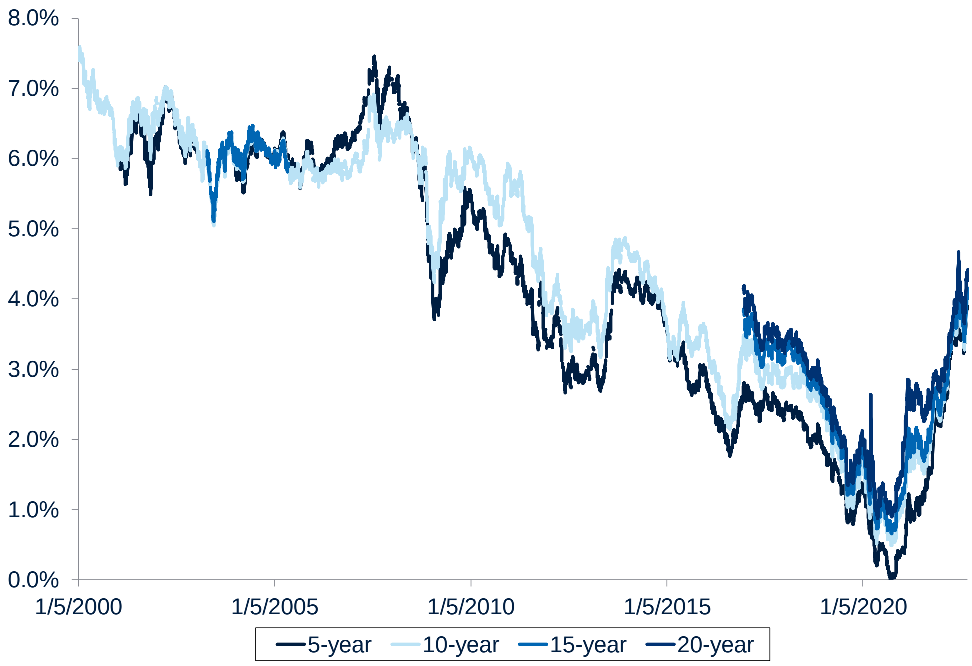
contentious to the AER and Ofgem stakeholders, the NZCC stakeholders heavily disputed the use of short-term averaging period, on the grounds that the short period has a negative impact on their hedging activities for debt and undercompensates their cost of embedded debt. The primary issue that we identify with the 3 month averaging period relates not to its use in the CoE calculation but in its use in estimating the RFR component of the CoD. We therefore do not discuss this further at this stage, and return to this issue in more detail in section 5.

Annual update

Unlike Ofgem, the NZCC does not update its RFR estimates annually. The decision not to update the RFR more frequently is likely to be more problematic in future regulatory periods because we observe that the bond yields of NZ government bonds have become increasingly volatile since the 2016 IM (see Figure 2.1).

Figure 2.3 shows that the yields on NZ government bonds across five- to 20-year maturities spiked from under 1% to over 4% between end of 2020 and September 2022. To the extent that upward pressure on rates, and on the volatility of interest rates, persists into the next regulatory period, this should warrant a reassessment by the NZCC on whether to update the RFR annually (i.e. 'indexation') going forward.

Figure 2.3 Yields on New Zealand benchmark government bonds



Source: Oxera analysis based on Bloomberg data.

While indexation is a simple and commonly used regulatory tool for addressing market-driven volatility in regulatory parameters, e.g. RFR, the following measures could also be used to mitigate exposure to interest rate risk:[29]

[29] More generally a number of tools—e.g. pass-through mechanisms, 'true-ups', triggers or reopeners to instigate changes to allowances within the period—can all be used to manage uncertainty about movements in the market which are beyond companies' control.

- introducing triggers or reopeners, as previously used in the energy network controls by the Italian regulator;[30]
- adjusting the allowance (e.g. by allowing headroom above current rates) to allow for the risk of interest rate movements over the future regulatory period;
- cross-checks against expected future movements in interest rates, e.g. by assessing a forward rate adjustment to the RFR estimates, relative to spot market rates.

[30] ARERA (2021), 'Criteri per la determinazione e l'aggiornamento del tasso di remunerazione del capitale investito per i servizi infrastrutturali dei settori elettrico e gas per il periodo 2022-2027 (TIWACC 2022-2027), Allegato A' paras 6.1–6.8, 8.1–8.3, available here.

3 Tax-adjusted market risk premium

The MRP is the additional return, exceeding the RFR, that investors require to hold a portfolio of risky assets, specifically the average risk portfolio.

In the context of WACC-setting by the NZCC, which uses the simplified Brennan–Lally CAPM, the MRP is adjusted for the tax burden borne by investors on equity returns, resulting in the TAMRP.

This section explains how the NZCC calculates the TAMRP. Where recent evidence suggests that the approach adopted by the NZCC could be revised relative to the approach taken in the 2016 IM, we explain and substantiate such reasoning.

There are many considerations for regulators when estimating the MRP. Some key ones, which we discuss in this section, are:

- the relationship between the MRP and the RFR, which determines the weights placed by the regulator on the constant total market return (**TMR**) approach and the constant MRP approach;
- whether it is appropriate to use the DGM and survey data as inputs to the TMR estimation;
- whether it is appropriate to use the arithmetic mean instead of the geometric mean when averaging historical equity market returns;
- the length of the sampling period used to calculate historical equity market returns;
- the NZCC's decision to round its TAMRP estimate to the nearest 0.5%.

3.1 The approach taken by the NZCC

The NZCC finds that the TAMRP is a market-wide parameter, it does not vary across sectors, and is set at the start of the regulatory period. Furthermore, to provide certainty to stakeholders, it should not be adjusted during the regulatory control period. The NZCC estimates the TAMRP, in nominal terms—not through a purely mechanical process—but it does put a certain weight on quantitative estimates to guide it in setting the TAMRP.[31]

In its 2016 IM review, the NZCC referred to Dr Lally's (2015) research when setting the TAMRP.[32] The NZCC targets the median of the results produced by five models, consisting of forecast and historical estimates, rounded to the closest 0.5%. In addition, the results are benchmarked with estimates of market participants, including New Zealand investment banks.

Table 3.1 below shows the methodologies and respective estimates used to calculate the median TAMRP, on which the NZCC's current TAMRP estimate of 7% is based. As the simplified Brennan–Lally CAPM, used by the NZCC, assumes full tax imputation, all models below convert MRP estimates to TAMRP estimates.[33] The investor tax rate is assumed to be the maximum

[31] NZCC (2019), 'Amendments to Electricity Distribution Services Input Methodologies Determination: Reasons Paper', 26 November, available here.
[32] Lally, M. (2015), 'Review of submissions on the risk-free rate and the TAMRP for UCLL and UBA services', 13 October, Table 4, available here.
[33] This means that the NZCC applies the investor tax rate to the RfR term, resulting in the tax-adjusted RfR, which is subtracted from the expected market returns, giving the TAMRP.

prescribed investor rate applicable at the start of the disclosure year of an investor who is resident in New Zealand and an investor in a multi-rate portfolio investment entity (**PIE**). Under the PIE regime, the maximum investor tax rate is equal to the maximum corporate tax rate, at 28%.[34]

In Table 3.1, the Ibbotson, and the Siegel version 1 and 2 methods estimate the historical TAMRP, while the DGM produces a forward-looking estimate based on forecasts of future dividends, and the 'surveys' method compiles the expectations of investors on the MRP and converts these to an estimate of the TAMRP.[35] The NZCC and Dr Lally estimate the TAMRPs based on New Zealand data and data from other comparable markets. Other markets consist of a sample of 20 developed countries for the models based on historical returns (i.e. Ibbotson, and Siegel 1 and Siegel 2). They refer to the Australian market for the DGM and to a sample of 21 advanced countries for the surveys method.

Table 3.1 TAMRP estimations conducted by the NZCC in October 2015

Model name	New Zealand	Other markets
Ibbotson estimate	7.1%	7.0%
Siegel estimate: version 1	5.9%	5.9%
Siegel estimate: version 2	8.0%	7.5%
DGM estimate	7.4%	9.0%
Surveys	6.8%	6.3%
Median	7.1%	7.0%

Note: The Ibbotson, Siegel version 1 and Siegel version 2 are backward-looking models, the DGM is forward-looking, and the surveys are estimates of investor expectations of MRP. All estimates are converted to a tax-adjusted MRP by replacing the RFR with a tax-adjusted RFR. 'Other markets' refer to a sample of 20 developed countries for the backward-looking models, the Australian market for the DGM, and to a sample of 21 advanced countries for the surveys method.

Source: NZCC (2016), 'Input Methodologies review decisions. Topic paper 4 Cost of capital issues 20 December 2016', 20 December, available here. Lally, M. (2015), 'Review of submissions on the risk-free rate and the TAMRP for UCLL and UBA services', 13 October, Table 4, available here.

Below, we summarise each model in turn, and highlight the key issues discussed between the NZCC and stakeholders regarding TAMRP estimation. More detailed descriptions of the models can be found in Appendix A2.

3.1.1 Ibbotson model

The Ibbotson model estimates the TAMRP using:

- yearly arithmetic average equity returns for New Zealand and 20 other developed markets from the early 1900s;
- the tax-adjusted ten-year government bond rate, which is further adjusted for consistency with a five-year regulatory period.

[34] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4 Cost of capital issues', 20 December, para. 576, available here.
[35] See Dimson et al. (2019) for the first three models, and Fernandez et al. (2015) for the surveys model. Dimson, E., Marsh, P. and Staunton, M. (2015), 'Credit Suisse Global Investment Returns Sourcebook 2015', Credit Suisse, February, found here. Fernandez, P., Aguirreamalloa, J. and Linares, P. (2013), 'The Market Risk Premium and Risk Free Rate Used in 51 Countries', IESE Business School working paper, available here.

Dr Lally found a TAMRP estimate of 7.1% for New Zealand and 7% for the other markets. These estimates equal the median of all five estimation models for New Zealand and other markets respectively. In 2019, Dr Lally subsequently revised the estimate to 7.5%, which the NZCC is minded to update in the next IM review in 2023.[36]

3.1.2 Siegel version I and version II

Both Siegel models aim to improve on the Ibbotson model by adjusting the TAMRP estimate for an alleged upwards bias introduced through the late 20th century inflation shock.[37]

The first version of the Siegel model substitutes the RFR term from the Ibbotson model with an improved long-run expected real RFR, while the second version of the Siegel model assumes the market return to be constant over time, and that the RFR fluctuates across time.

Both Siegel approaches found significantly different estimates. The first version estimated the TAMRP for New Zealand to be 5.9%, which is the lowest among all models used, while the second version found an estimate of 8%, which is the highest. The NZCC attributes the strong divergence in estimates to the differences in the underlying assumptions of the two models.[38]

The Siegel estimates are described by Dr Lally as being alternatives rather than complementary, and are therefore both included in the sample of estimates.[39] In addition, Dr Lally states that the second version is independent of the historical inflation shock, as the prevailing real RFR is not affected by the inflation shock period.

3.1.3 The dividend growth model

The DGM is forward-looking and calculates the TMR as the discount rate that sets the present value of expected future dividends per share (**DPS**) equal to the current share price. Subsequently, the long-run tax-adjusted RFR is subtracted from this expected market return to arrive at the final TAMRP estimate.

Similarly to the AER, the NZCC uses a three-stage model to predict expected future dividends. This model takes into account current analysts' expectations on dividends, making it less based on historical data. The NZCC's DGM arrived at a TAMRP estimate of 7.4% for New Zealand and 9% for the other markets.

3.1.4 Surveys

Finally, the NZCC uses forward-looking estimates of MRP from surveys, by Fernandez et al. (2015), to estimate investor expectations on the TAMRP.[40]

[36] NZCC (2022), 'Part 4 Input Methodologies Review 2023. Process and Issues paper', 22 May, para. 6.51, available here.
[37] Siegel (1992) found that the Ibbotson model produced an upwards bias estimation of the MRP throughout periods characterised with inflation shocks, specifically within the timeframe of 1926–90, which Siegel identified to include pronounced unanticipated inflation, as well as very low real returns on bonds. See Lally, M. (2015), 'Review of submissions on the risk-free rate and the TAMRP for UCLL and UBA services', 13 October, p.26, available here.
[38] NZCC (2020), 'Fibre input methodologies: Main final decisions — reasons paper', 13 October, p. 445, available here.
[39] Dr Lally states that each version of the Siegel model adjusts the RFR estimate for the inflation shock in a unique way, and should be included in the sample of estimates.
[40] This survey collected the required MRPs of investors, including professors, analysts and financial companies, as well as non-financial companies, from 51 counties. Dr Lally chose a sample of 21 developed

The NZCC cross-checked the MRP estimates from the Fernandez et al. (2015) study with estimations from practitioners, including investment banks from New Zealand, and found the estimates to be reasonable.

Dr Lally finds a TAMRP estimate of 6.8% for New Zealand and 6.3% for the other markets; both estimates are slightly below the median in Table 3.1.

3.1.5 Other issues discussed between the NZCC and stakeholders

The NZCC received feedback on setting the TAMRP term at the start of the regulatory period instead of during the cost of capital IMs.[41] Vector Communications suggested that using a TAMRP estimate that was set during a period of low interest rates and not adjusting it during the regulatory period could result in high TAMRP estimates if interest rates rise after the IMs were set. With the current interest rates significantly higher than those determined in 2020, and the high uncertainty in future interest rates, it is relevant to consider how stable the TAMRP estimate will be over the regulatory period.[42] The NZCC has decided against adjusting the determination date of the TAMRP in order to assure the predictability and certainty of the IMs.[43] The NZCC expects the 2020 estimate, from the Fibre IMs, to be relatively stable over time, and is considering using it for the next ED&T (electricity distribution and transmission) IMs.

The NZCC also received feedback on the rounding of the TAMRP to the closest 0.5% in the 2016 IM review, as well as during the Fibre IMs process.[44] The stakeholders suggested more precise rounding (i.e. to the nearest 0.1% or 0.25%) or to forgo the rounding all together and to rely on the median of the estimates. They stated that rounding the TAMRP has an economic impact on consumers as well as suppliers, and that rounding the TAMRP parameter introduces inconsistency in the WACC framework, since no other parameter is rounded. The NZCC refers back to Dr Lally's expert report and states that estimating the TAMRP with higher precision is not achievable, and that the rounding of the estimation offsets estimation errors over time. Solely relying on

countries for the 'other countries' estimate. See Fernandez, P., Aguirreamalloa, J. and Linares, P. (2013), 'The Market Risk Premium and Risk Free Rate Used in 51 Countries', IESE Business School working paper, available here.

[41] Electricity Networks Association (2020), 'Draft Fibre IM Determination', 28 January, para.19, available here. Vector Communications (2020), 'Vector Communications Submission to the Commerce Commission Fibre Input Methodologies Project', 28 January, para. 42-5, available here. Vector Communications (2020), 'Cross-submission on Fibre Input Methodologies – Draft decision' 17 February, para. 25, available here.

[42] The prevailing five-year RFR—which the second Siegel, DGM and Survey approaches, in Dr Lally's specification, subtract from the market return to determine the TAMRP—is based on the 'Secondary market government bond yields' variable for the 2015 and 2020 TAMRP estimates, available on the Reserve Bank of New Zealand's website here.
We observe that the five-year RFRs used by Dr Lally in his 2015 and 2020 TAMRP estimations were 2.75% (August 2015 average) and 1.7% (February 2019 average) respectively. The most recent five-year RFR estimation is currently at 4.36% (October 2022 average), up from a previous low of 0.77% in March 2020. We observe that the RFR variable has fluctuated substantially in recent years and that the current high RFR is likely to persist and could increase further. This is because New Zealand is currently experiencing high inflation, measured at 7.3% p.a. (as at July 2022, see here), which means that the Reserve Bank may increase interest rates in the future. ASB Bank recently stated in its August 2022 Economic Forecast Update that 'NZ, one of the early countries to experience surging inflation, remains at the forefront of the firefighting, with the OCR [Official Cash Rate] up to 3% and a potential 4% peak looming.' ASB (2022),' Economic Forecast Update', August, p. 2, available here.

[43] NZCC (2020) notes that the TAMRP is a non-observable variable and that setting it requires judgement on behalf of the regulator. The NZCC deems that setting the TAMRP during the cost of capital IMs balances the provision of certainty around the parameter against the use of the most recent inputs (which could happen if a date closer to the start of the regulatory period was used). In addition NZCC (2022) notes that there is not clear evidence in support of estimating the TAMRP more frequently. It states that if there were significant changes in the economic outlook, the TAMRP could be adjusted in the next IMs.

[44] NZCC (2022), 'Part 4 Input Methodologies Review 2023 Process and Issues paper', 20 May, paras 6.52–6.54, available here. NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', 13 October, paras 6.553–6.567, available here.

the median would put too much weight on the individual estimation approaches and on the choice of using the median.

The NZCC discussed the validity of including models that differ in view on the relationship between the RFR and the MRP.[45] The majority of the models used assume the MRP to be constant in time, while solely the second Siegel approach assumes the TMR to be constant, with the MRP and RFR being inversely related. The NZCC noted that this divergence in views between the models used is intentional; it deems there to be insufficient evidence to rely on one single approach.[46]

3.2 Evidence from other regulators

The AER

The AER's MRP parameter is the expected Australian dollar return on the Australian market portfolio less the expected return on the Australian dollar risk-free asset. The AER, similarly to Ofgem, considered the view that the MRP and RFR vary across time, while the market return is stable. However, it finds that there is no consensus among experts on whether and, if so, how a variable MRP could be modelled.[47] Having reviewed the Australian market evidence on MRP and TMR, the AER determined that the constant-TMR approach should not play a role in its MRP estimation process.[48]

The AER determines the TMR based on estimates of the historical excess returns (HER). It considers three sample periods for calculating the HER: 1972–2021, 1980–2021 and 1988–2021,[49] and ends up using the period starting from 1988, which it considers to be the most representative of current market conditions.[50] We interpret this as meaning that the AER placed more weight on recent market evidence. We also note that the AER uses the arithmetic average to estimate the MRP.[51]

The AER also cross-checks the results of its HER analysis with a DGM, but gives the DGM limited weight. This is because it considers that 'in times of low interest rates, which we are now seeing, the DGM can increasingly produce

[45] During the 2020 Fibre IM determinations, the NZCC noted that historical premiums, such as those used by the Ibbotson and in both Siegel approaches, have traditionally been used by regulators and practitioners to estimates future returns. However, the NZCC acknowledged that some finance experts consider that future returns are likely to be inferior to historical returns, and as such it emphasised the importance of including both backward- and forward-looking models in the TAMRP estimation. See NZCC (2020), 'Fibre Input Methodologies: Main decisions – reasons paper', 13 October, paras 6.541–6.545, available here.
[46] The NZCC noted that other regulators, specifically Ofgem and the AER, are split on the matter. UK regulators, including Ofgem, estimate the TMR and infer an MRP estimate from it. This approach assumes that the MRP and RFR are inversely related, both terms cancelling each other's variation out in the long term, and as such that the TMR is seen to be constant in time. The AER has concluded that there is neither strong theoretical nor empirical evidence that the RfR and MRP are consistently inversely related.
[47] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 135, available here.
[48] Ibid, p.160.
[49] These dates are chosen due to specific events. 1972 is the earliest year for which five-year RFR data is available, matching the regulatory period. 1980 is the first year for which the ASX All Ordinaries accumulation index is available at a daily frequency, which improves the accuracy of the estimate. 1988 is the year of the introduction of dividend imputation in Australia, which affected the tax burden from equity investments for Australian investors. Ibid, p.131.
[50] The NZCC found that the standard deviation of the most recent sample (1988–2021) was below the values found for the alternative samples (1972–2021 and 1980–2021). However, it finds that the advantages of a more recent sample period outweigh concerns about robustness. Ibid, p.131.
[51] The AER discussed the use of the arithmetic mean relative to the use of a geometric mean when determining the MRP estimate. The AER has received feedback from stakeholders that the use of geometric averaging is inappropriate, with one report by the Consumer Reference Group (**CRG**) stating that arithmetic average estimates are superior to geometric ones only if the returns are serially uncorrelated, which might not be the case. See AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 134, available here. CRG (2022), 'Advice to the Australian Energy Regulator: CRG Response to the AER's December 2021 Information paper', March, p. 70, available here.

upwardly biased results.'[52] Our understanding of this concern from the AER is that if the DGM assumes a constant market CoE, low RFR rates would imply MRP rates that are significantly higher than the MRP rate estimated by the constant-MRP model (e.g. the Ibbotson model). In other words, the DGM makes no assumptions about the stability of the market CoE.

That said, the AER is considering two alternative frameworks for determining a point estimate for MRP, both of which would give more importance to forward-looking models such as the DGM model.[53]

The first alternative is similar to the 2013 approach, which uses the results from the DGM to select an appropriate point estimate from the HER range—where there is an increasing/decreasing trend in the DGM estimates, the AER would pick a point from the higher/lower end of the range of the HER estimates.[54]

The second alternative is to take the average of the HER and three-stage DGM estimates.[55] In addition, the AER proposes to update the MRP estimates annually. Under this framework, the data would more closely reflect the current market returns and RFR for the HER, while increasing the accuracy of current market expectations with regard to future dividends and the long-term growth rate for the DGM. The AER is currently considering and requesting stakeholder feedback on the approach.

Another cross-check employed by the AER is to look at survey evidence. The AER noted that surveys 'have limitations and are not at a level of reliability to give weight as a direct estimation method of the MRP'.[56] However, it considered the survey results to be useful in informing the forward expectations of survey participants.

Ofgem

Ofgem's view is that the TMR is generally more stable in the long run.[57] As such, Ofgem does not estimate the MRP, but instead estimates the TMR directly. It defined the TMR as the real return that equity investors expect for the market-average level of risk.[58] Ofgem applies a degree of regulatory judgement when determining a range for the TMR and uses the midpoint of that range as the TMR estimate for the CoE estimation.

Ofgem determines the TMR using the historical long-run outturn market returns, and cross-checks its results from this against forward-looking approaches, including DGMs and estimations from a range of professional investment managers.

Ofgem received advice from academics and practitioners on how to calculate the TMR for the 2018 UKRN study.[59] That study calculated the real

[52] AER (2018), 'Discussion paper: Market Risk Premium, risk free rate averaging period and automatic application of the rate of return', March, p. 24, available here.
[53] AER (2021), 'Rate of return: Overall rate of return, equity and debt omnibus', working paper, December, pp. 32–33, available here.
[54] AER (2021), 'Rate of return: Overall rate of return, equity and debt omnibus', Final working paper December, p. 16, available here.
[55] We note that AEG has proposed an equal weighting between the HER and the three-stage DGM model.
[56] AER (2021), 'Rate of return: Overall rate of return, equity and debt omnibus', Final working paper December, p. 153, available here.
[57] Ofgem (2019), 'RIIO-2 Sector Specific Methodology Decision – Finance', 24 May, para. 3.44, available here.
[58] Ofgem (2018), 'RIIO-2 Framework Decision', p. 116, available here.
[59] This report was jointly commissioned by the UK regulators (CAA, Ofcom, Ofgem, Ofwat) from the UK Regulators Network (**UKRN**) and is commonly referred to by the UK regulators as the 'UKRN study'.

(geometrically averaged) market returns from 1900 to 2016, based on Dimson, Marsh and Staunton (**DMS**) data on UK market returns, and used the back-cast CPI index from the Bank of England to adjust for inflation.[60] The report suggested an inflation-adjusted TMR range between 6% and 7%, with the range determined by the size of the uplift applied to the geometric average. The size of this uplift was based on a subjective assessment of the degree of returns predictability and the extent to which this justified adopting a TMR below the arithmetic average.

CEPA, on behalf of Ofgem, cross-checked the UKRN study's TMR range with a DGM, similar to the DGM methodology used by the NZCC and AER.[61] CEPA found a spot nominal TMR estimate of 7.9% and two-year average of 8.5%.[62]

Based on the information above (and after adjusting the CEPA estimates for inflation), Ofgem put forward, as part of the RIIO-ED2 framework, a TMR range of 6.25–6.75%, with an allowed point estimate (midpoint) of 6.5% as the working assumption for the TMR.[63]

Ofgem discussed four main issues that stakeholders had with the TMR estimate. Briefly, these issues cover:

- the correct method for measuring inflation—the retail price index (**RPI**) versus the consumer price index (**CPI**)—when adjusting nominal returns to real returns;
- the time period over which the TMR should be calculated;
- whether an arithmetic or geometric mean should be used to estimate the TMR;
- whether survey evidence should be used, and how to estimate the assumed future growth rate for dividends in the DGM.

Table 3.2 presents the key similarities and differences between the NZCC, the AER and Ofgem approaches for estimating the MRP and/or TMR.

See Wright, S., Burns, P., Mason, R. and Pickford, D. (2018), 'Estimating the cost of capital for implementation of price controls by UK Regulators', UK Reproducibility Network, available here.
[60] When calculating the geometric mean of the real market returns, Ofgem applies an uplift of 125 basis points (**bp**) to adjust for underestimation as a result of using a geometric mean.
[61] Ofgem summarises the findings from CEPA in its RIIO-2 Sector Specific Methodology. See Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance', 14 March, Appendix 3, available here.
[62] Ofgem has stated that these estimates are the lower and upper bounds of the DGM-implied TMR range. See Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance', December, para. 3.73, available here.
[63] Ofgem also cross-referenced this assumption against the medium- and long-term estimates from investment managers and advisers. Ofgem concluded that the average TMR estimate was 6.59%, which fell close to the middle of its assumed range. See Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 3.24, available here; and Ofgem (2018), 'RIIO-2 Sector Specific Methodology Annex: Finance', December, Table 10, available here.

Table 3.2 Summary of regulators' approaches to MRP/TMR

	NZCC	AER	Ofgem
Assumed relationship between MRP and RFR	Negative and undetermined, depending on model	Undetermined	Negative
Models based on historical returns	Ibbotson, Siegel I and Siegel II	HER	DMS historical returns
Models based on forward-looking estimations	DGM and survey	DGM and surveys (cross-checks)	DGM and investment managers' estimates (cross-check)
Averaging method	Arithmetic	Arithmetic	Geometric with uplift
Sampling period	From early 1900s	From early 1988	From early 1900s
Tax imputation?	Yes	Yes	No
Rounding approach	To the closest 0.5%	To the closest 0.1%[1]	To the closest 0.25%[2]

Note: [1] Based on the evidence presented in the AER's determination for MRP. [2] Implied by Ofgem's approach to determining a point estimate for TMR.

Source: Oxera.

3.3 Oxera assessment of implications for the NZCC approach

While the NZCC, AER and Ofgem have all relied on different models and inputs for their TMR/MRP estimations, some common issues have been discussed by all three regulators. These include the following.

- **The relationship between the MRP and the RFR**. A negative relationship provides justification for putting weight on the constant-TMR approach adopted by Ofgem, whereas a lack of correlation would allow for the constant-MRP approach currently adopted by AER and the NZCC. We recommend that the NZCC place more weight on approaches that account for a negative relationship and less weight on those that assume zero correlation between the MRP and the RFR.
- **The use of the DGM and survey data**. While both AER and Ofgem placed limited weight on forward-looking methods such as the DGM and surveys, using them as cross-checks only, the NZCC placed the same weights on forward-looking methods and methods relying on historical data (Ibbotson, Siegel I and Siegel II). Given the limitations of survey evidence in particular, we recommend placing less weight on survey results.
- **The use of the arithmetic versus the geometric mean**. The NZCC has relied exclusively on arithmetic averages of historical market returns. In contrast, Ofgem uses the geometric average and adjusts it upwards in an attempt to offset the downward bias of geometric averages. The AER had regard to the HER using both the arithmetic and the geometric average, but ultimately agreed with the NZCC on using the arithmetic average to calculate the MRP. We consider with reference to academic evidence that it is appropriate for the NZCC to (continue to) use the arithmetic mean for estimating the TMR.
- **Sampling period**. The NZCC and Ofgem both decided to use historical market return data dating back to the early 1900s, whereas the AER considered only the more recent market returns from 1988 onwards.[64] In

[64] We note that the NZCC could perform sensitivity analysis on the sampling period used for its TAMRP estimation models. If the TAMRP estimates are relatively insensitive to changes in the sampling period (as was the case in Australia), the choice of sampling period would be rendered moot.

general, it is appropriate to use the longest available time series for TMR estimation that contains reliable data.[65]

- **Rounding to the nearest 0.5**. The NZCC's approach to rounding is inconsistent with those adopted by the AER (round to the nearest 0.1%) and Ofgem (round to the nearest 0.25%). We recommend that the NZCC reassess its approach to rounding.

We discuss each of these points in more detail below.

The relationship between the MRP and the RFR

Forming a precise view on the expected TMR is made challenging by the wide range of estimates from the various sources of evidence. The central issue in the current debate over the TMR (and the estimation of the MRP, either directly, or a residual from an overall TMR estimate) is the degree to which the expected MRP adjusts to offset changes in the RFR. One view is that the MRP is approximately constant over time and largely independent of the RFR. Another view suggests that the expected TMR reverts to a long-term average, and that changes in the RFR are largely offset by changes in the MRP.

One of the clearest expositions of the first view—that the MRP is approximately constant over time (especially in the long run) and largely independent from the RFR—is that of DMS:

> There are good reasons to expect the equity premium to vary over time. Market volatility clearly fluctuates, and investors' risk aversion also varies over time. However, these effects are likely to be brief. Sharply lower (or higher) stock prices may have an impact on immediate returns, but the effect on long-term performance will be diluted. Moreover volatility does not usually stay at abnormally high levels for long, and investor sentiment is also mean reverting. For practical purposes, we conclude that to forecast the long-run equity premium, it is hard to beat extrapolation from the longest history available when the forecast is being made.[66]

This view effectively assumes that, in the long run, the risk-free asset provides a unique anchor point for the pricing of all other assets. Expected returns for all asset classes increase or decrease one-for-one with changes in the RFR.

One of the clearest expositions of the second view—that the expected TMR reverts to a long-term average and that changes in the RFR are offset by changes in the MRP—is academic evidence linking required returns to economic uncertainty. In this view, changes in the way risk is priced affect the risk-free and risky assets simultaneously. When economic uncertainty increases, there is a 'flight to safety', which raises demand for the risk-free asset and lowers demand for risky assets. This reduces the yield on the risk-free asset and increases the premium required to hold risky assets. Details on this academic research are provided in Box 3.1 below.

[65] As we explain below, the reason why we suggest the NZCC should continue using a long time series for the TAMRP estimate, but focus on shorter-term estimates for other parameters, is because there is academic evidence to support that the total market return is relatively stable over time, such that using the full period for which reliable data is available should improve estimation accuracy.
[66] Dimson, E., Marsh, P. and Staunton, M. (2017), 'Credit Suisse Global Investment Returns Yearbook 2017', Credit Suisse, February, p. 41, available here.

Box 3.1 Summary of academic research that suggests the TMR is constant over time

In this box we first outline the theoretical work that provides a basis for expecting that the TMR is roughly constant over time, and then explain some of the results of empirical academic research.

The theoretical work that supports a roughly constant TMR has come out of the literature on the MRP puzzle: the seemingly high level of the MRP that is observed in financial markets, relative to that which might be expected theoretically. Historically, the high MRP had been explained either by assuming high levels of risk aversion for investors, or a high expected probability of extreme events (as both of these would increase the return that investors require for holding risky assets). Recent research allows for the MRP to be explained with more realistic utility functions of consumers and investors, and without resorting to a high likelihood of extreme events.[67]

An example of this research is the consumption-based asset pricing model developed by the Bank of England, which predicts that consumers and investors will respond to an increase in economic uncertainty by increasing demand for risk-free assets and reducing demand for risky assets.[68] In this model, higher economic uncertainty simultaneously puts downward pressure on the RFR and upward pressure on the ERP, meaning that the TMR is roughly constant over time. The Bank of England model also assumes that consumers and investors care about large negative shocks as well as the local volatility of consumption and investment returns. When the distribution of expected consumption and GDP growth is more negatively skewed and has a higher probability of extreme events (kurtosis), the ERP is higher and the RFR is lower.[69]

The empirical literature examines the negative correlation between the estimate of the RFR and ERP, and also finds support for the TMR being relatively stable (such that changes in the RFR are largely offset by changes in the ERP). For example:

- evidence previously relied on by Ofgem, from Mason, Miles and Wright (2003), proposed a methodology whereby the TMR should be assumed to be constant (implying a one-for-one offsetting change in the RFR and MRP),[70] and set in the light of realised historical real returns over long samples. The authors noted that there is considerably higher uncertainty about the true historical RFR, and the ERP, than there is about the TMR;[71]
- related to the preceding point, this academic view was supported in a later paper by Wright and Smithers (c. 2014–15), which concluded that 'real market cost of capital should be assumed constant, on the basis of data from long-term historic averages of realised stock returns'.[72] The authors implied a negative correlation coefficient of 1: 'It is therefore an application of simple arithmetic to conclude that, applying our methodology, the (assumed) market risk premium and the RFR must move in opposite directions: i.e., must be perfectly negatively correlated';[73]
- a similar conclusion about the relative stability of the TMR over time was also observed in the US market. A study in the USA found that the MRP is inversely related to the RFR—i.e. as the RFR falls, the ERP increases.[74] Specifically, the authors concluded that, for the period 1986–2010, using data from the S&P 500, the coefficient of the relationship between the interest rate and the MRP was -0.79, such that a 1% decline in the RFR would be offset by a 0.79% increase in the ERP.[75]

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[67] Specifically, Epstein–Zin preferences are used, allowing for the elasticity of intertemporal substitution and risk aversion to be independent of each other rather than jointly determined, as in the standard CAPM.
[68] Summarised in Vlieghe, G. (2017), 'Real interest rates and risk', Society of Business Economists' Annual conference, 15 September, available here.
[69] Martin, I. (2013), 'Consumption-Based Asset Pricing with Higher Cumulants', *Review of Economic Studies*, **80**, pp. 750–51.
[70] The constant TMR was reaffirmed as a conclusion of the 2003 paper in a later paper in 2014–15 (cited below).
[71] Wright, S., Mason, R. and Miles, D. (2003), 'A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the U.K.', on behalf of Smithers & Co, 13 February, available here.
[72] Wright, S. and Smithers, A. (undated), 'The Cost of Equity Capital for Regulated Companies: A Review for Ofgem', p. 2, available here.
[73] Wright, S. and Smithers, A. (undated), 'The Cost of Equity Capital for Regulated Companies: A Review for Ofgem', p. 16, available here.

Overall, the latest asset pricing research refutes the view that the MRP is a stable parameter and that the main source of variation over time in the TMR is the RFR.

In the context of NZCC's methodology for determining TAMRP, only the second Siegel approach supports a negative relationship between the MRP and the RFR. Accordingly, we recommend that the NZCC place more weight on approaches that account for a negative relationship and less weight on approaches that assume zero correlation between MRP and RFR.

Use of DGM and survey data

Both the AER and Ofgem placed limited weight on the DGM, using it as a cross-check rather than a direct input into the final MRP estimate. The AER was sceptical of the DGM's 'complexity, predictability and replicability' in the context of generating a robust estimate of MRP for the regulatory determination of the WACC.

While we agree that the results of DGMs can vary materially with changes in inputs, we also consider that the forward-looking nature of DGMs provides a useful cross-check on the backward-looking nature of other estimates of the TAMRP.

With respect to the use of survey data, we do not consider it appropriate to place equal weights on survey data and other empirical methods (i.e. Ibbotson model, the two Siegel models and the DGM). We note that neither the AER nor Ofgem use survey estimates as direct inputs into their MRP or TMR estimates.[76]

Specifically, survey results need to be interpreted with a high degree of caution when used as another source of evidence for the ERP and TMR. Issues with survey evidence include:

- respondents' answers possibly being influenced by the way questions are phrased—for example, whether the question asks about required returns to equity or expected returns on a specified stock market index (the 'framing effect');
- there is a tendency for respondents to extrapolate from recent realised returns, making the estimates less forward-looking and prone to be anchored on recent short-term market performance ('recency bias');
- the results are based purely on judgement, which may also be influenced by a respondent's own position or biases, and are less reliable than estimates based more on market evidence on pricing.

As Brealey and Myers stated in their renowned corporate finance textbook:[77]

> Do not trust anyone who claims to *know* what returns investors expect. History contains some clues, but ultimately we have to judge whether investors on average have received what they expected.

[74] Harris, R. and Marston, F. (2013), 'Changes in the Market Risk Premium and the Cost of Capital: Implications for Practice', *Journal of Applied Finance*, **1**.
[75] Harris, R. and Marston, F. (2013), 'Changes in the Market Risk Premium and the Cost of Capital: Implications for Practice', *Journal of Applied Finance*, **pp. 6-7**.
[76] The AER uses survey evidence as a cross-check on the TMR estimates, whereas Ofgem uses estimates from investment managers (comparable to surveys) as a cross-check.
[77] Brealey, R., Myers, S. and Allen, F. (2016), *Principles of Corporate Finance*, 12th edition, McGraw-Hill International Edition, p. 169.

Therefore, consistent with the approach adopted by the AER and Ofgem, we recommend using survey evidence only as a cross-check on the outputs from other empirical methods, and not as a direct input into the TAMRP calculation.

Use of arithmetic versus geometric mean

When Dr Lally estimated the TAMRP for NZCC in 2019, he commented that 'geometric differencing is not consistent with the definition of the market risk premium.'[78] Similar views were shared by the AER, which decided that the arithmetic average is the appropriate tool to use.

The regulated allowed rate of return determines annual cash flows, which are not compounded over time in the regulatory model. Regulators have at times considered various ways of combining different estimators developed for other purposes based on geometric and arithmetic averages when determining the market parameters of the CoE. For example, regulators sometimes place weight on the estimators developed by Blume (1974)[79] and by Jacquier, Kane and Marcus (2005)[80] to estimate the future value of an investment based on compounding of equity returns. Estimators have also been developed by Cooper for the purpose of valuation and capital budgeting.[81]

However, the relationship between the estimators listed above and the unbiased estimate of the regulated allowed rate of return is a complex problem that has not been solved. Therefore, to avoid introducing downward bias into the estimate, two options include: adopt an arithmetic average; include the Cooper estimators alongside those of Blume (1974) and Jacquier et al. (2005).

As highlighted by Professor Stephen Schaefer in his submission to the UK CMA for the NATS (2020) regulatory period redetermination, the observed relationship between the arithmetic and geometric averages suggests that any serial correlation is insignificant, or that the impact of serial correlation on the relationship between arithmetic and geometric average returns is insignificant. Professor Schaefer states that:[82]

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

Professor Schaefer further shows, based on analysis of the DMS data, that:[83]

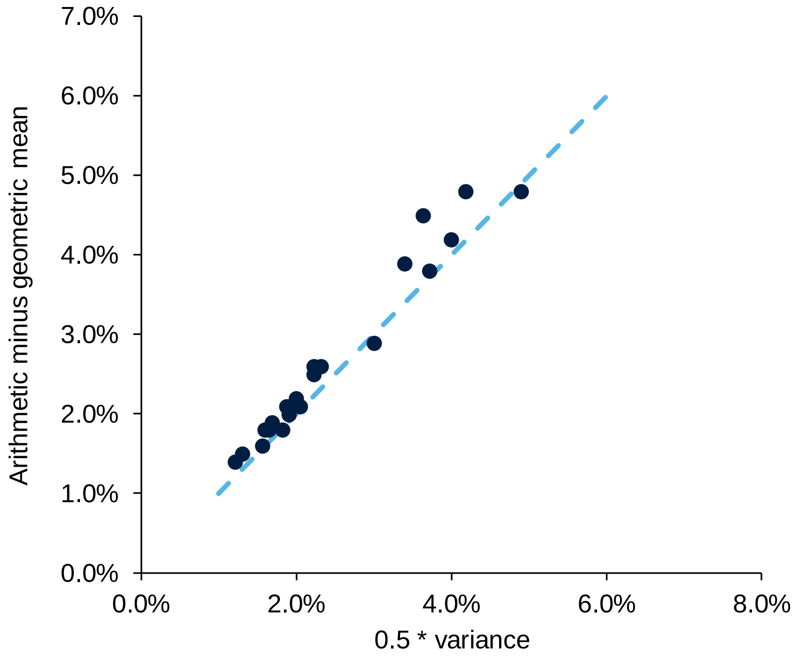
> despite this, the difference between the arithmetic and geometric means is indeed well approximated in the data by one half the variance.

Figure 3.1 reproduces Professor Schaefer's analysis, which plots the difference between the arithmetic and geometric mean returns against the variance of the annual returns divided by two. This exercise was conducted using 119 years of returns across 21 countries based on DMS data from 1899 to 2019. The figure shows that, irrespective of whether variance and expected returns vary over time, the difference between the arithmetic and the geometric

[78] Lally, M. (2019), 'Estimation of the TAMRP', 26 September, footnote 9, available here.
[79] Blume, M.E. (1974), 'Unbiased Estimators of Long-Run Expected Rates of Return', *Journal of the American Statistical Association*, **69**:347.
[80] Jacquier, E., Kane, A. and Marcus, A. (2005), 'Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation: A Case of Compounded Estimation Risk', *Journal of Financial Econometrics*, **3**:1, pp. 37–55.
[81] Cooper, I. (1996), 'Arithmetic versus geometric mean estimators: Setting discount rates for capital budgeting', *European Financial Management*, **2**:2, pp. 156–67.
[82] Schaefer, S. (2020), 'Using Average Historical Rates of Return to set Discount Rates', Appendix contained within Oxera (2020), 'Deriving unbiased discount rates from historical returns', 14 February.
[83] Ibid.

mean is closely approximated by half of the realised variance. The implication is that applying the appropriate upward adjustment to the geometric mean of half the variance of annualised returns would result in an estimate close to the arithmetic average.

Figure 3.1 Difference in mean returns plotted against variance



Source: Reproduced from Schaefer (2020).

Some stakeholders in Australia and the UK have stated that arithmetic averages are superior to geometric ones only if the returns are serially uncorrelated, which might not be the case. We have not seen robust evidence that negative serial correlation exists. Professor Schaefer's analysis indicates that the difference between arithmetic and geometric mean returns is accounted for almost entirely by the variance in the returns, and does not suggest the existence of serial correlation.

In summary, we recommend that the NZCC keep its current approach of relying solely on arithmetic averages.

Sampling period

In general, academic evidence supports the idea that the TMR is relatively stable over time (see Box 3.1).[84] In this context, it is appropriate for regulators to use the full time series for which reliable data is available, to improve estimation accuracy in estimating the TMR. While we have not been able to assess the underlying quality of the NZCC's time series, the general approach that the NZCC is taking, of using a long time series, is consistent with this approach. It is also consistent with that used by Ofgem, which also considers a long time series from the early 1900s.

[84] For example, see summarised in Vlieghe, G. (2017), 'Real interest rates and risk', Society of Business Economists' Annual conference, 15 September; Martin, I. (2013), 'Consumption-Based Asset Pricing with Higher Cumulants', *Review of Economic Studies*, **80**, pp. 750–51; Wright, S., Mason, R. and Miles, D. (2003), 'A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the U.K.', on behalf of Smithers & Co, 13 February; and Wright, S. and Smithers, A. (undated), 'The Cost of Equity Capital for Regulated Companies: A Review for Ofgem', p. 2, available here.

While this approach does differ from that taken by the AER, we note that the AER found that, for all the time periods it considered, the range on the arithmetic average (6.2–6.8%) and the geometric (4.5–5.1%) average was very similar.

Rounding to the nearest 0.5%

While we do not disagree with Dr Lally's assertion that estimating the TAMRP with higher precision is not achievable, we have not seen empirical evidence supporting the view that rounding of the TAMRP estimate offsets estimation errors over time. We recommend that the NZCC reassess its approach to rounding, for three main reasons:

- the accuracy of the NZCC's TAMRP estimates would be improved once survey data is excluded (or de-emphasised) from the evidence pool;
- where the decimals of the TAMRP estimate are close to 0.25% or 0.75%, the NZCC's approach to rounding could have a non-negligible impact on the EDBs' overall revenue allowances;
- reducing the rounding interval would be aligned with the approaches to rounding adopted by the AER (round to the nearest 0.1%) and Ofgem (round to the nearest 0.25%).

In summary, we find that, with respect to the five issues we cover in this section, the NZCC could consider:

- placing more weight on approaches that account for a negative relationship, and less weight on those that assume zero correlation between the MRP and the RFR;
- retaining its current approach to the DGM but place less weight on surveys;
- using (continuing to use) the arithmetic mean for TMR estimation, given the academic evidence supporting this approach;
- reviewing the reliability of the data and sampling periods used for its TAMRP estimation models. If the TAMRP estimates are relatively insensitive to changes in sampling period (as was the case in Australia[85]), the NZCC may not need to investigate this further. We have noted that it is appropriate to use the full time series for which reliable data is available to improve estimation accuracy in estimating the TMR;
- reassessing its approach to rounding.

[85] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 130, available here.

4 Equity beta

Equity beta measures the exposure of a particular asset to systematic risk, which is the proportion of total risk that cannot be removed by diversification. An estimate of the equity beta is used to determine the expected return of the asset to equity investors, i.e. the CoE. The equity beta of traded stocks can be estimated by regressing the historical returns of stocks against an index of market returns.

This section is structured as follows:

- section 3.1 describes the approach taken by the NZCC;
- section 3.2 describes the approaches taken by Ofgem and the AER;
- section 3.3 describes Oxera's assessment of alternative approaches that the NZCC could adopt.

There are many considerations for regulators when estimating the equity beta. Some key ones, which we discuss in this section, are:

- the comparator sample that is used to produce equity beta estimates;
- the observation period for the equity beta regressions—the length of the time series that are used to estimate the equity beta;
- the observation frequency—whether the equity beta regressions use daily, weekly, monthly, or some other frequency of data;
- whether to include COVID data when calculating the equity beta.

4.1 The approach taken by the NZCC

In its 2016 IM review, the NZCC used 72 comparators from the energy sectors of New Zealand, Australia, the UK and the USA to estimate the equity beta for the EDBs. These are the same comparators as were used to estimate leverage (see section 6.1). International comparators were used because Vector was the only listed New Zealand network. The NZCC also did not want to reduce the sample from 72 companies because it considered that this would be too subjective.

Both electricity and gas companies were included because the NZCC considered it necessary to keep integrated utilities (for example, a utility that operates in multiple areas of the energy value chain, or in both the electricity and gas sectors) in its sample. This is because Vector—the only New Zealand company in its comparator set—is an integrated utility.[86] An additional reason for the large sample size was to maintain 'consistency and stability with the approach used when setting the original IMs in 2010'.[87]

The NZCC calculated the equity beta using weekly and four-weekly observations over the five-year periods to: 31 March 2001; 31 March 2006; 31 March 2011; and 31 March 2016. Also, it used daily equity beta estimates

[86] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 277.2, available here.
[87] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 277.3, available here.

reported by Bloomberg over the same periods.[88] For the periods prior to 31 March 2016, the sample is smaller due to lower data availability.[89]

The equity beta for each comparator was de-leveraged using a tax-neutral de-leveraging formula,[90] to obtain the asset beta estimates, which were then averaged to obtain the sector asset beta estimates for each period. The averaging process was unweighted, meaning that the beta of each comparator was considered equally informative about the equity beta being determined for the EDBs.[91]

When estimating the average asset beta, the NZCC gave the same weight to weekly and four-weekly betas. It also explained that it did not give significant weight to the daily beta estimates.[92] While the NZCC was not explicit about the precise process it followed to combine its various equity beta estimates, its review led to the estimate of an average asset beta of 0.35, which, when combined with a notional leverage estimate of 42%, resulted in an allowed equity beta of 0.60.[93]

In its 2022 IM review, the NZCC expressed interest in receiving views on whether the beta estimation should be adjusted to take into account stock market movements related to COVID-19.[94]

4.2 Evidence from other regulators

The AER

The AER, in its latest draft explanatory statement, followed the same approach used in the previous regulatory period to estimate the equity beta. The sample of comparators included nine Australian energy network firms.

Betas were estimated using weekly data both for individual firms and for a number of 'portfolios'—the term used by the AER to describe certain groupings of the comparators. These estimates were performed over three periods:

- the last five years—since, over time, Australian energy networks have been de-listing, the five-year estimates are available for only three comparators;
- a period from after the tech bubble to the present, excluding the period of the 'Global Financial Crisis';[95]
- the longest available period—this period varies depending on how far back data is available on the traded prices of Australian regulated utilities. However, the individual company with the oldest available data dates back

[88] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 287, available here.
[89] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, Table 1, available here.
[90] The formula is $B_a = B_e(1 - L) + B_d L$, where B_a is the asset beta, B_e is the equity beta that has been calculated through the regressions, L is leverage, and B_d is the debt beta, although the NZCC assumed that the debt beta is zero. NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 295, available here.
[91] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 303, available here.
[92] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 303, available here.
[93] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 338, available here.
[94] NZCC (2022), 'Part 4 Input Methodologies Review 2023. Process and Issues paper', 20 May, para. 6.22.2, available here.
[95] It is not clear whether the AER's estimate of beta using the period from the tech bubble to the present, but excluding the global financial crisis, has been taken into consideration.

to January 1990 and the portfolio with the oldest available data dates back to June 2000.[96]

The exclusion of data from the period of the global financial crisis in one of the regression periods suggests that the AER may consider it relevant to exclude exceptional events from its equity beta estimates. However, the fact that it has not excluded COVID data more recently suggests the opposite.

The AER was not explicit about how it constructed its estimate of equity beta and it does not appear to have applied a formulaic approach, choosing instead to exercise regulatory judgement. Specifically, the AER explained that its choice of a final point estimate of 0.6 was based on the fact that:[97]

- it had chosen a point estimate of 0.6 in the previous regulatory period and considered regulatory stability to be important;
- the evidence that the AER considered supported an equity beta estimate between 0.5 and 0.6.

The evidence considered by the AER was based primarily on the equity beta results from the longest estimation period. This is because the AER considers that systematic risk for Australian regulated energy networks is stable over the long term. Additionally, it considered there to be a benefit from the fact that the longer time period contained more observations and that the longer time series would abstract away from short-term changes in equity beta.[98] We infer from this that the AER may consider that movements in equity beta over time reflect noise rather than fundamental changes in the exposure of energy network investors to systematic risk.

The AER also places less weight on the five-year period estimates because data was available for only three comparators, and it has observed that domestic comparators' equity betas have trended downwards recently, while those of international comparators have trended upwards.[99]

Ofgem

In its Draft Determination for RIIO-ED2, Ofgem followed the same approach used for RIIO-GD&T2. The equity beta was determined using a sample of five UK-based comparators from the energy and water sectors. Ofgem decided to put more weight on the pure energy player (National Grid) and on the three water companies, which it considers to have a similar exposure to systematic risk as the energy networks.[100] It placed less weight on the remaining comparator (Scottish and Southern Electricity, SSE) because the company had a substantial proportion of non-regulated energy revenues.

As Ofgem used National Grid's beta as one of the proxies for the beta for electricity distribution, it also considered the possibility that different energy sub-sectors (gas and electricity) might have different levels of systematic risk. However, Ofgem concluded that the evidence did not suggest any material differences between the sub-sectors.[101]

[96] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, Table 8.1, Table 8.2, available here.
[97] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p.165, available here.
[98] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 176, available here.
[99] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', 16 June, p. 18, available here.
[100] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 3.30, available here.
[101] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 3.33, available here.

In its analysis, Ofgem considered a range of estimation approaches and averages, combining two-, five-, and ten-year estimation windows with spot values and two-, five-, and ten-year averaging periods. More weight has been put on larger samples of data (i.e. a ten-year estimation window and ten-year averages).[102]

Following its analysis, and exercising regulatory discretion, Ofgem estimated an asset beta of 0.349 and a notional equity beta of 0.759 (assuming a debt beta of 0.075 and notional gearing of 60%).[103]

Ofgem acknowledged the possible impact of COVID on the beta estimates, particularly in overestimating the TMR, but did not exclude any data from its analysis, citing the risk of cherry-picking.[104]

Table 4.1 presents the key similarities and differences between the NZCC, the AER and Ofgem approaches for estimating the equity beta.

Table 4.1 Summary of regulators' approaches to equity beta

	NZCC	AER	Ofgem
Comparator sample	72 international comparators from New Zealand, Australia, the UK and the USA, operating in the energy sector	9 domestic energy network companies (a number that has fallen further over time due to de-listing).	5 domestic comparators including water utilities, one energy utility, and one integrated energy company (albeit less weight is placed on the latter company)
Observation period	4 consecutive periods of 5 years each (March 1996–March 2016). More weight is placed on the periods covering the last 10 years	3 overlapping periods: (i) last 5 years; (ii) the longest available period; (iii) the period starting after the tech-bubble to the present, excluding the global financial crisis. More weight is placed on the longest period	2-, 5- and 10-year overlapping periods. More weight is placed on the longer samples
Observation frequency	Daily, weekly and 4-weekly. Weekly and 4-weekly data preferred	Weekly	Not specified
COVID data	Minded to include (in consultation)	Included	Included

Source: Oxera.

4.3 Oxera assessment of implications for NZCC approach

As noted at the outset of this report, there can be differences in regulatory approaches across jurisdictions—e.g. based on differences in market structure, regulatory duties, and the stability of the regulatory regime in the jurisdiction. As explained at the start of this section, to inform the views of the EDBs in engaging with the NZCC on its evolution of the regime in New Zealand, we comment on the approach that the NZCC could take with respect to:

- The selection of the comparator sample. We recommend a sample that includes companies that are more similar to the New Zealand networks;

[102] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 3.30, available here.
[103] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, Table 11, available here.
[104] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 3.30, available here.

- the estimation period. We recommend a medium-term estimation period, as this allows the equity beta to reflect the exposure of investors in energy networks to the most recent levels of systematic risk;
- the frequency of observation. We recommend that, when the stocks included in the sample are liquid, a daily observation frequency is used and when illiquid stocks cannot be excluded from the sample, a weekly observation frequency is used;
- the use of COVID data. We recommend that COVID data is included in the equity beta estimate because the COVID period still contains important information regarding the exposure of networks to systematic risk.

Comparator sample

To estimate a beta that reflects the systematic risk of the EDBs, the comparator sample would ideally focus only on (or give greatest weight to) close comparators. This is because comparators with material exposure to different sectors (either geographically or in terms of the product/service that they provide) might face different levels of systematic risk. If such an approach leads to relatively few comparators, it can be justifiable to expand the sample, but only in a way that does not add disproportionate weight to comparators that are too different. The total sample size selected through this process does not need to be as large as that used by the NZCC, particularly as both Ofgem and the AER use sample sizes of fewer than ten comparators.

In practice, the NZCC could refine its sample of comparators by reviewing the characteristics and comparability of US-based utilities in more detail. These companies account for over 60 of the comparators in the NZCC's sample, and not all of them will be subject to the same type of regulatory regime as in New Zealand. Specifically, as was also noted by Dr Lally, some US-based utilities are subject to rate-of-return regulation rather than price cap regulation as in New Zealand.[105] Removing some of the less comparable companies from the sample would reduce the NZCC's sample to a size more comparable to that of Ofgem and the AER.

We also consider that the comparator sample used by the NZCC includes illiquid companies, which can result in a mis-statement of the equity beta.[106] Filtering out illiquid companies reduces the impact that illiquid stocks can have in driving the results, which is particularly important if the NZCC chooses to align with international regulatory precedent in selecting a smaller sample. This filtering can be done by assessing:

- **the bid–ask spread**—a narrow bid–ask spread means that brokers are offering to buy shares at prices closer to those that sellers are offering (the 'ask' price), and are offering to sell shares at prices closer to those that buyers are offering (the 'bid' price). This is more likely to occur in liquid markets, where brokers know that they can unwind their positions relatively quickly and easily in a short space of time;

[105] Dr Lally states that price cap regulation involves a regulator setting prices for a fixed term (commonly five years), except in respect of 'uncontrollable' costs for which automatic 'pass-through' is permitted. He concludes that firms under price cap regulation face greater risks than those subject to rate of return regulation, on the basis that under price cap regulation (i) significant macroeconomic shocks may not induce a rapid reversion to prices, and (ii) firms are exposed to divergences between efficiency and actual costs. Lally, M. (2016), 'Review of WACC Issues', 25 February. Oxera (2016), 'Asset beta for gas pipelines in New Zealand', 4 August, Table 3.1, available here.
[106] Oxera (2016), 'Asset beta for gas pipelines in New Zealand', 4 August, available here.

- **the percentage of days traded**—the proportion of trading days in a year in which at least one share of the stock is traded. A higher percentage indicates higher liquidity;
- **the percentage of free-float shares**—the proportion of shares that can be publicly traded. A low proportion suggests low liquidity.

Observation period and frequency

When determining the appropriate observation period, regulators need to trade off: (i) the need for periods to be long enough to include enough observations to get statistically robust results; (ii) not using observations that are too far in the past, if these reflect different market conditions. While the AER considers that systematic risk does not change over time, this is not necessarily the case for regulated utilities in other jurisdictions. When the regulatory framework changes or market conditions change, the exposure of networks to systematic risk can also change. For this reason, we consider that more weight should be placed on recent beta estimates, but the time period of the estimate should not be too short.

An appropriate balance may be to use primarily betas calculated from data that is no more than ten years old with a focus on shorter periods, e.g. two- and five- year betas, as this provides a relatively large sample without being overly focused on the near term. While neither the AER nor Ofgem focuses exclusively on short-term betas, Ofgem does place weight on two- and five-year betas.[107]

The NZCC's current approach is broadly in line with this, as it places most weight on the past ten years of beta estimates. However, we do not consider it necessary for the NZCC to give weight to very old periods (such as the 1996–2001 period used in its 2016 IMs.[108]) In addition, the NZCC could place some more weight on more recent beta estimates.

Moreover, the frequency of the observations should be set accordingly. Unless the NZCC applies liquidity filters that eliminate the less liquid companies from the sample, we consider weekly returns to be more appropriate because the daily returns time series is more likely to have data missing. However, weekly returns are sensitive to the choice of reference day. Choosing Wednesday as the reference day tends to reduce distortions of weekly beta estimates that are created by public holidays. A monthly approach is unlikely to be appropriate as it will significantly reduce the number of observations for the beta calculation (24 in the case of a two-year beta and 60 in the case of a five-year beta). If the NZCC does remove illiquid companies then daily beta estimates are likely to be most appropriate.

COVID

We consider that it is reasonable for data from the time of the COVID pandemic to be included in the estimation of equity beta. This is because the response of an equity's return to a change in market conditions reflects the exposure of that equity to systematic risk. Such an approach is consistent with that taken by Ofgem, which explained that excluding COVID-19 data could introduce the risk of cherry-picking data.[109]

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[107] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 3.30, available here.
[108] NZCC (2016), 'Input Methodologies review decisions Topic paper 4: Cost of capital issues', 20 December, Table 1, available here.
[109] Ofgem (2021), 'RIIO-2 Final Determinations – Finance Annex (Revised)', February, p. 158, available here.

Box 4.1 CEPA update: equity beta

The CEPA report largely replicated the comparator selection process adopted in the 2016 IMs, with some minor changes to account for delisting, lack of liquidity and lack of comparability (e.g. due to the comparator having a low percentage of regulated revenue).[110]

Using this updated sample of comparators, CEPA updated the beta estimates using the methodology adopted in the 2016 IMs. Specifically, they estimated the daily, weekly and four-weekly asset betas over the five-year periods to: 2012, 2017 and 2022. The asset betas are defined as unlevered equity betas using a debt beta of zero.

As CEPA's approach largely follows that undertaken by the NZCC, we consider that it could be adjusted to place more weight on daily betas calculated across a more recent time-period. In addition the NZCC could consider refining the sample of comparators, such that only those that operate under comparable regulatory regimes remain in the sample.

[110] CEPA (2022), 'Review of Cost of Capital 2022/2023', p. 9, available here.

5 Cost of debt

This section explains how the NZCC calculates the Cost of Debt (CoD) and compares this to evidence from other regulators. The CoD refers to the financing costs paid by a company on its borrowings, including loans, bonds and other debt instruments. In general, regulators take one of two approaches to estimating the CoD:

- the **market CoD** can be estimated with reference to current yields of comparable market-traded debt instruments, using similar credit ratings and debt tenors. For example, to estimate the CoD of a company rated BBB, one can refer to BBB rated bonds in the market or a BBB rated index;
- the **actual CoD** can be calculated with reference to the company's existing debt obligations. This information is generally available in its financial statements.

There are many considerations for regulators when estimating the CoD. Some key ones, which we discuss in this section, are:

- the main differences between the NZCC's build-up approach, whereby it estimates the CoD as the sum of the debt premium and the RFR, and the AER and Ofgem's direct indexation approach, whereby they estimate the CoD directly using the traded yields of bonds issued by companies with comparable credit ratings.
- how the NZCC could use the direct indexation approach to reduce (the risk of) CoD over-/underperformance

5.1 The approach taken by the NZCC

The NZCC's CoD has three key components:[111]

- the RFR;
- the debt premium;
- other additional allowances, which include allowances for issuance costs and the term credit spread differential (**TCSD**).

5.1.1 The RFR

As the methodology used for estimating the RFR is set out in section 2, we do not discuss it in detail here. However, as a recap, the main areas where we consider the NZCC could adjust its approach are in: (i) considering the yields on longer-maturity government bonds, (ii) giving weights to the highest-quality non-government bonds to account for the convenience premium, and (iii) indexing the RFR throughout the regulatory period.

5.1.2 Debt premium

The debt premium is calculated as the prevailing five-year average of the difference between:

- the bid yield to maturity on New Zealand dollar-denominated corporate bonds with five years of remaining time to maturity; and

[111] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 77, available here.

- the contemporaneous interpolated bid yield to maturity of notional benchmark New Zealand government nominal bonds with five years of remaining time to maturity.

The corporate bonds that are considered by the NZCC must:

- be issued by an EDB or a gas pipeline business (**GPB**) that is neither 100% owned by the Crown nor a local authority;
- be publicly traded; and
- have a qualifying rating of grade BBB+.

In its 2016 IM review decision, the NZCC moved from the 'prevailing' approach to debt premium estimation, which used short-term averages, to a historical average approach, whereby the NZCC calculates the mean of the debt premium across the past five years. The NZCC explained that this change was aimed at addressing stakeholders' concerns about the volatility of the short-term debt premium:[112]

> we recognise that if the determination window happened to coincide with a period of abnormal market conditions, then suppliers could be over or undercompensated in comparison to their incurred debt.

The NZCC's decision to exclude government bonds issued by 100% state-owned entities was driven by the submission by CEG (an adviser to one of the stakeholders), which noted that the yields on these bonds are likely to behave differently and have lower debt premiums than other equivalent bonds.

Similar to the methodology used for the RFR (see section 2), the NZCC decided against updating the calculation of debt premium annually. It is instead estimated ahead of, and remains constant throughout, the control period.

5.1.3 Additional allowances

Debt issuance costs are incurred when companies issue loans and bonds. They may include fees and commissions paid to banks, law firms, auditors and regulators.

The 2016 IM review decision saw a reduction in the allowance for issuance costs, from 0.35% p.a. in previous controls to 0.20% p.a. The NZCC explained that this represents its best estimate of the 'average cost' of a benchmark supplier that issues New Zealand domestic vanilla bonds on a regular basis consistent with its 'simple approach' to estimating the cost of debt.[113] The simple approach refers to the issuance of solely vanilla corporate bonds, not other forms of debt such as bank debt, overseas bonds and structured bonds.

The NZCC's estimate of debt issuance cost comprised:

- debt issuance costs of 9–10bp p.a., based on a confidential debt survey of regulated suppliers that issued vanilla New Zealand domestic corporate bonds;[114]

[112] Input Methodologies, para. 144.
[113] Input Methodologies, para. 201.
[114] From this survey, the NZCC identified 30 vanilla New Zealand domestic bonds equivalent to the type of bond from which it estimated the debt premium. The average issuance cost provided in the debt survey of

- swap transaction costs of 3-4bp p.a.; and
- compensation for 'potential' additional costs, where efficiently incurred, associated with brokerage, new issue premiums, committed facilities/costs of carry, and forward starting swaps, of 7–9bp p.a.

Notably, given the uncertainties of the potential additional costs, the NZCC has decided against focusing on the precision of the estimates of debt issuance costs. Instead, it exercised regulatory judgement to set the total debt issuance costs to be no higher than 20bp p.a. for debt with a five-year maturity.

The cost of capital IM also includes a TCSD allowance to compensate suppliers for the additional debt premium that can be incurred from issuing debt with a longer original maturity than the five-year regulatory period.

The TCSD is calculated by way of a formula that combines:

- the additional debt premium associated with each issuance of debt that has an original term to maturity in excess of the five-year debt premium (the 'spread premium');
- a negative adjustment to take account of the lower per-annum debt issuance costs associated with longer-maturity debt.

The NZCC estimated the spread premium using New Zealand domestic bond data from 2010 to 2016. Specifically, assuming a linear relationship between maturity and the additional premium over the average five-year debt premium, the NZCC found the spread premium to be 7.5bp p.a.

5.2 Evidence from other regulators

5.2.1 AER

The AER's CoD allowance is proxied by the ten-year trailing average of the yield on BBB+ debt instruments with remaining time to maturity of ten years, which is updated annually.[115] The BBB+ yields are estimated as the weighted average of BBB (2/3) and A (1/3) rated yield curves published by the RBA, Bloomberg, and Thomson Reuters. The CoD is updated annually on a rolling basis, an approach that the AER has described to be 'reflective of benchmark business financing practices' and that it 'ensures the trailing average return on debt continuously reflect changing market conditions and new information.'[116]

The selection of a ten-year maturity for debt instruments is based on a weighted average term to maturity at issuance (**WATMI**) approach, which is defined as the average of term to maturity from the issuance date and weighted by the face value of debt and bonds issued by electricity and gas network service providers.

The weighting assigned to BBB and A bonds was based on the analysis of actual debt raised by service providers, published in 2018. Since then, the AER has continuously monitored the outperformance of debt and has not found evidence that its methodology towards credit rating has been a driver of outperformance.

these bonds was 9bp p.a. when averaged over the original tenor of the bond, and 10bp p.a. when the costs are assumed to be averaged over a five-year term.

[115] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', June, p. 20, available here.

[116] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', June, p. 242, available here.

5.2.2 Ofgem

In its Draft Determination for RIIO-ED2, Ofgem determined that its CoD allowance would be expressed in real terms and be based on the yearly indexed yield of a benchmark index and an additional cost of borrowing component.[117] Ofgem states that:

> the cost of debt allowance is set using a notional company approach rather than reflecting actual individual company costs of debt. Calibration of this notional approach is informed by actual company debt costs at the sectoral level.[118]

This approach is consistent with its previous price determination.

We describe below the approach taken by Ofgem in determining both components.

Benchmark index return

Ofgem calculates the 17-year trailing average real yield of the iBoxx GBP Utilities 10yr+ index.[119] As this component of the CoD allowance is indexed, it is recalculated annually. The nominal yields from the index are deflated by a long-term inflation assumption, based on the forecast from the UK Office for Budget Responsibility (OBR).

Previously, Ofgem relied on broader non-financial corporate indices. Ofgem argues that the iBoxx GBP Utilities 10yr+ index can better match network companies' debt costs:[120]

> the GBP Utilities 10yr+ index remains a relatively broad and representative index, with 84 bonds in the index with a value of £37bn+.

Ofgem received feedback during the RIIO-GD&T2 Draft Determinations which signalled that the average credit rating of the constituents of the GBP Utilities 10yr+ index has been falling over time, such that its use could lead to the risk profile of regulated companies not being matched.[121] Ofgem stated that it will monitor and reassess this possibility in later stages of the IMs determination.

Additional cost of borrowing

Ofgem proposes a fixed additional cost of borrowing component of 25bp p.a. which will not be adjusted within the regulatory period. This component consists of the following five elements.[122]

- The transaction cost represents ongoing and upfront costs related to debt issuance.[123] Ofgem set an allowance for the transaction cost premium of 6bp p.a.
- The Liquidity/Revolving Credit Facility (**RCF**) cost represents the additional costs tied to liquidity and revolving credit facilities. Ofgem sets the allowance for the liquidity/RCF costs at 4bp p.a.
- The cost of carry is associated with the issuance of debt in anticipation of using the acquired capital to generate a return in the future. Ofgem notes

[117] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 2.8, available here.
[118] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 2.41, available here.
[119] iBoxx GBP Utilities 10yr+ index's ISIN reference is 'DE0005996532'.
[120] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 2.10, available here.
[121] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 2.12, available here.
[122] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, Table 6, available here.
[123] The costs include underwriting/arrangement/listing fees, rating fees and legal fees.

that this allowance ensures that companies can meet operational requirements. Ofgem sets the allowance for the cost of carry at 10bp p.a.

- The CPI basis risk mitigation costs relate to the risks to companies from holding RPI-linked debt, as Ofgem is switching from indexing the RAV using RPI at RIIO-1 to CPIH at RIIO-2.[124] Ofgem sets the allowance for the CPI basis risk mitigation costs at 5bp p.a.

- The infrequent-issuer premium reflects an increase in the CoD for those regulated companies that are expected to issue less new debt than their peers, due to their smaller RAV sizes and lower RAV growth during the upcoming regulatory period.[125] Ofgem set the allowance for the infrequent-issuer premium at 6bp p.a. This is then applied to companies that are expected to issue less than £150m new debt per annum on average.

Ofgem has discussed the validity of making an additional adjustment for the 'halo effect'—i.e. the ability of network companies to issue debt at lower rates than the chosen iBoxx benchmark. Ofgem found the halo effect to be negligible and that there is insufficient certainty around whether it will pertain throughout the regulatory period.[126]

Table 5.1 below presents the key similarities and differences between the NZCC, the AER and Ofgem approaches for estimating the CoD.

Table 5.1 Summary of regulators' approaches to cost of debt

	NZCC	AER	Ofgem
Maturity	5-year	10-year	10+ years
Choice of proxy	NZD-denominated vanilla bonds issued by EDBs and GPBs	Weighted average of BBB (two-thirds) and A (one-third) rated debt instruments (including non-bonds) based on data from third-party providers. Cross-checked using yields on actual debt issued by electricity and gas network service providers to ensure no over- or underperformance	iBoxx £ Utilities 10+ index (bonds only, but includes structured bonds)
Components	Nominal RFR and nominal debt premium	Nominal yields	Nominal yields and additional adjustments, deflated by a long-term inflation forecast
Averaging period	3 months for RFR, five years for debt premium	10-year	17-year
Size of additional adjustments	Up to 20bp	n/a	25bp
Annual update?	No	Yes	Yes

Source: Oxera.

[124] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 2.29, available here.
[125] Ofgem does not include the infrequent-issuer premium for embedded debt, otherwise actual debt costs would dilute incentives to minimise debt costs.
[126] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, paras 2.14–2.16, available here.

5.3 Oxera assessment of implications for NZCC approach

To inform the views of the EDBs in engaging with the NZCC on its evolution of the regime in New Zealand, we comment on the NZCC's high-level approach to estimating the CoD. We consider that the NZCC could:

- consider using the same averaging period for the debt premium and the RFR;
- reduce the risks around recovering the costs of embedded debt by considering an extension of the averaging period for the debt premium and RFR;
- study the feasibility of adopting a direct indexation approach similar to that adopted by the AER and Ofgem.

We discuss each of these points in turn.

The averaging period used for the RFR and debt premium

The AER and Ofgem estimate the nominal CoD based on the yield of a selection of bonds issued by comparable companies (i.e. energy networks in the case of the AER and a broader set of utility companies in the case of Ofgem). The NZCC, however, estimates the RFR and debt premium separately, before combining them to arrive at its final CoD estimate. This use of a prevailing RFR, which has a three-month averaging period, and the historical debt premium, which is calculated as a five-year average, leads to a mismatch in the method by which the two elements of the CoD are calculated. This means that the NZCC's CoD reflects neither a five-year average nor a three-month average, but a hybrid average where the CoD allowance is likely to reflect the actual cost of raising debt at some point in the past three months to five years. As this CoD does not reflect the actual yield that an EDB would pay on its debt, we consider that the NZCC could adjust the tenors of the RFR and debt premium so that they match.

Risks around recovering the cost of embedded debt

Furthermore, the NZCC considers a relatively short averaging period, of five years compared to ten years (AER) and 17 years (Ofgem). Based on data provided to Oxera by the EDBs we worked with on this report, the mean tenor of the debt that EDBs raise is 8.5 years. Thus, if the interest payments on debt issued more than five years ago are materially different to the hybrid average that the NZCC calculates, the EDBs will be either over- or undercompensated. Specifically, if the CoD is higher in the period prior to the last five years, the NZCC's methodology will undercompensate the EDBs, and if lower in the period prior to the last five years, it will overcompensate EDBs.

To assess the likelihood of this, we investigated whether the debt premium in New Zealand was higher before 2017 than it is now. If it is, even a five-year methodology (i.e. whereby both the RFR and debt premium are averaged over five years) would result in the CoD allowance being insufficient to compensate EDBs for the interest they are paying on older debt.

Figure 5.1 shows that for debt issued between 2013 and 2017 this is unlikely to be the case. This is because the debt premium in this period is roughly similar to the debt premium in the past five years. However, prior to 2013 the debt premium is considerably higher, indicating that debt issued prior to 2013 could be under-remunerated by the current approach taken by the NZCC.

Figure 5.1 Average debt premium of the outstanding vanilla NZD-denominated bonds issued by the big six EBDs

Note: The debt premium is calculated by subtracting the maturity-matching RFR from the yields on EDB bonds. The EDB bonds include all outstanding NZD-denominated vanilla bonds (i.e. excluding callable and puttable bonds) issued by Aurora, Orion, Powerco, Unison, Vector and Wellington Electricity. The yield curve for the RFR is linearly interpolated based on the benchmark yield curve from Eikon.

Source: Oxera analysis based on data from Eikon and Bloomberg.

One practical solution to this would be to extend the time period over which the CoD is calculated, from the three-month to five-year hybrid used by the NZCC to an approach that calculates the average yield over a longer period of time, such as the ten years considered by the AER or the 17 considered by Ofgem. We note that the Italian energy regulator, ARREA, has also adopted an averaging period of ten years.[127]

Alternative solutions were also considered by other regulators. For example, the Northern Ireland Utility Regulator (UR)'s GD17 price control allowed for a weight to the actual cost of embedded debt, in assessing the allowed CoD in its 2017–22 price control period.[128]

Risks around volatility of cost of debt parameters

Figure 5.1 above shows that there is substantial volatility in the debt premium. We also discussed, with regards to the RFR, that there has been an increase in the level of volatility, in relation to interest rate movements since the 2016 IM (see for example, Figure 2.1). This implies that, during a price control period, the overall yield on debt that the EDBs need to issue could materially depart from the allowance set at the start of the price control period.

One solution to mitigate the impact of volatile debt yields could be to index the CoD allowance, which would help reduce the networks' exposure to the high

[127] See Oxera (2022), 'Addendum to the methodological review of the cost of capital estimation', 11 February, p. 3.
[128] Utility Regulator (2016), 'Price Control for Northern Ireland's Gas Distribution Networks GD17', 15 September, para 10.48.

level of movement in market rates. This would be consistent with the approach adopted by the AER and Ofgem.

6 Combining the cost of debt and the cost of equity into the WACC

After calculating the CoE parameters discussed in sections 2, 3, and 4, the NZCC combines them into the CoE. The most common method for doing this is through the CAPM. Other methods—such as dividend discount models, multifactor regressions and asset risk premium—are generally used as cross-checks on the CAPM framework.

The specific approach taken by the NZCC, the simplified Brennan–Lally CAPM framework,[129] calculates the CoE as follows:

$$K_e = RFR + B_e * TAMRP$$

where K_e is the CoE and B_e is the equity beta. This CoE calculation is very similar to that in the traditional CAPM, except that the TAMRP is adjusted for the tax borne by equity investors.

This section sets out how the NZCC combines the CoD and CoE into the WACC. It therefore first discusses the NZCC's approach to calculating the notional leverage for regulated networks (section 6.1) and then the tax adjustments it makes to the WACC (section 6.2).

6.1 Leverage

Financial leverage ('gearing') ratios measure the extent to which a company is financed through borrowing. In the context of WACC-setting for regulated utilities, it is used to: (i) de-lever the equity beta; and (ii) assign weights to the CoE and CoD before combining them into the final WACC estimate.

There are many considerations for regulators when estimating financial leverage. Two key ones, which we discuss in this section, are:

- the comparator sample, which determines the companies that are used to estimate the leverage of the EDBs;
- the time period over which the average gearing is calculated.

6.1.1 Approach taken by the NZCC

In its 2016 IM review, the NZCC stated that it had maintained its 2010 approach to estimating leverage, which is to select an efficient 'notional' level of leverage based on external comparators rather than using the actual leverage of service providers in New Zealand.[130]

The motivation behind its 'notional' leverage approach is that it helps to mitigate the possibility of perverse incentives arising out of the 'leverage anomaly' under the simplified Brennan–Lally CAPM framework. Specifically, Dr Lally found that the WACC estimated under the SBL CAPM, if left unmitigated, increases with leverage.[131, 132] Due to this, the use of service providers' actual

[129] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', para. 644, available here.
[130] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 547, available here.
[131] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 551, available here.
[132] Lally, M. (2009), 'WACC and Leverage', 17 November, p. 3, available here.

leverage could create incentives for service providers to take on more debt in the hope of receiving a higher WACC allowance.[133]

Specifically, the NZCC's notional leverage is estimated based on the ten-year average (2006–16 for the 2016 IM review) market gearing across its comparator set, which is calculated as the book value of net debt/(book value net debt + market value equity).[134] The comparator sample for leverage is identical to that used to estimate the equity beta, which includes 72 listed electricity and gas utilities based in New Zealand, Australia, the UK and the USA. The comparators were selected using a 'top-down' approach:[135]

- the NZCC started with all companies classified by the Industry Classification Benchmarks as 'Electricity', 'Gas Distribution', 'Pipelines, and 'Multiutilities';
- it then excluded any firms that it considered not to be sufficiently comparable, using its regulatory judgement;
- lastly it excluded one company for illiquidity, as measured by the percentage of days traded. The NZCC acknowledges, but does not adopt, the additional liquidity filters suggested by Oxera, which cover the average free-float percentage, average bid–ask spread percentage and average gearing.[136]

Based on this, the NZCC arrived at a notional leverage estimate of 42%.

6.1.2 Evidence from other regulators

The AER

Similar to the NZCC, the AER, in its June 2022 draft explanatory statement for the rate of return instrument, estimates five-, ten- and 16-year (2006–21) average market gearing across its comparator set, with a point estimate of 60%. The comparator set is selected based on regulatory judgement and the gearing estimate is based on analysis of average market gearing, measured in terms of the market value of equity and the book value of debt.[137]

The AER's comparator set covers five listed Australian energy networks, with only three comparators for the most recent five-year period. For the 2022–26 period, the comparator set may fall further, to one company, because two of the three companies used most recently have de-listed.[138] The AER accepts that it has a small sample size, which may limit the robustness of its leverage estimate. However, overall it concludes that the sample size of three is sufficient, although a sample of one 'may not best satisfy the criteria for sustainability and flexibility for changing market conditions in the future'.[139]

[133] Dr Lally explains that this anomaly occurs only because the NZCC does not assume a debt beta in its WACC estimate and that, if it could calculate an appropriately calibrated debt beta, this anomaly would disappear. Lally, M. (2009), 'WACC and Leverage', 17 November, p. 4, available here.
[134] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, paras 287 and 572, available here.
[135] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, paras 275–85, available here.
[136] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, para. 275, available here.
[137] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', 16 June, p. 77, available here.
[138] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', 16 June, footnote 119, available here.
[139] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', 16 June, pp. 78–79, available here.

It is important to note that the AER's comparator set does include one company (APA) with a large proportion (90%) of non-regulated revenue.[140] While the AER states that APA's gearing may be less relevant for assessing the risks of providing regulated services, it does not remove APA from its comparator set. As APA's gearing is very similar to the average gearing of the sample, removing it from the comparator set would make relatively little difference to the calculated gearing.[141]

Ofgem

Unlike the NZCC and the AER, Ofgem's notional gearing of 60% for RIIO-ED2 is largely based on regulatory judgement.[142] The 60% gearing level was a 5% reduction from the RIIO-ED1 and RIIO-T1 levels. Ofgem did not give precise reasoning for this, but did explain that networks were content with a 60% gearing, and the gearing ratios that Ofgem calculated were closer to 60% than 65%.[143] It also stated that, while most companies did not favour notional gearing above 60%, several argued that reducing notional gearing below 60% was not practical because it would not be feasible to raise the amount of equity needed to implement this change.

Therefore the 60% notional gearing decision may have been a matter of regulatory judgement rather than being based on specific market evidence.

Table 6.1 presents the key similarities and differences between the NZCC, the AER and Ofgem approaches for estimating gearing.

Table 6.1 Summary of regulators' approaches to gearing

	NZCC	AER	Ofgem
Sample size	72	3 to 5	5
Averaging period	10y	5-, 10- and 16-year	2-, 5- and 10-year
Use of regulatory judgement	Limited	Limited	Leverage is determined by regulatory judgement
Formula used	BV debt/EV	BV debt/EV	Net debt/RAV
Method	BV debt/(BV debt + MV equity)	BV debt/(BV debt + BV equity)	MV of equity, and both BV and MV of debt

Note: BV, book value; MV, market value.

Source: Oxera.

6.1.3 Oxera assessment of implications for NZCC approach

As noted at the outset of this report, there can be differences in regulatory approaches across jurisdictions—e.g. based on differences in market structure, regulatory duties, and the stability of the regulatory regime in the jurisdiction. As explained at the start of this section, to inform the views of the EDBs in engaging with the NZCC on its evolution of the regime in New Zealand, we comment on the approach that the NZCC could take with respect to:

- **the comparator set used to estimate leverage**. We recommend a sample that includes companies that are more similar to the New Zealand networks;

[140] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', 16 June, p. 78, available here.
[141] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', Table 4.2, available here.
[142] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, Table 31, available here.
[143] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para 5.39, available here.

- **the length of time used to calculate the leverage**. We consider that recent market evidence should be given priority over very long-term averages.[144]

The comparator set used to estimate leverage

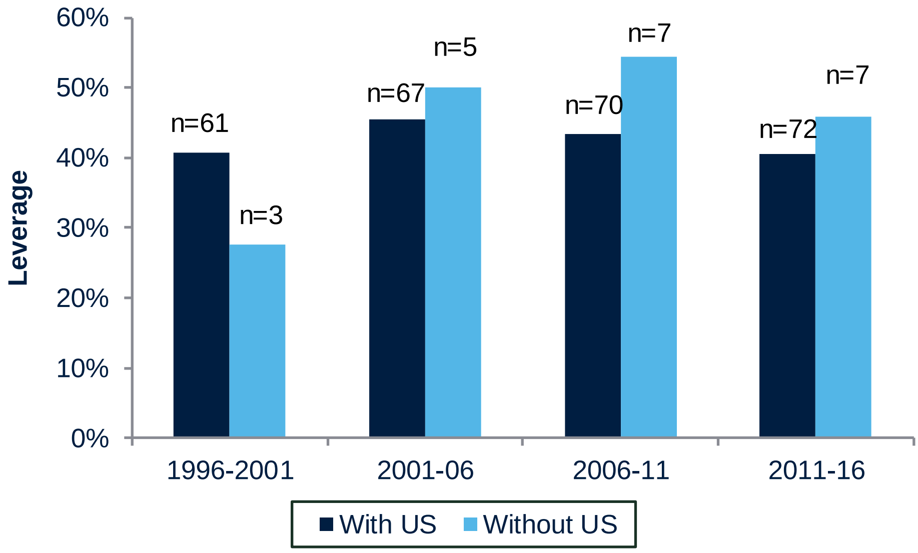
The composition of the NZCC's comparator set is significantly different from those of the AER and Ofgem. While the AER and Ofgem both included only listed domestic utility companies (in the AER's case, only listed domestic energy utilities), the NZCC's comparator set is more than ten times larger and comprises companies from various jurisdictions.

Although a small comparator set may not be optimal due to the higher probability of the gearing estimate being driven by noise, a large and unfiltered comparator set may also be problematic. Specifically, in the case of the NZCC, some of the US regulated utilities may be less comparable to the EDBs than others. We have already discussed potentially changing the comparator set in section 4.3 and so do not discuss this further here.

Refining the comparator set is likely to lead to a change in the notional leverage that is assumed by the NZCC. This can be seen from Figure 6.1, which shows that when US comparators are excluded, the mean leverage of the comparator sample increases in every time period considered by the NZCC, except for 1996–2001, but in this time period the sample size when US firms are excluded is very small and therefore potentially unreliable. When the three periods between 2001–16 are considered (i.e. when the sample of non-US comparators is five or more), the mean gearing across the sample increases from 43% to 50%. The effects of filtering out only some of the US comparators would depend on which comparators were selected.

[144] As was also mentioned in section 3.3, the reason why we suggest the NZCC should continue using a long time series for the TAMRP estimate, but focus on shorter-term estimates for other parameters, is because there is academic evidence to support that the total market return is relatively stable over time, such that using the full period for which reliable data is available should improve estimation accuracy.

Figure 6.1 Mean leverage of sample with and without US comparators



Note: Table 29 listed in the source below contains JEL LN Equity and NFG US Equity, both of which are filtered out of the analysis by the NZCC. The above Figure follows the NZCC's approach in excluding these companies from the leverage calculation.

Source: Oxera analysis based on NZCC (2016), 'Input Methodologies review decisions. Topic Paper 4: Cost of capital issues', Table 29, available here.

This increase in gearing without US comparators is also consistent with the use by the AER and Ofgem of a 60% gearing assumption.

The length of time used to calculate the leverage

We consider it appropriate for a regulator to consider primarily relatively recent gearing estimates, such as those from the last two to five years—within the 10-year period that NZCC presently considers. Since the gearing estimate is used as an input in 'relevering' the beta within cost of equity estimation, it is appropriate to consider alignment of the period over which gearing and betas are assessed. As with beta estimation, in the estimation of the gearing ratio, an appropriate balance may be to use primarily ratios calculated from data that is no more than ten years old with a focus on shorter periods, e.g. two- and five-years.

Box 6.1 CEPA update: leverage

The CEPA report adopted the same updated comparator sample for leveraging estimation as it did for asset beta estimation. The main change from the methodology adopted in the 2016 IMs is that leverage is now estimated based on five-year rather than ten-year averages.[145] This updated averaging period is now more consistent with the estimation period for asset beta. It also moves the averaging period for the leverage calculation closer to the more short-term time period that we suggested above.

[145] CEPA (2022), 'Review of Cost of Capital 2022/2023', p. 18, available here.

6.2 Tax

New Zealand and Australia have similar dividend imputation tax regimes. Local investors that receive a dividend payment from a company are given an imputation credit,[146] lowering the investors' income tax liability. As a result, the return on equity is taxed less than in other jurisdictions such as the UK.

The NZCC uses both a corporate tax rate and an investor tax rate in its WACC estimate, while the AER and Ofgem use only a single corporate tax rate in their respective methodologies. Below, we discuss the general approaches to tax adopted by each regulator.

6.2.1 Approach taken by the NZCC

The NZCC uses both the corporate and the investor tax rate in its IMs. The former is used to adjust the WACC to a post-tax estimate and the latter is used when adjusting the MRP estimates to take into account tax credit imputation (see section 3.1 for more on how the MRP is adjusted to calculate the TAMRP).

The corporate tax rate equals the statutory corporate tax rate, and is set at 28% in the current regulatory period.

The investor tax rate is assumed to be the maximum prescribed investor rate applicable at the start of the disclosure year of an investor who is resident in New Zealand and an investor in a multi-rate PIE.[147] Under the PIE regime, the maximum investor tax rate is equal to the maximum corporate tax rate, at 28%.[148]

6.2.2 Evidence from other regulators

The AER

The AER uses the corporate tax rate when uplifting equity returns in the DGM during the MRP cross-checks (see section 3.2).[149] The AER assumes the corporate tax rate to be equal to the statutory tax rate of 30%.[150]

Ofgem

Ofgem, in contrast to the NZCC and the AER, does not directly factor tax rates into its (real vanilla) WACC estimate; instead, it incorporates a separate tax allowance into allowed revenues. For the upcoming RIIO-2 regulatory period, the tax allowance consists of 'a notional tax allowance with a number of

[146] Imputation credits are based on the corporate tax paid by the company. The NZCC and the AER both assume that 100% of corporate tax paid can be received as a imputation credit.
[147] 'Under the PIE regime, individuals are able to limit their tax liability on interest earned to a maximum of the corporate tax rate. The NZCC acknowledges that there is a range of statutory tax rates for interest earned by individuals depending on their total taxable income. Using the maximum prescribed PIE rate is a useful proxy for estimating the average investor tax, which we note has little effect on the final allowed rate of return.' NZCC (2016), 'Input methodologies review decisions. Topic paper 4 Cost of capital issues', 20 December, para. 577, available here.
[148] NZCC (2016), 'Input methodologies review decisions. Topic paper 4 Cost of capital issues', 20 December, para. 576, available here.
[149] When cross-checking the HER MRP estimate with the DGM, the AER uplifts its dividend yield estimates by a factor that incorporates the corporate tax rate and the proportion of dividends that are affected by dividend imputation. The tax rate is set at the Australian corporate tax rate: 30%.
[150] AER (2013), 'Better Regulation Explanatory Statement Rate of Return Guideline (Appendices)', December, Footnote 530, available here.

additional mechanisms and protections in place' enabling Ofgem to monitor and review the tax allowance, if required.[151]

Ofgem has four mechanisms to deal with tax rate uncertainty throughout the regulation period:[152]

- a tax trigger mechanism that reflects changes in corporate tax rates, legislation or accounting standards;
- a tax clawback mechanism that claws back the tax benefit a licensee obtains as a result of gearing levels that are higher than assumed for the notional company;
- a tax reconciliation mechanism that requires companies to report annually a tax reconciliation between the notional allowance and actual tax liability (as per their most recent corporation tax returns), as well as an accompanying board assurance statement;[153]
- a tax review mechanism that enables Ofgem to formally review and adjust the companies' tax allowances during the regulatory period.

6.2.3 Oxera assessment of implications for NZCC approach

The NZCC incorporates dividend imputation credits into its WACC estimate, making international precedent less relevant when looking at the tax component itself.

Due to New Zealand's tax regime (dividend imputation), we cannot draw clear comparisons between the approaches to regulatory tax rates in New Zealand and the UK.

The Australian tax regime has more similarities to that in New Zealand due to the similar application of dividend imputation. However, the AER incorporates the impact of tax on equity returns in ways that are significantly different from the NZCC approach:

- the AER uplifts the market returns directly by imputation credit estimates in the HER model;
- the NZCC relies on the simplified Brennan–Lally CAPM, which adjusts the RFR with the investor tax rate before subtracting it from the market return estimate.[154]

Accordingly, unless the simplified Brennan–Lally CAPM model is altered or replaced, there is limited relevance for the NZCC to draw on insights from the AER's approach to tax.

[151] Ofgem (2022), 'RIIO-ED2 Sector Specific Methodology Decision: Annex 3 Finance', 11 March, para. 6.3, available here.
[152] Ofgem (2021), 'RIIO-2 Final Determinations – Finance Annex (REVISED)', February, paras 7.1–7.67, available here.
[153] The annual board assurance statement provides assurance over the appropriateness of the values on which the reconciliation is based.
[154] The NZCC uses the TAMRP to estimate the impact that dividend imputation has on investor equity returns.

7 Financeability assessment

Financeability refers to the ability of regulation to ensure that regulated companies can raise and repay capital in financial markets readily and on reasonable terms. It is typically tested by ensuring that certain key financial ratios that demonstrate an ability to repay debt investors are not violated as a result of the regulations proposed in a regulatory period. The assessment of financeability is a critical component of ensuring that a price control is in the public interest, given the potentially significant costs to users (and society) if the company experiences financial distress or it lacks the ability and the incentives to make efficient investments.

The NZCC currently does not perform any financeability assessment.

As we explained earlier, there is likely to be a greater need to ensure the financeability of regulated networks in future regulatory periods. This is because decarbonisation requirements mean that delays in the construction of electricity infrastructure, which could occur if networks are insufficiently funded, could have an outsized and adverse impact on society. Accordingly, as the economy electrifies, it is important to ensure adequate risk-adjusted remuneration for regulated networks. Conducting financeability testing is a relatively simple way to reduce the probability that networks are insufficiently funded.

This section first explains how the AER (section 7.1) and Ofgem (section 7.2) perform financeability assessments. Based on these two approaches, we explain in section 7.3 how the NZCC could integrate financeability assessment into its approach to determining the WACC. The purpose of this discussion is to facilitate engagement between the EDBs and the NZCC as part of the forthcoming review of IMs.

7.1 Approach adopted by the AER

The AER adopts a relatively simple framework for financeability, treating it as one of the six cross-checks for its estimates of the rate of return. It focuses exclusively on the metric 'funds from operations (**FFO**)/net debt', which measures debt financeability.[155] No analysis is conducted on other debt financeability metrics or equity financeability (in contrast to the more detailed approach adopted by Ofgem, which we discuss in section 7.2).

It may be that the AER adopts a more limited financeability assessment because it considers that financeability plays only a 'contextual' role. Notably, the AER acknowledges that its financeability analysis is limited for the following reasons.[156]

- The AER does not include any subjective considerations that are taken into account by rating agencies, nor does it simulate an overall credit score.
- The FFO/net debt metric calculated by the AER for the regulated utilities is assessed against a benchmark of 7%, which the AER describes as 'subjective'. More generally, the AER does not consider there to be a universally acceptable methodology for conducting a financeability assessment. We note that the 7% benchmark used by the AER does not

[155] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', p. 24, available here.
[156] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', pp. 24 and 268, available here.

satisfy Moody's requirement for an investment-grade rating for this sub-factor,[157] where an FFO/net debt ratio of above 11% is required.

- Regulated firms actively choosing a higher level of debt could worsen debt financeability.
- There is a lack of clarity about the AER's role in addressing financeability issues.
- There may be differences in how rating agencies and regulators assess cash flows.

In addition, the AER notes that whether the costs of an actual or notional regulated utility should be used is unclear. However, its view is that financeability should be conducted on a notional basis because the purpose of regulation is to provide an efficient allowance for a benchmark firm, and not for a (potentially) inefficient firm.[158]

7.2 Approach adopted by Ofgem

Compared to the AER, Ofgem adopts a more detailed approach to financeability, which helps mitigate some of the concerns the AER raised about financeability assessment. The implementation of this approach is motivated by the definition of Ofgem's statutory duties in ensuring the financeability of service providers; namely, Ofgem must have regard to the need to secure that licence holders are able to finance the activities that are the subject of obligations on them.[159] These duties are set out in UK legislature, specifically Section 3A of the Electricity Act 1989 and section 4AA of the Gas Act 1986.[160]

Having recognised concerns similar to those of the AER (i.e. the lack of a simple and universally acceptable methodology for assessing financeability), Ofgem grounded its financeability assessment on the financial ratios and rating methodologies defined by the rating agencies, with minor adjustments to make them fit for purpose in the regulatory context. The financeability assessments are performed primarily on a notional efficient operator in the relevant sector. This approach helps mitigate the concerns that the actual companies might be inefficient. Appendix A3 summarises the metrics used by Ofgem and the credit rating agencies, and shows that they are very similar, although there are some instances where Ofgem uses additional metrics that the rating agencies do not consider.

7.3 Oxera assessment of implications for NZCC approach

As discussed in the sections above, the AER and Ofgem have both acknowledged the usefulness of financeability assessments. The differences in the approach to financeability between these two regulators reflect a trade-off between accuracy and simplicity. Ofgem may have adopted a more detailed approach because it has a statutory duty to ensure the financeability of regulated networks, whereas we understand that no such clear statutory duty exists in Australia. Despite this, it is notable that the AER still considers financeability an important consideration.

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[157] For example, Moody's, in its 2017 rating methodology for Regulated Electric and Gas Networks, assigns a Ba (below investment grade) rating to companies with FFO/net debt between 5% and 11%. See Moody's (2017), 'Regulated Electric and Gas Networks', 16 March, p. 19.
[158] AER (2022), 'Draft Rate of Return Instrument: Explanatory Statement', p. 268, available here.
[159] Ofgem (2022), 'RIIO-ED2 Draft Determinations – Finance Annex', 29 June, para. 5.1, available here.
[160] Ofgem (2019), 'Financeability Assessment for RIIO-2: Further Information ', 26 March, Slide 4, available here.

Irrespective of whether the NZCC chooses an approach that is more similar to Ofgem's or the AER's, introducing a financeability assessment will require the NZCC to make decisions on three issues:

- whether the assessment should be based on an actual or notional company (section 7.3.1);
- which credit rating the regulator should target (section 7.3.2);
- what metrics should be used to assess whether the regulatory package allows the regulated utility to finance its operations (section 7.3.3).

7.3.1 Should the assessment be based on an actual or notional company?

A key aspect of regulatory financeability tests is the nature of the company (or companies) whose financeability is modelled. These tests can be based on an actual or notional company. If a notional company is selected, its capital structure and debt portfolio needs to be determined.

Both Ofgem and the AER perform their financeability assessment for a notional company. For the financeability assessment to be meaningful, this notional company should be 'exogenously' defined based on robust evidence of the notionally efficient financing structure. However, it is also important for the regulator to consider whether the notionally efficient structure is achievable. This reflects the views of the CMA, which considers that there is limited value in conducting financeability assessments on companies whose characteristics cannot be achieved by firms actually operating in the sector.[161] Due to this, if there are substantial differences between some regulated utilities and the notional company, the regulator could consider running financeability tests on the actual company, potentially also allowing for its characteristics to gradually converge to those of the notional company over time. Accordingly, financeability assessment could be based on a notional company basis but informed by market evidence such as the EDBs' actual capital structures. To the extent that the NZCC already has financial models for each of the EDBs, checking the financeability of actual companies may be achievable at relatively low cost.

7.3.2 What credit rating should be the regulator target?

Regulators generally accept that a financeable company should be able to secure a 'comfortable/solid' investment-grade credit rating.[162] This reflects the fact that borrowing costs tend to be much higher for firms with sub-investment-grade ratings. A 'comfortable/solid' investment-grade rating has been defined in different ways, and regulators have increasingly relied on companies to

[161] The CMA followed this principle in its PR19 redetermination: 'the actual credit ratings will be influenced heavily by the ability of the water companies to achieve the cost and outcomes targets set for AMP7. It is therefore important to consider whether the assumptions made about costs and outcomes are likely to be achievable in practice, and whether the balance of risk for the companies is consistent with those credit ratings'. Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report', 17 March, para. 10.73 (d), available here.
[162] For example, in RIIO-ED1 Ofgem stated: 'We generally assume that a DNO will be financeable if it can maintain an investment grade credit rating and we test to see whether our decisions will make it unduly difficult for a DNO to do this.' Ofgem (2014), 'RIIO-ED1: Draft determinations for the slowtrack electricity distribution companies', p. 41, para. 5.22. In RIIO-GD/T2, Ofgem targeted the credit rating two notches above the investment grade: 'At Draft Determinations, we indicated that we were comfortable with network companies' suggestions of target credit quality of two notches above investment grade (which provides headroom over their investment grade licence obligation). This remains our position…' Ofgem (2020), 'Decision - RIIO-2 Final Determinations – Finance Annex (Revised)', 3 February, para. 5.36, available here.

provide their own analysis and assurance around the appropriate target rating. However, it has been common practice across companies (and regulators) to target a credit rating two notches above investment grade (i.e. BBB+/Baa1).

The use of BBB+ rated bonds is consistent with the approach adopted by the NZCC in assessing the debt premium, as only BBB+ bonds are used in the sample to estimate this (see section 5.1). This was also the case for all GB transmission and gas distribution networks in the RIIO-GD/T2 regulatory review, as well as for the water networks in England and Wales in PR19.[163] The CMA used the same BBB+/Baa1 target credit rating in its PR19 redeterminations.[164]

Based on this, a BBB+ credit rating seems appropriate for the NZCC to target.

7.3.3 What metrics should be used and how?

We consider that it is appropriate for regulators to apply the same metrics that are used by the credit rating agencies in performing financeability assessment. This is because the rating assigned by the credit rating agencies reflects and (may in turn affect) the rate at which companies can raise debt and their ease of access to debt markets. In the UK, the credit rating also determines whether a licensee satisfies its licence requirement to maintain an investment-grade credit rating.

Both the AER and Ofgem apply the same metrics as the credit rating agencies, as Ofgem considers a number of financial metrics while the FFO/net debt metric used by the AER is also used by a number of the credit rating agencies.[165] However, the approach taken by Ofgem is closer to that adopted by the credit rating agencies, which consider several metrics and factors. The range of factors considered by Moody's is summarised in Table 7.1 below,[166] which clearly cannot be replicated through the consideration of a single ratio, as the AER does.

[163] Ofgem noted that all networks assured their business plans on the basis of a target rating of at least BBB+/Baa1. See Ofgem (2020), 'RIIO-2 Draft Determinations – Finance Annex', 9 July, para. 5.6, available here. Similarly for PR19, according to Ofwat, all water companies assessed notional company financeability in terms of BBB+/Baa1, and this formed the basis of Ofwat's assessment. See Ofwat (2019), 'PR19 final determinations: Aligning risk and return technical appendix', December, p. 78, available here.
[164] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations. Final report', 17 March, para. 10.100, available here.
[165] See Appendix A3.
[166] We refer to Moody's as Ofgem's approach and metrics are based on Moody's rating methodology.

Table 7.1 Moody's rating methodology for regulated energy networks

Factors	Factor weighting	Sub-factors
Regulatory environment and asset ownership model	40%	Stability and predictability of regulatory regime (15%) Asset ownership model (5%) Cost and investment recovery (ability and timeliness, 15%) Revenue risk (5%)
Scale and complexity of capital programme	10%	
Financial policy	10%	
Leverage and coverage	40%	AICR *or* FFO interest coverage (10%) Net debt/RAV *or* net debt/fixed assets (12.5%) FFO/net debt (12.5%) Retained cash flow/net debt (5%)

Note: AICR, adjusted interest cover ratio.

Source: Moody's (2022), 'Rating methodology: Regulated electric and gas networks', 13 April, p. 3, available here.

Once the NZCC decides on the metrics that it wants to assess, it needs to consider the thresholds to set for those metrics. Although financial ratios do not determine 100% of the final issuer credit rating, the credit rating agencies provide guidance on minimum thresholds for key ratios.

Table 7.2 shows Fitch's and Moody's credit ratio threshold guidance. The NZCC could use these thresholds, although it may not be advisable to apply only the lower end of the thresholds. This is because the rating agencies also exercise a degree of discretion when rating a company. Therefore, if regulated utilities are only narrowly meeting the benchmarks for the various credit ratings, there is a risk that the application of discretion could lead the utility to have its rating reduced.

Table 7.2 Indicative ranges by the credit rating agencies for sub-ratings and credit ratings

Credit metrics	Fitch Sub-rating: BBB	Moody's Sub-rating: Baa	Moody's Company rating: Baa1
Net debt/RAV (%)	60–70%	60–75%	68–75%[1]
AICR (x)/cash PMICR (x)	1.6–2.2	1.4–2.0	1.4–1.6[1]
Nominal PMICR (x)	1.8–2.5		
FFO (interest expense)/net debt (%)		11–18	
Retained cash flow/net debt (%)		7–14	

Note: PMICR, post-maintenance interest coverage ratio. It is important to distinguish between thresholds that define the rating of a ratio as a sub-factor (a 'sub-rating') and those that trigger a change in the overall rating of the company. Sub-ratings are averaged across the factors using sub-factor weightings, to determine an overall rating of the company—this is the way in which sub-ratings have an impact on the overall credit rating of the company.

Source: Moody's (2022), 'Rating methodology: Regulated electric and gas networks', 13 April, p. 6, available here. Fitch (2022), 'Sector Navigators: Addendum to the Corporate Rating Criteria', 15 July, p. 204, available here. Moody's (2020), 'RIIO-2 Draft Determinations webinar', 9 September, p. 16.

It may be prudent for the NZCC to consider any trends over time in its financeability testing, as measured by the credit metrics calculated for the EDBs. This is because passing the credit metrics (i.e. receiving a score for a credit metric that is 'better' than the Baa1/BBB+ benchmark) on average across a regulatory period but with a downward trend could indicate that an EDB's credit rating may be at risk of downgrade towards the end of the regulatory period.

In addition, while the credit rating agencies' methodologies give an indication of debt financeability, they do not cover equity financeability—i.e. the extent to which the price control provides an equity return that appropriately remunerates investors given the risk of the investment. As the regulated networks finance themselves through a combination of debt and equity, this is an important component of ensuring that the networks can finance their activities. Accordingly, in the context of a regulated period, the NZCC may also need to consider the adequacy of the equity return accruing to equity investors, for example using ratios such as EBITDA/RAV or the return on regulated equity, as Ofgem does.[167]

[167] See Appendix A3 for further information on metrics that can be used to assess equity financeability.

8 Conclusion

In this review we have compared the approach taken by the NZCC to setting the WACC with that of other regulators and academic research. At various points, we have also reviewed capital market evidence to help inform our conclusions.

Where we have identified that the NZCC's approach differs from that of other regulators or academics, we have offered suggestions for the issues on which the EDBs could engage with the NZCC, and how the NZCC could evolve its methodology in the next IM.

The risk-free rate

With regard to the RFR, we have considered four main areas:

- whether the five-year benchmark bond maturity considered by the NZCC should be revised. We find that assessing evidence on a range of maturities (for government bonds with maturities between five and 20 years) could be appropriate—for example, to allow for relatively long investment horizons for network assets;
- whether the yields on corporate bonds should be included in the calculation of the RFR. We find that a convenience yield premium, anchored on academic research and regulatory precedent, could justify calculating the RFR as the average across government and high-quality non-government bonds;
- the extent to which the current three-month averaging period is appropriate, given the evidence on interest rate volatility. We consider the current three-month approach to be appropriate in the context of the CoE estimation, but discuss why it could be refined when estimating the CoD parameter;
- the role of (annual) indexation and/or other measures that reduce investors' exposure to market movements in government bond yields. Given the increase in the volatility of New Zealand government bond yields since the last IM and the increase in yields in recent years, we find that the NZCC could consider indexing the RFR over the regulatory period. This would reduce the risk that yields on government bonds move away significantly from the RFR that was estimated before the start of the regulatory period.

The tax-adjusted market risk premium

With regard to the TAMRP, we have considered five areas:

- the amount of weight that should be placed on methods that assume a constant TAMRP. We find that academic evidence and Ofgem's precedent supports the use of a variable TAMRP,[168] and therefore that the NZCC could consider reducing the weight it places on models that assume a constant TAMRP;
- the amount of weight that the NZCC places on two specific sources that it considers: the DGM and survey data. We find that there are no material issues with the use of DGMs, while survey data could be used as a cross-check rather than primary source for TAMRP calculation;

[168] Alternatively this can be expressed as: the TMR return is a largely stable parameter over time.

- whether a geometric or arithmetic mean should be used to estimate the TMR from which the TAMRP is derived. We find that the use of the arithmetic mean is more appropriate;
- the time period that the NZCC uses to estimate the TAMRP. We find it appropriate that the NZCC's current approach is consistent with using the longest available time series that contains reliable data;
- the level of rounding that the NZCC applies to estimates of the TAMRP. We find that the NZCC could consider adopting a more granular rounding approach, similar to those used by the AER and Ofgem.

The equity beta

We have considered four issues in our discussions of the equity beta:

- the sample size used by the NZCC. We find that the NZCC uses a larger sample than other regulators and there is therefore a risk that many of the comparators are dissimilar to the EDBs. It may therefore be appropriate for the NZCC to consider a smaller sample;
- the length of the estimation period. We find that the NZCC could consider placing more weight on medium-term (two- to five-year) equity beta estimates;
- the frequency of observations. We consider that if the NZCC's sample is liquid, it could use daily observations, while if the NZCC needs to keep illiquid companies in its sample, it could use weekly observations;
- use of COVID data—we consider that evidence from the COVID period provides useful information regarding the exposure of EDBs to systematic risk and could therefore be included in the equity beta calculation.

The cost of debt

We have considered three issues related to the cost of debt:

- whether it is appropriate to combine an RFR that is based on a three-month average with a debt premium that is based on a five-year average. We find that the NZCC could consider matching the averaging period of the RFR and debt premium in its CoD estimation;
- whether the averaging period that is currently used (between three months and five years) is sufficiently long. We find that this time period may not allow the EDBs to be adequately compensated for older embedded debt that was raised more than five years in the past;
- whether the CoD could be indexed. As noted above, increased volatility in interest rates as well as the upward movement in rates in recent years have increased the risk exposure of the EDBs. Given the length of time that elapses between a WACC re-set in New Zealand, we find that indexing the CoD could help to reduce the networks' exposure to movements in market rates.

Leverage

With regard to leverage, we have considered two areas:

- the sample size used by the NZCC. As noted in the context of beta estimation, we find that the NZCC uses a larger sample than other regulators and there is therefore a risk that many comparators are dissimilar to the EDBs. It may therefore be appropriate for the NZCC to consider a smaller sample;
- whether a ten-year averaging period is appropriate. We find that the NZCC could consider placing more weight on more recent data in its analysis. Since the gearing estimate is used as an input in 'relevering' the beta within cost of equity estimation, it is appropriate to consider alignment of the period over which gearing and betas are assessed. Therefore, an appropriate balance may be to use primarily ratios calculated from data that is no more than ten years old with a focus on shorter periods, e.g. two- and five- years, aligning with the estimation periods for beta.[169]

Tax

Under the simplified Brennan–Lally CAPM, tax is used to adjust both the CoD by the corporate tax rate and the CoE by the investor tax rate. There is limited read-across from the approaches taken by other regulators to tax because the tax regime in New Zealand is unique, as is the use of the simplified Brennan–Lally CAPM. We therefore do not comment on whether the NZCC could adjust its methodology in respect of tax.

Financeability

We find that the introduction of a financeability test is timely, as decarbonisation requires higher levels of electrification of the economy. Any delays to this, which might be caused by insufficient funding, could have material adverse impacts on New Zealand's ability to achieve net zero by 2050.

Key considerations for the NZCC when deciding how to implement financeability tests are as follows.

- **Deciding whether its assessment should be based on a notional or actual company**. We consider that a notional approach is appropriate, but the NZCC may also want to ensure that any networks whose capital structures depart from the notional company are still financeable, at least during a period of time when the NZCC considers the actual companies may be adjusting their capital structures to match the notional company. Accordingly, financeability assessment could be based on a notional company basis but informed by market evidence such as the EDBs' actual capital structures.
- **Deciding on what credit rating to target**. The NZCC currently considers bond yields rated BBB+ for its debt premium assessment. This is consistent with the assumed credit rating for regulated networks in the UK and Australia; the NZCC may consider this an appropriate benchmark rating.
- **Deciding which metrics to use to assess the credit rating, and what benchmarks to apply to them.** Depending on the comprehensiveness of its financeability assessment, the NZCC may want to consider a large or small number of financeability metrics. It may then be appropriate for the NZCC to use benchmarks that match those used by the credit rating

[169] The NZCC should also, where possible, seek consistency between the period of beta estimation and the estimation of leverage, since the leverage estimate is used to de-lever the market equity beta.

agencies. It may also be appropriate for the NZCC to exercise some judgement in aiming for more than a narrow passing of financeability tests, as a narrow pass could indicate that if market conditions change by a small amount, an EDB could face higher debt costs.

Box 8.1 CEPA update: implications for our conclusion

CEPA has largely performed a mechanical update of the NZCC's approach, with a specific focus on the equity beta analysis. We therefore consider that many of the comments we had on the NZCC's approach apply to CEPA. Specifically:

- with respect to the comparator sample, which affects both equity beta and leverage, we consider that it could be refined to reflect a sample of utilities that are more similar to New Zealand EDBs;
- with respect to equity beta, we consider that more weight could be placed on daily beta estimates from more recent time periods;
- with respect to leverage, the reduction of the averaging period from the most recent 10 to the most recent 5 years is consistent with our suggestions for placing more weight on a shorter-term averaging window, unless there are data quality issues, as discussed.

A1 Evidence on the convenience premium and its size

A1.1 Academic and empirical evidence

A substantial amount of evidence from the academic literature explicitly supports the use of an RFR for the CAPM that is higher than the yield on government bonds. For example, Krishnamurthy and Vissing-Jorgensen (2012) conclude that:[170]

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

Berk and DeMarzo (2014) also explain that:[171]

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

According to Feldhütter and Lando (2008), the magnitude of the convenience premium varies over time and can range from 30bp to 90bp.[172] They explain the convenience premium as follows:[173]

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

Similarly, Krishnamurthy and Vissing-Jorgensen (2012) estimate the average of the liquidity component of the convenience premium to be 46bp from 1926–2008.[174] Ofwat has also helpfully noted that Van Binsburgen et al. (2020) estimate a convenience premium of around 40bp on US government bonds over 2004–18.[175]

A Bank of England study finds that some investor groups in UK government bonds display the behavioural properties that theory associates with preferred-habitat investors.[176] It concludes that these groups of investors, which comprise institutional investors such as life insurers and pension funds, are less sensitive to price movements than other investor groups. This empirical finding is consistent with the academic theories underlying the convenience premium, where investors have reasons to hold government bonds and these

[170] Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), 'The Aggregate Demand for Treasury Debt', *Journal of Political Economy*, **120**:2, pp. 233–67.
[171] Berk, J. and DeMarzo, P. (2014), *Corporate Finance*, third edn, Pearson, p. 404.
[172] Feldhütter, P. and Lando, D. (2008), 'Decomposing swap spreads', *Journal of Financial Economics*, **88**:2, pp. 375–405.
[173] Feldhütter, P. and Lando, D. (2008), 'Decomposing swap spreads', *Journal of Financial Economics*, **88**:2, p. 378.
[174] Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), 'The Aggregate Demand for Treasury Debt', *Journal of Political Economy*, **120**:2, pp. 233–67.
[175] Van Binsbergen, J.H., Diamond, W.F. and Grotteria, M. (2022), 'Risk-free interest rates', *Journal of Financial Economics*, **143**:1, pp. 1–29.
[176] Giese, J., Joyce, M., Meaning, J. and Worlidge, J. (2021), 'Preferred habitat investors in the UK government bond market', Bank of England Research Paper Series, 10 September, available here.

reasons go beyond the rate of return expected on these instruments. It also further supports the existence of a convenience premium in the UK.

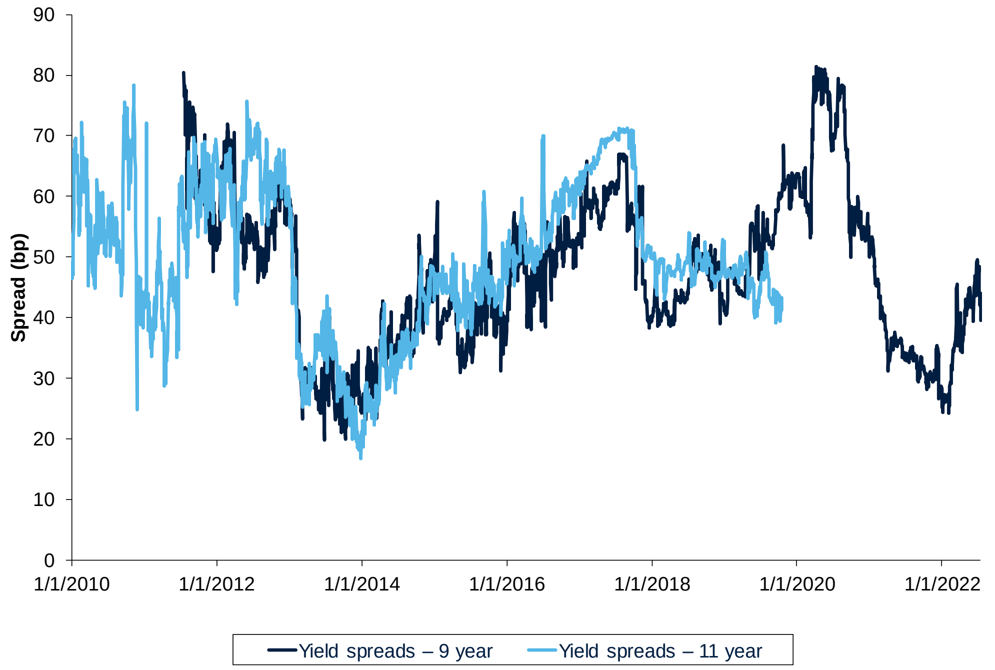
Koijen and Yogo (2020) develop a pricing model to study sources of variation in exchange rates, long-term yields, and stock prices across 36 countries from 2002 to 2017.[177] Their model finds that, in the absence of special-status demand for US assets by foreign investors and foreign exchange reserves, the US long-term yield would be 215bp higher. In other words, the authors find evidence consistent with a significant convenience premium for US Treasuries between 2002 and 2017.

Longstaff (2004) also examines the 'flight to liquidity' premium in Treasury bond prices by comparing them with the prices of bonds issued by the Resolution Funding Corporation (REFCORP), a US government agency, which are guaranteed by the US Treasury.[178] Using yield data from April 1991 to March 2001, Longstaff finds a premium in Treasury bonds relating to: changes in consumer confidence; the amount of Treasury debt available to investors; and the flows into equity and money market mutual funds. Longstaff concludes that these features of Treasury bonds directly affect their value.

Using a methodology broadly consistent with that set out in Longstaff (2004), we also estimate the size of this premium since 2010. Figure A1.1 below shows that the long-term convenience premiums implied by the spreads of nine- and 11-year REFCORP bonds from 2010 to date are on average 47bp and 50bp respectively. It can be seen that the 11-year spreads reduced significantly in early 2020 when the COVID-19 pandemic began, but at the start of January 2022 this reversed and the spreads are now trending upwards.

[177] Koijen, R.S. and Yogo, M. (2020), 'Exchange rates and asset prices in a global demand system', No. w27342, National Bureau of Economic Research.
[178] Longstaff, F.A. (2002), 'The flight-to-liquidity premium in US Treasury bond prices', No. w9312, National Bureau of Economic Research.

Figure A1.1 Evolution of yield spreads of nine- and 11-year zero-coupon REFCORP bonds strips since 2010



Note: Assumes a cut-off date of 1 July 2022. The yield spreads at a given point in time are calculated by averaging the daily spreads across all outstanding REFCORP bond strips with maturities equal to the target maturities at that time (i.e. nine- and 11-year). The spreads are calculated based on the USD US Treasury bonds/notes (FMC 82) zero coupon yield curve, which has maturities available at yearly intervals between one and ten years, and at 15, 20 and 30 years. The gaps between these maturities are linearly interpolated.

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

Source: Oxera analysis using Bloomberg data.

A1.2 Regulatory precedents

The CMA, in its final decision for the PR19 redetermination, observes that ILGs closely match the key requirement of the RFR. At the time, the UK government enjoyed a strong credit rating of AA/Aa3 (which is lower than New Zealand's rating of AA+/Aaa), and as a sovereign nation has monetary and fiscal levers to support debt repayment that are not available to commercial lenders.[179]

In considering whether highly rated, non-government bonds may improve the RFR estimation in the context of WACC determination, the CMA assessed the IHS iBoxx UK non-gilt AAA 10+ index and the IHS iBoxx UK non-gilt AAA 10-15 index.[180] It concluded that the constituents of these indices are not 'risk-free' in the same way as government bonds denominated in the home country's currency are. This is because investors in these non-government bonds still

[179] CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report', para. 9.103, available here.
[180] CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report', para. 9.145, available here.

bear liquidity risks, as well as the additional default risks associated with the issuer. That said, the CMA recognised that the default risks of these high-quality bonds are exceptionally low, and evidence from actual performance suggests that the expected loss is significantly lower than the debt premium.[181] As a result, the CMA concluded that the yields on AAA-rated non-government bonds are suitable inputs to the RFR estimation.[182]

The allowance for the convenience of government bonds is also not a novel concept in the context of international energy regulation. For example, the Italian energy regulator, ARREA, has allowed for a convenience premium of 100bp.[183] The German federal network agency, Bundesnetzagentur, has also implicitly allowed for an adjustment for convenience premium since 2005.[184] Specifically, Bundesnetzagentur, in its cost of capital determination for regulated energy networks, uses 'yields on debt securities outstanding issued by residents'[185] as a proxy for the RFR. The official regulatory consultation published in 2021 explained that this designated index includes some corporate bonds and bank bonds.[186]

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181 CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report', para. 9.146, available here.
182 CMA (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report', para. 9.162, available here.
183 ARREA (2021), 'L'Autorità di Regolazione per Energia Reti e Ambiente', 23 December, p. 7, available here.
184 Bundesnetzagentur (2021), 'Verordnung über die Entgelte für den Zugang zu Elektrizitätsversorgungsnetzen (Stromnetzentgeltverordnung - StromNEV)', para. 7, available here.
185 Official English translation by Bundesbank. 'Umlaufsrenditen inländischer Inhaberschuldverschreibungen / Insgesamt / Monatswerte' (in German).
186 Bundesnetzagentur (2021), 'Verordnung über die Entgelte für den Zugang zu Elektrizitätsversorgungsnetzen (Stromnetzentgeltverordnung - StromNEV)', Abs. 6 StromNEV/GasNEV, p. 5, available here.

A2 Detailed descriptions of the NZCC's models for estimating the TAMRP

A2.1 Ibbotson model

In the Ibbotson model, Dr Lally first estimated the historical yearly arithmetic average equity returns for New Zealand, through the returns on the NZX50 Gross index, from 1931 to 2014.[187] To address data availability constraints, Dr Lally first estimated the yearly TAMRP estimate by subtracting the yearly market return by the tax adjusted ten-year government bond rate averaged over the respective year.[188] Further adjustments are made to the RFR component of this TAMRP estimate to ensure consistency with a five-year regulatory period. Specifically, to account for the lower risk of the shorter-term risk-free rate, Dr Lally added the tax-adjusted average differential between the five- and ten-year government bonds to the previously estimated average TAMRP estimate.[189]

For the other markets, Dr Lally took the arithmetic average of the yearly MRP estimates, calculated based on yearly TMR and the ten-year average RFR, of 20 developed countries from 1900 to 2014, based on the Dimson et al. (2015) dataset.[190] Subsequently, Dr Lally adjusted this average MRP to ensure consistency with a five-year regulatory period and dividend imputation.[191]

Dr Lally found a TAMRP estimate of 7.1% for New Zealand and 7% for the other markets. These estimates equal the median of all five estimation models for New Zealand and other markets respectively. The NZCC has discussed feedback from stakeholders regarding the Ibbotson approach. In 2019, Dr Lally estimated the TAMRP for the purposes of setting IMs for Part 6 of the Telecommunications Act 2001 and identified a mathematical error in his previous estimation of the market returns in his 2015 report. He determined that the error did not affect the final result, when rounded up to the closest 0.5%. In addition, he updated the New Zealand sample to include data up to 2018, and found an updated TAMRP of 7.5%, up 0.5 percentage points from the 2015 estimation. The NZCC adopted this higher estimate of 7.5% in the gas distribution and transmission IMs and has signalled, in the absence of methodological changes, that the next regulatory period of ED would also be adjusted to the new estimate.[192]

[187] The NZX50 Gross index returns are adjusted to exclude imputation credits.
[188] A New Zealand five-year RFR is not available before 1985. The ten-year government bond rates are based on rates from the New Zealand Reserve Bank, available here.
[189] The average differential estimate comprises two elements: from 1985 to 2014 it is the difference between New Zealand's average government five-year bond rate and the ten-year rate, adjusted for tax imputation; from 1931 to 1985, US data is used—specifically, the difference between the five-year Treasury constant-maturity bond (GS5) and the Treasury ten-year constant-maturity bond (GS10). The average differential over the period 1931–2014 is 0.08% and the tax-adjusted differential is 0.568%. By adding this tax-adjusted differential to the TAMRP estimate, Dr Lally adjusts it for the additional risk of a five-year period over a ten-year one.
[190] Dimson, E., Marsh, P. and Staunton, M. (2015), 'Credit Suisse Global Investment Returns Sourcebook 2015', Credit Suisse, February, available here.
[191] The differential between the five- and ten-year US rates for the 1900–2014 period was proxied by the average differential between the five-year Treasury constant-maturity bonds (GS5) and the Treasury ten-year constant-maturity bond (GS19) between 1953 and 2014. First Dr Lally added the tax-adjusted differential of five- and ten-year rates, of 0.0568%, to the average MRP. Next, he added the tax-adjusted current five-year RFR to determine the TAMRP estimate. See Lally, M. (2015), 'Review of submissions on the risk-free rate and the TAMRP for UCLL and UBA services', 13 October, Table 1, available here.
[192] NZCC (2022), 'Part 4 Input Methodologies Review 2023. Process and Issues paper', 22 May, para. 6.51, available here.

A3 Financial metrics used by Ofgem and the credit rating agencies for financeability assessment

Table A3.1 sets out the financeability metrics used by Ofgem for its financeability assessments, and the comparable metrics used by credit rating agencies in their credit rating assessments. We note that many of the metrics compare Ofgem's approach to that of just one or two of the big three credit rating agencies. The reason we do not compare all three agencies' approaches is because they do not all publish the approaches that they take.

Table A3.2 sets out the indicative ranges for investment-grade rating from the credit rating agencies, for some of the metrics set out in Table A3.1—the entry is left blank where the indicative ranges are unclear or unspecified.

Table A3.1 Comparative review of Ofgem's financeability metrics

Ofgem's and credit rating agencies' metrics and formulae	Differences between Ofgem's approach and rating agencies' approaches
Debt ratios	
Gearing $$\frac{Net\ debt}{RAV}$$	None
FFO interest cover (interest expense) Ofgem: $$\frac{FFO\ (pre\ cash\ net\ interest)}{Cash\ net\ interest + principal\ inflation\ accretion}$$ Moody's (2017): $$\frac{FFO\ (pre\ cash\ net\ interest)}{Cash\ net\ interest}$$	Ofgem's metric explicitly includes principal inflation accretion in the denominator, which is the increase in the value of index-linked debt due to increases in the inflation rate It is unclear formulaically how the credit rating agencies treat inflation-linked debt, but Moody's (2017) and S&P (2013) both mention that they make appropriate adjustments. Therefore in practice there may be little to no difference in the approaches taken
FFO interest cover (cash interest) $$\frac{FFO\ (pre\ cash\ net\ interest)}{Cash\ net\ interest}$$	None
AICR Ofgem (2019): $$\frac{FFO\ (pre\ cash\ net\ interest) - RAV\ depreciation}{Cash\ net\ interest}$$ Moody's (2017): $$\frac{FFO\ (pre\ cash\ net\ interest) - non\ cash\ accretion - capital\ charg}{Cash\ net\ interest - non\ cash\ accretion}$$	Capital charges, such as regulatory depreciation, the excess of 'fast money' over OPEX, and the excess of 'profiled revenue' over 'un-profiled revenue' are subtracted from FFO by Moody's Non-cash accretion is deducted in the numerator, only to the extent that it has been included in FFO, and is deducted from the denominator only to the extent that it has been included in interest expense In practice, this means that the main difference between Moody's approach and Ofgem's is that Moody's adjusts FFO for one-off differences in cash flow caused by the excess of profiled revenue over unprofiled revenue
Nominal PMICR[1] Ofgem (2019): $$\frac{FFO\ (pre\ cash\ net\ interest) - RAV\ depreciation + YoY\ RAV\ infla}{Cash\ net\ interest + principal\ inflation\ accretion}$$ Fitch (2018):	Similar to the AICR, Ofgem subtracts RAV depreciation from FFO, but it is unclear whether it makes any adjustments for other capital charges

$$\frac{FFO\ (pre\ cash\ net\ interest) \pm net\ working\ capital - maintenanc}{Cash\ net\ interest}$$	Fitch takes a different approach by subtracting maintenance CAPEX and net working capital from FFO. Ofgem adds RAV inflation to FFO, and adds principal inflation accretion to the interest expense in the denominator
FFO/net debt (interest expense) Ofgem (2019): $$\frac{FFO\ (post\ cash\ interest) - principal\ inflation\ accretion}{Net\ debt}$$ Standard & Poor's (2013) and Moody's (2017): $$\frac{FFO\ (post\ cash\ interest)}{Net\ debt}$$	Ofgem's calculation of the metric includes an adjustment for principal inflation accretion in the numerator. However as noted above, S&P and Moody's both state that they adjust for inflation. So, in practice, there may be little to no difference between the approaches
FFO/net debt (cash interest) Ofgem (2019): $$\frac{FFO\ (post\ cash\ interest)}{Net\ debt}$$ Standard & Poor's (2013) and Moody's (2017): $$\frac{FFO\ (post\ cash\ interest)}{Net\ debt}$$	None
RCF/net debt Ofgem (2019): $$\frac{FFO\ (post\ cash\ interest) - dividends - \ principal\ inflation\ accre}{Net\ debt}$$ Moody's (2017): $$\frac{FFO\ (post\ cash\ interest) - dividends}{Net\ debt}$$	Ofgem's calculation of the metric includes an adjustment for principal inflation accretion in the numerator. However as noted above, S&P and Moody's both state that they adjust for inflation. So, in practice, there may be little to no difference between the approaches
Equity ratios	
EBITDA/RAV Ofgem (2019): $$\frac{EBITDA}{RAV}$$	Not considered by rating agencies
RORE Ofgem (2019): $$\frac{EBIT - tax - (cost\ of\ debt * debt\ RAV)}{Equity\ RAV}$$	Not considered by rating agencies
Dividend cover Ofgem (2019): $$\frac{Profit\ after\ tax}{Dividends\ declared}$$ Fitch (2018): $$\frac{FFO\ (post\ cash\ interest)}{Dividends\ declared}$$	Ofgem considers this metric from an accounting profit perspective, while the credit rating agencies work on a cash basis
Dividend/regulated equity Ofgem (2019): $$\frac{Dividends\ declared}{Equity\ RAV}$$	Not considered by rating agencies

Notes: [1] The PMICR is described as the ratio between cash flows from operations less maintenance CAPEX and net interest expense. Cash flows from operations are FFO plus net working capital. For a more detailed description of the definitions of cash-flow measures as used by Fitch, see Fitch (2019), 'Corporates – Corporate Rating Criteria: Master Criteria', 19 February, p. 46.

Source: Oxera analysis; Moody's (2017), 'Regulated Electric and Gas Networks', 16 March, p. 19; Fitch (2018), 'Corporates—Sector Navigator: Addendum to the Corporate Rating Criteria', March, p. 189; Standard & Poor's (2013), 'Corporate Methodology: Ratios and Adjustments', 19 November, p. 36; Fitch (2018), 'Corporates—Sector Navigator: Addendum to the Corporate Rating Criteria', March, p. 117.

Table A3.2 Indicative ranges for investment-grade rating from the credit rating agencies

Ratio	Fitch		Moody's[1]		Standard & Poor's[2]	
Debt metrics	A	BBB	A	Baa	A	BBB
Net debt/RAV (%)	60	70	45–60	60–75	<70	>70
FFO interest cover, including accretion (i.e. total interest expense) (x)	4.5	3.5	4–5.5	2.8–4		
FFO interest cover, excluding accretion[3] (i.e. cash interest) (x)					>3.5	2.5–3.5
AICR (x)	1.75	1.5	1.6–1.8[3]	1.2–1.4[3]		
Nominal PMICR (x)	2.5	1.8				
FFO (cash interest)/ net debt (%)			18–26	11–18	>12	8–12
RCF/net debt (%)			14– 21	7–14		

Note: [1] Moody's subtracts inflation accretion from FFO and the interest expense to the extent that it is included. [2] Unlike Moody's and Fitch, S&P does not provide indicative ranges. The ranges interact with additional considerations such as the business risk profile and industry risk. See Standard & Poor's (2013), 'Criteria | Corporates | General: Corporate Methodology', tables 3, 17–19. We have reported the indicative ranges provided by Ofgem during the RIIO-1 period. See Ofgem (2011), 'Decision on strategy for the next transmission and gas distribution price controls – RIIO-T1 and GD1 Financial issues', 31 March, p. 40. [3] Moody's guidance minimum rating for a Baa2 rating (1.2), Baa1 rating (1.4), A3 rating (1.6), and A2 rating (1.8) from 29 May 2019 commentary. Moody's does not provide a guidance figure for a Baa3 rating.

Source: Fitch (2022), 'Corporate rating criteria Sector Navigators', p. 204, available here; Moody's (2017), 'Rating Methodology Regulated Electric and Gas Networks, 16 March, p. 19; Moody's (2018), 'Regulated electric and gas networks – UK. Risks are rising, but regulatory fundamentals still intact', 29 May, p. 4; Ofgem (2011), 'Decision on strategy for the next transmission and gas distribution price controls – RIIO-T1 and GD1 Financial issues', 31 March, p. 40, available here.

A4 Evidence on liquidity premium embedded in highest quality NZD-denominated bonds

If there is a difference in the liquidity risk of the highest quality corporate bonds and government bonds, any difference in this liquidity risk can be accounted for in the estimation of the convenience premium. This can be done by deducting the difference between the liquidity premium from the highest quality corporate bonds, and the liquidity premium on government bonds. Below, we briefly discuss the existing empirical evidence from the academic literature, as well as the findings from our own empirical analysis.

Van Loon (2015) decomposed the credit spreads of the constituents of the iBoxx GBP Investment Grade Index from 2003 to 2014, and found that the median liquidity premium on AAA bonds fluctuated between c. –8bp and +48bp.[193] Excluding the periods of the global financial crisis (2007–08) and the height of the European debt crisis (2011–12), the median liquidity premium largely fluctuated between 0bp and +20bp. While this analysis relied on pre-2014 data, it serves as cross-check on our own empirical analysis, which we outline below.

While there are many proxy measures of liquidity, our empirical analysis focuses primarily on the bid–ask spread of the selected AAA-rated NZD-denominated bonds.

The bid–ask spreads are expressed in percentage terms, calculated as $\frac{(Ask\ price – Bid\ price)}{Mid\ price}$.[194] We calculate the one-year trailing average of the percentage bid–ask spread preceding 8 September 2022 for each of the AAA bonds.

A liquidity premium of 9bp is calculated by dividing the percentage bid–ask spreads over an assumed holding period of 20 years. This estimate is largely in line with estimates by Van Loon (2015), and is around 7bp over and above the liquidity premium of NZ government bonds.

[193] Inferred from Figure 20 in Van Loon, P.R., Cairns, A.J., McNeil, A.J. and Veys, A. (2015), 'Modelling the liquidity premium on corporate bonds', *Annals of Actuarial Science*, **9**:2, pp. 264–89.
[194] The percentage bid–ask price may also be calculated using the ask price or the bid price as the denominator. In our analysis, we follow the definition set out in the IMF's Financial Soundness Indicators Compilation Guide, which uses the mid-price as the denominator. See International Monetary Fund (2006), 'Financial Soundness Indicators Compilation Guide', para. 8.44.

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