3 February 2023

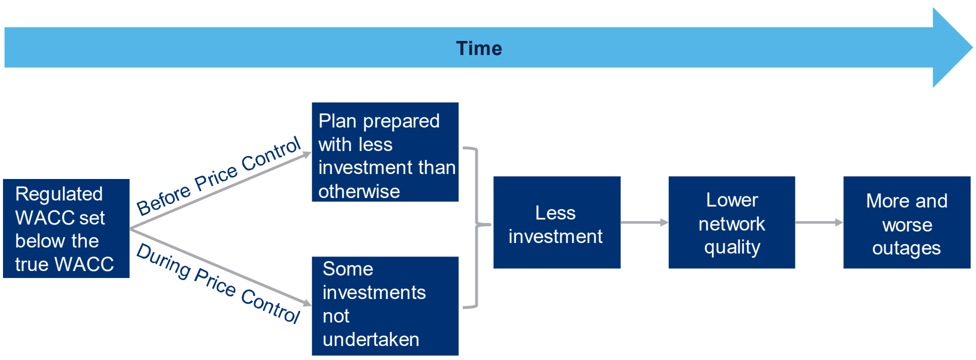
Geoff Brooke, Senior Economist
Via email im.review@comcom.govt.nz

Tēnā koutou,

## The review of the cost of capital IM is an opportunity to ensure incentives for infrastructure investment support the impacts of customer and industry decarbonisation

This review of aspects of the cost of capital input methodologies will shape industry investment in decarbonisation and electrification infrastructure for decades. Powerco is one of Aotearoa's largest gas and electricity distributors, supplying around 340,000 (electricity) and 112,000 (gas) urban and rural homes and businesses in the North Island. These energy networks provide essential services and will be core to Aotearoa achieving a net-zero economy in 2050. An appropriate cost of capital allowance will enable networks to deliver these services and continue to support customer choices about their energy needs as New Zealand's energy sector decarbonises.

Networks have a crucial role enabling New Zealand's decarbonisation journey while maintaining reliable supply almost all New Zealanders. The cost of capital settings are a core part of the regulatory framework that supports the investment needed to achieve this. The Commission's consultation considers several of the weighted-average cost of capital (WACC) settings used to *estimate* the true WACC faced by distributors. Our views on the Commission's consultation are informed by expert reports from Oxera that we have co-commissioned with other electricity and gas network businesses. Oxera observe that a regulated WACC below the true WACC creates incentives to propose and undertake fewer investments, reducing network reliability. The impact on consumers is asymmetric when balancing the costs of setting a WACC too low against the social costs of unreliability.




Source: Oxera

For this 2023 Input Methodologies review, a paired back ‘what’s changed?’ approach has been taken, with the Commission seeking feedback on a report from CEPA on a subset of the WACC inputs. A relatively short engagement/consultation process has been used too. We support this approach and have scaled our response proportionately. We note that this differs from the 2016 Input Methodologies review of cost of capital which was comprehensive, with considerable input and debate from experts to inform the Commission’s final decision.

Our submission[1] on the IM review ‘process and Issues’ paper[2] commented that the IMs (and application in each DPP reset process) need mechanisms that:

- Support electricity distributors meet the long-term individual and collective customer needs from electrification
- Support gas distributor long-term investment and operation required to support a transition off natural gas

WACC settings are part of the regulatory system that enable these outcomes. A theme of Oxera’s reports is that that regulatory stability and minimised network disruption are essential aspects of the pathway to decarbonisation. In that context, our views on the WACC settings raised by the Commission are:

## WACC percentile

- Maintain an uplift on the WACC percentile at or above the 67th percentile for electricity networks, given the costs of underinvestment are heightened in an environment of accelerated electrification
- Maintain an uplift of WACC percentile at or above 67th percentile for gas networks to preserve incentives to invest in secure and reliable gas networks to ensure an orderly energy transition

## Asset beta and leverage

- Maintain combined energy comparator sample due to nature of energy businesses in New Zealand
- Maintain uplift of asset beta for gas networks given heightened risk (consistent with 2016 IM decisions paper[3]

Attachment 1 contains more commentary about how we arrived at these views, and references reports from Oxera submitted jointly with other networks. If you have any questions regarding this submission or would like to talk further on the points we have raised above, please contact Jeremy.Smith@powerco.co.nz.

Nāku noa, nā,

**Andrew Kerr**
**Head of Policy, Regulation, and Markets**
**POWERCO**

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[1] https://comcom.govt.nz/__data/assets/pdf_file/0023/288014/Powerco-Submission-on-IM-Review-Process-and-Issues-paper-and-draft-Framework-paper-11-July-2022.pdf

[2] https://comcom.govt.nz/__data/assets/pdf_file/0031/283864/Part-4-Input-Methodologies-Review-2023-Process-and-Issues-paper-20-May-2022.pdf

[3] https://comcom.govt.nz/__data/assets/pdf_file/0021/60537/Input-methodologies-review-decisions-Topic-paper-4-Cost-of-capital-issues-20-December-2016.pdf

# Attachment 1. Response to CEPA report

The Commission has invited submissions on the report by Cambridge Economic Policy Associates Pty Ltd (CEPA) on aspects of the cost of capital input methodologies[4]. The report is part of the 2023 review of the input methodologies that underpin the Commission's regulation of airport services, electricity lines services, and gas pipeline services[5].

The Commission listed the issues from CEPA's report that will be considered for preparation of the draft decision. We've summarised these as:

1. **Asset beta comparator sample** - should the Commission continue to use companies from Australia that have been recently delisted, and should we provide weightings to countries to reduce the weighting of companies from the United States in the comparator sample (as these make up the majority).
2. **Gas asset beta** – the Commission are considering whether to split the energy comparator sample into gas and electricity and whether the uplift of Gas asset beta is still justified?
3. **WACC percentile** – given that the justification for the uplift of WACC percentile was developed solely with reference to electricity distribution and transmission and the cost of electricity blackouts, should we continue to apply an uplift for gas businesses. How does increased electrification of the economy impact the Commission's reasoning around cost of blackouts and methodology for considering whether a WACC uplift is warranted?

Our submission is informed by evidence from expert reports we have co-commissioned with gas and electricity network companies. Powerco own and operate both electricity and gas networks and our submission covers both of these services. For ease of reading these two areas have been separated into sections.

## Electricity Lines Services

Powerco supports the findings outlined in the CEPA report, specifically Powerco's view is that:

- The increased electrification of the economy since the 2016 review, as part of the response to climate change, amplifies the cost and risk of underinvestment. CEPA outlines the cost of network failure has increased by nearly $1bn ($1bn to 1.9bn) as a proxy of change in GDP and value of lost load in New Zealand. The net social benefit of setting the WACC percentile above the midpoint has also increased to a range of $80-200m at the 70$^{th}$ percentile.
- In reference to the UKRN recommendation outlined in the report, it states "regulators should only deviate from the midpoint…if there are strong reasons to do so[6]." Rising costs of network failure and net social benefits of a WACC percentile above midpoint are strong reasons to increase from the midpoint with an uplift.
- Use of an updated comparator sample for the calculation of asset beta and leverage.
- Use of an updated single leverage metric across EDBs and GPBs.
- Setting the nominal credit rating at BBB+ for EDBs and GPBs

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[4] CEPA "Review of Cost of Capital 2022/2023 - New Zealand Commerce Commission" (29 November 2022)

[5] The background of the review is set out in the Notice of Intention: Commerce Commission "Notice of Intention: Input Methodologies Review 2023" (23 February 2022)

[6] UKRN, UKRN guidance for regulators on the methodology for setting the cost of capital – consultation

Two reports by Oxera[7] have been prepared on behalf of the 'Big 6' EDBs, which cover the IM review cost of capital issues relating to Electricity Lines Services. The key conclusions relating to the issues raised in the CEPA report are:

- The regulatory approach to reliability supports targeting a percentile between the 65th and 85th percentiles of the WACC distribution based on their assessment of the socio-economic benefits of aiming up on the WACC percentile.
- The Commission has not found evidence of overcompensation due to a 67th percentile WACC, rather it has published evidence they have been under-compensated. This shows customers have not faced unduly high costs.
- Gives weight to the need to maintain regulatory stability, this supports the retention of at least the 67th WACC percentile.
- Improvements can be made in selecting the most appropriate companies for the comparator sample used for asset beta and leverage.

We also draw attention to other cost of capital issues raised in these two reports.

- Risk-free rate - currently, the Commission estimates this rate by observing yields on 5-year NZ government bonds for 3 months of the most recent data. Oxera recommends the Commission should adjust its method to reflect a wider range of government bonds from 5-20 years. This is supported by regulatory precedent and reflects the varying time horizons of network investments. Some European regulators have applied an uplift to the risk-free rate estimates to reflect the safety and liquidity characteristics of government bonds.
- Indexing - proposal that the risk-free rate and cost of debt should be indexed to reduce the risk of exposure from market movement in interest rates during the regulatory period. In the current high inflationary period, there is increase in volatility and would align with Ofgem and AER practises.
- Financeability – recommends that the Commission add a financeability assessment to the regulatory process as the AER and Ofgem do. This would ensure EDBs receive sufficient funding for decarbonisation and increased electrification. This assessment could be made on a notional basis by analysing market information on the actual capital structure of EDBs. These metrics would ensure EDBs satisfy a minimum credit rating.

We support the ENA's submission, in particular:

- Issues relating to the WACC percentile, including the impact of higher growth and uncertainty on the WACC percentile, as well as the impact of the evolving role of EDBs. Both require support for growth in investment levels for EDBs.
- Issues relating to comparator sample selection for asset beta and leverage.

WACC is part of the package of settings that influence network investment. Just as important is the process for setting appropriate allowances for opex and capex to support decarbonisation. This is a separate process the Commission will undertake during reset of the Default Price-quality path.

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7 Oxera "Review of the NZCC's WACC-setting methodology" and "Review of the percentile of the WACC distribution that should be targeted by the NZCC"– commissioned by the "Big 6" EDBs

## Gas Pipeline Services

Powerco supports the findings outlined in the CEPA report, specifically Powerco's view is that:

- The Commission should continue to apply an uplift of WACC percentile to price-quality regulated gas businesses. Gas has an important security of supply role during the energy transition to decarbonisation, helping to minimise electricity blackouts, and with higher income elasticity of demand[8].
- In reference to the UKRN recommendation outlined in the report, it states "regulators should only deviate from the midpoint…if there are strong reasons to do so[9]." Rising costs of network failure and net social benefits of a WACC percentile above midpoint are strong reasons to increase from the midpoint with an uplift.
- The Commission continue to apply an uplift of asset beta for Gas given the CEPA evidence of a gas asset beta of at least 0.5-0.9 higher than the energy sample.
- Powerco supports the use of an updated single leverage metric across EDBs and GPBs.
- Powerco supports setting the nominal credit rating at BBB+ for EDBs and GPBs

A report by Oxera[10] has been prepared on behalf of the GPBs which covers the IM review cost of capital issues relating to Gas Pipelines. The key conclusions relating to the issues raised in the CEPA report are:

- There is empirical and theoretical evidence supporting the upward adjustment of Gas asset beta when compared to electricity.
- Improvements can be made in selecting the most appropriate companies for the comparator sample used for asset beta and leverage.
- There is both academic and regulatory precedent support for aiming up on WACC percentile as well as regulatory stability.
- There does not appear to be a clear case for changing the way gas network reliability is incentivised in New Zealand as WACC uplift does not seem to be causing excess profits based on the Commission's analysis.
- The cost of network failures has increased, and it could be difficult to reverse the impact of underinvestment.

[8] Detailed in 2016 IM review submissions

[9] UKRN, UKRN guidance for regulators on the methodology for setting the cost of capital – consultation

[10] Oxera "Asset beta and WACC percentile for New Zealand gas distribution businesses" - commissioned by GPBs

# Attachment 2. Oxera - Review of the NZCC's WACC-setting methodology

# Review of the NZCC's WACC-setting methodology

Prepared for
Aurora, Orion, Powerco, Unison,
Vector, Wellington Electricity

10 November 2022—reviewed on 31 January 2023

Final

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Oxera Consulting LLP is a limited liability partnership registered in England no. OC392464, registered office: Park Central, 40/41 Park End Street, Oxford OX1 1JD, UK; in Belgium, no. 0651 990 151, branch office: Avenue Louise 81, 1050 Brussels, Belgium; and in Italy, REA no. RM - 1530473, branch office: Via delle Quattro Fontane 15, 00184 Rome, Italy. Oxera Consulting (France) LLP, a French branch, registered office: 60 Avenue Charles de Gaulle, CS 60016, 92573 Neuilly-sur-Seine, France and registered in Nanterre, RCS no. 844 900 407 00025. Oxera Consulting (Netherlands) LLP, a Dutch branch, registered office: Strawinskylaan 3051, 1077 ZX Amsterdam, The Netherlands and registered in Amsterdam, KvK no. 72446218. Oxera Consulting GmbH is registered in Germany, no. HRB 148781 B (Local Court of Charlottenburg), registered office: Rahel-Hirsch-Straße 10, Berlin 10557, Germany.

## Figures and tables

# 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

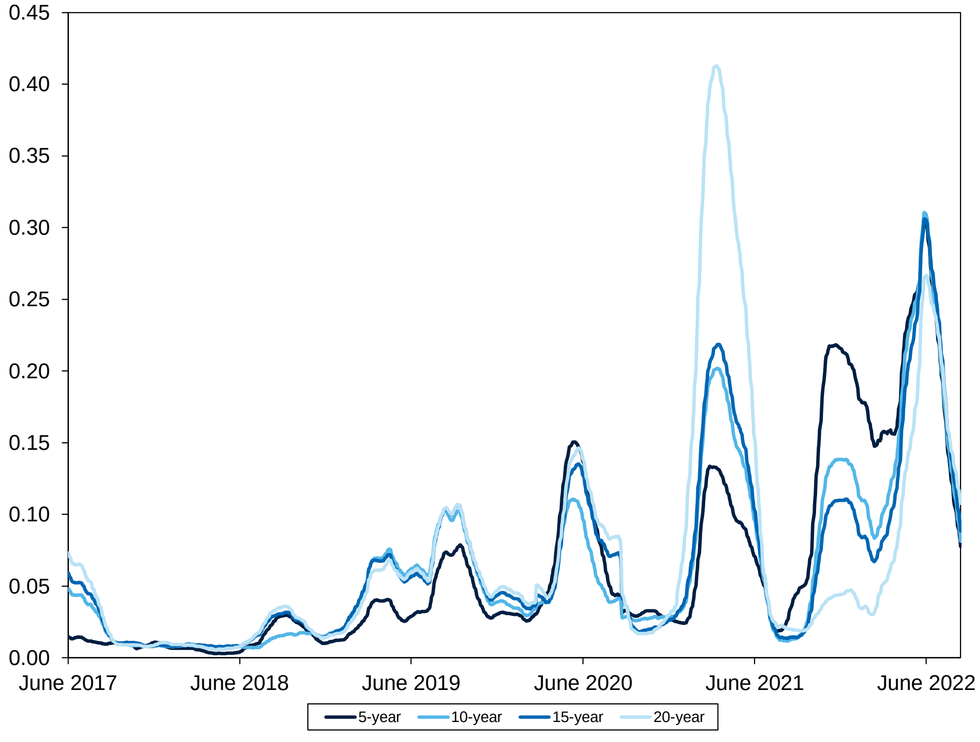
[24] We note that we come to a different conclusion in section 5 when we discuss the cost of debt, as there we suggest that the averaging period for the RFR is extended beyond the current 3 month window. The reason for recommending a longer averaging period for the RFR in the context of CoD is to match 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]

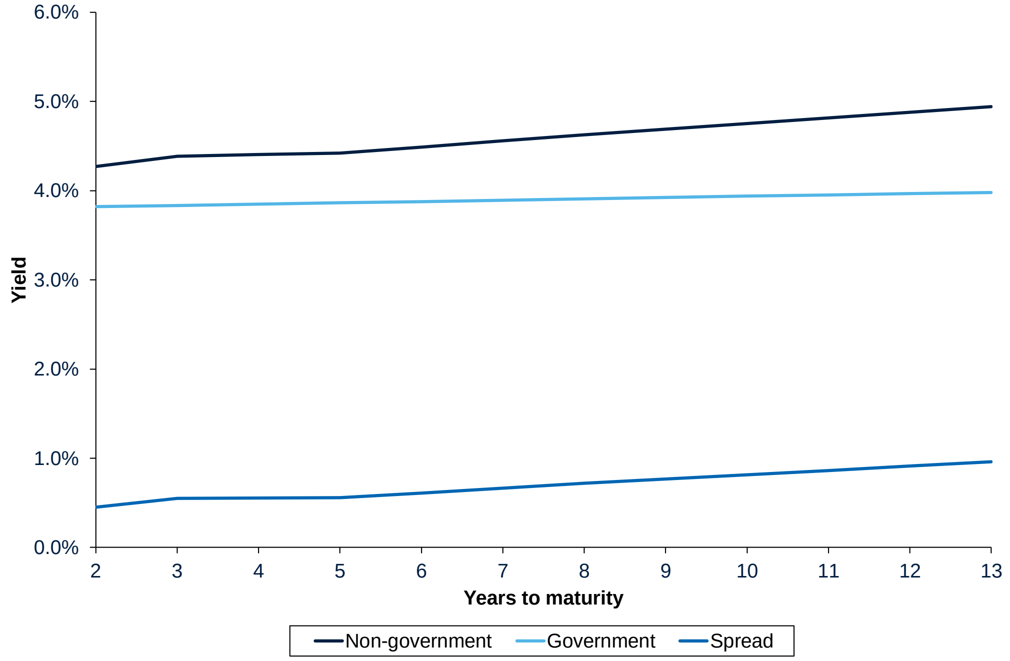
> ILGs have traditionally been considered as the best proxy for the RFR. However, analysis of the current and historic yields associated with these instruments demonstrates that the **government can borrow at rates significantly lower than would be accessible by even the highest-rated private investor**.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

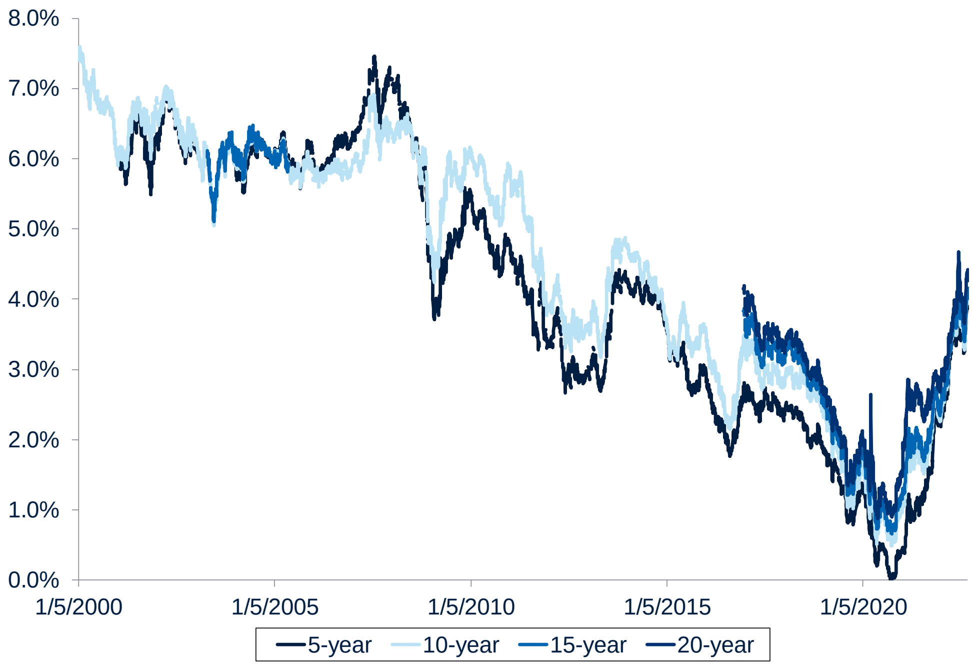
contentious to the AER and Ofgem stakeholders, the NZCC stakeholders heavily disputed the use of short-term averaging period, on the grounds that the short period has a negative impact on their hedging activities for debt and undercompensates their cost of embedded debt. The primary issue that we identify 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]

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[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]

[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]

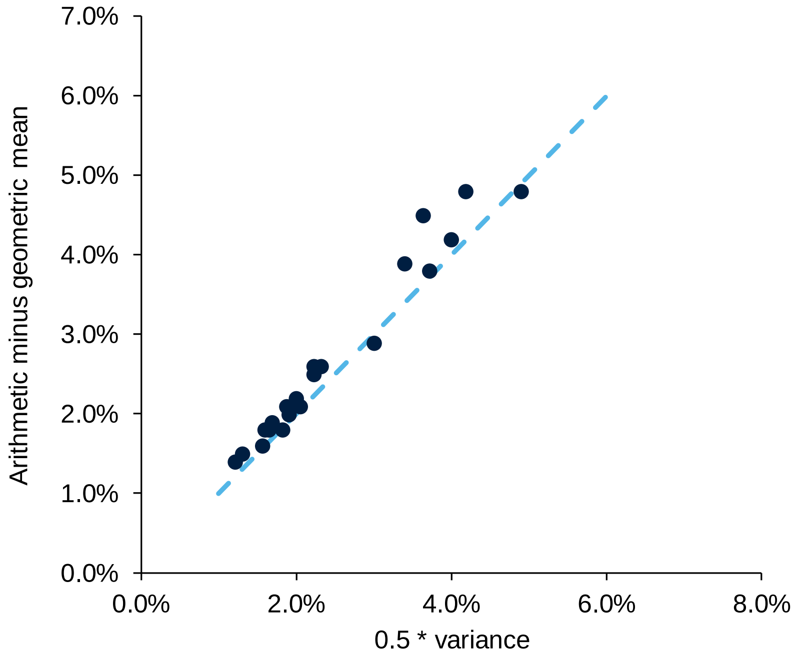
> despite this, the difference between the arithmetic and geometric means is indeed well approximated in the data by one half the variance.

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]

[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.

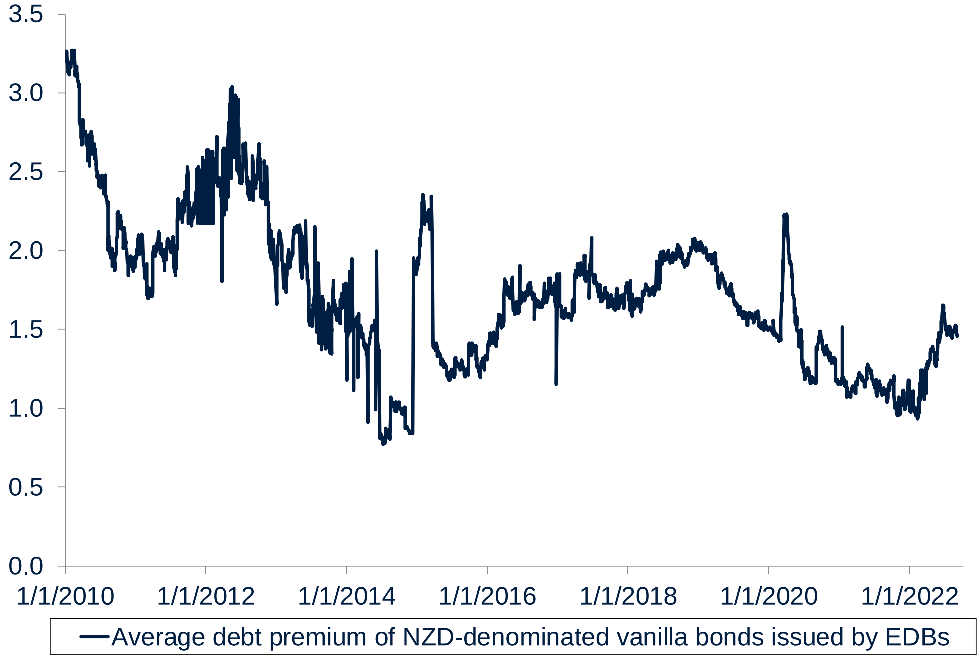
**Risks around recovering the cost of embedded debt**

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**

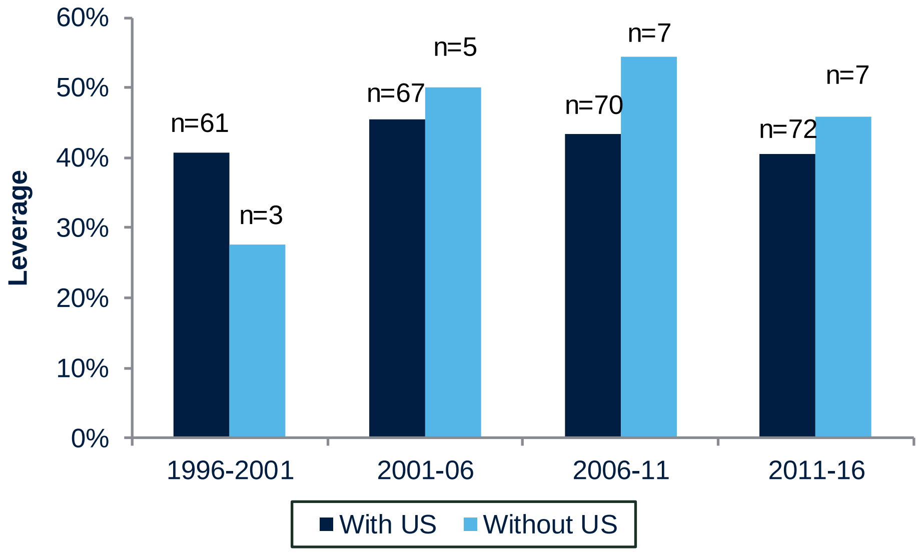
The composition of the NZCC's comparator set is significantly different from those of the AER and Ofgem. While the AER and Ofgem both included only listed domestic utility companies (in the AER's case, only listed domestic energy utilities), the NZCC's comparator set is more than ten times larger and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

[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%)<br>Asset ownership model (5%)<br>Cost and investment recovery (ability and timeliness, 15%)<br>Revenue risk (5%) |
| Scale and complexity of capital programme | 10% | |
| Financial policy | 10% | |
| Leverage and coverage | 40% | AICR *or* FFO interest coverage (10%)<br>Net debt/RAV *or* net debt/fixed assets (12.5%)<br>FFO/net debt (12.5%)<br>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<br>Sub-rating: BBB | Moody's<br>Sub-rating: Baa | Moody's<br>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.

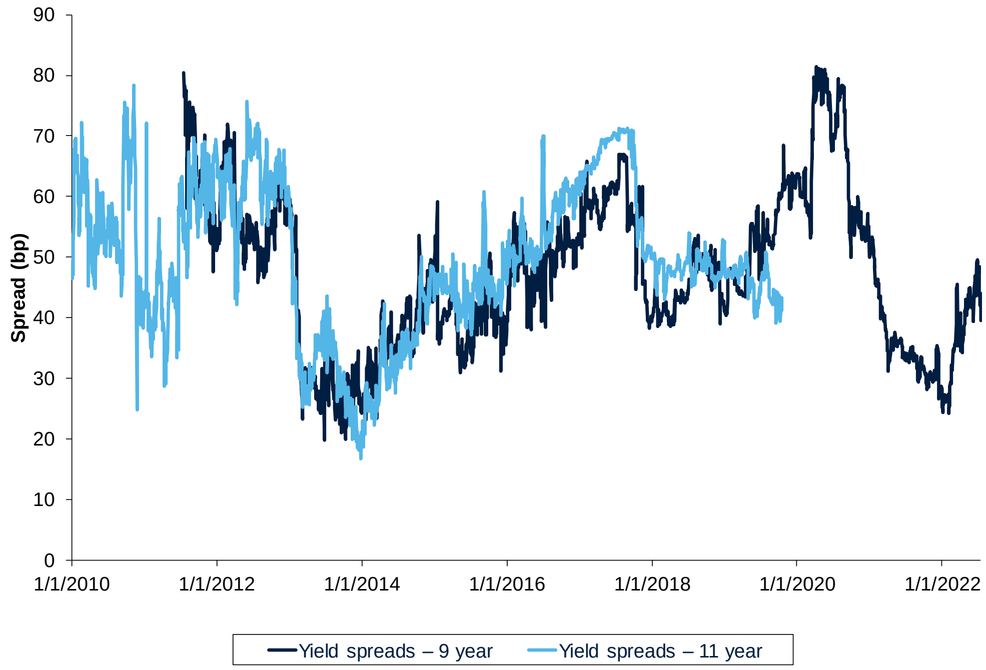
Koijen and Yogo (2020) develop a pricing model to study sources of variation in exchange rates, long-term yields, and stock prices across 36 countries from 2002 to 2017.[177] Their model finds that, in the absence of special-status demand for US assets by foreign investors and foreign exchange reserves, 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]

[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)**<br>Ofgem:<br>$\frac{FFO\ (pre\ cash\ net\ interest)}{Cash\ net\ interest + principal\ inflation\ accretion}$<br>Moody's (2017):<br>$\frac{FFO\ (pre\ cash\ net\ interest)}{Cash\ net\ interest}$ | 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<br>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)**<br>$\frac{FFO\ (pre\ cash\ net\ interest)}{Cash\ net\ interest}$ | None |
| **AICR**<br>Ofgem (2019):<br>$\frac{FFO\ (pre\ cash\ net\ interest) - RAV\ depreciation}{Cash\ net\ interest}$<br>Moody's (2017):<br>$\frac{FFO\ (pre\ cash\ net\ interest) - non\ cash\ accretion - capital\ charg}{Cash\ net\ interest - non\ cash\ accretion}$ | 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<br>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<br>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]<br>Ofgem (2019):<br>$\frac{FFO\ (pre\ cash\ net\ interest) - RAV\ depreciation + YoY\ RAV\ infla}{Cash\ net\ interest + principal\ inflation\ accretion}$<br>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 |

| | |
|---|---|
| $\frac{FFO\ (pre\ cash\ net\ interest) \pm net\ working\ capital - maintenance}{Cash\ net\ interest}$ | 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)**<br>Ofgem (2019):<br>$\frac{FFO\ (post\ cash\ interest) - principal\ inflation\ accretion}{Net\ debt}$<br>Standard & Poor's (2013) and Moody's (2017):<br>$\frac{FFO\ (post\ cash\ interest)}{Net\ debt}$ | 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)**<br>Ofgem (2019):<br>$\frac{FFO\ (post\ cash\ interest)}{Net\ debt}$<br>Standard & Poor's (2013) and Moody's (2017):<br>$\frac{FFO\ (post\ cash\ interest)}{Net\ debt}$ | None |
| **RCF/net debt**<br>Ofgem (2019):<br>$\frac{FFO\ (post\ cash\ interest) - dividends - principal\ inflation\ accre}{Net\ debt}$<br>Moody's (2017):<br>$\frac{FFO\ (post\ cash\ interest) - dividends}{Net\ debt}$ | 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**<br>Ofgem (2019):<br>$\frac{EBITDA}{RAV}$ | Not considered by rating agencies |
| **RORE**<br>Ofgem (2019):<br>$\frac{EBIT - tax - (cost\ of\ debt * debt\ RAV)}{Equity\ RAV}$ | Not considered by rating agencies |
| **Dividend cover**<br>Ofgem (2019):<br>$\frac{Profit\ after\ tax}{Dividends\ declared}$<br>Fitch (2018):<br>$\frac{FFO\ (post\ cash\ interest)}{Dividends\ declared}$ | Ofgem considers this metric from an accounting profit perspective, while the credit rating agencies work on a cash basis |
| **Dividend/regulated equity**<br>Ofgem (2019):<br>$\frac{Dividends\ declared}{Equity\ RAV}$ | 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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# Attachment 3. Oxera - Review of the percentile of the WACC distribution that should be targeted by the NZCC

# Review of the percentile of the WACC distribution that should be targeted by the NZCC

Prepared for
Aurora, Orion, Powerco, Unison, Vector, Wellington Electricity

14 October 2022—reviewed on 31 January 2023

Final

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# Contents

## Figures and tables

# 1 Executive summary

In its 2010 Input Methodologies (**IM**) Decision for energy networks, the New Zealand Commerce Commission (**NZCC**) set the WACC at the 75th percentile. This meant that, after estimating the mid-point for the WACC, the NZCC then adjusted this mid-point to the 75th percentile by assuming that the WACC was normally distributed with a standard error that was estimated as part of the NZCC's WACC methodology. Following a court challenge in 2013, the NZCC reduced the WACC uplift to the 67th percentile for the 2016 IM Decision. More recently, in 2020, the NZCC set the WACC percentile for regulated fibre to the 50th percentile.

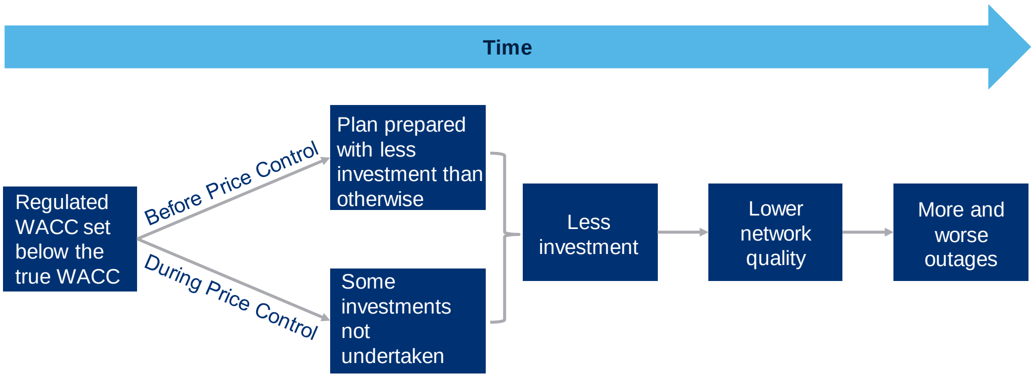
Oxera has been commissioned by Aurora, Orion, Powerco, Unison, Vector, and Wellington Electricity (together, '**the Electricity Distribution Businesses (EDBs)**') to assess the appropriate percentile that the NZCC should aim for in its methodology. The purpose of this report is to inform the EDBs in relation to the percentile of the WACC distribution that the NZCC targets for regulated energy networks and, specifically, electricity distribution. The report is being written in the context of the NZCC's ongoing review into its methodology for the 2023 IM for energy networks.

In this report, we find that the evidence supports the NZCC in targeting a WACC estimate that is in the range of the 65th to 75th percentile. This would suggest that the 70th percentile of the WACC distribution would be the most appropriate percentile to target. However as the NZCC targeted the 67th percentile in the last regulatory period, and (i) this percentile is within our range; (ii) we consider there to be substantial value in maintaining regulatory stability, we conclude that it would be appropriate for the NZCC to continue targeting the 67th percentile of the WACC. The process that would need to be taken to accurately calculate the 67th percentile of the WACC distribution would be to start with an unbiased estimated of the 50th percentile, then adjust this estimate to reach the 67th percentile, based on the distribution of the WACC.

First, we assess the implications of using a network reliability framework. This is the framework that the NZCC has used historically, to assess the appropriate percentile to target in a range of regulated industries. Within this framework, it is necessary to decide how to select a point estimate within a WACC range (i.e. what percentile, and whether to 'aim up' relative to the mid-point of the range) because there is uncertainty about the level of the 'true' WACC, i.e. the risk-adjusted return that is required in the sector. This means, in turn, that the regulated (allowed) WACC can differ from the true WACC.

The causal mechanism that explains the relationship between the level of the regulated WACC and the true WACC is depicted in Figure 1.1 below. This shows that a regulated WACC set below the true WACC creates incentives for networks to propose less investment prior to a regulatory period and to undertake fewer investments during a regulatory period. This lower level of investment will reduce the quality of the network and eventually lead to more and worse outages, which is not in the long-term interests of consumers.

### Figure 1.1 How might the regulated WACC being below the true WACC undermine network reliability?




Source: Oxera.

The network reliability framework thereby trades off the additional consumer costs of aiming for a higher WACC percentile against the reduced likelihood and severity of outages. Importantly, it also finds that there is likely to be an 'asymmetric loss function', whereby the effects of increased outages are more damaging to society than any additional costs which consumers incur for electricity if a WACC percentile above the mid-point is selected. In concluding on the reasonableness of the 65th to 75th percentile range, we observe that the evidence we have reviewed in this report shows that—from a network reliability perspective—a percentile anywhere between the 65th and 85th could be reasonable.

Second, we consider how the asymmetric effects of delaying the connection of low-carbon technologies (**LCTs**) could generate further reasons to aim up on the WACC percentile. We refer to this as the 'decarbonisation framework' and consider that if regulated utilities are unable to upgrade their networks in a way that allows for timely connection of LCTs,[1] then this will generate a further source of asymmetric costs, because the social costs of delaying decarbonisation are substantial. This additional benefit would increase the range that should be targeted, although it has not been possible for us to identify the precise magnitude of this effect. We therefore interpret this to indicate that: (i) the bottom end of the range we identified (i.e. around the 65th percentile) is not appropriate; (ii) maintaining a WACC uplift (at the 67th percentile) is more strongly supported now than it was in 2014, when we wrote our previous report for the NZCC.

Third, as a countervailing consideration to aiming up within the WACC range, we consider that the upper end of the range may prove unnecessarily expensive for end-consumers, as other regulatory tools can also play a role in mitigating the risks of under-investment. Selecting too high a percentile could unnecessarily increase the incentives for 'gold-plating' in relation to network investments. We consider this to rule out targeting a WACC percentile above the 80th, as we find that targeting the 85th percentile of the WACC results in consumers experiencing an increase in electricity bills that is approximately twice as high as what they experience at the 70th percentile.

We also observe that the evidence from the most recent (ongoing) energy regulatory period is largely supportive of maintaining the 67th percentile as an appropriate percentile estimate. Specifically, we have found that, across the course of the ongoing regulatory period, both the asset health and age of the

[1] Irrespective of whether the investment in LCTs is undertaken by the EDBs or by third parties.

networks has increased slightly. This suggests that networks have maintained network quality without significant net increases in the installed asset base, indicating that the regulatory period has effectively delivered a balance between maintaining (in fact, improving) network quality and preventing over-investment.

Fourth, we note the fact that the NZCC has not found any evidence of over-compensation of energy networks. In fact, the NZCC has published evidence that regulated utilities have been under-compensated (i.e. earned relatively low returns) over the period. This indicates that, despite setting the WACC at the 67th percentile in the previous control, consumers have not faced unduly high electricity costs.

Taken together, we therefore find that two pieces of evidence—specifically, the outcomes of the last regulatory period and the ability for other regulatory measures to mitigate some risk of under-investment—suggest that a percentile from the lower part of the 65th to 85th percentile range should be selected. The presence of decarbonisation benefits acts against this and suggests a percentile from the upper end of the range could be more appropriate.

Owing to the fact that we consider the two reasons for selecting a percentile from the lower end of the range to be more compelling than the reasons for selecting a percentile from the upper end, we conclude that a percentile between the 65th and 75th is appropriate.

We note that our conclusion on the appropriateness of the 65th to 75th percentile range has not been informed by evidence from regulatory precedents. We observe in this report that recent international regulatory precedent within the energy sector has typically (but not always) been for regulators to aim straight, rather than up, on the WACC. While, in principle, the frameworks that we considered apply to all regulated network activities where the social costs of under-investment exceed the benefits, in practice most regulators do not consider this framework when setting the appropriate WACC percentile with the same level of rigour that the NZCC has. Therefore, the lack of international regulatory precedent on using this framework to infer the extent to which the regulator needs to aim up, above the mid-point of the estimated WACC range, should not be seen as invalidating the NZCC’s approach. This would suggest that the 70th percentile of the WACC distribution would be the mid-point to target, but as explained above, we give weight to the 67th percentile from the last regulatory period as there is substantial value in maintaining regulatory stability for long-lived network investments.

In addition to our conclusions on the WACC percentile, we also explain that the NZCC should re-consider the way that it calculates the standard error of the WACC. Currently, the NZCC only includes the standard errors of some parameters of the WACC. While the standard errors of many of the parameters that it excludes may be relatively small, and therefore their exclusion could be justified on the basis of immateriality, this is not the case with leverage (i.e. the gearing ratio) as in New Zealand this is calculated on the basis of a large number of comparators, with very different levels of leverage. Consequently, the standard error of leverage is likely to be material and to reflect genuine uncertainty as to the notional leverage that should be assumed. We therefore do not see a good reason for excluding this parameter from the calculation of the WACC standard error. The consequence of adding the standard error of leverage into the estimate of the WACC standard error would be to increase the standard error of the WACC, meaning that aiming for a particular percentile of the WACC distribution would result in a higher regulated WACC.

## 2 Scope and context

In its 2016 IM for EDBs, the NZCC chose to set the WACC at the 67th percentile of the WACC distribution. The EDBs have asked Oxera to provide an independent view on whether the 67th percentile is the appropriate level at which to set the WACC in New Zealand, or whether it should be amended to an alternative percentile.

We have conducted our work in the context of the NZCC's review of the IMs for EDBs, gas pipelines, and airports. This review started in April 2021 and is planned to end in December 2023,[2] and the findings of this report are intended to inform the EDBs in their engagement with the NZCC on the WACC percentile that it should target in its regulatory decision.

Oxera's terms of reference in relation to this review cover investigation of the following questions.

- Why a regulator might want to aim for a percentile of the WACC distribution that is above the 50th percentile. In answering this question, we have been asked to consider both the reasons already included in the NZCC's framework, as well as any new reasons that may be relevant.
- Whether the rationale behind such a decision applies in the context of New Zealand and, if so, whether the 67th percentile represents the appropriate level.
- Whether the findings of the IM Decision for regulated fibre from October 2020, which determined that the 50th percentile was appropriate for providers of regulated Fibre Fixed Line Access Services (FFLAS), are applicable to EDBs.
- How regulators in other jurisdictions deal with uncertainty in the WACC.

The remainder of this report is structured as follows:

- section 3 explains the approach that the NZCC has historically taken to assessing which percentile of the WACC should be targeted;
- section 4 explains an appropriate percentile for the NZCC to aim for within the context of the framework that it has historically used;
- section 5 expands this framework, considering new evidence regarding the NZCC's framework that was not available to the NZCC during previous regulatory periods;
- section 6 concludes.

**Box 2.1 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').[3] 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'.

[2] NZCC (2022), '2023 input methodologies review', accessed 25 August 2022, available here.
[3] CEPA (2022), 'Review of Cost of Capital 2022/2023', available here.

# 3 The NZCC's approach to setting a percentile for the WACC

This section is split into two subsections:

- section 3.1 summarises the reasons why the NZCC chose to set the WACC for EDBs at the 67th percentile in its last IM Decision;
- section 3.2 summarises the reasons why the NZCC chose to set the WACC for providers of regulated FFLAS at the 50th percentile in its most recent IM Decision for fibre.

Accordingly, this section provides important context for understanding the NZCC's network reliability framework— specifically, how the framework influences the choice of an appropriate point estimate in the WACC range. This framework subsequently forms the basis of our discussion of the percentile of the WACC distribution that should be targeted, in section 4.

## 3.1 Reasons why the NZCC chose to target the 67th percentile of the WACC distribution for EDBs

In its 2014 Reasons paper about why it chose to set the WACC at the 67th percentile for EDBs and gas pipelines (henceforth '**2014 Reasons Paper**'),[4] the NZCC broadly followed a two-step approach. First, it explained why it considered that the WACC should be set at a level above the 50th percentile.[5] Second, it considered the specific WACC percentile that should be targeted,[6] although this part of its report primarily focused on why the WACC should be below the 75th percentile. To align with the NZCC's two-step approach, we first explain why the NZCC chose to aim above the 50th percentile (section 3.1.1), then turn to why it chose to aim below the 75th percentile (section 3.1.2).[7]

### 3.1.1 Why did the NZCC choose a WACC percentile above the mid-point?

This section first explains the general framework used by the NZCC for assessing the trade-off between setting the WACC at different percentiles. It then explains why the NZCC considered that a higher WACC percentile could reduce the incentives for under-investment. Finally, it discusses a number of other considerations regarding why the NZCC should target a higher WACC percentile.

**The framework that the NZCC used for assessing the trade-off between targeting different WACC percentiles**

The framework that the NZCC used to consider whether a WACC percentile above the mid-point would be appropriate was primarily a **network quality** or **network reliability** framework.[8] Within this framework, aiming up on the WACC is appropriate if a higher WACC is more likely to result in the levels of

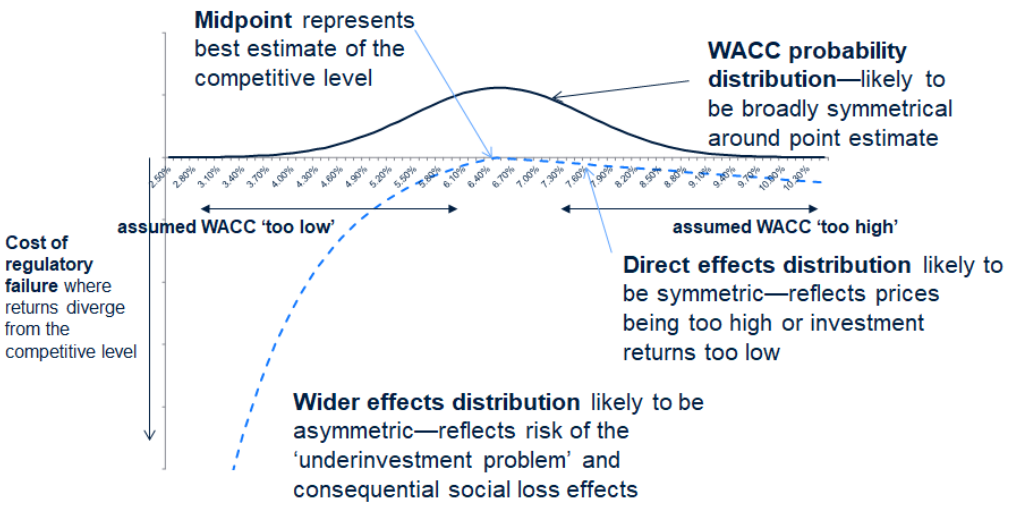
[4] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', available here.
[5] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', section 5, available here.
[6] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', section 6, available here.
[7] While section 3.1.1 primarily draws from section 5 of the 2014 Reasons Paper and section 3.1.2 primarily draws from section 6, we have also included factors that we understand affected the NZCC's decision but which are located elsewhere.
[8] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', paras 5.78–5.79.

investment meeting the appropriate level, and if the benefits of meeting this investment level (i.e. through having fewer outages) exceed the additional costs that consumers face as a result of a higher WACC. The reason why consumers face higher costs as a result of a higher WACC is that it is typically assumed in energy markets that costs are (approximately) fully passed through, meaning that consumers pay for the higher regulated return on the RAB.

This network reliability framework was developed for the NZCC by Oxera, and was applied by the NZCC in its decision-making.[9] The framework can be visualised as in Figure 3.1 below, which maps the WACC distribution against an asymmetric loss function. The figure shows:

- the distribution of the estimated WACC of the regulated industry as a black line.[10] The distribution of the estimated WACC is centred around a mid-point that is assumed to reflect the true WACC. This means that the regulator's estimate of the WACC is more likely to be close to, than far away from, the true WACC, which is why the distribution has the characteristic bell-shape;
- the loss function, which is shown as a light-blue line, declines significantly towards the left of the WACC distribution, while it only drops off slightly at the right of the WACC distribution. This reflects the fact that aiming up on the WACC (i.e. targeting a point to the right of the distribution) results in a higher cost to consumers, but this cost is relatively low compared to the cost of setting the WACC 'too low'.

**Figure 3.1 Illustration of the framework for the WACC percentile**




Source: Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', p. 2, available here. NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', Figure 6.8, available here.

This result (i.e. of an asymmetric loss function) arises because the cost of setting a WACC that is too low results in a greater risk of under-investment in the network and, consequently, outages. As the (social) cost of outages is typically assessed to be greater than the additional cost that the consumer

[9] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', paras 5.28 and 5.60, available here.
[10] In the figure, the WACC is assumed to be normally distributed. This is because the WACC is typically estimated by summing a series of parameters whose asymptotic distributions are normal.

bears, the loss function will be asymmetric in the way shown in Figure 3.1. We note that the NZCC agrees with the basic principle that the potential impacts of outages could be significant,[11] and therefore with the characterisation of the asymmetric loss function in the New Zealand energy industry.

We also note that the NZCC placed some, but little, weight on considerations outside of the network reliability framework. Specifically, the NZCC considered that areas outside of network reliability (i.e. demand growth, innovation, and economic investments) did not exhibit an asymmetric loss, and therefore that under-investment in these areas would not lead to social costs in excess of the additional costs that consumers have to pay for a higher WACC. In short, they stated that the case for aiming up was 'relatively weak' in these areas.[12] While we understand this to mean that the NZCC did not place zero weight on such considerations, it considered them to be relatively immaterial in the context of its previous decision for the energy networks.

In 2014, the NZCC also did not consider the possible asymmetric effects of failing to meet net zero targets if a lower WACC percentile was selected. These considerations, which we refer to as the 'decarbonisation framework' in this report, are discussed in section 5.2.

**The framework that the NZCC used to link a higher WACC percentile to a lower risk of under-investment**

The NZCC also agreed with the mechanism we outlined for the relationship between a higher allowed WACC and a lower risk of under-investment.[13] Oxera's framework explained that companies will make more investments when it is less likely that the net present value (**NPV**) of the project will drop below 0: this is more likely to happen if a regulator aims for a WACC percentile above the mid-point. There is uncertainty about the level of the 'true' WACC, i.e. the risk-adjusted return that is required in the sector. This means, in turn, that the regulated (allowed) WACC can differ from the true WACC. Therefore, if the regulated WACC is below the true WACC, companies will have an incentive to reduce their levels of investment.

The regulated WACC is more likely to be below the true WACC if the regulator targets the 50th percentile of the WACC than if it targets some higher percentile, such as the 67th percentile.[14] This will also be true if one takes a 'trigger' approach to under-investment, whereby under-investment only materialises if the true WACC is above the estimated WACC by some material margin, such as 0.5% (which is a margin that both we and the NZCC have applied in the past[15]). In our 2014 report, we found that the probability of the true WACC being more than 0.5% above the estimated WACC was 32.1% at

[11] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', paras 3.36 and 3.44, available here.
[12] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', paras 5.82–5.83, available here.
[13] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', paras 5.28 and 5.60, available here.
[14] This is because the probability of the true WACC being below the actual WACC is equal to 1 minus the percentile that is targeted (i.e. 50% if the 50th percentile is targeted and 33% if the 67th percentile is targeted).
[15] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.22.3, available here. NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.822, available here.

the 50th percentile, 19.7% at the 65th percentile, and 16.1% at the 70th percentile (we did not estimate the probability at the 67th percentile).[16]

In the NZCC's framework, the under-investment problem can arise at the following stages.

- **The planning stage**—the network will have an incentive to reduce the amount of investment that it proposes to undertake if the allowed WACC for the regulatory period is likely to be below the true WACC that is required by investors. This incentive effect applies to all types of investment.
- **During the regulatory period**—when the regulated company receives limited benefits from investment (i.e. where the NPV of investment is zero or close to zero), and absent any mitigating factors,[17] the company will have an incentive to inefficiently defer investment.
- **After the regulatory period decision is taken**—the under-investment will turn into an enduring under-investment problem if it cannot be resolved at the next review period.

As we noted in our 2014 report, this risk of under-investment can be mitigated by other elements of the regulatory period, such as incentive mechanisms.[18] However, as we explain in section 4.3, there is a limit to how effective this mitigation can be because replacing insufficient remuneration through potentially punitive measures like performance standards is not an effective long-term solution. In general, as we explain later, such mitigation will only be effective to the extent that, if the allowed WACC has been set too low by the regulator, these other mechanisms have been set in such a way that, in expectation, the investors can expect to earn a total return that is commensurate with the required return, i.e. the true WACC.

### Other considerations

The NZCC considered two further types of evidence in deciding that a WACC percentile above the mid-point should be used. The first was evidence from regulatory precedents in other jurisdictions and the second was the impact of a higher WACC percentile on other markets.

The NZCC found that international regulators often adopt a WACC estimate above the mid-point by using estimates of individual parameters that are generous in favour of network companies.[19] The NZCC explained that this evidence from regulatory precedents affected its decision to set a WACC above the mid-point.[20] However, the NZCC does not appear to have discussed regulatory precedents in much detail, such that the weight that it placed on these as part of its overall decision, is unclear.

The NZCC also considered the impact of selecting a higher WACC percentile on other markets (i.e. industries that use electricity as an input into their

[16] The precise probability of the true WACC being greater than the estimated WACC by some absolute number of percentage points will depend on the standard error of the WACC. In our 2014 report, we used the standard error of the WACC as estimated by the NZCC. Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', Tables 6.1 and Table 7.3, available here.
[17] By mitigating factors, we refer to regulatory mechanisms that can reward or penalise the company to enforce that a certain level of investment is met.
[18] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', p. 50, available here.
[19] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.84.3, available here.
[20] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.84.3, available here.

production processes). The NZCC considered that there could be an allocative inefficiency throughout the economy, due to the role of electricity prices as an input.[21] The NZCC considered expert evidence from both the Oxera 2014 report and from its adviser, Dr Martin Lally.

First, in relation to this issue, Oxera's evidence considered two possible theories of harm and concluded that the effects of both theories of harm were likely to be immaterial:

- we considered whether a higher WACC could reduce the incentives for downstream businesses that use electricity as an input to undertake investment. We considered whether this could happen as a result of, among other things, their profits being reduced by the higher electricity price. We concluded that this was unlikely to have any material effects because even a 5% increase in electricity prices would affect less than 1%, and in many cases less than 0.1%, of the industrials' cost bases;[22]
- we considered whether a higher WACC would reduce the international competitiveness of New Zealand businesses. Here we found that, even for the most energy-intensive industries, the result of setting the WACC at the 75th percentile would be an increase in end-prices of less than 0.25% if there was full pass-on of the higher electricity costs, and a reduction in profit margins of 0.2% if there was no pass-on.[23]

Second, Dr Lally's evidence commented on the effects of a price increase on allocative efficiency generally, and did not consider an explicit theory of harm.[24] His advice was interpreted by the NZCC as implying that the question of downstream effects was relatively immaterial.[25]

Based on the evidence presented by Dr Lally and ourselves, the NZCC considered that arguments related to the indirect effects of a higher WACC on the competitiveness of New Zealand industry were not material to its decision that a percentile above the mid-point should be used.[26]

In summary, the above explains why the NZCC first concluded that a WACC percentile above the mid-point (50th percentile) of its estimated range was appropriate. It did this to reduce the risk of under-investment leading to poor network reliability, as a WACC set above the mid-point would tend to arise if the allowed WACC were lower than the true WACC required by investors. We turn now to the second step in the NZCC's methodology—why it chose to set the allowed WACC below the 75th percentile of its estimated range.

### 3.1.2 Why did the NZCC choose to set the WACC below the 75th percentile?

After explaining why it wanted to aim up on the WACC, the NZCC considered the reasons why it would want to aim for a specific percentile above the 50th. However, as we explained above, this part of the NZCC's 2014 Reasons Paper primarily focused on explaining why it had chosen a percentile below the 75th. Below, we therefore summarise the six reasons that we have distilled as to

[21] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.90, available here.
[22] Oxera (2014), 'Input Methodologies: Review of the '75th percentile', pp. 35–7, available here.
[23] Oxera (2014), 'Input Methodologies: Review of the '75th percentile', pp. 37–9, available here.
[24] Lally (2014), 'The Appropriate Percentile for a the WACC Estimate', p. 18, available here.
[25] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.92, available here.
[26] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.94, available here.

why the NZCC assessed that it was appropriate to set an allowed WACC below the 75th percentile, notwithstanding that it had already decided to aim up above the mid-point.

**Reason 1: Evidence from investment plans and investor returns**

Evidence from investment plans and investor returns implied that targeting the 75th percentile was at least sufficient to encourage the right level of investment

The NZCC considered that, at the 75th percentile, the incentive levels were at least sufficient, and potentially too large, to encourage investment in the energy networks.[27] It concluded this based on two types of evidence: the levels of infrastructure investment undertaken by network companies, and the returns earned by network companies.

First, with respect to the levels of infrastructure investment, the NZCC considered that there did not appear to be risk of significant under-investment in the network:

- the NZCC considered that the levels of investment that Orion (an EDB) had proposed were larger than necessary, and the levels of investment that Transpower had proposed were in line with requirements;[28]
- it found that there had been no evidence of the EDBs running down (i.e. failing to re-invest) their asset bases in the past.[29]

Second, with respect to investors' required returns, the NZCC considered that there was evidence of strong investor interest in New Zealand energy networks. It cited the acquisition of a 42% stake in Powerco alongside favourable commentary on the regulatory environment in New Zealand, as well as EV/RAB multiples above 1 as evidence of this.[30] The NZCC interpreted EV/RAB multiples above 1 as potentially indicating that the allowed return was too large,[31] although it did also acknowledge that this result could arise from a number of other factors, such as outperformance of regulatory benchmarks and higher profitability of the non-regulated parts of a business.[32]

The NZCC stated that it placed a particularly high level of weight on both of these pieces of evidence, stating that these outweighed any theoretical arguments for aiming above the 75th percentile.[33]

[27] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 6.12, available here.
[28] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 6.14, available here.
[29] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 6.16, available here.
[30] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 6.17, available here.
[31] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 6.29, available here.
[32] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 6.35, available here.
[33] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 6.18, available here.

### Reason 2: Implications of using a consumer welfare standard

The use of a consumer welfare standard implies that there is less reason to aim up on the WACC than the use of a total welfare standard

The NZCC considered that a consumer welfare standard was the most appropriate way to assess the socio-economic benefits of targeting a particular percentile of the WACC.[34] This was consistent with the approach taken by Oxera in 2014, and was justified on the basis of Section 52A of the Commerce Act.[35]

The main alternative to a consumer welfare standard is a total welfare standard. The relationship between total welfare and consumer welfare can be expressed as:

$$TW = \alpha CS + (1-\alpha)PS$$

- where TW is total welfare;
- CS is consumer surplus (i.e. the level of consumer welfare);
- PS is producer surplus (i.e. the level of producer welfare);
- $\alpha$ is a weight.

If $\alpha$ is equal to 1, then total welfare is equal to consumer welfare, while the more $\alpha$ drops below 1, the greater the level of weight that is placed on producer welfare.[36] In this case, 'producers' are investors in the energy networks.

When a policy, such as the targeting of a particular percentile is introduced, the net socio-economic benefits of this policy are therefore assessed by summing the benefits that the policy delivers to consumers and energy networks, with the two benefits being weighted by $\alpha$ and (1- $\alpha$). As the increase in the WACC percentile also delivers higher returns to the investors in the energy networks, the consumer welfare approach implies that no consideration is given to the benefits that producers experience from a higher WACC percentile.

Section 52A of the Commerce Act explains that the regulation of goods and services should be in the long-term interests of consumers. In this context, both the NZCC and Oxera considered that determining the percentile to target should be based on the relative costs and benefits that were experienced by consumers, and therefore that a consumer welfare rather than a total welfare standard should be used.[37]

### Reason 3: Regulatory mitigants against risk of under-investment

The existence of alternative regulatory tools limits the extent to which the regulator needs to aim up on the WACC

[34] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above pp. 33–35, available here.
[35] Parliamentary Council Office (2022), 'Commerce Act 1986', Section 52A, available here.
[36] For more information, see Oxera (2014), 'Review of expert submissions of the input methodologies', section 3.3, available here.
[37] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', pp. 33–35, available here.

The NZCC considered that, due to the existence of alternative regulatory tools besides the WACC allowance, there was a limited risk of under-investment. While in its 2014 Reasons Paper, the NZCC did not put as much emphasis on the existence of alternative regulatory tools as it did in its 2020 IM Decision for regulated fibre (we discuss this in section 3.2), it did cite this as a reason to aim below the 75th percentile.

For example, the NZCC considered that:

- ex post incentive mechanisms would likely be more effective ways than the WACC allowance of incentivising investment in innovation;[38]
- economic investments can be incentivised through incentive measures that link grid outputs and quality standards to revenue;[39]
- providing allowances for a catastrophic event can be better dealt with through resetting the price paths than through increasing the regulated WACC.[40]

**Reason 4: Assessment of biases in WACC estimation**

The NZCC assessed that submissions stating that the mid-point estimate of the WACC was biased were incorrect

The NZCC received a number of submissions that stated the mid-point of the WACC that the NZCC calculates is downward-biased, and therefore that aiming up to the 75th percentile was needed to address this.[41]

The NZCC concluded that its estimate of the mid-point of the WACC was not downward-biased, and that if it was downward-biased then the appropriate way to address this would be to correct the mid-point of the WACC directly, rather than to aim up on the WACC.[42] For this reason, the NZCC did not feel that arguments about systematic downward bias in the WACC estimate presented any further reasons (i.e. over and above the reliability framework outlined in section 3.1.1) to aim up on the WACC.

**Reason 5: Further increases in WACC percentile not justified**

The NZCC did not consider some of the evidence for a higher WACC percentile (i.e. higher than 75th percentile) to be reliable

The NZCC received one quantitative submission, from Frontier Economics on behalf of Transpower, and several qualitative submissions from other stakeholders, that there was a need to target a higher percentile of the WACC. The evidence from Frontier Economics appears to have been the main evidence received by the NZCC and it argued for a WACC set at the 99th

[38] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.72, available here.
[39] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.77, available here.
[40] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', paras 4.35–4.36, available here.
[41] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 4.25, available here.
[42] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 4.26, available here.

percentile if a total welfare approach was taken, and a WACC at the 87th percentile if a consumer welfare approach was taken.[43]

The NZCC considered that the model developed by Frontier Economics, which based on a paper written by Professor Dobbs, was not reliable. This was because Professor Dobbs' model was:[44]

- designed to deal with a regulatory system where a regulator sets the WACC at the start of a regulatory period, and the WACC then changes over time. By contrast, the problem that the NZCC was considering was the effect of mis-estimating the WACC at the start of the regulatory period;
- developed on the basis of a total welfare approach, and the NZCC considered that adjusting it for a consumer welfare approach could not be done robustly;
- designed for the telecoms sector, and therefore less appropriate for energy networks.

The NZCC asked Professor Dobbs to review Frontier's model, and he concluded that 'it [was] unclear how much quantitative significance should be placed on the model's predictions'.[45]

We note that the NZCC also concluded that some of the evidence presented by Oxera potentially over-stated the economic costs of power outages. Specifically, the NZCC stated that our estimate that severe outages could result in annualised costs of NZ$1bn to the New Zealand economy might be over-statements because they were based on studies that considered the impacts of outages in the USA. According to the NZCC, there was evidence of under-investment in electricity distribution in the USA but not in New Zealand, and therefore these estimates might be upward-biased for New Zealand.[46]

**Reason 6: Use of cross-checks**

Comparisons of the NZCC's WACC estimates at the 67th percentile with other estimates indicated that the NZCC's estimates were reasonable

The NZCC ran a number of cross-checks on the WACC that it calculated based on the 67th percentile and concluded that the point estimate produced by aiming for the 67th percentile was not out of line with other sources, and was therefore reasonable.[47] Specifically the NZCC found that both its mid-point estimate of the WACC and its estimate of the 67th percentile were within the range of WACC estimates provided for Transpower and the EDBs by other independent parties, while the 75th percentile of the WACC was slightly above the estimates from other providers.[48] Due to this, the NZCC considered the

[43] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', B51, available here.
[44] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 6.22, available here.
[45] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 6.23, available here.
[46] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 6.9.1, available here.
[47] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 6.57, available here.
[48] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', D19-D23, Figure D1, available here..

67th percentile to be a more reasonable basis for setting the WACC than the 75th.

### 3.1.3 Concluding remarks

In summary, the NZCC concluded that it was not appropriate to select a point estimate of the WACC that was higher than the 75th percentile.

Within its two-step approach to determining the point estimate percentile as part of the 2014 Decision, this led the NZCC to a point estimate that was:

- higher than the 50th percentile (section 3.1.1);
- no higher than the 75th percentile (section 3.1.2).

Accordingly, the NZCC selected the 67th percentile as the appropriate point estimate for its allowed WACC, within the estimated range for the WACC.

However, the NZCC revised its decision on the point estimate in a subsequent regulatory period. Specifically, the NZCC adopted a lower point estimate within its allowed WACC range, i.e. the 50th percentile, in its 2020 Decision for regulated fibre. We turn now to a review of this latter Decision.

## 3.2 Choice of 50th percentile in the 2020 Decision for regulated fibre

In its assessment of the percentile that should be applied for regulated fibre networks in 2020, the NZCC highlighted that there were three main reasons for setting the WACC at the 50th percentile. In addition to these three reasons, we have identified two further reasons that appear to have been instrumental in the NZCC's Decision, since they were discussed in detail at the time.

We outline the three main reasons in section 3.2.1 followed by the remaining two reasons in section 3.2.2.

### 3.2.1 Explicit reasons for the NZCC's choice of a lower (50th) percentile

The NZCC stated that there were three main reasons why it chose to target the 50th percentile of the WACC distribution for regulated fibre. These reasons were:[49]

- under-investment in the fibre network would be visible and gradual;
- there are other tools that better target under-investment in regulated fibre than the WACC;
- the NZCC can adjust the IMs every seven years, and therefore can always return to a higher percentile if necessary.

These are discussed in turn, below.

**Under-investment in regulated fibre is visible and gradual**

First, the NZCC explained that the degradation of the telecommunications network was likely to be visible and gradual because this could be observed by the growth in traffic over time.[50] For this reason, it considered there to be less of a need to aim up on the WACC because the visible degradation would allow

[49] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.647, available here.
[50] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.798, available here.

it to resolve the problem relatively quickly using the alternative regulatory tools that we discuss below.[51]

As context for this review, it is important to note that the NZCC's 2020 Decision for regulated fibre drew an explicit contrast between the regulated fibre network and energy networks. Specifically, the NZCC explained that the energy networks were not subject to gradual and visible degradation, and that reinforcing the energy network is harder and slower than reinforcing the regulated fibre network.[52]

**Other regulatory tools can be used to better manage under-investment risks**

Second, the NZCC considered that if under-investment were to arise,[53] it would have at least four alternative regulatory tools available that it considered superior to an uplift on the WACC.[54] These tools were:[55]

- a quality incentive scheme, by which is meant a scheme that rewards network operators for meeting certain quality-based targets;
- asset management plan reporting, which is where the owner of the fibre network explains how it plans to manage its assets during a regulatory period;
- a volume-based incentive to connect new users to the network;
- quality standards, which are minimum standards for network quality that operators need to meet.

The Electricity Networks Association (ENA) submitted to the NZCC that it considered the use of alternative tools which manifest themselves as penalties to be a coercive way of encouraging investment. The NZCC appeared to agree with this because it explained that, while it was reasonable for pecuniary penalties to exist, 'such schemes are not meant to allow for a WACC that is set too low'.[56] We understand this to mean that the NZCC would not want to introduce any alternative regulatory tools in an asymmetric way—i.e. in a way that reduces the expected returns of regulated fibre networks.

Related to this, we note that the NZCC considered that using the WACC to stimulate investment was unnecessarily expensive because the WACC uplifts the return on all investment, while the purpose of aiming up on the WACC is to stimulate future investment only.[57] It therefore considered that there were not only alternative regulatory tools that it could use, but also that using the WACC was a relatively blunt instrument (similar to the views the NZCC expressed in the 2014 Reasons Paper, discussed in section 3.1).

**The seven-year IM cycle allows for regular adjustment of the WACC**

As a third and final explicit point, in justifying its decision to set a WACC based on the (lower) 50th percentile, the NZCC noted that it reviews the IMs every

[51] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.798, available here.
[52] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.798, available here.
[53] Which, as noted above, they expected to be able to readily identify.
[54] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', paras 6.835–6.842.
[55] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', paras 6.835–6.842.
[56] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.842.
[57] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.721.

seven years. This allows the NZCC to consider the effects of its previous Decisions and to change them if necessary. This implied that the NZCC might consider an uplift on the WACC in future regulatory periods, if the (outturn) evidence were to substantiate that a higher WACC percentile should have been selected.[58]

### 3.2.2 Other reasons that underpinned the choice of the 50th percentile

In addition to the three main reasons cited by the NZCC, we have also identified two further reasons that were given elsewhere in the decision:

- the social impact of poor network performance in the regulated fibre sector is relatively minor;
- in any case, the asset health of the regulated fibre network was already very high and there was therefore a low probability that under-investment would lead to negative socio-economic impacts.

In relation to these, first, the NZCC explained that the costs of an outage for end-consumers are relatively minor in the regulated fibre industry, especially when compared to outages in the energy sector.[59] One of the reasons why this impact is relatively small is that outages in regulated fibre networks do not have knock-on effects, as they do not affect the provision of services other than Internet. The NZCC explained that this contrasts with energy outages, which, for example, prevent households from being able to use Internet services as well as any other electrical appliance, meaning that the impact is greater when outages occur in electricity networks.[60]

Additionally, as regards the first reason, the availability of substitutes limits the impact of fibre outages. Specifically, in the event of a fibre outage, consumers can still use mobile services to access the Internet, especially for emergency services like calling and email.[61] The NZCC explained that this contrasts with energy networks, for which there is no substitute in the event of outage.[62]

Finally, in relation to the second reason, the NZCC noted that the asset health of the regulated fibre network is very high, so there are limited risks from under-investment. The NZCC considered that the fibre network in New Zealand was ‘at the leading edge of fixed line networks worldwide’.[63] It explained that the regulated fibre network is relatively new, was built ahead of demand (implying that there is excess capacity), and was built to recognised international technical standards.[64] With a new and leading-edge network, the risks and effects of any under-investment would be likely to be limited, as they would still leave the network operating at a high level of quality.

Having reviewed how the predominantly network-reliability-based approach taken by the NZCC has been applied in its 2014 and 2020 Decisions for energy networks (section 3.1) and regulated fibre (section 3.2), respectively, we can now assess the implications for the current regulatory and market context. Accordingly, in section 4, we assess the up-to-date evidence base for

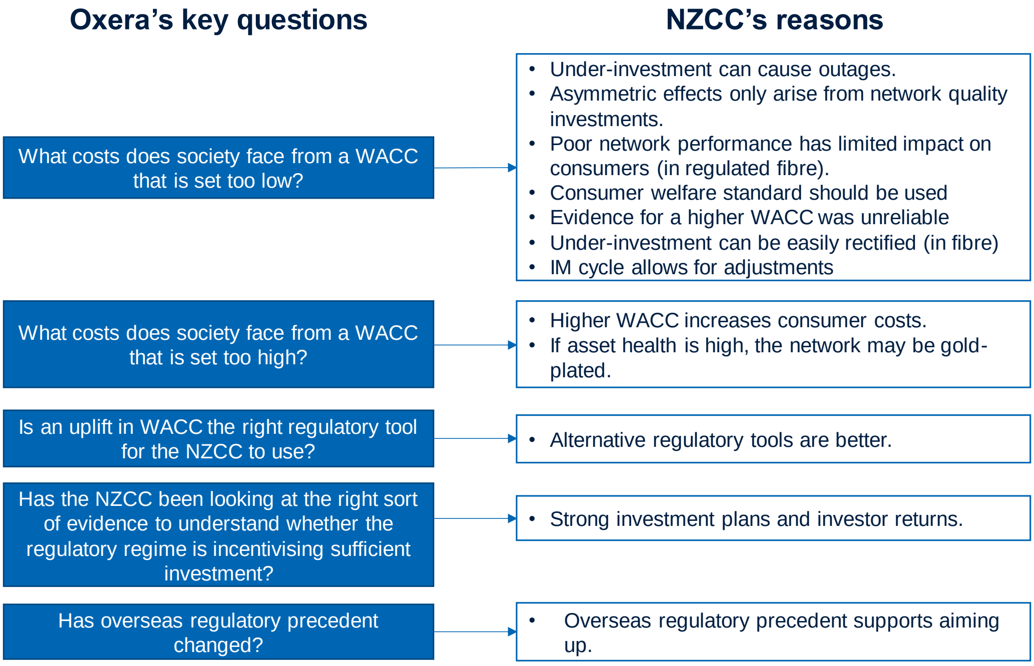
[58] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, para. 6.647.3.
[59] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, para. 6.778.
[60] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, para. 6.779.
[61] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, paras 6.674–6.675 and 6.788.
[62] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, para. 6.674.
[63] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, para. 6.746.
[64] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, para. 6.748.

calibrating the appropriate percentile estimate within the regulated WACC range for energy networks as part of the NZCC's ongoing IM process.

# 4 The appropriate WACC for the NZCC to set in electricity distribution

We consider that the reasons the NZCC has given for targeting a particular WACC percentile (see section 3), can be summarised into five main questions (‘**Oxera’s key questions**’), each of which we address in this section. Figure 4.1 provides a visual representation of the mapping from the reasons given by the NZCC to target a particular percentile, against these five key questions.

**Figure 4.1 Mapping of reasons given by the NZCC for a WACC percentile and Oxera’s key questions**




Note: We note that in this figure we have not mapped two of the NZCC reasons to an Oxera key question. These two reasons are: (i) the NZCC’s discussion on the downstream effects on other markets from a higher WACC; and (ii) the reasons it gave in relation to the WACC being systematically downward-biased. The reason for not mapping these is because, first, in respect of the issue of potential downstream effects (see section 3.1.1), this was largely resolved in the 2014 Reasons Paper and so we see limited value in revisiting this; second, we do not consider it necessary to discuss the possibility that the NZCC produces a downward-biased estimate of the WACC. At this stage, the NZCC has yet to produce an estimate of the WACC for the 2023 IMs and is consulting on the methodology that it plans to use. In addition, we discuss the comparison of the WACC to other calculations in section 5.3.

Source: Oxera.

This section is structured around the five key Oxera questions, with a different question addressed in each section (i.e. in sections 4.1 to 4.5). These questions group and classify the multitude of factors that the NZCC has historically considered, in setting a WACC percentile. Accordingly, considering the Oxera questions allows us to understand the percentile that the existing NZCC framework (i.e. the network reliability framework) would recommend targeting.

We note that there are two other categories of reasoning that could also justify aiming up on the WACC:

- reasons outside of the network reliability framework. The decarbonisation framework falls into this category and is discussed in section 5.2;
- if the methodology adopted by the regulator fails to set an appropriate level of return. However, in this case the first-best solution would be to fix any potential problems with the WACC methodology.

## 4.1 Q1. What costs does society face from a WACC that is set too low?

In order to address this first question, which examines the costs that society faces from setting a WACC that is too low relative to the true WACC that is required by investors, we break it down it into the following sub-questions:

- what is the welfare standard used to measure social costs (section 4.1.1)?
- what is the causal mechanism by which a WACC that is lower than required leads to adverse consumer outcomes (section 4.1.2)?
- is it likely that consumers would experience the effects of network under-investment (section 4.1.3)?
- what would these effects of under-investment be (section 4.1.4)?

### 4.1.1 What welfare standard should be used to measure social costs?

Before answering the question of what costs society faces from a WACC that is set too low, one needs to define how social costs are to be measured. As we explained above, a relevant debate in this context is between measures of total welfare and consumer welfare. We note that the correct welfare standard for the NZCC to use will be governed by its statutory obligations.

As noted earlier, Section 52A of the Commerce Act explains that the purpose of regulated industries is to promote the long-term benefits of consumers.[65] However, Section 52A also explains that this needs to be done by, among other things, ensuring that suppliers (i.e. regulated networks) have sufficient incentives to innovate, invest, and improve their efficiency. Furthermore, in Section 52R, the Act explains the purpose of the IM is to 'promote certainty for suppliers and consumers'.[66] We note also that maintaining the incentives of regulated networks to innovate and invest is necessary to maintain long-term benefits for consumers.

We therefore maintain the view that we expressed in Oxera's 2014 report, that a consumer welfare standard is the appropriate standard to apply, but that some consideration could be given to producer interest.[67] Nonetheless, for the remainder of this report, we take a conservative approach in assuming that any additional returns that accrue to investors as a result of setting the WACC above (rather than at) the mid-point, do not contribute towards social welfare via the producer interest.

### 4.1.2 What is the process by which a low WACC leads to bad outcomes for consumers?

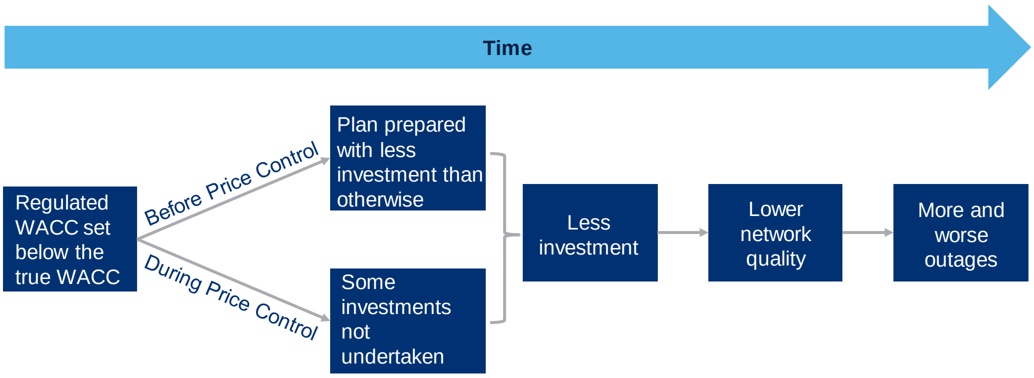
In order to assess the actual impact of a WACC that is set too low, one first needs to define the process by which a particular level of the WACC affects consumer outcomes. This is shown in Figure 4.2 below, which depicts a causal

[65] Parliamentary Council Office (2022), 'Commerce Act 1986', Section 52A, available here.
[66] Parliamentary Council Office (2022), 'Commerce Act 1986', Section 52R, available here.
[67] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', p. 11, available here.

chain from the level of the regulated WACC to consumer outcomes. The figure explains that, in a period where the true WACC rises above the regulated WACC, there will be two possible effects that result in less investment, depending on whether the time period in question is before or during a regulatory period:[68]

- if it is before the expected outcome of a regulatory period, the regulated network will have an incentive to prepare a plan with less investment;
- if it is during a regulatory period, the regulated network will have an incentive to undertake the minimum legally permissible amount of investment. This may also affect its willingness to prepare a plan with high levels of investment in the next regulatory period, such that there is an interaction between these two effects.

**Figure 4.2 Causal mechanism from the regulated WACC being below the true WACC to bad outcomes for consumers**




Source: Oxera.

In both of these cases, the reason why the regulated network has less of an incentive to invest is because it will recover a lower level of its costs through future charges.

Once a level of investment that is below the needs of the network has been realised, it is likely that the network will become lower-quality which, in turn, will cause more and worse outages.[69] Specifically, the NZCC distinguishes between investments in network quality, demand growth, innovation, and economic investments, and only considers the network quality investments to be the source of a potential asymmetric loss, as these are the investments that prevent consumer outages.[70]

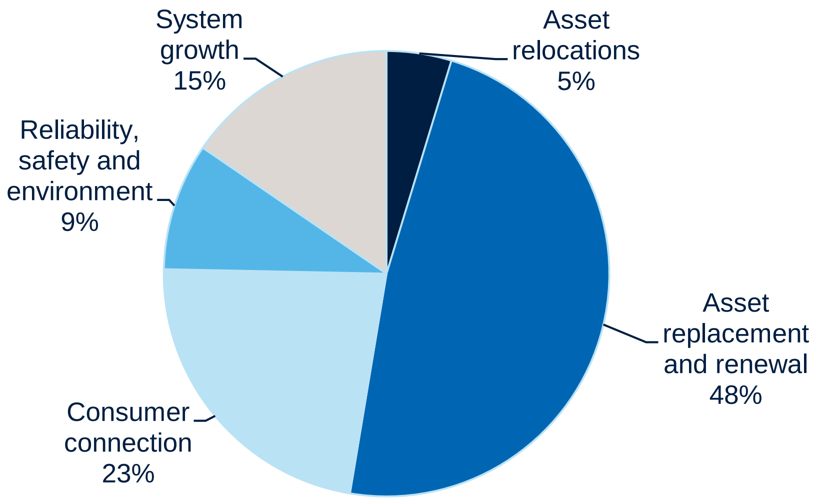
While we agree that network reliability investments are the main investments of relevance, we consider that a large proportion of the investments undertaken by the EDBs have positive effects on network reliability. In Oxera's 2014 report, we explained how investments related to Asset Replacement and Renewal, System Growth, and Reliability, Safety and Environment, would all be likely to contribute to improving network reliability.[71] This is because:

[68] We note that the NZCC agrees with us on both of these mechanisms. See NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', heading above para. 3.27, available here.
[69] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', paras 5.53–5.83, available here.
[70] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.58, available here.
[71] Oxera (2014), 'Review of expert submissions of the input methodologies', p. 25, available here.

- Asset Replacement and Renewal replaces assets that are older and therefore more likely to cause faults;
- System Growth expands the capacity of the network, without which the demand for network capacity (from generators, storage, and off-takers) would exceed the capacity of the grid and require the EDBs to curtail off-take (i.e. introduce managed outages). The investments that expand the grid in order to facilitate that connection improve network quality, as without them the new connection would tend to increase grid congestion and therefore outages;
- Reliability, Safety, and Environment investments are, to a large extent, directly targeted at improving the reliability and safety of the grid.

The investments across these categories accounted for 77% of EDB CAPEX in 2014.[72] We have updated this analysis for 2021 and Figure 4.3 shows that 73% of CAPEX was still invested in these areas. This means that a large majority of investment was, and is, in areas that have reliability benefits.

**Figure 4.3 Breakdown of EDB CAPEX investments by type of investment**




Source: Oxera analysis based on data received from the EDBs.

Accordingly, as far as EDB investment is concerned, more than 70% of CAPEX investments are directly identifiable as delivering reliability benefits. Consequently, setting the WACC too low is likely to have material downside effects on network reliability and, conversely, setting the WACC above the mid-point is likely to materially mitigate against this risk.

This is particularly likely to be the case when there is greater electrification of the New Zealand economy. Without adequate investment in the above-mentioned CAPEX categories, there is a risk that the EDBs will not be able to keep pace with the growth of demand for electricity. While network companies should not be incentivised to undertake inefficient levels of infrastructure investing without considering the role of other solutions such as flexibility, a

[72] Oxera (2014), ‘Review of expert submissions of the input methodologies’, p. 25, available here.

successful decarbonisation strategy relies on them having sufficient CAPEX to stay ahead of a rapidly increasing demand for electricity.

#### 4.1.3 Is it likely that consumers would experience the impacts of network under-investment?

Both the probability and impact of outages are hard to link quantitatively and precisely to a specific WACC percentile. This is because to do so would require:

- an understanding of the precise magnitude of the effect that the WACC has on additional investment. This magnitude would need to take into account the entirety of the regulatory regime (as there are other incentive mechanisms and quality standards that affect investment) over both the short term and the long term;[73]
- an understanding of how the current state of the network affects the likelihood that under-investment will lead to more outages, as if the network has excess capacity or is gold-plated then there is likely to be a 'buffer zone' where some level of under-investment can occur without resulting in more or worse outages.

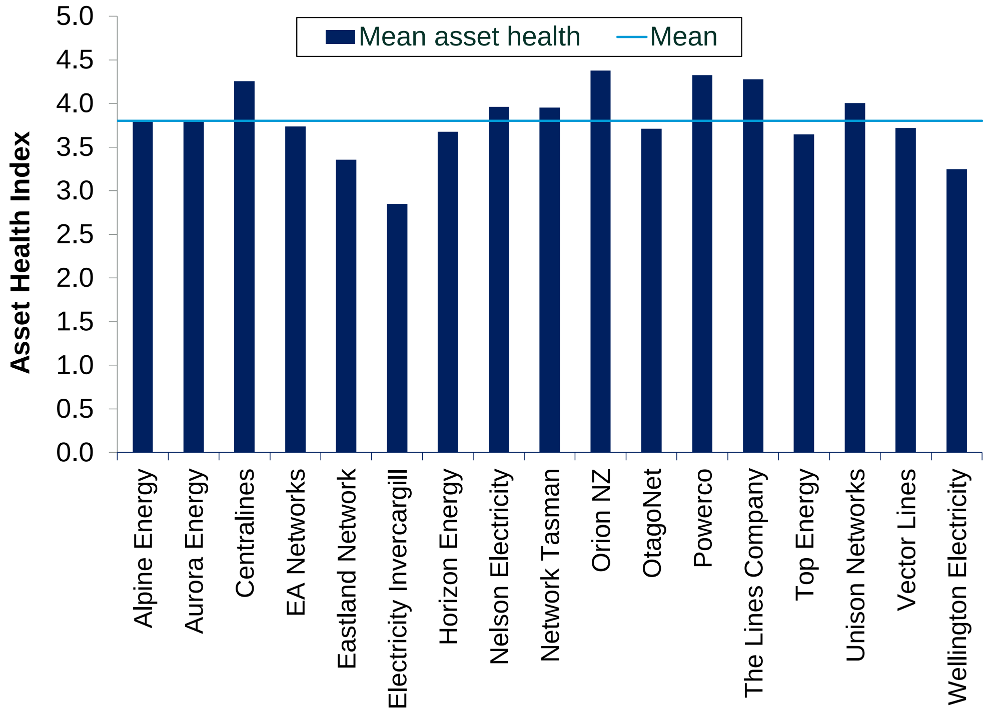
With regard to the latter issue, we have not found evidence of current gold-plating in the New Zealand distribution networks. This indicates that if under-investment does occur, there would be no material buffer zone that allows networks to withstand downward pressure on network reliability. It also indicates that the current regulatory framework—which aims for the 67th percentile—does not appear to have led to over-investment by networks.

Specifically, we analyse whether there is evidence of excess capacity or gold-plating of network assets in New Zealand with reference to the asset health of the EDBs. The quality of the networks can be assessed through the industry standardised asset health index (AHI), which the NZCC publishes for each EDB on an annual basis.[74,75]

Figure 4.4 presents the mean AHI of all assets of each EDB in 2021, and compares it to the industry mean.

[73] The distinction between the short term and the long term may be important because, in the short term, under-investment may be mitigated by using performance guarantees. However, in the long term, if a regulator is relying on punitive measures to incentivise investment without providing sufficient rewards in line with the risks of the sector, investors will tend to divest the relevant assets.
[74] Wellington Electricity (2021), 'Wellington Electricity Asset Management Plan 2021', 1 April, available here.
[75] The AHI grades assets on a scale of 1 to 5. An AHI of grade 1 means that an asset has reached the end of its useful life and must be replaced within one year; grade 2 means that an asset is at material failure risk and should be replaced shortly; grade 3 means that an asset is exposed to increasing failure risk and medium-term replacement is needed; grade 4 is an asset with a reasonable degree of deterioration that requires regular monitoring, expecting replacement in over a decade; and grade 5 is a new asset that has over two decades of lifespan left. See NZCC (2022), 'Performance summaries for electricity distributors – Year to 31 March 2021', 28 April, available here.

**Figure 4.4 Average asset health in 2021**




Note: Average asset health of EDBs active in New Zealand measured through the asset health index (AHI). The mean asset health is calculated as the mean AHI across each company's asset class in 2021.

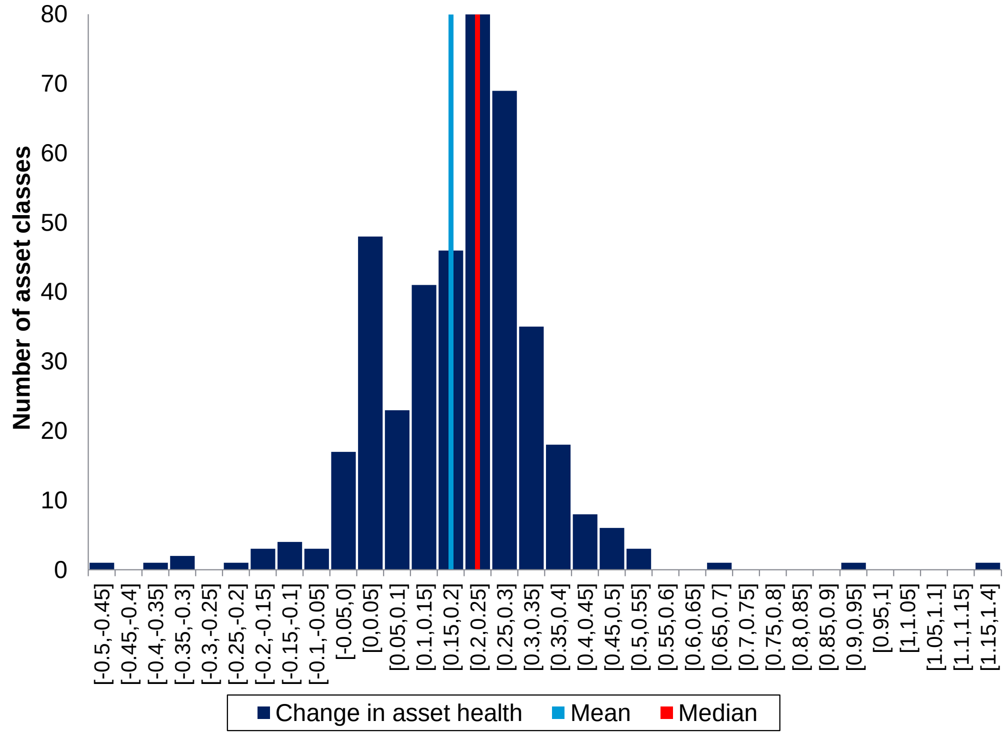
Source: Oxera analysis based on NZCC (2022), 'Performance summaries for electricity distributors – Year to 31 March 2021', available here.

Figure 4.4 shows the mean of the mean AHI, measured at a grade of 3.8, which indicates that the network is in a good state, requiring regular monitoring, but is neither completely new nor in disrepair. This is broadly consistent with the reliability of New Zealand network, which, according to the NZCC, has exhibited 'little change'.[76] The existing regulatory framework, which targets the 67th percentile, therefore appears to have achieved a good balance of outcomes for consumers.

Figure 4.5 provides further insight into the trend of asset health over the last regulatory period by presenting the distribution of the difference in asset health between 2018 and 2021 across asset classes. This figure shows that the change in asset health, measured through the change in AHI (which is shown on the x axis), has on average improved by 18.9%, measured by the mean and 21.4%, measured by the median. Therefore, we observe a positive trend in the quality of the network over this period.[77] We note that, even though the asset health of the network has increased, it has not risen to a level that indicates the installation of predominantly new assets, suggesting that excess network capacity is installed—i.e. the health of the network assets does not indicate gold-plating.

[76] NZCC (2022), 'Trends in local lines company performance', p. 3, available here.
[77] We find that the distribution is centred on the median, but is skewed toward the right, with only 7.77% of asset classes experiencing a negative change, indicating that the improvement in asset health is systemic across the industry.

**Figure 4.5 Distribution of change in EDB asset health, 2018–21**



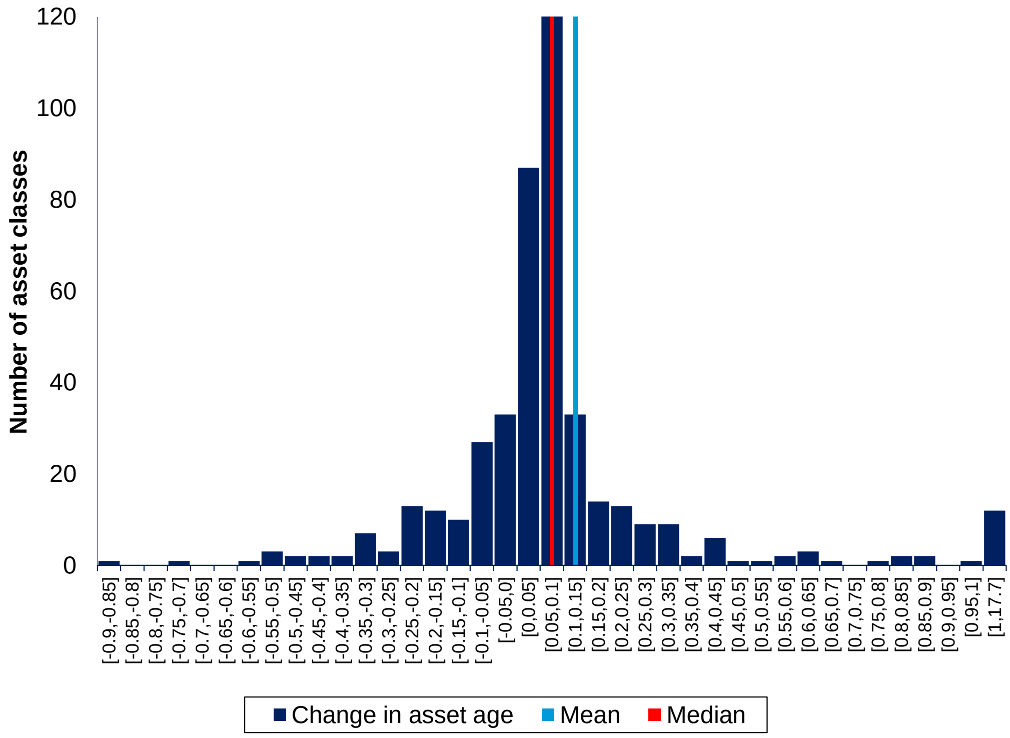

Note: The x axis presents the change in the AHI index between 2018 and 2021. The graph can be interpreted as follows—the tallest bar in the graph shows that approximately 80 asset classes experienced an increase in asset health of between 0.2 and 0.25 points in the AHI index, over the period.

The width of bins on the right side of the distribution has been adjusted for readability.

Source: Oxera analysis based on NZCC (2022), 'Performance summaries for electricity distributors – Year to 31 March 2021', 28 April, available here.

Figure 4.6 below shows the distribution of the difference in mean asset age across asset classes within the same regulatory period. We observe that the average change in the age of an asset class (measured in years, and shown on the x axis) across companies, has on average increased by 12.9% (mean estimate) or 5.3% (median estimate). This evidence indicates that the network has aged slightly during the regulatory period.

**Figure 4.6 Distribution of change in asset age, 2018—21**




Note: The x axis shows the change in the age of assets between 2018 and 2021, measured in years, with positive numbers reflecting aging assets and negative numbers reflecting asset classes that have more new assets. The graph can be interpreted as follows—the tallest bar in the graph shows that slightly more than 120 asset classes experienced an increase in age of between 0.05 and 0.1 years.

The width of bins on the right side of the distribution has been adjusted for readability.

Source: Oxera analysis based on NZCC (2022), 'Performance summaries for electricity distributors – Year to 31 March 2021', 28 April, available here.

Taken together, this analysis of changes in average asset health and asset age over the current regulatory period does not indicate that there has been inefficient investment in, or gold-plating of, the network in response to the previous decision to aim up in the WACC range. Improved asset health with a slightly older installed asset base is consistent with better monitoring and maintenance of the network, rather than investment in new assets (which may not yet be needed).

### 4.1.4 Impact of under-investment on consumers

The impact that the under-investment would have on consumers will be equal to the change in the probability and impact of outages that arises as a result of under-investment in the network (i.e. stripping out other causes of outages) multiplied by the impact of those outages. To inform an assessment of this impact, we have updated the research that we undertook in 2014[78] into the economic impacts of outages. The table below shows that network failure can have a negative impact of between 0.26% and 6.1% of GDP each year. Note that in the absence of data being available for New Zealand specifically, this exercise is informed by outage events in other jurisdictions. If equivalent levels

[78] See, for example, Oxera (2014), 'Review of expert submissions of the input methodologies', Table 4.2, available here.

of network failure occurred in New Zealand, this would cost the economy between NZ$0.92bn and NZ$21.7bn annually.

### Table 4.1 Summary of studies into economic cost of power outages

| Study | Country | Event period (year) | Cost of outage (US$ bn) | GDP in year of study year (US$ bn)[1] | Cost (% of GDP) | NZ GDP in 2021 (NZ$ bn) | Implied cost of outages in NZ (NZ$ bn)[2] |
|---|---|---|---|---|---|---|---|
| **Annual studies (i.e. studies of equivalent annualised effect)** | | | | | | | |
| ASCE (2011) | USA | 2012–20 | 55 | 18,869 | 0.29 | 355 | 1.0 |
| ASCE (2011) | USA | 2020–40[3] | 97 | 25,648 | 0.38 | 355 | 1.3 |
| LaCommare et al. (2004) | USA | 2004 | 79 | 12,300 | 0.6 | 355 | 2.1 |
| Nexant (2003) | Nepal | 2001 | 0.025 | 6.3 | 0.4 | 355 | 1.4 |
| EPRI (2001) | USA | 2001 | 119–188 | 10,600 | 1.1–1.8 | 355 | 3.9–6.4 |
| Swaminathan and Sen (1997) | USA | 1998 | 39 | 9,100 | 0.4 | 355 | 1.4 |
| Targosz and Manson (2007) | EU-25 | 2003–04 | 180 | 16,546 | 1.1 | 355 | 3.9 |
| Zachariadis and Poullikas (2012) | Cyprus | 2011 | 1.52 | 24.98 | 6.1 | 355 | 21.655 |
| EBP (2020) | USA | 2020-29[3] | 63.7 | 24,525 | 0.26 | 355 | 0.92 |
| **Annual, weather-related only** | | | | | | | |
| Campbell (2012) | USA | 2012 | 25–55 | 16,200 | 0.15–0.4 | 355 | 0.5–1.4 |
| Council of Economic Advisors et al. (2013) | USA | 2003–12 | 18–33 | 14,116 | 0.13–0.23 | 355 | 0.46–0.82 |
| **Specific event** | | | | | | | |
| Reichl et al. (2013) | Austria | 2013 | 2.3 | 417.6 | 0.6 | 355 | 2.1 |

Note: [1] GDP is reported in current prices. For studies spanning over several years, the average value of the GDP has been taken. Forward GDP figures have been estimated assuming a constant growth of 2% per year. [2] Based on the same proportion of GDP as in country of occurrence. [3] These studies present simulations of outages in the future.

Source: Oxera analysis, based on various academic studies: ASCE (2011), 'Failure to act: The economic impact of current investment trends in electricity infrastructure', available here; LaCommare, K. and Eto, J. (2004), 'Understanding the cost of power interruptions to U.S. electricity consumers', available here; Nexant (2003), 'Economic impact of poor power quality on Industry, Nepal', available here; EPRI (2001), 'The Cost of Power Disturbances to Industrial & digital economy companies', available here; Swaminathan, S. and Sen, R.K. (1997), 'Review of power quality applications of energy storage systems', available here; Targosz, R. and Manson, J. (2007), 'Pan-European lpqi power quality survey', available here; Zachariadis, T., Poullikas, A. (2012), 'The cost of power outages: A case study from Cyprus', available here; EBP (2020), 'Failure to act: Electric infrastructure investment gaps in a rapidly changing environment', available here; Campbell, R.J. (2012), 'Weather-related power outages and electric system resiliency', available here; Executive Office of the President (2013), 'Economic Benefits of Increasing Electric Grid Resilience to Weather Outages', Council of Economic Advisors et al, available here; Reichl, J., Schmidthaler, M. and Friedrich, S. (2013), 'Power Outage Cost Evaluation: Reasoning, Methods and an Application', available here.
Data from World Bank and Statistics New Zealand (2013), 'Regional Gross Domestic Product', March, available here.

None of the studies in Table 4.1 provide a perfect comparator for New Zealand and the full range of impacts is very wide—between NZ$0.5bn and NZ$21bn, as mentioned above. However, excluding the outlier of Cyprus in 2011, the single event studies, and those with a narrow remit (e.g. related to severe weather), result in a tighter range of NZ$0.9bn to NZ$6.4bn.

Furthermore, we consider that the ASCE study is likely to be the most relevant to the New Zealand economy, because it focuses specifically on the costs from under-investment in electricity infrastructure, whereas the other studies are not clear about the cause of the outage impact that they estimate. The cost for the New Zealand economy implied from these studies is between NZ$0.92bn and NZ$1.3bn. We also note that CEPA has produced its own estimate of the impacts of network failure from underinvestment. This estimate is NZ$1.9bn, and is based on updating our 2014 estimate of NZ$1bn for inflation and changes in the VoLL.[79]

While the 2020 study by EBP is a more recent update of the ASCE paper, we place less weight on this than the ASCE paper because it only covers lost output from businesses, meaning that it may understate the full losses (due to, for example, excluding the impacts on households). We therefore consider the estimates of NZ$1bn-NZ$1.9bn from the ASCE 2011 paper to be more reliable for our assessment, and draw insight from the lower bound of this estimate (i.e. NZ$1bn) in our analysis.

We note that in its 2014 Reasons Paper, the NZCC explained that it considered studies from the USA to potentially overstate the impacts of under-investment because there was already an under-investment problem in the USA, whereas no such problem existed in New Zealand.[80] The analysis that we have undertaken in this report is informative, to address this criticism. Specifically, we have shown in section 4.1.3 that the age and asset health of the New Zealand network does not support a hypothesis that the network is all new and in an excellent state of repair; rather, the age and asset health indicators show that the New Zealand networks do require ongoing levels of investment. Therefore, it seems plausible that a relatively small level of under-investment could result in New Zealand moving towards evidence of under-investment as in the USA, making the NZ$1bn figure a realistic estimate of the impacts on New Zealand. In any case, as noted above, this estimate of NZ$1bn is at the lower end of the range in Table 4.1.

There are also two reasons why the NZ$1bn estimate may be an under-estimate of the outage impact:

- if it is not easy or quick to rectify the under-investment, then the effective annualised costs of under-investment will be greater because it could take several years to rectify the under-investment, meaning that 1 year of under-investment could result in more than 1 year of the effects of under-investment.[81] In this context it is important to note that the NZCC does not consider it easy to observe and rectify under-investment in electricity networks,[82] which implies that the annual costs of under-investment in New Zealand could exceed NZ$1bn;
- as the New Zealand economy decarbonises, it may be more dependent on electricity than the studies that we have used assume. If this were to be the

[79] CEPA (2022), ‘Review of Cost of Capital 2022/2023’, section 4.6, available here.
[80] NZCC (2014), ‘Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services’, para. 6.9.1, available here.
[81] This can be most easily seen through the following example. Consider an under-investment problem that results in economic costs of NZ$1bn per annum from year t. Suppose that at year t+2, the regulator identifies the problem and implements a policy (such as an increase of the WACC percentile) that aims to rectify it. However, suppose that this policy takes two years to take effect, for example because there is a two-year lag between the regulated companies receiving the higher regulated return, making an investment plan, tendering for the new investments, and finally constructing those new investments such that the NZ$1bn impact is reversed. In this example the effective annual costs of the under-investment are NZ$2bn because the regulator reverses the policy that caused under-investment in period t+2, but it is only in period t+4 that the effects of the under-investment are fully reversed.
[82] NZCC (2020), ‘Fibre Input Methodologies: Main final decisions – reasons paper’, paras 6.779 and 6.798, available here.

case then the impacts of outages would be greater than those assumed in the papers that have been written to date.

**Box 4.1 CEPA update: impact of under-investment on consumers**

As we described above, CEPA has updated our analysis by adjusting it for changes in New Zealand's GDP growth rate and the VoLL since 2014. CEPA initially conducted this analysis in 2013 price terms and then inflated it to 2022 prices.[83]

As the costs of under-investment estimates by CEPA, at NZ$1.9bn, are higher than the lower-bound costs that we estimated, the benefits of aiming up on the WACC are higher under CEPA's approach than under ours. This can be seen by comparing the benefits in the column for the 0.5% threshold in the CEPA report with the benefits in Table 4.3 below. Due to this, CEPA's approach will tend to support aiming up for a higher percentile than our approach.

We consider that CEPA's approach is reasonable—as our choice of NZ$1bn was a conservative, lower-bound estimate—such that their finding that the benefits of aiming up outweigh the costs at the 70th percentile would support our conclusion that it would be appropriate for the NZCC to continue targeting the 67th percentile, at a minimum.

## 4.2 Q2. What costs does society face from a WACC uplift?

The costs that society faces from a WACC uplift are the costs of: (i) additional investment that is undertaken, which did not need to be undertaken; and (ii) the cost for the investment that is undertaken being higher as a result of a higher WACC.

While it is not possible to rule out that additional inefficient investment is undertaken if a WACC uplift is included in a regulatory regime, the regulatory framework in New Zealand has several measures in place to limit the extent to which it is possible for the EDBs to over-invest. These measures include the following.

- The existence of information disclosure requirements within the Asset Management Plans of EDBs. In the case of asset replacement, these plans require the EDBs to justify any forecast investment based on an asset health assessment of the asset they are planning to replace. In the case of network reinforcement, the plans need to contain a capacity and demand assessment. If the case for new investment is deemed insufficiently strong, it can be rejected by the NZCC.
- Under a Default Price-Quality Path (DPP), CAPEX is subject to a 'gates procedure', meaning that CAPEX categories need to meet certain criteria before being allowed to proceed.[84] An overall 120% cap on CAPEX also applies.
- Increases in investment (such as those that could be caused by over-investment) are assessed more rigorously, such as through higher levels of scrutiny if an EDB moves from a DPP to a Customised Price-Quality Path (CPP) or through re-openers for significant investments.

[83] CEPA (2022), 'Review of Cost of Capital 2022/2023', p.41, available here.
[84] We understand from the EDBs that gates operate at the level of CAPEX categories, not at a project level.

- The revenue cap prevents the EDBs from collecting more revenue than is needed to fund their allowable investment levels. If the EDB engages in unnecessary investment, it will increase its costs without increasing its revenues, which will tend to reduce its level of profits. Under the Incremental Rolling Incentive Scheme (IRIS), this overspend has to be borne by the EDBs (as well as customers) beyond the end of the regulatory period. This means that over-investment is likely to have a material negative impact on EDB returns.

In addition, as noted in section 4.1.3, we have not seen evidence that the EDBs have engaged in unnecessary investments over the course of the most recent regulatory period.

Consequently, the main cost of a WACC uplift is the fact that consumers pay higher prices for their electricity. We have calculated these prices on a per MWh and economy-wide basis in Table 4.2 below. The calculation took the RAB of Transpower and the EDBs,[85] and multiplied it by the uplift to the WACC at different percentiles of the WACC distribution, using the standard deviation of the WACC that was used in the 2016 IMs (1.01%). In addition, the table shows:

- the approximate annualised impact of under-investment (NZ$1bn based on the estimates discussed in section 4.1);
- the probabilities of the true WACC being more than 0.5% and 1% below the regulated WACC, respectively. We have included these estimates because, under the NZCC's framework, under-investment is only likely to happen if the true WACC falls below the regulated WACC by a 'material' amount, which is assumed to be at least 0.5%.[86]

**Table 4.2 Consumer cost impact of a higher WACC percentile**

| Percentile | WACC impact | Cost (NZ$m) | Cost per MWh (NZ$/MWh) | Annualised impact of under-investment (NZ$m) | Probability of true WACC being more than 0.5% below regulated WACC | Probability of true WACC being more than 1% below regulated WACC |
|---|---|---|---|---|---|---|
| 50% | 0.00% | 0.00 | 0.00 | 1,000 | 31.0% | 16.1% |
| 55% | 0.13% | 23.01 | 0.58 | 1,000 | 26.7% | 13.2% |
| 60% | 0.26% | 46.38 | 1.16 | 1,000 | 22.7% | 10.7% |
| 65% | 0.39% | 70.54 | 1.76 | 1,000 | 18.9% | 8.5% |
| 70% | 0.53% | 96.01 | 2.40 | 1,000 | 15.4% | 6.5% |
| 75% | 0.68% | 123.49 | 3.09 | 1,000 | 12.1% | 4.8% |
| 80% | 0.85% | 154.08 | 3.85 | 1,000 | 9.1% | 3.3% |
| 85% | 1.05% | 189.75 | 4.74 | 1,000 | 6.3% | 2.1% |
| 90% | 1.29% | 234.63 | 5.87 | 1,000 | 3.8% | 1.2% |
| 95% | 1.66% | 301.14 | 7.53 | 1,000 | 1.6% | 0.4% |

Note: All cost estimates are relative to the costs that would be incurred at the 50th percentile of the WACC.

[85] The RAB of Transpower is taken from its 2016 value of NZ$4.6bn, while the RAB of the EDBs is taken from their 2021 value of NZ$13.5bn. NZCC (2021), 'Electricity Distribution Statistics Year to March 2021', available here.
[86] NZCC (2014), 'Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services', para. 5.22.3, available here.

Source: NZCC (2016), 'Input methodologies review decisions', 20 December, p. 186, available here; NZCC (2022), 'Total electricity distribution Year to 31 March 2021', 28 April, available here; NZCC(2014), 'CC19. Transmission Transpower ID Disclosures 2015-16_Rev3', 28 February, available here; Ministry of business innovation & employment (2022), 'Energy in New Zealand 22', August, available here.

The optimal WACC percentile will be determined by the percentile that maximises consumer welfare. Consumer welfare is defined as the difference between the change in the impact of power outages as a result of a higher WACC (i.e. lower duration and frequency of outages) less the additional costs that the higher WACC imposes on customers (i.e. the pass-through of network costs into electricity prices). Therefore, the WACC percentile that maximises this difference is the optimal percentile.

Table 4.3 below shows the social benefit enjoyed by New Zealand consumers. This social benefit is calculated as follows:

- first, we calculate the change in the probability of under-investment relative to the 50th percentile by calculating the change in the probability that the true WACC is more than 0.5% below the regulated WACC (see the second column of the table);
- this change in probability is then multiplied by the annual impact of under-investment (of NZ$1bn) to produce a monetary estimate of the reduced impact of under-investment (see the third column);
- this is then compared to the additional cost faced by consumers (which is copied into the fourth column of the table below from Table 4.2) in order to produce the social benefit of targeting the particular percentile (see the fifth column).

The analysis indicates that the optimal percentile is somewhere between the 75th and the 80th, as these are the percentiles where the social benefit is highest.

### Table 4.3 Social benefit at different percentiles

| Percentile | Change in probability of under-investment | Reduced impact of under-investment (NZ$bn) | Additional cost faced by consumers (NZ$bn) | Social benefit (NZ$bn) |
|---|---|---|---|---|
| 50% | 0.00% | 0.00 | 0.00 | 0 |
| 55% | 4.29% | 42.89 | 23.01 | 20 |
| 60% | 8.32% | 83.17 | 46.38 | 37 |
| 65% | 12.10% | 120.95 | 70.54 | 50 |
| 70% | 15.63% | 156.29 | 96.01 | 60 |
| 75% | 18.92% | 189.19 | 123.49 | 66 |
| 80% | 21.96% | 219.62 | 154.08 | 66 |
| 85% | 24.75% | 247.46 | 189.75 | 58 |
| 90% | 27.25% | 272.47 | 234.63 | 38 |
| 95% | 29.41% | 294.10 | 301.14 | -7 |

Source: Oxera analysis based on Table 4.2.

We note that this analysis relies on a number of assumptions that could, in principle, be adjusted in ways that either increase or decrease the optimal

WACC percentile.[87] The analysis that we present in Table 4.3 should therefore be interpreted as indicative of the order of magnitude percentile that the NZCC should target.

For this reason, we consider that an appropriate conclusion to draw is that, as the social benefits appear to be highest in the region of the 65th to the 85th percentiles, the optimal WACC is likely to be in this range. We note that this is similar to the recommendation we made in one of our 2014 reports, where we described the 80th percentile as a 'prudent' approach, but whose cost would be 'potentially excessive'.[88] In those reports, we ultimately concluded that a percentile between the 60th and the 70th was most appropriate, in part due to the fact that under-investment can also be mitigated through other regulatory measures.[89] We turn to this issue in the next sub-section.

**Box 4.2 CEPA update: costs of aiming up on the WACC**

CEPA has also updated the costs that society faces from a WACC uplift. The costs that CEPA has calculated are very similar to our estimates, and this can be seen by comparing the estimates we presented in Table 4.3 above to the estimates that CEPA presents in Table 4.8 of their report.[90]

The analysis that we presented on the costs that society faces, above, did not include any assessment of: (i) the deadweight loss arising from changes in the quantity of energy demanded at higher prices; (ii) the indirect financial effects of higher energy prices (i.e. the impact of higher electricity prices on downstream companies). It is helpful to note that CEPA has updated our 2014 analysis and confirms that both of these effects remain small,[91] which is consistent with our approach of not including these in the present analysis.

## 4.3 Q3. Is an uplift on the WACC the right regulatory tool for the NZCC to use?

Regulators have many different tools available to them to prevent under-investment in the network. Examples include performance guarantees and incentive schemes that reward regulated companies if they outperform selected reliability metric(s). Some of these tools could be used instead of, or in combination with, an uplift to the WACC in order to prevent or mitigate under-investment. However, given that the prevailing methodology in New Zealand uses aiming up on the WACC, any change that is now introduced would tend to undermine regulatory stability, and any change would need to be introduced on a forward-looking, NPV-neutral basis.

[87] A non-exhaustive list of these assumptions is that:
- there is no additional inefficient investment as a result of a higher WACC percentile. We have explained that we do not consider it likely that this would happen due to various regulatory safeguards, and that at the 67th percentile there does not appear to be evidence of this happening, but if a very high percentile such as the 80th were adopted, the risk of this happening could be increased (as the EDBs would have greater incentives to over-invest). This would reduce the optimal percentile that the NZCC should target;
- the NZ$1bn investment could be under- or over-stated, in which case the optimal WACC percentile would be lower and higher, respectively, than implied by Table 4.3;
- as explained earlier, it is likely to be the case that under-investment cannot be quickly resolved, in which case the annual costs of under-investment would be in excess of the NZ$1bn that we have assumed. This would increase the percentile that the NZCC should target.

[88] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach' pp. 6 and 72, available here.
[89] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach' p. 72, available here.
[90] CEPA (2022), 'Review of Cost of Capital 2022/2023', Table 4.8, available here.
[91] CEPA (2022), 'Review of Cost of Capital 2022/2023', p.37, section 4.5, available here.

Stable regulatory regimes provide benefits to consumers because they reduce the regulatory risk that investors need to be compensated for. If regulation becomes more stable and investors are not compensated for this, there is a risk that they will divest. This would lead to higher required returns for debt and equity holders in regulated networks, and consequently higher consumer prices. We note that regime stability was an important consideration to which we also gave weight in our 2014 advice to the NZCC, where we explained that 'any premium should be applied to all RAB assets and applied consistently, as the expected whole-life return on assets should be the relevant test for investors'.[92] This highlighted the regulatory risk of the NZCC choosing a particular WACC percentile at the time, only to change it in future periods.

It is possible that in the short run, effective reductions in remuneration such as the replacement of monetary rewards (e.g. aiming up in the WACC range) with penalties (e.g. use of stricter performance guarantees with higher fines for failure) would not lead to investors divesting. This is because investors may temporarily remain invested while they discuss regulatory changes with a regulator. However, in the long run this is likely to reduce incentives to invest and/or increase in incentives to divest, and could consequently lead to an increase in the cost of capital.

In this context, we note that in its 2020 Decision on regulated fibre, the NZCC considered that to mitigate the risk of under-investment in regulated fibre, it would be able to place 'greater reliance on quality standards and enforcement'.[93] Furthermore, the NZCC commented that:[94]

> We agree that more targeted tools are potentially available. At this stage we do not consider that such tools are needed but over time, to the extent concerns on under-investment prove substantive, **a WACC uplift appears a comparatively expensive way to address these concerns** for end-users [emphasis added]

However, in response to criticism of this approach from the ENA,[95] the NZCC provided reassurance that that it did not intend to make unilateral downward adjustments to the returns of regulated companies, as it explained that it did not consider that quality standards allow for the WACC (or more generally the expected return) to be set too low.[96] We consider this clarification important, because even if regulatory risk were not present, it would be important for the NZCC to introduce any changes on an NPV-neutral basis, if the existing regime does not show signs of systematic over-compensation. We note that regulatory stability helps to maintain investment incentives, especially in the context of long-lived network assets.

### 4.4 Q4. Has the NZCC been looking at the right evidence base to understand whether the regulatory regime is incentivising sufficient investment?

As discussed above, the regulatory regime should aim to incentivise sufficient but not excessive investment. A reasonable level of investment aims to reduce the risk of outages without unduly increasing the costs to consumers.

[92] NZCC (2014), 'Input Methodologies: Review of the '75th percentile' approach', p. 6, available here.
[93] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.715, available here.
[94] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.837, available here.
[95] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.840, available here.
[96] NZCC (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.842, available here.

We note that, in the past, the NZCC has considered evidence in relation to the EV/RAB ratios of regulated network companies, to assess whether the regulatory regime is promoting sufficient levels of investment. As this ratio does not describe the quality of the network—its reliability and underlying asset health—it is not informative in assessing whether sufficient levels of investment have occurred.

EV/RAB ratios are also not informative in assessing whether there is an excessive return that is earned by investors, such that they have incentives to over-invest in network assets. We do not consider the EV/RAB ratio to be a good measure of over-compensation, because other factors can explain the ratio being above 1, including:

- the winner's curse—a transaction-winning bid is that with the highest valuation, which is underpinned by more optimistic assumptions than other bids and therefore might be above the intrinsic asset value;[97]
- a control premium—if a majority stake has been acquired, investors may be willing to pay a premium for it;
- the 'stickiness' of investors' valuation expectations—investors tend to refer to past transactions to form their expectations about future valuation which may suggest an expected exit EV/RAB ratio, i.e. the terminal value, of above 1; the terminal value explains a significant proportion of the EV/RAB ratio being above 1;
- financial restructuring—there is the potential to restructure the financing of the business and create value for the shareholders;
- revenue and/or RAB adjustments as reconciliations from the preceding regulatory period;
- environmental, social and governance (ESG) factors and market sentiment;
- company-specific outperformance which does not apply to other companies in the industry;
- expectations over future RAB growth, because the RAB is a backward-looking measure while EV is a forward-looking measure;[98]
- the value of non-regulated business activities, which is additional to the value generated by the RAB. If a regulated business also engages in non-regulated activities then the value placed on the non-regulated activities will upward-bias the EV/RAB ratio;
- accrued dividends, which are likely to be embedded into the market capitalisation of a company but not the RAB, and would therefore lead to an EV/RAB ratio above 1x even when there is no over-compensation.

Also, importantly, our understanding is that the NZCC does not consider the EDBs to be over-compensated, as they have stated that profitability across the EDBs has been below the NZCC's estimates of reasonable returns.[99]

[97] See, for example, Andrade G., Mitchell M., and Stafford E. (2001), 'New Evidence and Perspectives on Mergers', *Journal of Economic Perspectives*, spring, **15**:2.
[98] Therefore, any expectations over future RAB growth will be reflected in a higher EV (as the share price of the company will increase with a higher absolute level of profit) but not in a higher RAB (until the RAB growth transpires).
[99] NZCC (2022), 'Part 4 Input Methodologies Review: Process and Issues paper', para. 5.18, available here.

Overall, we consider that the NZCC should consider evidence related to network investment—such as business plans, the age and asset health of assets—when assessing whether the regulatory regime is providing sufficient incentives to invest. In setting the allowed return, evidence of EV/RAB is not directly informative in this regard.

## 4.5 Q5. Has overseas regulatory precedent changed?

Notwithstanding that there are differences between regulatory regimes in New Zealand and other jurisdictions, we observe that in our 2014 reports, and in its past decisions, the NZCC has assessed international regulatory precedents in relation to the WACC percentile that is selected within an estimated range. We have undertaken a review of recent regulatory precedents in informing our assessment in this report. Our findings are summarised below, with more details in Appendix A1).

- In Oxera's 2014 report, we explained that **UK** regulators tended to aim up on the WACC, and typically chose the 73rd percentile of the WACC ranges that they considered.[100] Since then, Ofgem, the GB energy regulator has changed from aiming up to 'aiming straight' (i.e. choosing the mid-point of the WACC).
- We have also observed that the mid-point of the WACC range was selected in the recent energy decisions in **Australia** (by the AER[101]), the **Netherlands** (by the ACM[102]), **Germany** (by BNetzA[103]), and in **Italy** (by ARERA[104]).
- In **France**, however, the energy regulator (CRE) selected a WACC point estimate that is higher than the mid-point, in its recent decision.[105]
- However, we note that this generalised move towards aiming straight within the calibration of the allowed WACC has tended to be accompanied by other measures that have reduced (but not eliminated) the ability for the regulated WACC to deviate from the true WACC. In the UK, for example, Ofgem has indexed movements in the risk-free rate.
- In addition, the fact that the NZCC has not found any evidence of over-compensation suggests that there is no reason to adjust the regulatory framework in a manner that reduces the ex ante returns of energy networks.
- Also, the regulators that are cited in this review of international precedents have not used the NZCC's network reliability framework to present analysis that supports their decision to select the mid-point (50th percentile) of the WACC range. Therefore, their choice of WACC percentile is not directly comparable to the NZCC's, because it is made in a different context (e.g. they do not apply the network reliability framework to calibrate the allowed WACC).

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[100] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', Table 3.2, available here. As a point of detail, note that this 73rd percentile represents a percentile of a range of point estimates, rather than a percentile of a distribution around a WACC estimate.
[101] AER (2021), 'Final Decision: AusNet Services Distribution Determination 2021 to 2026', available here.
[102] ACM (2021), 'The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs', available here.
[103] Bundesnetzagentur, (2021), 'BK4-21-055', available here.
[104] 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', available here.
[105] CRE (2021), 'Délibération de la CRE du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de distribution d'électricité (TURPE 6 HTA-BT)', available here.

**Box 4.3 CEPA update: overseas regulatory precedent**

CEPA also finds that regulatory precedent has moved away from 'aiming up' towards 'aiming straight'. However, we note that CEPA also references some non-energy precedents for aiming up, such as the UK water and telecommunications sectors.[106] CEPA also finds that IPART, an Australian regulator, uses a methodology that appears to suggest that a WACC uplift would be appropriate in times of macroeconomic uncertainty.[107] In addition, CEPA does not reference the French precedent for aiming up that we refer to above. Therefore, combining our report and CEPA's report together results in more precedents for aiming up than taking either of the reports individually.

CEPA does not comment on the fact that the regulators that they have found now 'aim straight' are not regulators that formally use the NZCC's network reliability framework. We consider this to be an important distinction in the approach that the NZCC takes to setting its regulatory package relative to other regulators, and consider that this limits the direct read-across of the other regulators' decisions to the NZCC's.

### 4.6 Concluding remarks

In summary, we find that society is likely to face a substantial negative impact from outages if the electricity network suffers from under-investment. An uplift to the WACC can prevent this from happening, and the costs to consumers of applying it are relatively low. When the reduction in the cost of outages that is caused by an uplift to the WACC is traded off against the costs to consumers, we find that a WACC percentile somewhere between the 65th and the 85th is likely to reflect the highest social benefit.

While we consider that other regulatory tools can also mitigate against the cost of outages, the use of these tools needs to be traded off against (i) additional regulatory risk caused by changing the regulatory framework; and (ii) the need to make any regulatory changes NPV-neutral, especially in the context of a regulatory regime that does not have any evidence of over-compensation. Ultimately, the regulatory regime needs to provide a return that is sufficient for regulated companies to be funded by investors, and these alternative tools cannot necessarily compensate for an allowed return that is set too low.

Some of the evidence that the NZCC has previously considered to assess whether sufficient (or excessive) investment is being incentivised by the regulatory regime has focused more on the financial returns of the EDBs (e.g. the EV/RAB ratios) than on the incentives to invest (i.e. assessments of asset health, investment plans, etc.). We consider it more appropriate for the NZCC to consider measures that directly assess investment, such as business plans and the asset health of the network, rather than measures of investor returns which do not directly speak to the levels of investment being undertaken by the EDBs. In addition, we consider that the use of the EV/RAB ratio to measure investor returns is inappropriate as it can return a ratio in excess of 1 for reasons other than over-compensation.

In recent decisions, overseas regulators have tended to aim straight on the WACC, but have not done this universally. However, we consider the evidence from regulatory precedent to be of limited relevance to New Zealand, where the NZCC finds that the networks are not being over-compensated (and

[106] CEPA (2022), 'Review of Cost of Capital 2022/2023', section 4.3, available here.
[107] Ibid.

therefore limited a priori need to move away from the status quo of aiming up). Also, the choice by international regulators of the WACC percentile is not directly comparable to the NZCC's, because it is made in a different context (e.g. they do not apply the network reliability framework to calibrate the allowed WACC).

**Box 4.4 CEPA update: concluding remarks**

We consider that CEPA broadly comes to the same conclusion that we do. CEPA explains that the evidence for aiming up in the network reliability framework—as applied to the New Zealand energy sector—is stronger than it was in 2014, while observing that the international regulatory precedent has moved towards aiming straight.[108] CEPA was not asked to comment on whether they consider it appropriate to aim straight or aim up, but its main findings are similar to ours.

[108] CEPA (2022), 'Review of Cost of Capital 2022/2023', pp.4-5, available here.

# 5 Expansion of the NZCC framework and the impact that this may have on the WACC percentile that should be targeted

Section 4 discussed the reasons to aim up on the WACC within the context of the NZCC's framework. This section expands on that through three additional considerations that have not been taken into account by the NZCC to date.

The first consideration, discussed in section 5.1, is the extent to which further evidence has emerged regarding the optimal WACC percentile that a regulator should aim for, since the publication of our last report in 2014. The second consideration, discussed in section 5.2, explains why the need to decarbonise the economy and achieve net zero by 2050 strengthens the case for aiming up on the WACC. The third and final consideration, discussed in section 5.3, explains how the NZCC should more fully take into account another feature of parametric uncertainty (i.e. its estimation of standard errors) in the WACC estimate.

## 5.1 New academic evidence on the WACC percentile that regulators should aim for

We have reviewed new academic research, by Romeijnders and Mulder (2022), who studied the relationship between WACC uplifts and consumer welfare under a theoretical model.[109] They found that, under their model, the optimal solution was typically (but not always) to raise the regulated WACC above the historical WACC (i.e. target a percentile above the 50th). More details about their methodology and findings are summarised in Appendix A2.

The paper provides valuable insight on how the optimal regulated WACC should be set based on different assumptions about market conditions. Specifically, the authors find that the relationship between the WACC mark-up and the standard deviation of the WACC exhibits an inverted u-shape relationship, whereby the recommended uplift on the WACC increases with the standard deviation when the standard deviation is low, and decreases with the WACC when the standard deviation is high.

While the authors have presented their findings in terms of a percentage uplift to the WACC when the standard deviation of the WACC is at a particular level, it is possible to convert these WACC uplifts into percentile targets.[110] We have done this in Table 5.1 below, which shows how the optimal WACC percentile varies across:

- standard deviations of the WACC that are close to the NZCC's standard deviation estimate[111] of 1.01%;
- different proportions of the asset base that can be replaced in one year;
- the persistence of the WACC, with values closer to 1 indicating higher persistence and values closer to 0 indicating lower persistence.

[109] Romeijnders, W. and Mulder M. (2022), 'Optimal WACC in tariff regulation under uncertainty', *Journal of Regulatory Economics*, **61**, pp. 89–107.
[110] By dividing the percentage uplift by the standard deviation we calculate how many standard deviations the uplift is away from the mean. This allows us to use a standard normal distribution to determine the equivalent percentile that the percentage uplift corresponds to. For example, if the ratio of the uplift to the standard deviation is 0.5, this would imply, based on a standard normal distribution table, that the optimal WACC percentile was the 69th.
[111] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', para. 580, available here.

**Table 5.1 Optimal WACC percentile for different combinations of the WACC standard deviation, the percentage of investment that can be replaced in a year, and the persistence of the WACC**

| Uncertainty of WACC, measured by standard deviation | Percentage of asset base replaced in one year | Persistence[1] | Optimal WACC percentile |
|---|---|---|---|
| 0.50% | 10% | 0.92 | 91.92% |
| 1% | 10% | 0.92 | 81.59% |
| 1.50% | 10% | 0.92 | 74.75% |
| 2% | 10% | 0.92 | 67.36% |
| 0.50% | 7% | 0.92 | 93.32% |
| 1% | 7% | 0.92 | 88.49% |
| 1.50% | 7% | 0.92 | 82.47% |
| 2% | 7% | 0.92 | 77.34% |
| 0.50% | 10% | 0.5 | 78.81% |
| 1% | 10% | 0.5 | 72.57% |
| 1.50% | 10% | 0.5 | 63.06% |
| 2% | 10% | 0.5 | 58.90% |
| 0.50% | 10% | 0 | 72.57% |
| 1% | 10% | 0 | 59.87% |
| 1.50% | 10% | 0 | 55.30% |
| 2% | 10% | 0 | 52.99% |

Note: [1]The persistence is the autocorrelation factor of the model and measures how close the previous period's value of WACC is to the predicted WACC. The higher the persistence, the closer the predicted WACC value will be to the previous period's.

Source: Oxera analysis based pp. 102–105 of Romeijnders, W. and Mulder M.(2022), 'Optimal WACC in tariff regulation under uncertainty', *Journal of Regulatory Economics*, **61**, pp. 89–107.

We consider the salient points for the NZCC from Table 5.1 to be that:

- at high levels of persistence in the WACC (i.e. situations where under-investment could occur for multiple years), the optimal WACC percentile is always above the 67th;[112]
- at lower levels of persistence (i.e. situations where it is less likely that under-investment could occur for multiple years), and where the standard deviation is similar to the standard deviation calculated by the NZCC,[113] the suggested percentile is between 55% and 72%, thereby encompassing the 67th percentile used by the NZCC;[114]
- the most relevant rows to consider are likely to be those that have a standard deviation of between 1% and 1.5%, and persistence of 0.92 or 0.5. These rows are most relevant because the NZCC currently has an estimate of the standard error that is approximately 1%,[115] but the change that we suggest in section 5.3 would increase this. Furthermore, as the persistence

[112] This can be seen from the optimal WACC percentile in the rows that have a persistence parameter of 0.92. However, it is important to note that a persistence parameter of 0.92, which was the authors' estimate for the WACC in the Netherlands, may not reflect the level of persistence in the WACC in New Zealand.
[113] This can be seen by looking at the rows with a standard deviation of between 0.5% and 1.5%, as the NZCC's most recent estimate of the standard deviation of the WACC was 1.01%. NZCC (2016), 'Input Methodologies Review Decisions. Topic paper 4: Cost of capital issues', para. 580, available here.
[114] This can be seen by looking at the optimal WACC percentiles for the rows where the standard deviation is between 0.5 and 1.5% and persistence is either 0 or 0.5
[115] NZCC (2016), 'Input Methodologies Review Decisions. Topic paper 4: Cost of capital issues', para. 580, available here.

parameter of 0.92 is estimated using actual market data from the Netherlands, it seems relatively unlikely that a persistence parameter of 0 would reflect the levels of persistence in New Zealand. These rows suggest a mean percentile of 77%, which is materially higher than the NZCC's current percentile.

It is important to note that there are material limitations to this model, specifically because it assumes that:

- no investment is undertaken when the regulated WACC is below the true WACC, which increases the WACC percentile that it targets relative to a situation where some investment still takes place;
- a relatively high proportion of the asset base, at 7–10%, can be replaced in a single year, which reduces the WACC percentile that it targets relative to a situation where a more realistic assumption about asset replacement is made.

Therefore, the precise point estimates implied by the paper do not read-across directly to the New Zealand context. Rather, this academic evidence provides intuitive and empirical support, calibrated to the Dutch market, to underpin the approach taken in New Zealand of aiming up in the WACC range.

## 5.2 Aiming up in the context of the decarbonisation framework

As explained in section 3, the NZCC's framework considers that the primary form of under-investment that leads to an asymmetric loss is under-investment in network quality. This asymmetry largely arises from the fact that end-users place much more value on an uninterrupted electricity supply than they do on the additional costs that they pay from a WACC uplift. Under this framework, the higher the proportion of EDB investment that improves network quality, the greater the case for increasing the WACC percentile.

Under the NZCC's current framework any asymmetric loss arising from the need to decarbonise is not considered. However, since the framework was first introduced, New Zealand has committed itself to a 2050 net zero goal,[116] and the NZCC has stated that it may take into account New Zealand's climate change commitments in its ongoing review of the IMs.[117] Taking these commitments into account would tend to imply that the NZCC should target a higher percentile of the WACC than that which has been considered by the NZCC previously, or by us in the earlier parts of this report.

Decarbonisation tends to increase the asymmetry of the loss function for at least two reasons.

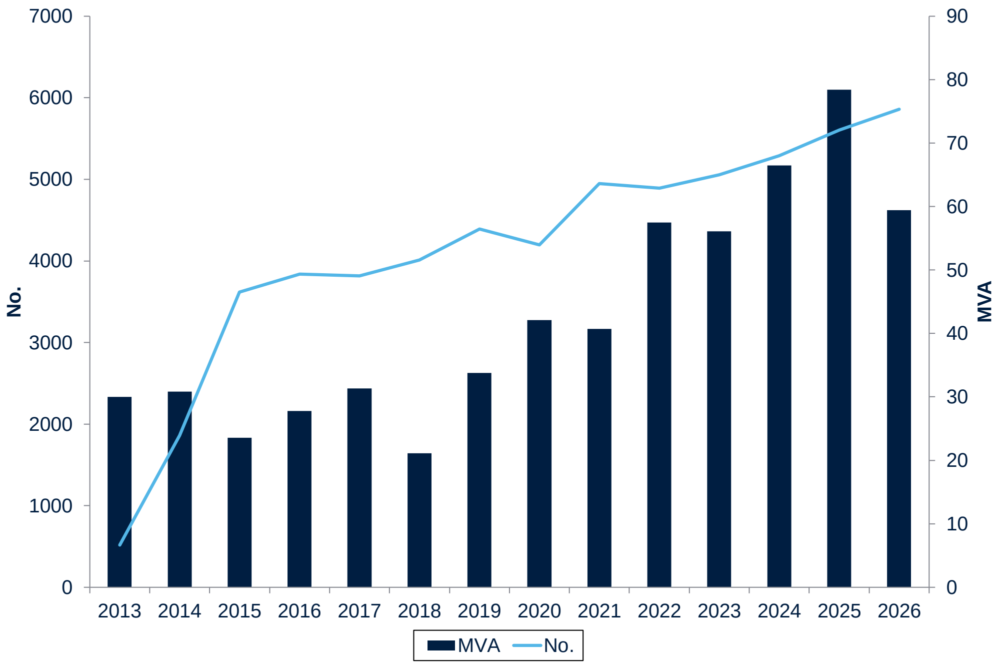
First, the need to connect new LCTs creates a further social benefit to any particular WACC uplift, without creating an additional countervailing cost. The need to deliver future decarbonisation investments requires that returns are sufficient for investment in infrastructure that facilitates new connections. As part of the energy transition, there will be a substantial increased demand for new connections, as a large number of functions that are currently not electrified will become electrified. These functions include, for example, electrification of heating and transport, and the electrification of various

[116] New Zealand Government (2022), 'Aotearoa sets course to net-zero with first three emissions budgets', available here.
[117] NZCC (2022), 'Note of clarification – our Part 4 Input Methodologies Review 2023 Framework paper', available here.

industrial processes. It is widely recognised that quick connection of LCTs is critical to the energy transition, with the New Zealand Electricity Authority commenting that investment in LCTs will need to rise to levels 'much faster than experienced in living memory'.[118]

Much of the increased demand for electrification will tend to be distribution-connected, affecting the EDBs, rather than transmission-connected (e.g. increased levels of embedded generation). Figure 5.1 below shows that, over 2022–26, there will be an average annual increase of 3.5% in the number, and 10.2% in the capacity of connections of distributed generation.

**Figure 5.1 Historical and future annual connections of distributed generation to the New Zealand distribution network**




Note: Forecast figures for Alpine Energy, Aurora, Eastland Network and Vector were provided 'cumulative' and have been amended to 'in year'.

Source: Oxera analysis based on client's data (Commerce Commission, EDB Information Disclosure Requirements, Schedule 9e: Report on network demand).

Accordingly, to successfully decarbonise the New Zealand economy, the EDBs will need to have sufficient capital and incentives to:

- connect new users, batteries, and generators to the grid. If EDBs have insufficient incentives to expand the network, there will not be enough capacity to connect these parties;[119]
- invest in transformational technologies (e.g. digitalisation, data, LV visibility, connectivity, two-way power flows, flexibility markets). These new technologies may be more risky than traditional network investments, such that there is a higher risk of disincentivising (riskier) investments if the WACC is set too low.

[118] Electricity Authority (2022), 'Price discovery under 100% renewable electricity supply. Issues discussion paper', para 3.5, available here.
[119] Alternatively, if the cost of increased connection charges is borne directly by new connectors rather than as part of network charges, this may also discourage LCT growth.

Second, as the New Zealand economy electrifies, the impacts of any outages will be more significant than they have been in the past. This could happen if, for example, manufacturing processes that currently use natural gas switch to electricity, or if more domestic heating is electrified. Related to this, if there is not enough spare capacity in the network to manage peak demand (which could happen if the EDBs do not have sufficient incentives to invest in the network), there could also be more outages.

Both of the above points provide a rationale to aim up for a higher percentile, relative to a network reliability framework that does not account for the social costs and benefits that are affected by the delivery of net zero.

### 5.3 How the NZCC should consider uncertainty in the WACC estimate

It is important for the NZCC to accurately estimate the uncertainty in the WACC estimate. This is because the standard error of the WACC determines the percentage point uplift that the EDBs will receive during a regulatory period.

Currently the NZCC calculates the standard error of the WACC by considering the standard error of three parameters: the Tax-adjusted Market Risk Premium (TAMRP), debt premium, and asset beta, and using these to calculate the standard error of the WACC.[120] This approach assumes that all other components of the WACC (i.e. the risk-free rate, debt issuance costs, leverage, and tax rates) have no uncertainty associated with them. In addition, it assumes that all the uncertainty with the three parameters is captured in their standard errors. As the standard errors of three parameters are estimated directly from the methods that the NZCC uses to estimate the WACC,[121] this means that the only uncertainty that the NZCC considers is the uncertainty that is contained within the models it uses. We refer to this as 'within-model' uncertainty and compare this to 'between-model' uncertainty, which is the uncertainty associated with choosing one particular approach to estimating a parameter at the expense of another.

It is unclear why the NZCC only considered the standard errors of three parameters when setting the WACC, thereby implicitly assuming that the other parameters were known with certainty. The assumption that other parameters can be known with certainty only seems reasonable for the tax rates, as these are fixed parameters that are determined by the New Zealand Government. However, this is not the case with the notional leverage, the risk-free rate, and debt issuance costs for the following reasons.

- The NZCC could be wrong about the optimal level of leverage that the EDBs should have. This might be more likely in New Zealand than in other countries because the approach that the NZCC takes to estimating the leverage uses a considerably larger number of comparators than most other countries, many of which are US-based and may therefore be materially different from the New Zealand EDBs.[122] Indeed, in his paper on estimating the WACC of energy networks, the NZCC's adviser, Dr Lally, explained that

[120] Further information on the NZCC's approach can be found in NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', pp. 149–157, available here.
[121] There is a minimum standard error that the debt premium needs to meet, and if the calculated standard error is below this level then the minimum level will be used instead. In addition, the NZCC does not appear to have explained how it calculated the standard error of the TAMRP. NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', pp. 149–157. available here.
[122] NZCC (2016), 'Input Methodologies review decisions. Topic paper 4: Cost of capital issues', 20 December, paras 275–285, Attachment A, available here.

there would be likely to be ‘significant uncertainty’ around the leverage of regulated networks.[123]

- The risk-free rate is a parameter that is likely to have a standard error because different measures of the risk-free rate (i.e. different high-quality bonds) will have different yields. Indeed, when writing his report on the approach that should be used for estimating the WACC of energy networks, Dr Lally assumed that the risk-free rate would have a standard error,[124] although he also considered that the standard error would be likely to be quite small.[125]
- Debt issuance costs may also vary between companies, which would also lead to these having a standard error. However, given that debt issuance costs are relatively low (0.2% in the last series of IMs[126]), it may be the case that their standard error would be relatively immaterial.

While we consider that best practice in estimating the standard error of the WACC would be to consider the standard error of all of its components, we acknowledge that this may not be practical or proportionate if the standard errors of some parameters are relatively low. This could justify the exclusion of the standard error for debt issuance costs and the risk-free rate, but it would not justify the exclusion of the standard error of leverage. The standard error of leverage is likely to be material due to the large and diverse set of comparators that the NZCC uses to estimate it, which is likely to result in companies with very different leverages being used for the estimate.[127] This variation in leverage would be captured in the standard error of the estimate, and therefore including this in the standard error of the WACC would give a more complete picture of the uncertainty in the estimated WACC range.

The NZCC does however compare its estimates of the mid-point of the WACC against independent WACC estimates from professional services firms, investment banks, and brokerages.[128] However the NZCC also performs this exact same comparison with the 67th percentile of the WACC range that it calculates. As it is likely that the independent WACC estimates are estimates of the mid-point, the NZCC should only sense-check its estimates of the mid-point of the WACC against these. It is inappropriate to sense-check a different percentile because percentiles above the 50th should, by definition, be higher and percentiles below the 50th should, by definition, be lower.

Even though the NZCC compares its estimates of the mid-point of the WACC to independent third parties, it does not compare the estimates that it could generate through applying alternative methodologies. To use the terminology introduced earlier, the NZCC only considers the within-model variation of some of the components of the WACC, but it does not consider the between-model variation of the components of the WACC at all. This contrasts with the approaches taken by other regulators, which consider a range of parameter values in order to assess which ones are the most realistic. To the extent that

[123] Lally, M. (2008), ‘The Weighted Average Cost of Capital for Gas Pipeline Businesses’, p. 91, available here.
[124] Lally, M. (2008), ‘The Weighted Average Cost of Capital for Gas Pipeline Businesses’, fn. 9, available here.
[125] Lally, M. (2008), ‘The Weighted Average Cost of Capital for Gas Pipeline Businesses’, fn. 9, available here.
[126] NZCC (2016), ‘Input Methodologies review decisions. Topic paper 4: Cost of capital issues’, para. 201, available here.
[127] NZCC (2016), ‘Input Methodologies review decisions. Topic paper 4: Cost of capital issues’, 20 December, Table 29, available here.
[128] NZCC (2014), ‘Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services’, paras D21–D27, Figure D1, available here.

considering alternative sources of evidence would widen the WACC range, not doing so will tend to lead to an under-estimate of the allowed point estimate within the range.

# 6 Conclusion

This report has assessed the percentile that the NZCC should target from the perspective of both the network reliability framework that the NZCC has considered (see section 4) and the extensions to the network reliability framework (see section 5).

We find that the network reliability framework supports targeting a percentile between the 65th and 85th percentiles of the WACC distribution, based on our assessment of the socio-economic benefits of aiming up on the WACC percentileer,. This conclusion is consistent with new academic evidence from Romeijnders and Mulder (2002)—the most relevant results of which support a WACC percentile of 77%. We do not over-rely on the Romeijnders and Mulder framework, as we identify how its results are sensitive to the modelling assumptions made by the authors. However, we consider it helpful in informing a choice of percentile that is higher than the mid-point of the WACC range.

Within the NZCC's existing framework, we note that the existence of other regulatory tools mitigates the risk, at least in the short term, of substantial under-investment. In addition, the current regulatory period, which targets the 67th percentile of the WACC, appears to be delivering good outcomes for consumers—albeit with returns that are potentially slightly too low for the EDBs as per the NZCC's assessment. These points tend to support the lower end of the 65th to 85th percentile range.[129] On the other hand, the increased asymmetry of the loss function from the decarbonisation framework we have introduced would tend to support the upper end of the 65th to 85th percentile range. On balance, across all of the evidence considered in this report, a percentile between the 65th and the 75th is appropriate. As the 70th percentile is in the middle of this range, this provides a focal point for the NZCC's decision on the appropriate percentile as part of the upcoming IM review. Giving weight to the need to maintain regulatory stability, this supports the retention of at least the 67th WACC percentile.

We note that regulatory precedent shows that overseas regulators have tended to aim straight in recent decisions, although CRE has aimed up on the WACC in its most recent decisions. However, this regulatory precedent is of limited direct read-across, as it comes from countries that do not explicitly undertake analysis related to applying the network reliability framework in setting the WACC, as the NZCC has done. In addition, in many of these countries, aiming straight has tended to be accompanied by measures that have reduced (but not eliminated) the ability for the regulated WACC to deviate from the true WACC, such as the use of indexation of the cost of equity and/or cost of debt allowances.

[129] Selecting too high a percentile could unnecessarily increase the incentives for gold-plating in relation to network investments. We consider this to rule out targeting a WACC percentile above the 80th, as we find that targeting the 85th percentile of the WACC results in consumers experiencing an increase in electricity bills that is approximately twice as high as what they experience at the 70th percentile.

# A1 Regulatory precedent on aiming up

## Table 6.1 Regulatory precedent on aiming up

| Name of regulator | Does the regulator aim up? | Rationale for decision/ further details |
|---|---|---|
| Ofgem (UK) | No, but three smaller companies receive an infrequent issuer premium on their cost of debt | • Takes the mid-point of the parameters used to estimate the cost of equity and does not add any premia such as convenience premia.<br>• Calculated cost of debt using the yields on 10-year utility bonds, uplifted for debt issuance costs and, in the case of three companies, a 6bps infrequent issuer premium. |
| AER (Australia) | No | • Based on cross-checks from EV/RAB multiples, financeability tests and other scenario testing, the AER considered the overall rate of return, under a method that aims straight, to be reasonable. |
| ARERA (Italy) | No, but a convenience premium is added to the RFR | • Several premia are added to the RFR.<br>• Two of them (an uncertainty premium and a forward premium) appear to be introduced to reflect the fact that the WACC is not indexed. As the WACC is indexed in New Zealand, this does not reflect an attempt to aim up relative to the approach taken by the NZCC.<br>• However, a convenience yield is also added to the RFR. |
| CRE (France) | Yes, although it does not explicitly discuss this | • For the TSO, CRE granted a WACC of 4.6% from a range of 3.87%-5.03%.<br>• For the EDB (DSO), a different remuneration methodology, which is based on the same parameters of the WACC, is used.<br>• The relevant rates, 'marge sur actif' and 'rémunération des capitaux propres régulés' were determined respectively at 2.5% from a range of 2.4%-2.5% and 2.3% from a range of 2.1%-2.5%. |
| BNetzA (Germany) | No but a convenience premium is added to the RFR | • A convenience yield is added to the RFR to reflect the fact that there is a divergence between government bond yields and corporate bond yields. |

| Name of regulator | Does the regulator aim up? | Rationale for decision/ further details |
|---|---|---|
| ACM (Netherlands) | No | • ACM does not uplift any of the parameters used to calculate the WACC |

Source: Ofgem (2022), ‘RIIO-ED2 Draft Determinations Finance Annex, available here; Ofgem (2021), ‘Ofgem response to CMA cost of capital working paper’, available here; AER (2021), ‘Final Decision: AusNet Services Distribution Determination 2021 to 2026’, available here; 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’, available here; CRE (2021), ‘Délibération de la CRE du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de transport d’électricité (TURPE 6 HTB), available here; CRE (2021), ‘Délibération de la CRE du 21 janvier 2021 portant décision sur le tarif d’utilisation des réseaux publics de distribution d’électricité (TURPE 6 HTA-BT)’, available here; Bundesnetzagentur (2021), ‘BK4-21-055’, available here; ACM (2021), ‘The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs’, available here.

# A2 Summary of methodology used by Romeijnders and Mulder (2022)

The approach taken by Romeijnders and Mulder was to take a stylised model that simulates investments undertaken by an electricity grid operator that is subject to price-cap regulation. The grid operator replaces a certain percentage (10% in the base case of the model) of the infrastructure in each year if the regulated WACC (which is set at the start of each 5-year regulatory period) is set above the true WACC, and performs no investment if the regulated WACC is set below the true WACC. Subsequently, the model estimates the expected quantity of lost load in a given year, based on the age of the infrastructure (which is a function of the operator's investment decisions). The lost load is valued at the Value of Lost Load (VoLL). The model also estimates the additional costs that consumers have to pay for electricity as a result of different percentiles of the WACC being chosen. In this way, the authors can trade off the impact that the investment effects of the higher WACC have on lost load and customers' bills, in order to see what size of uplift the regulator should aim for.

In order to increase the robustness of their results, the authors performed multiple sensitivity analyses on the uncertainty of the true WACC, by varying its standard deviation, the VoLL per MW/h, the expected quantity (in MWh) of lost load, the social discount rate, the percentage of assets that can be replaced by investment in a given year, and the persistence of the WACC (i.e. the extent to which the true WACC in one period is similar to the true WACC in the previous period[130]).

Consequently, the paper provides a very similar, but not identical, framework for considering the effects of a higher WACC percentile to the NZCC. It is a similar framework because it considers the effects from a consumer welfare perspective of the true WACC being below the regulated WACC, and it also assumes that the true WACC is not known to the regulator. The main way in which this framework extends the NZCC's framework is that the authors assume that the WACC is persistent from one period to the next. This extension is important because it means that if the regulator mis-estimates the WACC at the start of the regulatory period, it is likely that the direction of its mis-estimate will be the same in the next year of the regulatory period. However, as explained above, the authors also run a sensitivity analysis on the persistence of the WACC, meaning that we can observe how sensitive their results are to it.

[130] The paper assumes that the WACC on the capital market follows a first-order autoregressive process, the AR(1) model estimates the predicted value of WACC in period t through the sum of the long-term expected value of WACC, the error term and the difference of the expected value of WACC subtracted from the predicted WACC of period t-1 multiplied by the persistence term. The persistence measures the uncertainty of WACC on capital markets: the higher the persistence, the closer the predicted WACC value will be from the previous period's, and the more predictable the WACC is, the lower the uncertainty around WACC during the regulatory period is.

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# Attachment 4. Oxera – Asset beta and WACC percentile for New Zealand gas distribution businesses

# Asset beta and WACC percentile for New Zealand gas distribution businesses

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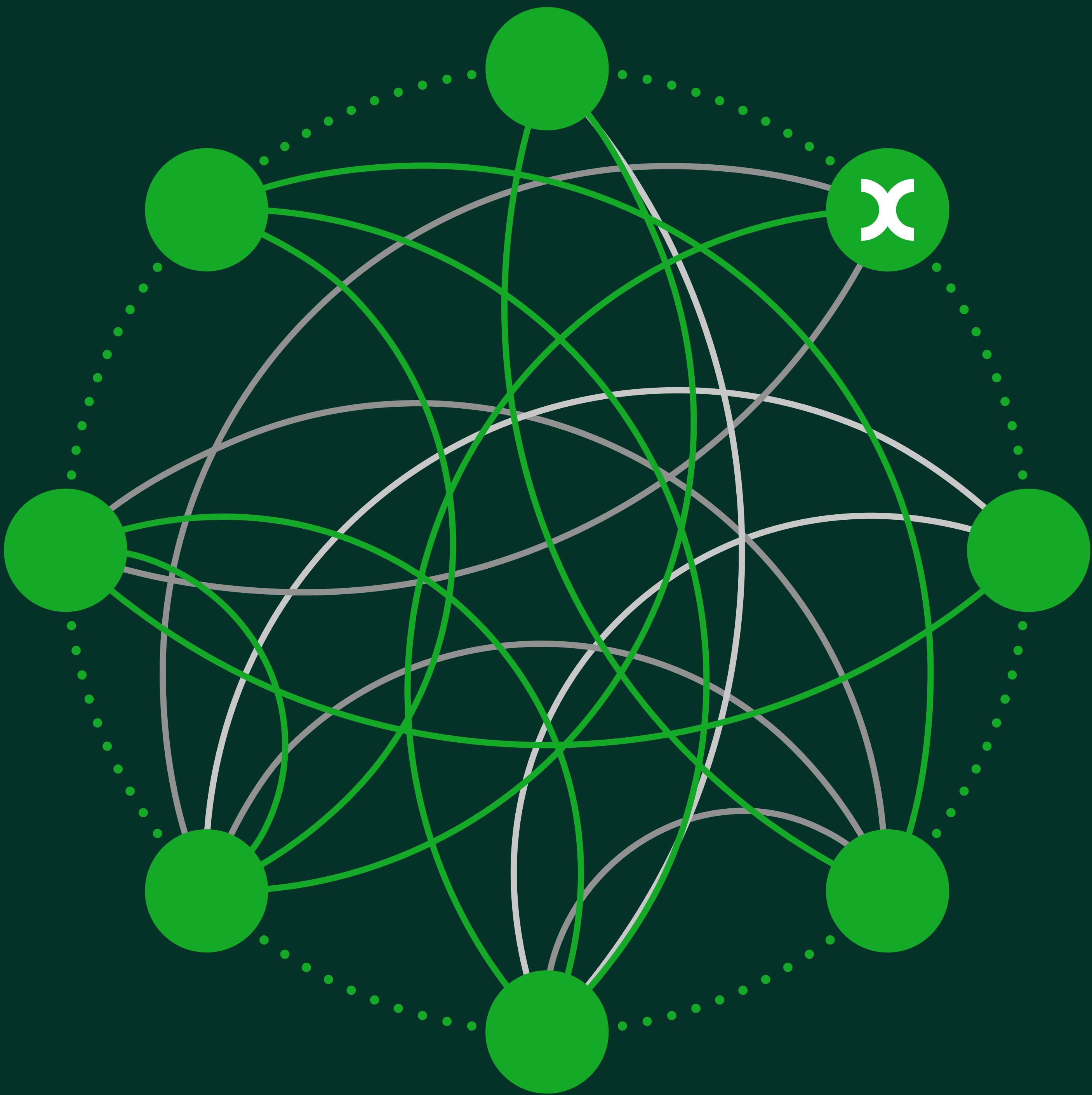
Prepared for Vector, Firstgas and Powerco

1 February 2023



## Contents

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## Executive summary

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The New Zealand Commerce Commission (NZCC) has recently begun the process of reviewing the Input Methodologies (IMs), which were last reviewed in 2016.[1] As a first step in its assessment of the weighted average cost of capital (WACC), the NZCC has commissioned an economic consultancy CEPA to undertake a numerical update of the regulatory allowed asset beta estimate, as well as the assessment of the appropriateness of setting the WACC allowance at the 67th percentile, i.e. of 'aiming up'.[2]

On behalf of a group of New Zealand gas distribution businesses (GDBs)—including Vector, Firstgas and Powerco—in this report we review CEPA's analysis.

In the context of the energy transition and New Zealand's legislative commitment to achieving net zero by 2050, there is significant uncertainty about the pace and form of transition and about the level of future gas demand. Besides maintaining business-as-usual network activities, this thereby translates into an uncertainty about the timing, level and distribution of expenditure that will be required in relation to commissioning new assets (for repurposing gas pipelines and potentially connecting new customers) as well as decommissioning under-utilised assets (due to phasing out the use of natural gas). These uncertainties translate into additional risks that may require compensation via a higher asset beta allowance, to the extent that these risks are systematic, or aiming up on the overall WACC.

### Asset beta for energy networks

By applying the same methodology to asset beta estimation as was used in the NZCC's 2016 decision, CEPA has estimated a regulatory allowed asset beta for energy networks of 0.35.[3] The NZCC is assessing separately whether any adjustments to this estimate are required due to the differences in systematic risks of New Zealand and comparator networks.

As a result of our assessment of the energy networks comparator sample, we have identified six companies that we exclude from CEPA's 2022 sample due to insufficient representation of utility network activities in their businesses and the insufficient liquidity of their stock.

Consistent with the NZCC's methodology, but based on our updated comparator sample, the table below shows the daily, weekly and four-

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[1] Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, https://comcom.govt.nz/__data/assets/pdf_file/0021/60537/Input-methodologies-review-decisions-Topic-paper-4-Cost-of-capital-issues-20-December-2016.pdf (accessed on 13 January 2023).

[2] CEPA (2022), 'Review of Cost of Capital 2022/2023', 29 November, p. 13, https://comcom.govt.nz/__data/assets/pdf_file/0014/301082/CEPA-report-on-Commerce-Commission-IM-Review-Cost-of-Capital-29-November-2022.pdf (accessed on 13 January 2023).

[3] Ibid., p. 14.

weekly asset beta estimates for the two most recent five-year periods of 2012–17 and 2017–22.

### Oxera asset beta estimates for the overall energy sample

| Specification | 2012–17 | 2017–22 |
|---|---|---|
| Daily asset beta | 0.38 | 0.42 |
| Weekly asset beta | 0.33 | 0.39 |
| Four-weekly asset beta | 0.29 | 0.35 |
| Number of companies in the sample | 47 | 48 |

Note: The 2012–17 figures exclude Evergy Inc (EVGR) due to insufficient data. The cut-off dates are 30 September 2017 and 30 September 2022 so as to be consistent with the CEPA analysis.
Source: Oxera based on the NZCC's asset beta spreadsheet and data from Bloomberg.

Typically, we would place weight on two- or five-year betas estimated based on the most recent available data. We would also use only daily betas, having filtered the sample of comparators for liquidity of their stock. Based on the estimates above, that would suggest a central asset beta of 0.42 (daily asset beta for 2017–22).

However, it is also important to consider regulatory stability. We observe that the NZCC places weight on the two most recent five-year periods (in this case, 2012–17 and 2017–22) and weekly and four-weekly estimates which are reported in the table above.

Given the benefits of using more frequent and recent data that is representative of current market conditions and given that the NZCC's concerns about stock illiquidity reducing the reliability of daily estimates is addressed by our multiple liquidity filtering checks, we include daily beta estimates in the assessment. This approach, i.e. the average of daily, weekly and four-weekly estimates over the 2012–17 and 2017–22 periods suggests an asset beta estimate of **0.36**, which is below the latest daily beta estimate of 0.42.

With the average leverage ratio of **40%**, based on our updated sample (compared with CEPA's 39%),[4] the re-levered equity beta corresponding to the asset beta of 0.36 would be **0.60** (compared with CEPA's 0.57).[5]

### Upward adjustment for GDBs' asset beta

In 2016, the NZCC also set a 0.05 upward adjustment for gas pipelines' asset beta. In relation to this, CEPA noted that it found that the asset beta for gas comparators was greater than that for electricity, but that this difference was not statistically significant.

In line with the NZCC's approach, we assess the required adjustment for GDBs-specific risks by looking at the empirical and theoretical evidence.

- We find the empirical evidence to be mixed, as it was in the previous NZCC IM reviews: the gas subsample asset betas are above those

[4] Ibid., p. 4.
[5] Ibid., p. 4.

for electricity for the 2012–17 period and for daily asset betas in 2017–22. The difference, however, is not statistically significant.
- In terms of the theoretical evidence, the NZCC's 2016 decision to provide an uplift was based primarily on the high income elasticity of demand for gas and low penetration of gas connections in New Zealand, with the latter amplifying the growth and asset stranding risk. Although we have not undertaken a revised analysis of elasticities, it is reasonable to expect that this finding would persist, as these are characteristics of the industry. Moreover, we expect asset stranding risk to have increased with New Zealand's net zero commitment.

On balance, we conclude that, in the New Zealand context, given the high elasticity of demand and relatively low penetration rates of the network, as well as the use of price caps (rather than revenue caps) for GDBs, it remains reasonable to expect higher systematic risk than for the electricity networks, and therefore maintain an uplift on the gas asset beta.

### WACC percentile

With regard to the WACC percentile, CEPA found that regulatory precedent had moved away from aiming up and towards aiming straight.[6] One of the reasons for this was that regulators have made increasing use of alternative performance-based regulatory tools that either reward networks for maintaining certain reliability standards, or require them to do so.[7]

CEPA found that the importance of network reliability had increased since the previous IM review, which would tend to provide more support for aiming up. However, CEPA also considered that the evidence on the impacts of underinvestment on network reliability could be overstated,[8] which would reduce the strength of the evidence for aiming up.

We have reviewed CEPA's report and conclude that, while it is true that some regulatory precedent has shifted towards aiming straight, a number of regulators continue to aim up. Some of these, such as the French regulator CRE, were not included in CEPA's report. Academic research by Romeijnders and Mulder, which also supports aiming up, has also been published since our 2014 report,[9] when the original aiming up methodology was developed. Furthermore, as those regulators that now aim straight do not formally adopt a network reliability framework to determine which percentile of the WACC distribution should be targeted, as the NZCC does, there may be limited read-across from the decisions that they make to those of the NZCC.

[6] Ibid., section 1 and section 4.8.
[7] Ibid., p. 27.
[8] Ibid., p. 39.
[9] Romeijnders, W. and Mulder, M. (2022), 'Optimal WACC in tariff regulation under uncertainty', *Journal of Regulatory Economics*, **61**, pp. 89–107. Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', https://www.oxera.com/wp-content/uploads/2018/07/Oxera-review-of-the-75th-percentile-approach.PDF.pdf (accessed on 24 January 2023).

While we agree that other performance-based regulatory tools can be used to mitigate underinvestment risk (i.e. to maintain reliability), New Zealand has chosen to use a WACC uplift to do so and therefore any move away from this and towards an alternative mechanism could introduce regulatory risk. Furthermore, there does not appear to be a clear case for changing the way in which gas (or electricity) network reliability is incentivised in New Zealand (i.e. even if regulatory risk were not a factor) because the WACC uplift does not seem to be causing excess profits based on NZCC analysis of the last seven years.[10]

We agree with CEPA that the evidence from the NZCC's network reliability framework supports aiming up, and find that CEPA's update to our 2014 analysis would support aiming up for the 80th percentile. However, we disagree with CEPA that the evidence used to generate the benefits of aiming up is likely to be overstated. This is because:

- other evidence on the costs of network failures could suggest higher costs than those assumed by CEPA;
- the annual costs of network failures that CEPA has updated could be difficult to reverse;
- if other elements of regulation, such as an asset beta uplift or accelerated depreciation, do not compensate gas networks for the additional risks associated with stranded assets in full, a WACC uplift or aiming up in the range could be applied to compensate for this;
- related to the point above, if the NZCC were also to consider (i.e. in addition to the network reliability framework) the impact that underinvestment may have on delaying the energy transition, the loss function considered by the NZCC would become more asymmetric, justifying greater aiming up on the WACC.

As we explained in our 2014 report, regulatory stability is valuable. We therefore consider that, taken together, the above arguments support the case for continuing to aim up for the 67th percentile of the WACC.

[10] Commerce Commission (2022), 'Part 4 Input Methodologies Review 2023 – Process and Issues paper', May, p. 61, https://comcom.govt.nz/__data/assets/pdf_file/0031/283864/Part-4-Input-Methodologies-Review-2023-Process-and-Issues-paper-20-May-2022.pdf (accessed on 24 January 2023).

# 1 Introduction

1.1 The New Zealand Commerce Commission (NZCC) has recently begun the process of reviewing the Input Methodologies (IMs), which were last reviewed in 2016.[11] The weighted average cost of capital (WACC) for energy networks is one of the topics on the NZCC's agenda and, as a first step, the NZCC has commissioned an economic consultancy CEPA to undertake a numerical update of the asset beta and leverage estimates, as well as an assessment of the appropriateness of the 67th WACC percentile—in both cases following the NZCC's methodology.[12]

1.2 On behalf of a group of New Zealand gas distribution businesses (GDBs)—Vector, Firstgas and Powerco—in this report we review CEPA's analysis, suggest improvements to the NZCC's approach to the estimation of the allowed asset beta, and consider whether it is still appropriate to set the allowance at the 67th percentile of the WACC range.

1.3 Our review is guided by the NZCC's economic principles from the **Decision Making Framework**.[13] These relate to:

- ex ante real financial capital maintenance (FCM);
- allocation of risk (between consumers and networks);
- the asymmetric consequences of over-/underinvestment.

1.4 The NZCC explains that these principles require regulated companies to be provided with an appropriate ex ante cost of capital allowance and can guide the decision of whether adjustments might be required to the regulatory WACC:[14]

> The FCM principle is that regulated suppliers should have the ex-ante expectation of earning their risk-adjusted cost of capital (ie, a 'normal return'),[…]
>
> In the context of the IMs, the principle of asymmetric consequences of over- /under-investment is relevant mainly to our [NZCC's] decision on whether an adjustment might be

[11] Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, https://comcom.govt.nz/__data/assets/pdf_file/0021/60537/Input-methodologies-review-decisions-Topic-paper-4-Cost-of-capital-issues-20-December-2016.pdf (accessed on 13 January 2023).
[12] CEPA (2022), 'Review of Cost of Capital 2022/2023', 29 November, p. 13, https://comcom.govt.nz/__data/assets/pdf_file/0014/301082/CEPA-report-on-Commerce-Commission-IM-Review-Cost-of-Capital-29-November-2022.pdf (accessed on 13 January 2023).
[13] Commerce Commission (2022), 'Part 4 Input Methodologies Review 2023. Framework paper', 13 October, para. 4.2, https://comcom.govt.nz/__data/assets/pdf_file/0034/294793/Input-methodologies-2023-Decision-Making-Framework-paper-12-October-2022.pdf (accessed on 20 January 2023).
[14] Ibid., paras 4.7 and 4.23.

required when calculating the regulatory WACC to protect consumers from the risk of under-investment.

1.5 The context in which the NZCC is undertaking the IMs review is of critical importance. In 2021, New Zealand legally committed to achieving **net zero by 2050**, relying on the businesses to support this commitment.[15] While formalising the target and developing plans for the pathway, the commitment crystallises risks to energy networks. In particular, natural gas supply is likely to be gradually phased out by 2050, meaning that gas pipeline businesses (GPBs) will face asset obsolescence and as a consequence, asset stranding if they suffer a financial loss. It is thereby uncertain whether GPBs will be able to fully recover their investments and how expenditure will need to be redistributed to match the pace of the obsolescence. Moreover, GPBs are expected to invest in infrastructure that is capable of handling renewable gases, although the exact needs of the market are for the companies to identify.[16] Finally, the NZCC itself highlights a political risk of government intervention in setting regulatory price paths, given the circumstances of the transition to a low-carbon economy.[17]

1.6 In addition to the energy transition developments, since the NZCC's previous review of the IMs in 2016 the **COVID-19 pandemic** has had a significant impact on financial markets and businesses. Of particular relevance to the cost of capital assessment is the fact that a change in traded equity betas has been observed across the markets, as is explored further in the main body of this report.[18]

1.7 Another contextual matter that is critical to the assessment of asset betas is the GDBs' **regulatory regime**, which defines the risks to which regulated utility networks are exposed.

1.8 GPBs and electricity networks in New Zealand are subject to both price and revenue caps. Historically, both gas and electricity distribution have been subject to a price cap, with a view to providing incentives to suppliers to grow the network, whereas transmission has been subject to a revenue cap. However, since the 2016 IMs review, only gas distribution has been subject to a price cap.[19] In other words, for gas distribution, growth in volumes is dependent on encouraging

[15] New Zealand Ministry of Business, Innovation and Employment (2022), 'Gas Transition Plan', https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/gas-transition-plan/ (accessed on 24 January 2023).
[16] For example, First Gas intends to transition its network to hydrogen in full by 2050. See Firstgas (2021), 'Firstgas Group announces plan to decarbonise gas pipeline network in New Zealand', 29 March, https://firstgas.co.nz/firstgas-group-announces-plan-to-decarbonise-gas-pipeline-network-in-new-zealand-3/ (accessed on 25 January).
[17] Commerce Commission (2022), op. cit., para. 4.31.
[18] For example, see Figure 2.3 in section 2.
[19] Commerce Commission (2016), 'Input methodologies review decisions. Topic paper 1: Form of control and RAB indexation for EDBs, GPBs and Transpower', 20 December, para. X3.

existing customers to increase their gas consumption and, more critically, on increasing the number of connections.

1.9 In this context, in the rest of the report we assess the following points.

- In section 2, we discuss the process of setting the asset beta for energy networks in general.
- In section 3, we consider the reasons why an upward adjustment is required for GDBs on top of the asset beta estimate for energy networks.
- In section 4, we discuss the merits of keeping the 67th WACC percentile for GDBs in this IMs review.
- In section 5, we provide high-level comments on other WACC parameters that the NZCC may seek to consider as part of its forthcoming IM review.

## 2 Asset beta for energy networks

2.1 In this section, we assess the NZCC's methodology to setting a regulatory allowed asset beta for energy networks. We start from the NZCC's 2016 methodology and CEPA's 2022 update in section 2.1 before moving on to Oxera's suggested improvements to the estimation methodology in section 2.2. We summarise our assessment in section 2.3.

2.2 We assess the question of the uplift for GPBs in a separate section (section 3).

### 2.1 The NZCC's 2016 approach and conclusions, and CEPA's 2022 update

2.3 We start by outlining the NZCC's 2016 methodology and conclusions, before looking at CEPA's 2022 update.

#### 2.1.2 The NZCC's approach and conclusions

2.4 In its Input methodology review decision published in December 2016, the NZCC set the asset beta for GPBs and electricity networks following a six-step approach, as set out in Figure 2.1.

Figure 2.1 Six-step process for estimating beta

Step 1
Identify a sample of comparator companies

Step 2
Estimate the equity beta for each firm in the sample

Step 3
De-lever each equity beta estimate to get an estimated asset beta for each firm in the sample (assuming a debt beta of zero)

Step 4
Calculate an average asset beta for the sample

Step 5
Apply any adjustments for regulatory differences or differences in systematic risk across services to the average asset beta for the sample

Step 6
Re-lever the average asset beta for the sample to an equity beta estimate using the NZCC's assumed notional leverage

Source: Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, pp. 60–61.

2.5 The NZCC looked at a sample of electricity and gas utilities from New Zealand, Australia, the UK and the USA. The international comparators were added to the sample due to the small number of comparable companies in New Zealand.

2.6 The approach that the NZCC used for sample selection is summarised in Box 2.1.

## Box 2.1 The NZCC's approach to identify comparators

### Identification of relevant companies

To find relevant comparator companies, the NZCC used Industry Classification Benchmarks (ICBs), as reported in the Bloomberg Industry Classification System. The NZCC's view was that there were not enough pure-play electricity and gas line comparators available. Therefore, it included the following four industries in its sample based on the ICB classifications: Electricity, Gas Distribution, Pipelines, and Multi-utilities.[1]

### Filtering criteria

To filter the resulting sample of companies, the NZCC used three criteria—i.e. that the company should have at least five years of trading data; a market value of equity greater than US$100m; and shares being traded every day.[2] The last two criteria were intended to exclude illiquid firms from the sample.

### Company description check

The NZCC assessed the nature of each business in the sample using 'Segment Analysis' information from Bloomberg, and excluded any that were deemed not to be sufficiently comparable.

Note: [1] The ICBs define Multi-utilities as 'utility companies with significant presence in more than one utility'. [2] The 'shares being traded' measure indicates the number of days in a year on which at least one share of the company was traded. A small proportion of days traded, relative to the total number of trading days in a year, indicates that the shares are thinly traded and the company's stock is likely to be illiquid.
Source: Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, pp. 62–65.

2.7 The comparators selection process resulted in a sample of 70 companies for the 2006–11 estimation window and 72 companies for 2011–16.

2.8 Based on the selected sample of comparators, the NZCC estimated the average of the weekly and four-weekly asset betas in the two most recent five-year periods (2006–11 and 2011–16).[20] This resulted in a 0.35 asset beta estimate set for electricity networks. Table 2.1 summarises NZCC's findings on the overall energy sample.

Table 2.1 Summary of NZCC's asset beta estimates for the overall energy sample

| Specification | 2006–11 | 2011–16 |
|---|---|---|
| Daily asset beta | 0.40 | 0.39 |
| Weekly asset beta | **0.38** | **0.36** |
| Four-weekly asset beta | **0.35** | **0.30** |
| Number of companies in the sample | 70 | 72 |

[20] Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, paras 297–298.

Note: The NZCC's final estimate was 0.35—the average of the figures highlighted in bold.
Source: Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, p. 69.

2.9 As per the GPBs, the NZCC applied an upward adjustment of 0.05 to the asset beta of 0.35 'to reflect the greater exposure to systematic risk faced by gas pipelines'.[21]

### 2.1.3 CEPA's 2022 update

2.10 CEPA has been 'requested by the Commission to replicate the methodology applied in 2016 but updated for new data'.[22]

2.11 In its report, CEPA notes that the same process of comparator selection as the NZCC applied in 2016 will create a different set of comparators in 2022, mainly because of companies being delisted, comparators now having sufficient data for estimation (when they previously did not), and changing characteristics of the comparators themselves.[23]

2.12 In the updated sample, CEPA removes 22 companies because they have been delisted and two companies because it considers these to have a low percentage of regulated revenues.[24] At the same time, CEPA has identified six new companies as relevant and added them to the sample.[25]

2.13 The resulting sample considered by CEPA comprises 54 companies. Table A2.1 in appendix A2 shows the list.

2.14 Table 2.2 summarises CEPA's asset beta estimates.

Table 2.2 Summary of CEPA's asset beta estimates for the overall energy sample

| Specification | 2007–12 | 2012–17 | 2017–22 |
|---|---|---|---|
| Daily asset beta | 0.38 | 0.38 | 0.42 |
| Weekly asset beta | 0.36 | **0.34** | **0.40** |
| Four-weekly asset beta | 0.33 | **0.30** | **0.37** |
| Number of companies in the sample | 51 | 53 | 54 |

Note: CEPA's final estimate is 0.35—the average of the figures highlighted in bold.
Source: CEPA (2022), op. cit., p. 13.

2.15 By applying the same methodology as used in the NZCC's 2016 decision, CEPA has found an asset beta of 0.35 for electricity networks.[26] CEPA also notes that '[i]f the same 0.05 upward

[21] Ibid., para. 455.
[22] CEPA (2022), op. cit., p. 4.
[23] Ibid., p. 4.
[24] UGI Corp (UGI US) and APA Group (APA AU). See CEPA (2022), op. cit., p. 9.
[25] Alaska Power and Telephone Co. (APTL US) and Mount Carmel Public Utilities Co. (MCBP US) were first added by CEPA to the sample and then subsequently dropped for having a low percentage of days traded. See CEPA (2022), op. cit., p. 8.
[26] CEPA (2022), op. cit., p. 14.

adjustment to gas were applied this again results in exactly the same value for gas namely 0.40'.[27]

## 2.2 Oxera's review of the NZCC's 2016 approach and CEPA's 2022 analysis

2.16 We have reviewed the following aspects of the NZCC's 2016 methodology and CEPA's 2022 analysis:

- the process of comparator selection—covered in section 2.2.1;
- the frequency of observations for beta estimates—covered in section 2.2.2;
- the time period on which to draw conclusions—covered in section 2.2.3.

2.17 Below, we suggest some minor modifications to the approach and estimate the asset beta, leverage ratio and re-levered equity beta if those modifications are applied.[28]

### 2.2.1 Comparator selection

2.18 Based on the NZCC's three elements of the comparator sample selection process (which comprised identifying companies via Bloomberg screening,[29] applying filtering criteria, and checking companies' descriptions), we have proposed alternative filtering criteria and cross-checked whether companies in the sample undertake energy network activities.[30]

**Comparators' business activities: cross-checks**

2.19 As a result of the qualitative review of business activities, we have removed three companies from CEPA's sample: ONEOK Inc. ('ONEOK'), Centrica Plc ('Centrica'), and Scottish and Southern Energy plc ('SSE') because we did not find the nature of their operations sufficiently comparable to those of New Zealand GDBs. Table 2.3 provides the details.

Table 2.3 Comparators excluded from the sample due to the nature of business activities

| Company | Oxera assessment |
|---|---|
| **ONEOK** | ONEOK is a USA-based company, engaged in the provision of midstream services. The company reports operations in: i) natural gas gathering and processing; ii) natural gas liquids; and iii) natural gas pipelines.[1] In 2021, the natural gas pipelines segment, which has regulated and non-regulated operations, accounted only for 3% of revenue and 16% of earnings before interest, taxes, depreciation and amortisation (EBITDA).[2] Thus, we exclude ONEOK from the sample. |

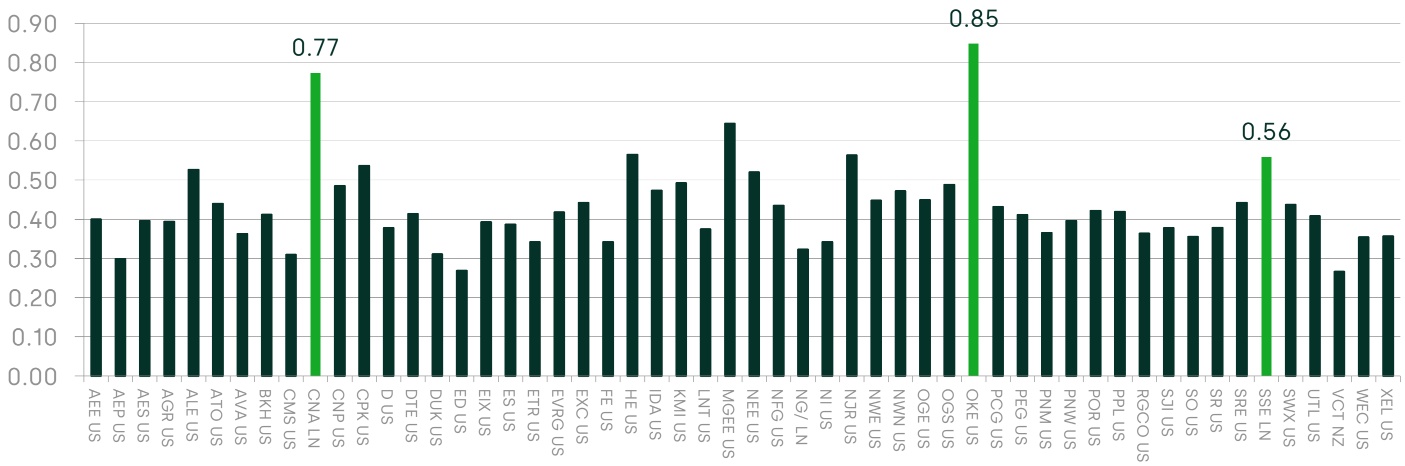
[27] Ibid., p. 14.
[28] Our calculations are based on the NZCC's 8 July 2016 'Asset beta spreadsheet' after correcting for the errors in the asset beta spreadsheet mentioned in NZCC's decision published in December 2016. Moreover, to compute returns we used (P2 – P1)/P1 instead of the revised formula that the NZCC reported, i.e. (P2 – P1)/P2. See Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, para. 292.
[29] We have not reproduced the Bloomberg screening, i.e. we have not checked that it was comprehensive and that CEPA identified all the companies that were potentially relevant for the analysis.
[30] For those companies for which the Bloomberg description was not sufficiently clear, we further investigated their relevance through desktop research, including an analysis of companies' websites, annual reports, and/or online articles.

| Company | Oxera assessment |
|---|---|
| **Centrica** | Centrica is a UK-based integrated energy business, organised along six business segments, including electricity and gas supply, trading and optimisation activities and an oil and gas business.[3] We exclude this company as it does not have any network activities.[4] |
| **SSE** | SSE is an integrated UK-based company engaged in electricity generation, transmission and distribution. According to its 2022 Annual Report, SSE's regulated network transmission and distribution businesses accounted for c. 10% of total revenues while over 80% SSE's revenues were from non-regulated activities.[5] Therefore, we exclude SSE from the sample. Excluding SSE would be consistent with the UK precedent, where the regulator did not put weight on SSE beta in setting a regulatory allowance for energy networks and the UK Competition and Markets Authority (CMA) did not find that to be wrong.[6] |

Note: [4] The company's revenues come primarily from its retail activities (accounting for c. 55% of total revenues in 2021) and its trading and optimisation activities (c. 32% in 2021). 'Retail activities' refers to 'British Gas Services & Solutions', 'British Gas Energy', and 'Bord Gáis Energy'. Trading and optimisation activities refer to 'Energy Marketing & Trading'. See Centrica (2022), op. cit., p. 16. [5] Non-regulated revenues are split as follows: Energy Portfolio Management (EPM): c. 38% of total revenues; energy customer solutions: c. 24%; gas storage: c. 15%; SSE thermal: c. 7%; and SSE Renewables: c. 5%. See SSE (2022), 'SSE Plc Annual Report 2022', pp. 224–228, https://www.sse.com/media/blhnuywb/sse-full-annual-report.pdf (accessed on 16 January 2023).
Source: [1] Securities and Exchange Commission (2022), 'Annual Report on Form 10-K of ONEOK', pp. 8–15, https://otp.tools.investis.com/clients/us/oneok_inc2/SEC/sec-show.aspx?FilingId=15621391&Cik=0001039684&Type=PDF&hasPdf=1 (accessed on 16 January 2023). [2] Securities and Exchange Commission (2022), op. cit., p. 97. [3] Centrica (2022), 'Annual Report and Accounts 2021', p. 13, https://www.centrica.com/media/5531/centrica-annual-report-and-accounts-2021.pdf (accessed on 16 January 2023). [6] Competition and Markets Authority (2021), 'Final determination: Volume 2A: Joined Grounds: Cost of equity', 28 October, paras 5.411–5.416, https://assets.publishing.service.gov.uk/media/617fe5468fa8f52980d93209/ELMA_Final_Determination_Vol_2A_publication.pdf (accessed on 17 January 2023).

2.20 The exclusion of these companies is also consistent with their asset betas as compared with the rest of the sample (see Figure 2.2): Centrica and ONEOK record the highest daily asset betas in the sample (0.77 and 0.85 respectively), while SSE's beta (0.56) is well above the sample median (0.41).

Figure 2.2 Daily five-year 2017–22 asset betas




Note: The cut-off date is 30 September 2022 so as to be consistent with the CEPA analysis. The chart shows all companies included in CEPA's 2022 sample.
Source: Oxera's calculations based on the 2016 NZCC Excel model.

### Filtering criteria

2.21 As mentioned above, the NZCC (and CEPA) uses the following filtering criteria:

- availability of at least five years of trading data;
- a market value of equity greater than US$100m;
- shares being traded every day.

2.22 The first criterion ensures that sufficient trading data is available to estimate five-year asset betas—we agree with this criterion and make no modifications to it.

2.23 The other two criteria are related to the liquidity of the comparators' shares—if the shares' trading volumes or frequencies are low, i.e. if they are illiquid, returns may not reflect the risks of the company accurately and market betas may be distorted. To assess the comparators' liquidity, we complement the NZCC's liquidity filters mentioned above with the following three metrics.

1. **Average bid–ask spread.** The bid–ask spread is a widely accepted measure of liquidity that indicates how easy it is to buy and sell an asset at a fair price. It is the difference between the lowest price at which an asset is offered for sale in a market and the highest price that is offered for the purchase of the asset. The lower the bid–ask spread, the more liquid the security. A narrow bid–ask spread implies that an individual can buy and sell the underlying asset at similar prices.[31]
2. **Average share turnover.** The share turnover percentage captures the value of the actively traded shares relative to the market capitalisation of each firm. The higher this percentage, the greater the trade among market participants, and therefore the more liquid the stock is likely to be.
3. **Percentage of zero return days.** This measure indicates the percentage of trading days on which the stock price did not change from the previous day. A high proportion of zero return days would indicate that the shares are thinly traded and the company is likely to be illiquid.[32] This metric targets the same characteristic of the shares as the NZCC's requirement for the shares to be traded every day but is more comprehensive. In particular, the data shows that there are days which are counted as traded but on which the share price does not change—we consider it more appropriate to take account of those days as non-traded.

[31] The NZCC accepted that this metric was informative, but did not apply it in its own analysis due to data concerns in an unrelated sector (airports). See Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, footnote 178.
[32] The percentage of zero return days is in line with the use of the percentage of days traded, which in 2016 led the NZCC to exclude Jersey Electricity from the sample. See Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, para. 284.1.

2.24 Typically, we also assess the **average percentage of free-float shares.** The free float of a company is the proportion of shares that can be publicly traded. A small proportion of shares floated would create an impediment to active trading—for example, it would make it more difficult for an investor to exit a long position. Stocks with a low percentage of free-float shares could therefore be considered less liquid. In its 2016 IM review decision, the NZCC considered this metric to be of limited value, commenting that the sufficient monetary value matters most and therefore using its US$100m traded shares threshold.[33] We have therefore cross-checked that no additional companies would be considered illiquid if this metric were applied in addition to the ones listed above. However, we do not elaborate on this analysis in the section below.

2.25 We do not have objectively defined thresholds for these liquidity metrics. However, outliers typically depart from the rest of the sample significantly. Therefore, we focus on excluding outliers.

2.26 In addition to the liquidity filters described above, we apply an **equity beta filter** to test the robustness of the analysis. In particular, we exclude companies with raw equity betas that are below the NZCC's assumed debt beta of zero.[34] Indeed, in theory, an equity beta cannot be below a debt beta, as equity is at least as risky as debt. Therefore, an equity beta below a debt beta cannot be a robust estimate and must be affected by the quality of the data used to estimate it. In practice, as we show below, this filter only confirms the results of the liquidity filters.

2.27 Table 2.4 summarises the results of our filtering process and compares them with the NZCC's/CEPA's results. In summary, we exclude the three companies that NZCC or CEPA excluded from their samples due to the low liquidity of their stocks—these are Jersey Electricity (JEL), Alaska Power and Telephone Co. (APTL) and Mount Carmel Public Utilities Co. (MCPB).[35] Furthermore, we exclude three more companies that, according to our analysis, are not liquid either: RGC Resources (RGCO), Vector Limited (VCT), and Avangrid (AGR).

2.28 We acknowledge the value of information contained in the beta of Vector, given that it is the only New Zealand company in the sample. Therefore, although the liquidity analysis indicates that Vector can be screened out of the sample, we refer to the Vector beta in our analysis, as a check on the results.

[33] Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, para. 285.1.
[34] Ibid., p. 119.
[35] Jersey Electricity (JEL) was excluded by the NZCC from the sample due to a low percentage of days traded in 2016. See Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, p. 64. Alaska Power and Telephone Co. (APTL) and Mount Carmel Public Utilities Co. (MCBP) were first added by CEPA to the sample and then subsequently dropped for having a low percent of days traded. See CEPA (2022), op. cit., p. 8.

Table 2.4 Summary of Oxera filtering results for the 2017–22 data

| Company | NZCC/CEPA assessment summary[1] | Bid–ask spread | Average share turnover | Percentage of zero return days | Equity beta filter | Oxera assessment summary |
|---|---|---|---|---|---|---|
| Jersey Electricity (JEL) | × | × | × | × | Abnormally low daily raw equity beta but above zero | × |
| Alaska Power and Telephone Co. (APTL) | × | × | × | × | Abnormally low daily raw equity beta but above zero | × |
| Mount Carmel Public Utilities Co. (MCPB) | × | – | No data | × | × | × |
| RGC Resources (RGCO) | – | × | – | – | Abnormally low four-weekly raw equity beta but above zero | × |
| Vector Limited (VCT) | – | – | × | 13% higher than the next highest percentage of zero return days | – | ×[2] |
| Avangrid (AGR) | – | – | × | – | – | × |

Note: × indicates that the company is excluded from the sample. [2] Vector is screened out of the sample but we have still estimated the beta of Vector and refer to it as a sense-check on our results, given that it is the only listed energy network company in New Zealand.
Source: Oxera analysis. [1] Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, p. 222. CEPA (2022), op. cit., p. 8.

2.29 Our final sample consists of 48 companies, which are listed in Table A2.1 in Appendix A2.

### 2.2.2 Frequency and estimation accuracy

2.30 In its 2016 decision, the NZCC determined its allowed asset beta based exclusively on weekly and four-weekly data.[36] The NZCC acknowledges the trade-off between using more and less frequent data to estimate betas:[37]

- daily betas could be distorted by stocks' illiquidity;
- weekly and four-weekly betas are based on fewer observations and therefore lead to lower statistical significance of the results.

2.31 The NZCC also summarises Oxera's 2016 submission on this topic where we explained that it would be reasonable to put

[36] The NZCC's past approach in the 2010 IMs decision was almost the same as in the 2016 decision—in 2010, the NZCC used weekly and monthly rather than weekly and four-weekly observations. See Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, para. 307.
[37] Ibid., para. 306.

weight on daily betas alongside weekly and four-weekly betas.[38] In short, we acknowledged the trade-off but did not consider that putting zero weight on daily betas was appropriate, as they provide useful information when only relatively liquid stocks are included in the sample. In this context, we note that we have already filtered illiquid companies out of the sample in this report, such that it is reasonable to rely on the daily beta estimates.

2.32 The NZCC's grounds for putting zero weight on daily betas were threefold:

- 'averaging weekly and four-weekly betas across all possible reference days significantly reduces any concerns about a lack of observations for weekly and monthly estimates';[39]
- a study of evidence from Australia, Germany and the UK concludes that '[…]longer frequency betas have superior characteristics for regulatory purposes in these countries[…]' '[implying] that low frequency beta estimates should always be preferred to high frequency beta estimates';[40]
- in the past, NZCC's approach was to focus on weekly and monthly/four-weekly estimates.

2.33 The UK regulatory precedent is informative in considering these points. The UK CMA recently used the same approach as the NZCC, where daily observations were averaged over a week to avoid the 'reference day bias' and form the basis for weekly beta estimates. However, the UK CMA still put weight on all daily, weekly and monthly estimates.[41] Indeed, when averaging daily returns to form weekly and four-weekly observations, the NZCC loses the data granularity to observe intra-week and intra-month co-movements of share price and index returns.

2.34 Despite the study referenced by the NZCC, many major regulatory institutions in the UK relied on daily betas after the study was published: as mentioned above, the UK CMA recently relied on the mix of daily, weekly and monthly evidence;[42] the energy regulator Ofgem uses exclusively daily betas;[43] and the UK consortium of regulators (the UK regulators network, UKRN)

[38] Ibid., para. 304.
[39] Ibid., p. 71.
[40] Gregory, A., Hua, S. and Rajesh, T. (2015), 'In search of beta', April, https://centaur.reading.ac.uk/75035/1/In%20search%20of%20beta%20Final%20oct_2017.pdf (accessed on 17 January 2023). Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, p. 71.
[41] 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. 9.465, https://assets.publishing.service.gov.uk/media/60702370e90e076f5589bb8f/Final_Report_---_web_version_-_CMA.pdf (accessed on 17 January 2023).
[42] Ibid.
[43] Ofgem (2019), 'Decision - RIIO-2 Sector Specific Methodology Decision – Finance', 24 May, p. 152, https://www.ofgem.gov.uk/sites/default/files/docs/2019/05/riio-2_sector_specific_methodology_decision_-_finance.pdf#page=152 (accessed on 17 January 2023).

also recently recommended daily betas in its cost of capital consultation.[44]

2.35 We also agree with the NZCC that the consistency of approaches over time is a valid factor in decision-making, but the NZCC may take into account concerns about consistent underfunding of the networks: daily estimates were higher than weekly and four-weekly estimates in 2016 and are higher than weekly and four-weekly estimates now.[45]

2.36 We have also looked at the average standard errors of individual comparators' beta estimates to see whether the statistical robustness of the daily beta estimates differs considerably from lower-frequency estimates. Table 2.5 shows that, in the two most recent five-year periods (2012–17 and 2017–22), daily asset betas on average had lower standard errors than the weekly and four-weekly asset betas, supporting the argument that higher frequency tends to lead to greater statistical accuracy.

Table 2.5 Average standard errors of individual comparators' five-year asset betas

| Specification | 2012–17 | 2017–22 |
|---|---|---|
| For daily asset betas | 0.019 | 0.019 |
| For weekly asset betas | 0.053 | 0.044 |
| For four-weekly asset betas | 0.120 | 0.083 |

Note: Based on the Oxera updated energy sample after applying liquidity and equity beta filters. The cut-off dates are 30 September 2017 and 30 September 2022 so as to be consistent with the CEPA analysis.
Source: Oxera based on the NZCC's asset beta spreadsheet and data from Bloomberg.

2.37 Table 2.6 presents the standard errors of the energy sample asset betas (rather than standard errors of individual comparators' asset betas), estimated based on the NZCC's methodology.[46] This shows that, for the second-most recent five-year period (2012–17), the daily asset betas had slightly lower standard errors than the weekly betas but higher standard errors than the four-weekly betas, while these standard error estimates have converged for daily, weekly and four-weekly analyses in the 2017–22 period.

Table 2.6 Standard errors of five-year asset betas for the energy sample

| Specification | 2012–17 | 2017–22 |
|---|---|---|
| For daily asset betas | 0.104 | 0.076 |
| For weekly asset betas | 0.115 | 0.077 |

[44] UK Regulators Network (2022), 'UKRN guidance for regulators on the methodology for setting the cost of capital — consultation', https://ukrn.org.uk/publications/ukrn-guidance-for-regulators-on-the-methodology-for-setting-the-cost-of-capital-consultation/ (accessed on 17 January 2023).
[45] For the 2016 results, see Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, p. 308. For the Oxera 2023 results, see Table 2.7. CEPA's daily estimates are also higher than its weekly and four-weekly estimates—see CEPA (2022), op. cit., p. 13.
[46] Commerce Commission (2010), 'Input methodologies (electricity distribution and gas pipeline services) Reasons paper', 22 December, para. H11.19; Lally, M. (2008), 'The weighted average cost of capital for gas pipeline businesses', 28 October, Appendix 3.

| Specification | 2012–17 | 2017–22 |
| --- | --- | --- |
| For four-weekly asset betas | 0.078 | 0.075 |

Note: Based on the Oxera updated energy sample after applying liquidity and equity beta filters. The cut-off dates are 30 September 2017 and 30 September 2022 so as to be consistent with the CEPA analysis.
Source: Oxera based on the NZCC's asset beta spreadsheet and data from Bloomberg.

2.38 The analysis presented above supports the conclusion that it is reasonable to include daily beta estimates in the assessment, especially after liquidity tests have already been applied to address the NZCC's concern about potential stock illiquidity.

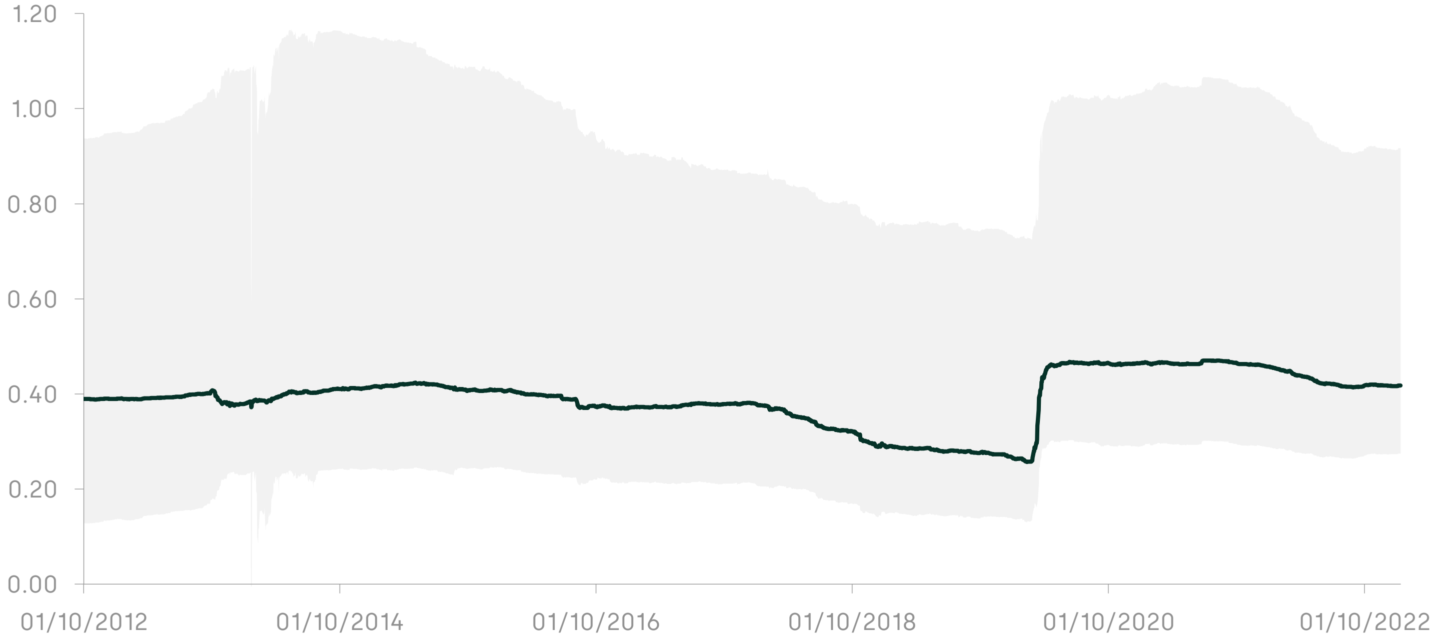
### 2.2.3 Time period

2.39 The NZCC, in its 2016 IMs review decision, and CEPA in its 2022 update, considered the two most recent five-year periods for setting the allowed asset beta (i.e. 2006–11 and 2011–16 for the NZCC, and 2012–17 and 2017–22 for CEPA).

2.40 We have plotted the evolution of five-year asset betas to see how they have changed over the last ten years. Figure 2.3 shows that betas surged at the start of the COVID-19 pandemic in early 2020 and are still at the pandemic level, suggesting a market re-pricing at times of volatility—the impact of the pandemic on energy networks may have been greater than the pre-pandemic market suggested. This movement in observed betas implies that taking an average of the latest two five-year periods risks underestimating the allowed asset beta, according to the latest market evidence.

2.41 We note also that the significant change in beta estimates is consistent with CEPA's findings (see Table 2.2 above for a comparison of the 2012–17 and 2017–22 estimates).

Figure 2.3 Five-year rolling daily asset betas (2012–22): whole energy sample




Note: The grey area shows the range of betas in the sample. Based on the Oxera updated energy sample after applying liquidity and equity beta filters.
Source: Oxera based on data from Bloomberg.

## 2.3 Results of Oxera's recommended asset beta for the energy sample

2.42 Table 2.7, Table 2.8 and Table 2.9 show the average five-year asset beta, leverage ratio and re-levered equity beta estimates for the Oxera sample of 48 comparator companies for the 2012–17 and 2017–22 periods. The sample excludes six companies from CEPA's 2022 sample due to insufficient representation of utility network activities in their businesses and the insufficient liquidity of their stock.

Table 2.7 Oxera asset beta estimates for the overall energy sample

| Specification | 2012–17 | 2017–22 |
|---|---|---|
| Daily asset beta | 0.38 | 0.42 |
| Weekly asset beta | 0.33 | 0.39 |
| Four-weekly asset beta | 0.29 | 0.35 |
| Number of companies in the sample | 47 | 48 |

Note: The 2012–17 figures exclude EVGR due to insufficient data. The cut-off dates are 30 September 2017 and 30 September 2022 so as to be consistent with the CEPA analysis.
Source: Oxera based on the NZCC's asset beta spreadsheet and data from Bloomberg.

Table 2.8 Oxera leverage ratio estimates for the overall energy sample

| Specification | 2012–17 | 2017–22 |
|---|---|---|
| Average leverage ratio | 39.0% | 40.1% |

Note: The 2012–17 figure excludes EVGR due to insufficient data. The cut-off dates are 30 September 2017 and 30 September 2022 so as to be consistent with the CEPA analysis.

Source: Oxera based on data from Bloomberg.

Table 2.9 Oxera re-levered equity beta estimates for the overall energy sample

| Specification | 2012–17 | 2017–22 |
|---|---|---|
| Daily re-levered equity beta | 0.62 | 0.70 |
| Weekly re-levered equity beta | 0.54 | 0.65 |
| Four-weekly re-levered equity beta | 0.48 | 0.59 |

Note: The 2012–17 figures exclude EVGR due to insufficient data. The cut-off dates are 30 September 2017 and 30 September 2022 so as to be consistent with the CEPA analysis.
Source: Oxera based on the NZCC's asset beta spreadsheet and data from Bloomberg.

2.43 We are showing evidence on five-year betas over a ten year period in the tables above, in line with the NZCC methodology, however, typically, we would place weight on relatively more recent evidence, e.g. two- or five-year betas estimated based on the most recent available data. We would also use only daily betas, having filtered the sample of comparators for liquidity of their stock. Based on the estimates above, that would suggest a central asset beta of 0.42 (daily asset beta for 2017–22).

2.44 However, we also consider regulatory stability to be important. We observe that the NZCC places weight on the two most recent five-year periods (in this case, 2012–17 and 2017–22) and weekly and four-weekly estimates, which with our sample would result in an asset beta of 0.34.

2.45 Given the benefits of using more frequent data as representative of current market conditions, and given that the corresponding concerns about stock illiquidity reducing the reliability of these estimates is already addressed in our analysis by multiple filtering checks on liquidity, we consider that it would be appropriate for the NZCC to include daily asset beta estimates in the assessment. This approach would suggest an asset beta estimate of 0.36, which is below the latest daily beta estimate of 0.42.

2.46 With the average leverage ratio of **40%** (compared with CEPA's 39%),[47] the re-levered equity beta corresponding to the asset beta of 0.36 would be **0.60** (compared with CEPA's 0.57).[48]

2.47 We have separately estimated the asset beta for Vector, which was screened out of the sample but is the only listed energy network company in New Zealand and therefore presents a datapoint of interest. Table 2.10 shows that asset beta estimates for Vector are lower than the average estimates for the energy sample. This observation is consistent with the

[47] CEPA (2022), op. cit., p. 4.
[48] Ibid., p. 4.

finding that Vector's stock is relatively illiquid—betas of illiquid stocks tend to be biased downwards.[49]

Table 2.10 Asset beta estimates for Vector

| *Specification* | 2012–17 | 2017–22 |
|---|---|---|
| *Daily asset beta* | 0.30 | 0.27 |
| *Weekly asset beta* | 0.28 | 0.27 |
| *Four-weekly asset beta* | 0.27 | 0.29 |

Note: The cut-off dates are 30 September 2017 and 30 September 2022 so as to be consistent with the CEPA analysis.
Source: Oxera based on the NZCC's asset beta spreadsheet and data from Bloomberg.

[49] It is well documented in the academic literature that thin-trading creates a downward bias in beta estimates. See, for example, an overview of the models correcting for the downward bias in McLelland, D.E., Auret, C.J. and Wright, T.K. (2014), 'Thin-Trading and Beta Estimation: Results from a Simulated Environment', *Studies in Economics and Econometrics*, **38**:2, pp. 19–32.

## 3 Adjustment to the asset beta for risks specific to New Zealand GDBs

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3.1 The adjustment to the asset beta for risks specific to New Zealand GDBs corresponds to Step 5 in the NZCC's beta estimation framework (see Figure 2.1 in section 2.1).

3.2 In the 2016 and 2010 IM reviews, the NZCC provided a GPBs-specific uplift to the asset beta estimated for all energy networks. In the 2010 IMs review, the uplift was 0.1.[50] The NZCC reports that there was significant theoretical support for the uplift due to potentially higher risks of GPBs relative to other energy networks in New Zealand.[51] However, the NZCC also mentions that, at that time, empirically, the gas networks' asset beta was assessed to be lower than that of electricity networks.[52]

3.3 In 2016, the NZCC set a lower 0.05 uplift for GPBs. The NZCC states that the main reasons for continuing to provide an uplift were a higher income elasticity of demand in gas than in electricity and a lower penetration of gas connections among New Zealand households than in the other countries in the comparator sample. Empirically, gas network asset betas were above those of electricity networks for the two latest five-year periods, i.e. for 2006–11 and 2011–16, but the difference was not statistically significant.[53]

3.4 Below, we discuss the statistical significance of the difference between gas and electricity asset betas and the weight to put on it, as well as the theoretical reasons supporting the need for a GPBs uplift.

### 3.1 Statistical significance of the difference between gas and electricity network asset betas

3.5 Although the NZCC assessed whether the difference between gas and electricity networks' asset betas was statistically significant, the regulator did not appear to put much weight on the results of this assessment: in 2010, it observed that gas betas were lower, while in 2016 gas betas were higher, but the difference was not statistically significant.

3.6 In Table 3.1 below, we present confidence intervals for asset betas of gas and electricity subsamples. We observe that, in 2012–17, gas network betas were above those of electricity, as were daily betas in 2017–22. Note, for example, that the daily beta estimates in 2017–22 for the gas businesses are 0.05 higher than those the electricity businesses and all energy businesses on average—this differential is consistent with the current allowed 0.05 gas uplift. Figure 3.1 shows the evolution

[50] Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, para. 349.
[51] Ibid., paras 347–349.
[52] Ibid., para. 348.2.
[53] Ibid., para. 378 and figures 7–9.

of daily betas and that the differential between gas and electricity used to be even wider than it is now.

3.7 However, weekly and four-weekly betas of 2017–22 were almost the same for gas and electricity, and none of the differences mentioned above are statistically significant due to the standard errors of beta estimates implying a wide confidence interval.

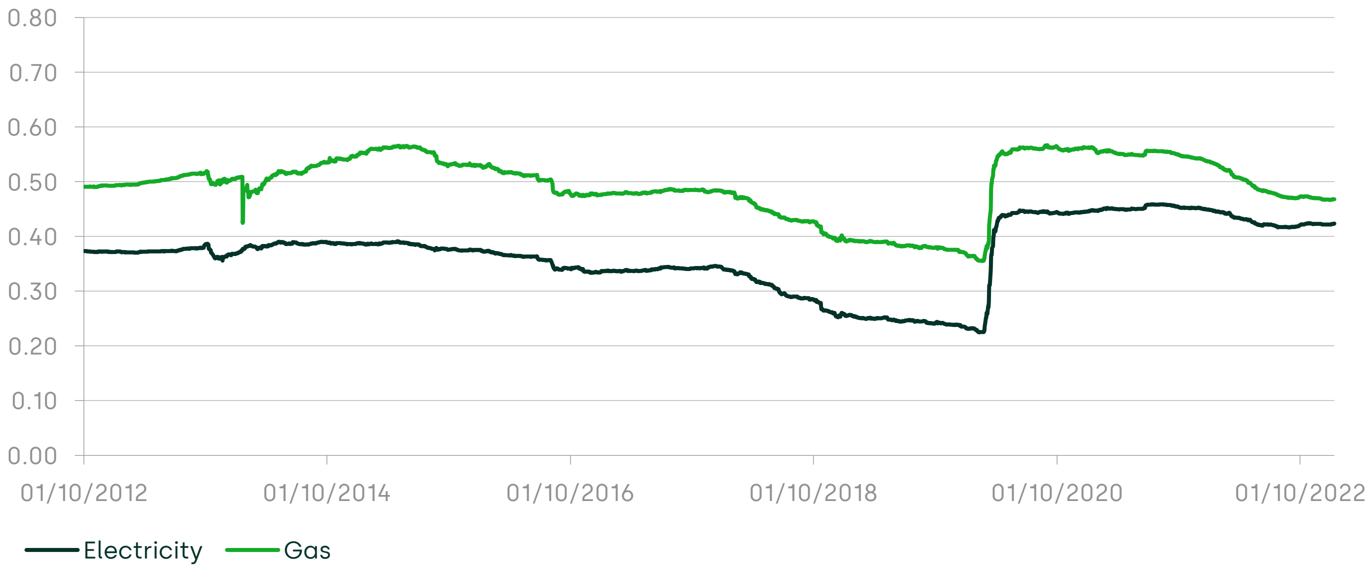
3.8 On average across the daily, weekly and four-weekly estimates over the two five-year periods, the difference between the gas subsample and total energy sample betas is 0.06, while the difference between the gas and electricity subsamples is 0.07.

Table 3.1 Statistical significance of the difference between asset betas of the gas and electricity subsamples

| | | | | 2012–17 | | | | 2017–22 |
|---|---|---|---|---|---|---|---|---|
| | Gas | Electricity | Total energy sample | Gas higher/gas statistically significantly higher | Gas | Electricity | Total energy sample | Gas higher/gas statistically significantly higher |
| Daily | **0.49** (0.23–0.74) | **0.34** (0.20–0.49) | **0.38** | ✓/✗ | **0.47** (0.35–0.59) | **0.42** (0.25–0.59) | **0.42** | ✓/✗ |
| Weekly | **0.44** (0.06–0.82) | **0.30** (0.17–0.44) | **0.33** | ✓/✗ | **0.40** (0.23–0.57) | **0.41** (0.30–0.52) | **0.39** | ✗/✗ |
| Four-weekly | **0.37** (0.09–0.65) | **0.28** (0.22–0.33) | **0.29** | ✓/✗ | **0.36** (0.20–0.51) | **0.37** (0.30–0.44) | **0.35** | ✗/✗ |
| Average of daily, weekly and four-weekly | 0.43 | 0.31 | 0.33 | | 0.41 | 0.40 | 0.39 | |
| Number of companies | 9 | 11 | 47 | | 9 | 12 | 48 | |

Note: The numbers of companies in the gas and electricity subsamples do not add up to the number of companies in the total energy sample due to the third 'integrated' companies subsample. Refers to the 95% confidence interval. Confidence intervals for each subsample have been estimated based on the following formula: (Average sample asset beta) ± (Sample standard error) * 1.96.
Source: Oxera based on the NZCC's asset beta spreadsheet and data from Bloomberg.

Figure 3.1 Rolling daily asset betas for gas and electricity subsamples (2012–22)




Note: Based on the Oxera gas and electricity updated subsamples after applying liquidity and equity beta filters.
Source: Oxera based on data from Bloomberg.

3.9 We now turn to evidence on the theoretical reasons for the gas uplift.

## 3.2 Theoretical evidence supporting the higher risk of GPBs

3.10 As mentioned above, in the 2016 IMs, the NZCC justified an asset beta uplift to GPBs with a combination of relatively high income elasticity of demand and a low penetration of gas connections. These conclusions are aligned with the analysis that we performed in 2016 in response to the NZCC's IMs review draft decision.[54]

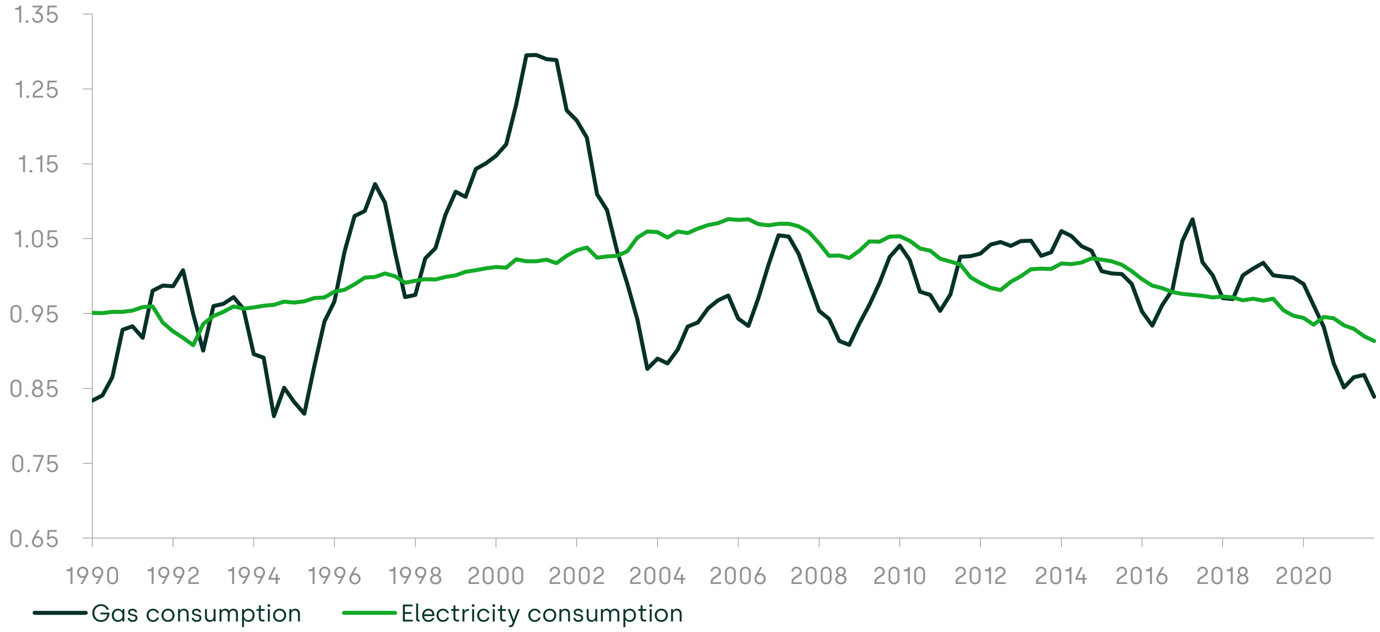
3.11 To summarise, we observed that GPBs in New Zealand faced higher demand-side risks than electricity networks, in terms of higher **volatility of consumption**. If translated into volatility in network returns, the volatility of consumption may be associated with both systematic and non-systematic risk (as also acknowledged by the NZCC).[55] However, **high elasticity of demand** suggests that at times of recession demand is more likely to be low, and vice versa. Therefore, the high elasticity of demand supports the interpretation that some of the demand volatility risk is systematic and therefore would justify an uplift to the GPBs' asset beta.

3.12 Figure 3.2 compares the volatility of gas and electricity consumption. In particular, it shows de-trended variation in total quarterly consumption for gas and electricity in New

[54] Oxera (2016), 'Asset beta for gas pipelines in New Zealand. Final Report. Prepared for First Gas', 3 August, section 3.
[55] Commerce Commission (2016), 'Input methodologies review decisions; Topic paper 4: Cost of capital issues', 20 December, paras 396–397.

Zealand. The figure shows a significantly higher variation in gas consumption relative to electricity.

Figure 3.2 Quarterly variations in gas and electricity consumption in New Zealand, 1990–2022 (petajoules, de-trended)




Note: Both the gas and electricity time series have been 'de-trended' in order to ensure comparability. Specifically, we calculated an annual moving average to account for seasonal fluctuations in consumption, and fitted a linear trend for each time series. The time series were then scaled (i.e. divided) by the trend line.
Source: Oxera analysis based on data from New Zealand Ministry of Business, Innovation and Employment (MBIE).

3.13 As rightly pointed out by the NZCC,[56] the regulatory regime has the potential to significantly modify the networks' exposure to volume risk. However, given that the New Zealand GDBs are regulated under the weighted average price cap, they are exposed to volume risk within the price control period (or, to be precise, the deviation of the actual demand from the demand forecast).

3.14 As for the relatively **low penetration** of gas connections, the NZCC reports two consequences for systematic risk and the asset beta:[57]

- growth options due to the potential for expansion when the economy is growing;
- a greater risk that the number of customers will decrease to a level where it would be insufficient to cover the networks' investment and expenses, which is related to both the short-term demand volatility and the long-term risk of economic asset stranding.

[56] Ibid., para. 344.1.
[57] Ibid., paras 419 and 423.

3.15 In the context of the energy transition (see New Zealand's commitment to achieving **net zero** by 2050[58]), the New Zealand Government has planned to phase out the use of fossil fuels while ensuring affordability. As a result, the demand for gas is more likely to become insufficient to cover gas pipelines' costs on an affordable basis, strengthening the asset stranding risk.

3.16 Some regulators compensate networks for the risk of asset stranding with higher asset beta allowances. For example, the French regulator CRE accounted for the asset stranding risk in setting the beta allowance for gas pipeline companies.[59] However, as explained above, the asset stranding risk is only one of the reasons why an uplift to the asset beta for New Zealand GDBs is justified.

3.17 Notably, accelerated depreciation targets the same risk—i.e. the risk of under-remuneration of the assets that may be under-utilised. However, while accelerated depreciation shortens the period for investment recovery, it does not eliminate the risk. Therefore, both of the regulatory tools—an uplift to the asset beta and accelerated depreciation—can be used together to mitigate the risk.

## 3.3 Conclusions on the GDBs-specific adjustment

3.18 In line with the NZCC's approach, we consider the required adjustment for GDBs-specific risks by looking at the empirical and theoretical evidence.

- We find the empirical evidence to be mixed, as it was in the previous NZCC IM reviews: the gas subsample asset betas are above those for electricity for the 2012–17 period and for daily asset betas in 2017–22. The difference, however, is not statistically significant.
- In terms of the theoretical evidence, the NZCC's 2016 decision to provide an uplift was based primarily on the high income elasticity of demand for gas and low penetration of gas connections in New Zealand. Although we have not undertaken revised analysis of elasticities, it is reasonable to expect that this finding would persist, as these are characteristics of the industry in New Zealand.

[58] New Zealand Ministry of Business, Innovation and Employment (2022), 'Gas Transition Plan'.
[59] Commission de Régulation de l'Energie (2020), 'Deliberation No. 2020-012. Deliberation by the French Energy Regulatory Commission of 23 January 2020 deciding on the tariffs for the use of GRTgaz's and Teréga's natural gas transmission networks', 23 January, p. 42, https://www.cre.fr/en/Documents/Deliberations/Decision/tariffs-for-the-use-of-grtgaz-s-and-terega-s-natural-gas-transmission-networks (accessed on 23 January 2023). Commission de Régulation de l'Energie (2020), 'Deliberation No. 2020-010. Deliberation by the French Energy Regulation Commission of 23 January 2020 deciding on the equalised tariff for the use of GRDF's public natural gas distribution networks', 23 January, p. 34, https://www.cre.fr/en/Documents/Deliberations/Decision/equalised-tariff-for-the-use-of-grdf-s-publicnatural-gas-distribution-networks (accessed on 23 January 2023).

3.19 Moreover, we expect asset stranding risk to have increased with New Zealand's net zero commitment and the associated policy interventions affecting demand.[60]

3.20 On balance, we conclude that, in the New Zealand context, given the relatively high income elasticity of demand for gas, low penetration rates of the gas networks as well as the use of price caps (rather than revenue caps) for GDBs, it remains reasonable to expect higher systematic risk than in the New Zealand electricity sector, and therefore maintain an uplift on the gas asset beta.

[60] For example, between 2021 and 2022 the Energy Efficiency and Conservation Authority (EECA), has invested in several projects aimed at replacing natural gas in industrial process heat. Moreover, in December 2022 the NZ's Ministry for Environment published a Cabinet paper, entitled 'National Direction on Industrial Greenhouse Gas Emissions', seeking approval for the development of a policy direction and a supporting rule framework for phasing out fossil fuels in process heat. See EECA, Approved GIDI projects, https://www.eeca.govt.nz/co-funding/industry-decarbonisation/approved-gidi-projects/ (accessed on 31 January 2023); Ministry for the Environment (2022), 'Cabinet Paper – National Direction on Industrial Greenhouse Gas Emissions: approval to develop a National Policy Statement and National Environment Standard', Cabinet papers and regulatory impact statements, 20 December, https://environment.govt.nz/what-government-is-doing/cabinet-papers-and-regulatory-impact-statements/cabinet-paper-national-direction-on-industrial-greenhouse-gas-emissions-approval-to-develop-a-national-policy-statement-and-national-environment-standard/ (accessed on 31 January 2023).

## 4 WACC percentile

4.1 We start our assessment of whether the WACC percentile of 67th is still appropriate for the NZCC's IMs by explaining the NZCC's approach in section 4.1. Then, we move on to our review of CEPA's analysis in section 4.2, before concluding in section 4.3.

### 4.1 The NZCC's approach

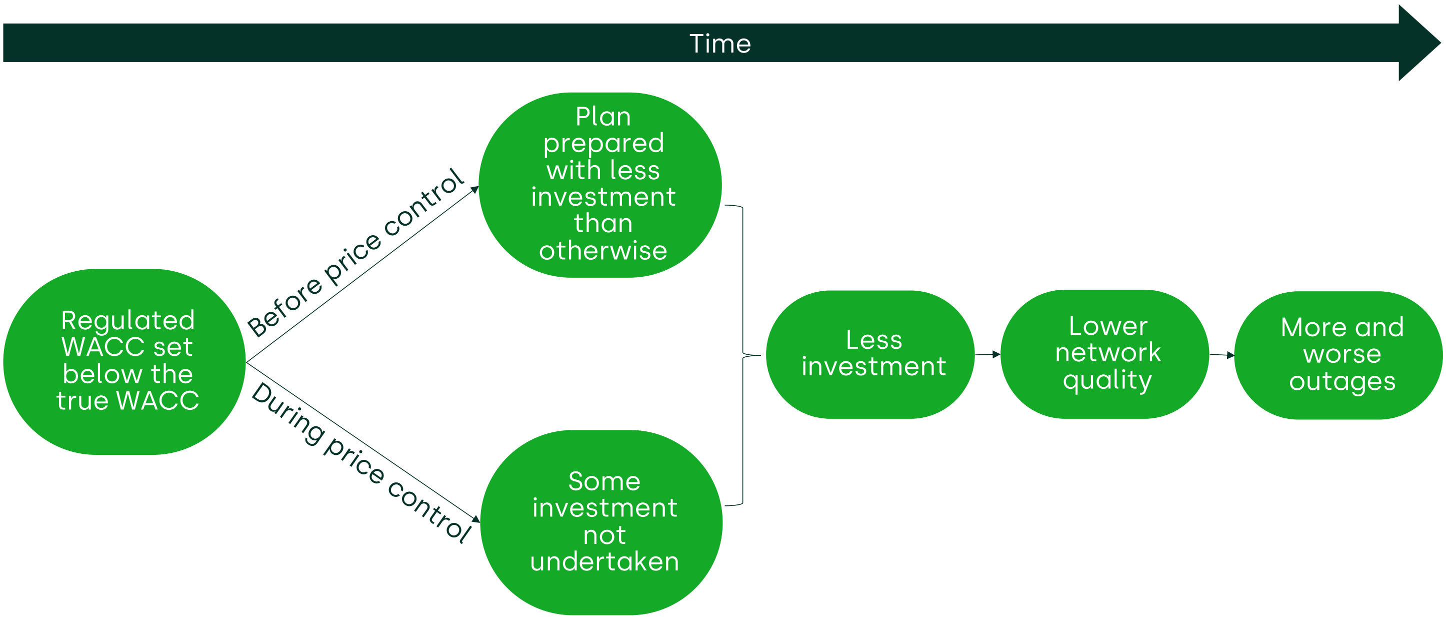
4.2 The conceptual framework that the NZCC uses to assess the percentile of the WACC distribution that should be targeted is based on a 2014 report by Oxera.[61] This framework considers the extent to which aiming up on the WACC generates network reliability benefits to the energy sector as a whole, rather than focusing on electricity and gas separately. Due to the greater availability of research and data on the reliability of electricity rather than gas networks, the framework has been calibrated primarily using data on electricity networks.

4.3 The framework begins by considering the causal mechanism under which a regulated WACC (i.e. the WACC set by a regulator) that is below the true WACC of an energy network could lead to underinvestment. This is shown in Figure 4.1 below, which depicts a causal chain from the regulated WACC to consumer outcomes. The figure explains that, if the true WACC rises above the regulated WACC, two mechanisms will create incentives for the energy network to underinvest:

- if the true WACC is above the regulated WACC *before* the start of a regulatory period,[62] the regulated network will have an incentive to prepare a plan with less investment;
- if the true WACC is above the regulated WACC *during* a regulatory period, the network will have an incentive to undertake the minimum legally permissible amount of investment. This may affect its willingness to prepare a plan with high levels of investment in the next regulatory period, such that there is an interaction between these two mechanisms.

[61] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', https://www.oxera.com/wp-content/uploads/2018/07/Oxera-review-of-the-75th-percentile-approach.PDF.pdf (accessed on 24 January 2023).
[62] More precisely, this would need to happen prior to the network submitting its investment plans for a regulatory period.

Figure 4.1 Causal mechanism explaining why consumers face negative impacts when the regulated WACC is below the true WACC



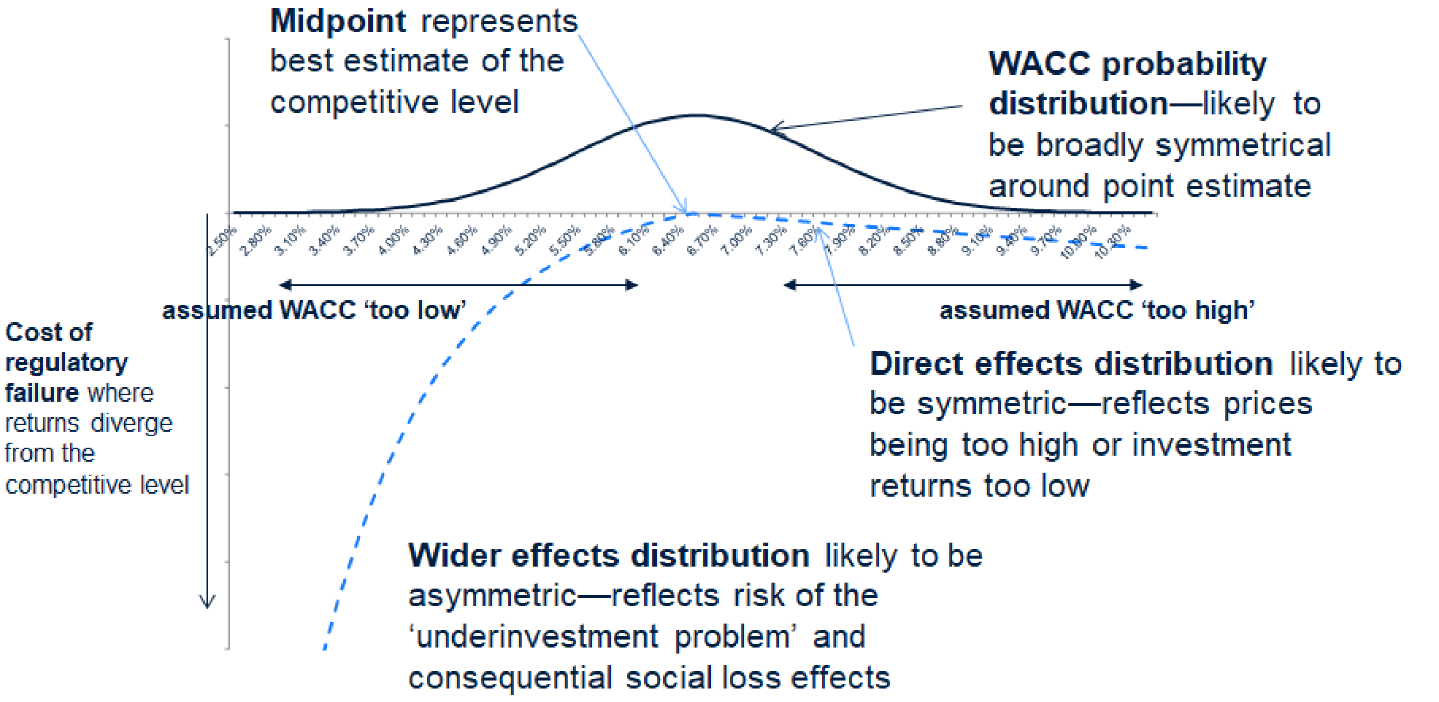

Source: Oxera.

4.4 The framework then explains that the decision of whether to aim up for the WACC should be based on a cost–benefit assessment. The costs of aiming for a higher WACC percentile are the additional costs to consumers arising from the need for the energy network to pass on its higher revenue allowance. The benefits consist of reducing the probability and magnitude of network outages and their consequential impacts (together, the 'impact' of network outages).

4.5 Importantly, the framework shows an asymmetric distribution of the effects of aiming for a higher WACC percentile. This asymmetric distribution exists because the costs of network outages are generally considered to be substantially higher than the fairly small increment that a higher WACC would apply to energy prices.

4.6 Figure 4.2 below shows this framework diagrammatically. The dark blue line shows the distribution of the WACC. The dashed, lighter blue line shows the net socioeconomic costs incurred by society. This line declines significantly towards the left of the WACC distribution, while it drops off only slightly at the right of the WACC distribution. This reflects the fact that aiming up on the WACC (i.e. targeting a point to the right of the distribution) results in a higher cost to consumers, but this cost is low relative to the reduced probability of network outages.

Figure 4.2 Illustration of the framework for the WACC percentile




Source: Oxera.

4.7 The key conclusion to be drawn from this figure is that targeting a WACC that is close to the midpoint creates a greater risk that the true WACC will be below it, resulting in society taking the risk of ending up on a point of the blue dashed line to the left of the graph. By contrast, targeting a higher WACC gives more assurance that this will not happen, meaning that the outcomes for society are more likely to be on the right-hand side of the graph. From an economics perspective, aiming up on the WACC is therefore similar to taking out an insurance policy against the very bad outcomes located on the far left of the asymmetric 'wider effects' distribution.

4.8 As part of the NZCC's review of the cost of capital, CEPA was commissioned to review the framework used by the NZCC to aim up to a particular WACC percentile.[63] CEPA reached two main conclusions.

4.9 First, CEPA found that the evidence for aiming for a higher percentile remained strong within the framework used by the NZCC, highlighting that the benefits of aiming for a higher percentile are higher than the costs at the 70th and 60th percentiles.[64] Our review of CEPA's evidence has found that the benefits of aiming for a higher percentile exceed the costs for every percentile, with the largest difference between benefits and costs, i.e. the highest level of net benefit, being found at the 80th percentile.

[63] CEPA (2022), op. cit.
[64] Ibid., section 4.8.

4.10 This can be seen in Table 4.1 below, which combines the data that CEPA produced on the costs and benefits of aiming for a particular percentile to produce the net benefits.[65] The benefits column contains the (estimated) monetary value of the reduced risks of network underinvestment that CEPA calculated would arise from targeting a higher percentile. The costs column calculates the total additional costs that end-consumers would face after the additional WACC (i.e. from targeting a particular percentile rather than the 50th) is applied to the regulatory asset base (RAB) of the networks, assuming 100% pass-on of those costs to end-consumers. The net benefits column is equal to the midpoint of the benefits column, less the costs column. Taken alone, this suggests that the 80th percentile would be the most appropriate percentile for the NZCC to target because net benefits start to fall at higher percentiles.

Table 4.1 CEPA estimates of the net benefits of aiming up at different WACC percentiles

| Percentile | Benefits (NZ$m) | Costs (NZ$m) | Net benefits (NZ$m) |
|---|---:|---:|---:|
| 50% | 0 | 0 | 0 |
| 55% | 80–55 | 25 | 42.5 |
| 60% | 160–105 | 50 | 82.5 |
| 65% | 230–145 | 70 | 117.5 |
| 70% | 300–185 | 100 | 142.5 |
| 75% | 360–215 | 125 | 162.5 |
| 80% | 420–245 | 155 | 177.5 |
| 85% | 470–265 | 195 | 172.5 |
| 90% | 520–285 | 240 | 162.5 |
| 95% | 560–300 | 305 | 125 |

Note: In line with CEPA's suggestions in section 4.8 of its report, which in turn draw on the suggestions in Oxera's 2014 report, the benefits have been taken from the 0.5% and 1% columns in Table 4.17. These two percentages correspond to the level that the true WACC needs to drop by relative to the regulated WACC in order for underinvestment to start. Therefore, the 0.5% column shows the benefits of aiming for a higher WACC if underinvestment is assumed to start when the true WACC is 0.5% below the regulated WACC, while the 1% column assumes that underinvestment starts only when the true WACC is 1% below the actual WACC. The net benefits column reflects the midpoint of the difference between the benefits and costs.
Source: CEPA (2022), 'Review of Cost of Capital 2022/2023', Tables 4.8 and 4.17.

4.11 Second, CEPA found that, in recent years, fewer regulators have aimed up on the WACC than in the past.[66]

4.12 CEPA does not state whether its update has specific recommendations for the percentile that the NZCC should target. However, in our review of the evidence presented by CEPA we observe that the evidence on the costs and benefits of aiming up is more supportive of aiming up than was the case in 2014. Furthermore, while we agree that most regulators now aim straight rather than up, we note that there is limited direct read-across where other regulators are not using the network reliability framework approach, as is the case for the NZCC.

[65] Ibid., Tables 4.8 and 4.17.
[66] Ibid., section 4.3.

Also, a number of regulators do still aim up, both in the energy sector and in other industries.

4.13 We explain these conclusions in further detail in the sections below.

## 4.2 Oxera's review of CEPA's conclusions regarding the WACC percentile

4.14 Balancing the need to maintain security of supply and delivering decarbonisation as part of the energy transition in the gas sector is an important concern for New Zealand. The transmission and distribution networks play a vital role in meeting these objectives.[67]

4.15 The need to maintain security of supply in New Zealand is important context for assessing the percentile of the WACC distribution that the NZCC should target. As gas networks balance the multiple roles of maintaining the reliability of the current gas supply, while redeploying assets as well as potentially investing in assets to facilitate (the option of and transition to) lower carbon fuels such as hydrogen or biogas (or blends), it is likely that a high proportion of gas infrastructure expenditure will have reliability implications if it is not undertaken.

4.16 In the remainder of this section, we turn to the specifics of CEPA's report as follows.

- While we agree with CEPA that there is now less regulatory precedent for aiming up than in the past, a number of regulators still do aim up and academic research continues to suggest that a WACC uplift is appropriate (section 4.2.1).
- The conclusion of the Australian Energy Regulator (AER) that any adjustments to the WACC based on 'aiming-up' logic would be arbitrary and would introduce 'further costs' does not appear to take into account the economic fundamentals underpinning the NZCC's framework for assessing the WACC. This approach is consumer-focused—it allows for non-arbitrary adjustments to be made based on a calculation of the relative benefits and costs. We also explain how underestimating the true WACC would be likely to lead to persistent underinvestment (section 4.2.2).
- The approach taken by CEPA to updating the evidence on the impact of network failures is appropriate. However, we do not agree with CEPA's view that the estimates may overstate the impact of network outages. In fact, we note that there are number of reasons why they may understate them (section 4.2.3).

[67] In response to a government request, Gas Industry Co published a report in 2021 that explained that, in order to maintain security of supply, additional investment in gas pipelines will be needed to safely and securely deliver natural gas to customers. Gas Industry Co (2021), 'Gas Industry Co. Market Settings Investigation', p. 17, https://www.gasindustry.co.nz/our-work/work-programmes/gas-market-settings-investigation/ (accessed on 24 January 2023).

- While other regulatory tools, such as incentive and performance-based mechanisms, can, in principle, be used to reduce the risks of underinvestment, there is not a clear case for doing so in New Zealand, particularly as GPBs do not seem to be over-remunerated and there is a risk that the change could introduce regulatory risk (section 4.2.4).
- There are a number of reasons why decarbonisation could increase the rationale for aiming up. These include: (i) the risks that underinvestment in renewable gas infrastructure could slow the rate at which hard-to-decarbonise sectors can reduce the carbon-intensity of their activities; (ii) asset stranding; and (iii) the need to ensure an orderly transition (section 4.2.5).

### 4.2.1 Review of regulatory precedent

4.17 CEPA's report has highlighted that regulators generally do not aim up on the WACC as much as they did in the past.[68] It explains that:

- between 2008 and 2014, UK regulators, on average, chose the 73rd percentile, and the midpoint was not chosen once. More recently, however, UK regulators have moved away from a WACC above the midpoint and towards selecting the midpoint WACC estimate;[69]
- the AER in Australia explicitly considered a WACC percentile above the midpoint in its 2018 decision, but concluded that there was insufficient evidence for a shift away from the midpoint. However, the AER did note that it was important not to set the allowed WACC below the true WACC, due to the potential for disincentivising underinvestment, which ultimately has adverse impacts on consumers.

4.18 However, CEPA also explains that another Australian regulator, the Independent Pricing and Regulatory Tribunal of New South Wales (IPART), noted that applying its standard WACC methodology may lead to large estimation errors during periods of increased macroeconomic uncertainty, which could lead to an understatement of the true WACC and underinvestment.[70] IPART has the power to diverge from its standard WACC methodology during periods of high macroeconomic uncertainty. While it is not entirely clear how IPART would choose to depart from its methodology, CEPA concludes that an uplift to the WACC could be an appropriate approach for IPART to take.[71] Given that inflation in New Zealand is currently high (7.2% in September 2022[72]), and

[68] CEPA (2022), op. cit., section 4.3.
[69] Ibid., pp. 26–30.
[70] Ibid., p. 32.
[71] Ibid., p. 32.
[72] Stats NZ (2022), 'Annual inflation at 7.2 percent', https://www.stats.govt.nz/news/annual-inflation-at-7-2-percent/#:~:text=The%20consumers%20price%20index%20increased,in%20the%20March%202022%20quarter (accessed on 24 January 2023).

monetary policy is expected to tighten,[73] this could mean that, under IPART's methodology, aiming up would be applied in New Zealand.

4.19 While recent regulatory decisions include fewer aiming-up decisions than previously, many regulators still consider aiming up to be reasonable. We summarise these precedents in Table 4.2 below and discuss some of them in further detail below.

Table 4.2 Precedents of aiming up in energy and non-energy regulation

| Regulator | Year | Sector | Percentile |
|---|---|---|---|
| CAR (Ireland) | 2019/22 | Aviation | 62 |
| CRE (France) | 2021 | Electricity transmission | 63 |
| CRE (France) | 2020 | Gas transmission | 81 |
| CRE (France) | 2020 | Gas distribution | 100 |
| **Identified by CEPA:** | | | |
| UK CMA | 2019 | Water | 78 |
| UK Ofcom | 2021 | Wholesale fixed telecoms | 59 |
| UK Ofgem | 2022 | Electricity distribution | 51 |

Note: CAR, Commission for Aviation Regulation. The percentiles are calculated from the selected WACC point and the lower and upper bounds of the range, based on a uniform distribution assumption. Since the French regulator CRE does not provide a range in its final determination, the consultation range is used for the percentile calculation.
Source: Commission for Aviation Regulation (2022), 'Decision on an Interim Review of the 2019 Determination in relation to 2023-2026', pp. 151–152, https://www.aviationreg.ie/_fileupload/2022%20Decision/Final%20Decision_2022_23Dec(2).pdf (accessed on 24 January 2023); CRE (2021), 'Délibération de la CRE du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de transport d'électricité (TURPE 6 HTB), https://www.cre.fr/Documents/Deliberations/Decision/tarif-d-utilisation-des-reseaux-publics-de-transport-d-electricite-turpe-6-htb (accessed on 24 January 2023); CRE (2020), 'Délibération de la CRE du 23 janvier 2020 portant décision sur le tarif d'utilisation des réseaux de transport de gaz naturel de GRTgaz et Teréga', https://www.cre.fr/Documents/Deliberations/Decision/tarif-d-utilisation-des-reseaux-de-transport-de-gaz-naturel-de-grtgaz-et-terega (accessed on 24 January 2023); CRE (2020), 'Délibération de la CRE du 23 janvier 2020 portant décision sur le tarif péréqué d'utilisation des réseaux publics de distribution de gaz naturel de GRDF, https://www.cre.fr/Documents/Deliberations/Decision/tarif-pereque-d-utilisation-des-reseaux-publics-de-distribution-de-gaz-naturel-de-grdf (accessed on 24 January 2023); CEPA (2022), 'Review of Cost of Capital 2022/2023', table 4.2.

4.20 The CMA overturned Ofwat's decision to choose the midpoint of the cost of equity for PR19, and selected the 67th percentile instead. The CMA's reasoning was based on the fact that aiming up can deliver a number of benefits, such as a more appropriate balance of risk, addressing the level of risk to investment, compensation for any asymmetries in the broader financial settlement, and financeability of the sector.[74]

4.21 The Irish Commission for Aviation Regulation includes an uplift to the WACC allowance of 50bps in the two most recent price

[73] OECD (2022), 'Economic Outlook November 2022 – New Zealand projection note', November. International Monetary Fund (2022), 'New Zealand – Selected issues', May.
[74] Competition and Markets Authority (2021), 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations – Final Report', https://assets.publishing.service.gov.uk/media/60702370e90e076f5589bb8f/Final_Report_---_web_version_-_CMA.pdf (accessed on 24 January 2023).

control periods. The Commission for Aviation Regulation's rationale appears to be based on a similar framework to the one used in New Zealand, as it explained that:[75]

> The reasoning behind applying the aiming up component remains unchanged compared to the Draft Decision and the original 2019 Determination: i) Risk of measurement errors in the WACC components. ii) Asymmetric economic effects of underinvestment relative to overinvestment, since underinvestment is likely to have asymmetric dynamic effects on welfare. iii) No implicit aiming up is included in other WACC components.

4.22 The description of 'asymmetric economic effects' appears to be a reference to the degradation of assets as a result of underinvestment, with the Commission for Aviation Regulation stating that:[76]

> We reiterate our views on the risks of underinvestment, which both restricts Dublin Airport's ability to expand (benefitting future users) and potentially leads to the degradation of existing assets, which would not be in the interests of current or future users.

4.23 The French energy regulator, CRE, has also aimed up in its most recent decisions for electricity transmission and distribution.[77] Specifically, the CRE granted a WACC of 4.6% from a range of 3.87–5.03% for the transmission system operator (TSO). This corresponds to the 63rd percentile of the WACC range. For the distribution system operators (DSOs), a different remuneration methodology was used, which was based on the same parameters as the WACC. The relevant rates, called the return on assets (marge sur actif) and return on equity (rémunération des capitaux propres régulés) were determined respectively at 2.5% from a range of 2.4–2.5% and at 2.3% from a range of 2.1–2.5%.

4.24 The CRE has also selected point estimates for the WACC above the midpoint in the most recent decisions and consultations for gas transmission and distribution tariffs.[78] For gas transmission, the range in the consultation was 3.6–4.4%, with the final WACC set at 4.25% (the 81st percentile of the range). For gas distribution, the final WACC was set at 4.10%, from a range in

[75] Commission for Aviation Regulation (2022), 'Decision on an Interim Review of the 2019 Determination in relation to 2023-2026', pp. 151–152.
[76] Ibid., pp. 151–152.
[77] CRE (2021), 'Délibération de la CRE du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de transport d'électricité (TURPE 6 HTB); CRE (2021), 'Délibération de la CRE du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de distribution d'électricité (TURPE 6 HTA-BT)', https://www.cre.fr/Documents/Deliberations/Decision/tarif-d-utilisation-des-reseaux-publics-de-distribution-d-electricite-turpe-6-hta-bt (accessed on 24 January 2023).
[78] CRE (2020), 'Délibération de la CRE du 23 janvier 2020 portant décision sur le tarif d'utilisation des réseaux de transport de gaz naturel de GRTgaz et Teréga'; CRE (2020), 'Délibération de la CRE du 23 janvier 2020 portant décision sur le tarif péréqué d'utilisation des réseaux publics de distribution de gaz naturel de GRDF'.

the consultation of 3.5–4.1% (the 100th percentile—i.e. the top of the range).

4.25 Moreover, academic research has continued to be published examining the relationship between WACC allowance uplifts and consumer welfare. We have reviewed a paper by Romeijnders and Mulder from 2022,[79] which uses a theoretical model that assumed that electricity grid operators invest in infrastructure replacement only if the WACC allowance is set above the true WACC, while no investments are performed if the WACC allowance is set below the true WACC. The authors' model also links the underinvestment to network failures and damage to consumers, quantified using estimates of the value of lost load (VoLL). The authors conclude from their theoretical model that in most cases the optimal WACC allowance is above the historical midpoint of the WACC range (which we can consider to be a proxy for the WACC estimate).

4.26 While the authors have presented their findings in terms of a percentage uplift to the WACC when the standard deviation of the WACC is at a particular level, it is possible to convert these WACC uplifts into percentile targets.[80] We have done this in Table 4.3 below, which shows how the optimal WACC percentile varies across:

- standard deviations of the WACC that are close to the NZCC's standard deviation estimate of 1.01%;
- different proportions of the asset base that can be replaced in one year;
- the persistence of the WACC, with values closer to 1 indicating higher persistence and values closer to 0 indicating lower persistence.

[79] Romeijnders, W. and Mulder, M. (2022), 'Optimal WACC in tariff regulation under uncertainty', *Journal of Regulatory Economics*, **61**, pp. 89–107.
[80] By dividing the percentage uplift by the standard deviation we calculate how many standard deviations the uplift is away from the mean. This allows us to use a standard normal distribution to determine the equivalent percentile that the percentage uplift corresponds to. For example, if the ratio of the uplift to the standard deviation is 0.5, this would imply, based on a standard normal distribution table, that the optimal WACC percentile was the 69th.

Table 4.3 Optimal WACC percentile for different combinations of the WACC standard deviation, the percentage of investment that can be replaced in a year, and the persistence of the WACC

| Uncertainty of the WACC, measured by standard deviation | Percentage of asset base replaced in one year[1] | Persistence[2] | Optimal WACC percentile |
|---|---|---|---|
| 0.50% | 10% | 0.92 | 91.92% |
| 1% | 10% | 0.92 | 81.59% |
| 1.50% | 10% | 0.92 | 74.75% |
| 2% | 10% | 0.92 | 67.36% |
| 0.50% | 7% | 0.92 | 93.32% |
| 1% | 7% | 0.92 | 88.49% |
| 1.50% | 7% | 0.92 | 82.47% |
| 2% | 7% | 0.92 | 77.34% |
| 0.50% | 10% | 0.5 | 78.81% |
| 1% | 10% | 0.5 | 72.57% |
| 1.50% | 10% | 0.5 | 63.06% |
| 2% | 10% | 0.5 | 58.90% |
| 0.50% | 10% | 0 | 72.57% |
| 1% | 10% | 0 | 59.87% |
| 1.50% | 10% | 0 | 55.30% |
| 2% | 10% | 0 | 52.99% |

Note: [1] The percentage of the asset base that can be replaced in one year determines the speed at which networks can recover from periods of underinvestment. Therefore, the higher the percentage of the asset base that can be replaced, the lower will be the impacts of underestimating the WACC. [2] The persistence is the autocorrelation factor of the model and measures how close the previous period's value of the WACC is to the predicted WACC. The higher the persistence, the closer the predicted WACC value will be to the previous period's.
Source: Oxera analysis based pp. 102–105 of Romeijnders, W. and Mulder, M. (2022), 'Optimal WACC in tariff regulation under uncertainty', *Journal of Regulatory Economics*, **61**, pp. 89–107.

4.27 We consider the salient points for the NZCC from Table 4.3 to be that:

- at high levels of persistence in the WACC (i.e. situations where underinvestment could occur for multiple years), the optimal WACC percentile is always above the 67th;[81]
- at lower levels of persistence (i.e. situations where it is less likely that underinvestment could occur for multiple years), and where the standard deviation is similar to the standard deviation calculated by the NZCC,[82] the suggested

[81] This can be seen from the optimal WACC percentile in the rows that have a persistence parameter of 0.92.
[82] This can be seen by looking at the rows with a standard deviation of between 0.5% and 1.5%, as the NZCC's most recent estimate of the standard deviation of the WACC was 1.01%. Commerce Commission (2016), 'Input Methodologies Review Decisions. Topic paper 4: Cost of capital issues', para. 580, https://comcom.govt.nz/__data/assets/pdf_file/0021/60537/Input-methodologies-review-decisions-Topic-paper-4-Cost-of-capital-issues-20-December-2016.pdf (accessed on 24 January 2023).

- percentile is between 55% and 72%, thereby encompassing the 67th percentile used by the NZCC;[83]
- the most relevant rows to consider are likely to be those that have a standard deviation of c. 1%, and persistence of higher than 0 (i.e. 0.5 or 0.92). These rows are most relevant because the NZCC currently has an estimate of the standard error that is approximately 1%.[84] Furthermore, as the persistence parameter of 0.92 is estimated using actual market data from the Netherlands, it seems relatively unlikely that a persistence parameter of 0 would be an appropriate assumption for New Zealand. These rows suggest a mean percentile of 81%, which is materially higher than the NZCC's current percentile.

4.28 It is important to note that there are limitations to this model, specifically because it assumes that:

- no investment is undertaken when the regulated WACC is below the true WACC. This increases the WACC percentile that should be targeted relative to a situation where some investment still takes place, and, in reality, networks would probably continue to make some investments;
- a relatively high proportion of the asset base, at 7–10%, can be replaced in a single year, which reduces the WACC percentile that it targets relative to a situation where a more realistic assumption about asset replacement is made.

4.29 Therefore, the precise point estimates implied by the paper do not read across directly to the New Zealand context. Rather, this academic evidence provides intuitive and empirical support, calibrated to the Dutch market, to underpin the approach taken in New Zealand of aiming up in the WACC range.

4.30 Overall, while we agree with CEPA that there is less regulatory precedent for aiming up than there has been in the past, there are still a number of regulators that do aim up, and academic research continues to suggest that a WACC uplift is appropriate.

### 4.2.2 CEPA's reference to the AER's conclusions regarding aiming up on the WACC

4.31 While CEPA has concluded that regulators in general are increasingly aiming straight, it appears to have given specific weight to the AER, as it is the only regulator mentioned in its conclusion. CEPA has stated that:[85]

> the AER reviewed selecting a WACC estimate away from the midpoint and observed that any adjustment would be arbitrary and could lead to less efficient outcomes than the midpoint.

[83] This can be seen by looking at the optimal WACC percentiles for the rows where the standard deviation is between 0.5% and 1.5% and persistence is either 0 or 0.5.
[84] Commerce Comission (2016), 'Input Methodologies Review Decisions. Topic paper 4: Cost of capital issues', para. 580.
[85] CEPA (2022), op. cit., p. 47.

> They argued that if the estimation of the rate of return was not systematically bias [sic], then the probability of the rate of return being too high or too low is symmetrical. This argument implies that over the long run the true rate or return should not be persistently underestimated, leading to persistent underinvestment.

4.32 This quote appears to suggest that the AER concluded that, as long as the rate of return is not systematically biased, there will not be persistent underinvestment.

4.33 We have not been able to identify the reference to persistent underinvestment in the AER's 2018 Rate of Return Explanatory Statement.[86] However we have found that the AER concluded that:[87]

- it is just as likely for a regulator to over- as to underestimate the true WACC;
- it is not possible to identify the appropriate adjustment to the WACC to take into account the relative costs of estimating a WACC that is either above or below the true WACC;
- adding further adjustments to the WACC is likely to introduce further costs.

4.34 We agree with the first bullet, because the 50th percentile of the WACC gives an unbiased estimate of the true WACC. However, we disagree with the second and third bullets.

4.35 We disagree with the third bullet because it ignores the fact that there is an asymmetric distribution of the effects of the regulated WACC being below the true WACC. As we explained in our 2014 report, the existence of this asymmetric distribution is well documented in a 2011 paper by Professor Ian Dobbs.[88] Since our 2014 report, the above paper by Professors Romeijnders and Mulder on the optimal WACC percentile to target in tariff-setting has used a similar framework.[89] It is precisely the existence of this asymmetric distribution that explains why the costs of aiming up on the WACC are less than the costs of aiming straight.

4.36 We disagree with the second bullet because it ignores the framework that the NZCC has built and used for the purpose of identifying a non-arbitrary adjustment. This framework weighs up the costs of targeting a WACC above the 50th percentile with the benefits of doing so. While the use of this framework requires assumptions to be made about the costs of network reliability, and a degree of judgement, this is also true of other

[86] AER (2018), 'Rate of Return Instrument: Explanatory Statement', Chapter 13, https://www.aer.gov.au/system/files/Rate%20of%20Return%20Instrument%20-%20Explanatory%20Statement.pdf (accessed on 24 January 2023).
[87] Ibid., p. 407.
[88] Dobbs, I. (2011), 'Modelling welfare loss asymmetries arising from uncertainty in the regulatory cost of finance', *Journal of Regulatory Economics*, **39**, pp. 1–28.
[89] Romeijnders, W. and Mulder, M. (2022), op. cit., pp. 89–107.

parameters in regulatory WACC determination.[90] As we explain in section 4.1, CEPA's calibration of this framework suggests that the 80th percentile should be targeted, which demonstrates how the framework can be used to generate a non-arbitrary adjustment.

4.37 Despite the fact that, as mentioned above, we have not found references in the AER's paper to the specific point of persistent underinvestment, we consider it helpful to explain why setting the regulated WACC below the true WACC would in general be expected to lead to persistent underinvestment.

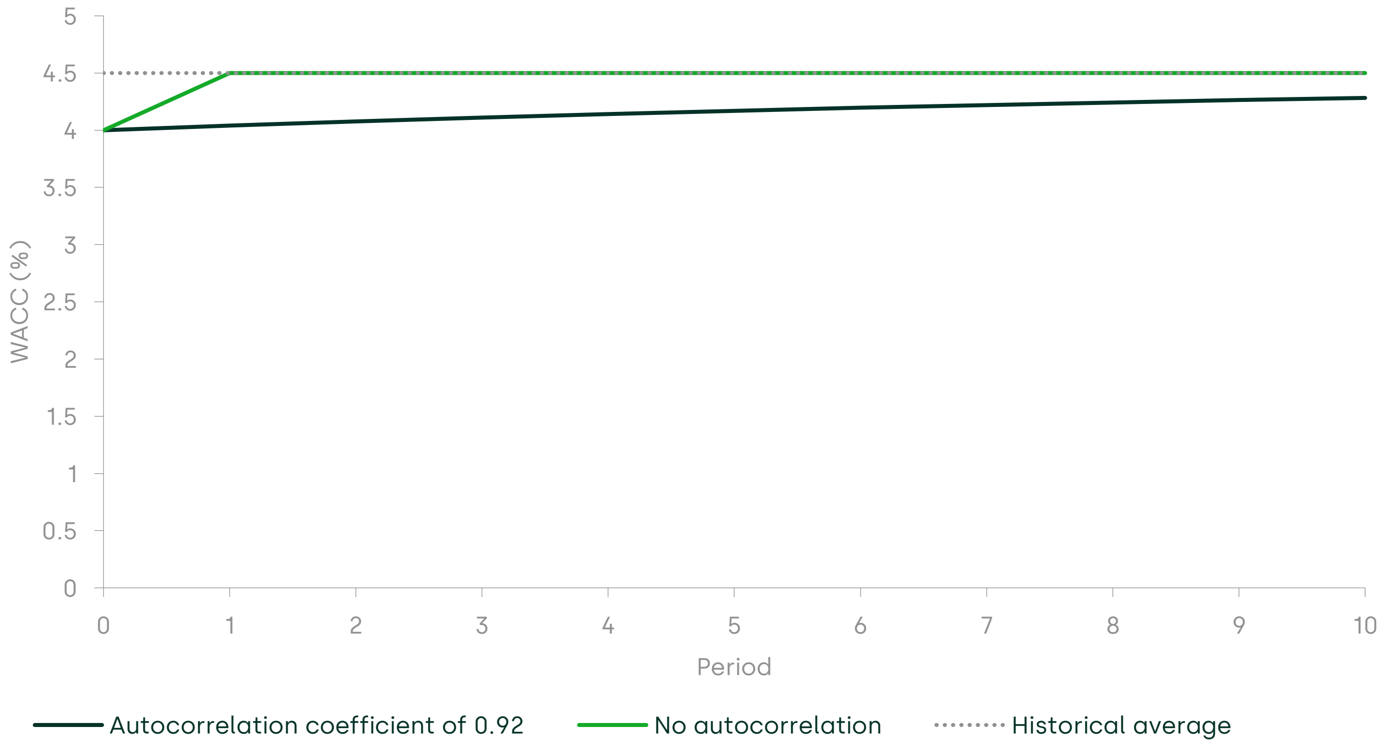
4.38 First, even if underinvestment lasts for only a short time, (construction) capacity constraints at the level of the transmission and distribution operators, or their suppliers, could mean that the underinvestment cannot be easily fixed.

4.39 Second, the true WACC is likely to exhibit 'stickiness' or autocorrelation, as explained in the paper by Romeijnders and Mulder (2022).[91] Autocorrelation refers to a mathematical relationship where the value of a particular variable (in this case the WACC) is likely to be more similar to its value in recent periods than its value in periods further back in the past: it is therefore a formal way of testing for 'stickiness'. If this is the case then, if the WACC is mis-estimated at the start of a regulatory period, it is more likely to remain mis-estimated throughout the regulatory period because the true WACC is unlikely to change significantly during this time.

4.40 We illustrate this graphically in Figure 4.3. The true WACC shown in the figure is based on the autocorrelation process in the Romeijnders and Mulder paper, where the WACC is assumed to follow an AR(1) process over time.[92] In this figure, the dark green line shows how the WACC would develop when it exhibits autocorrelation, and the light green line shows how the WACC would develop when it does not. The dark green line takes longer for the WACC to return to its 'average', which can be interpreted as the estimate that the regulator makes if it aims straight, and therefore shows that, when the true WACC exhibits autocorrelation, it is possible for the regulated WACC to remain above the true WACC for multiple periods.

[90] We also understand that the network reliability framework has not been subject to a merits review in New Zealand.
[91] Romeijnders, W. and Mulder M. (2022), op. cit., pp. 89–107.
[92] The precise formula that the WACC follows in the paper is $w_t^c = \mu_{wacc} + \rho(w_{t-1}^c - \mu_{wacc}) + \varepsilon_t$, where $w_t^c$ is the WACC in time t, $\mu_{wacc}$ is the long-term average of the WACC, and $\varepsilon_t$ is an idiosyncratic shock factor. This formula illustrates a process whereby the WACC in period t is a function of: (i) its long-term average, which can be interpreted as the estimate that the regulator makes of the WACC if it aims straight; (ii) its value in the previous period—with the previous period value playing a more important role the higher is the autocorrelation coefficient (iii) an idiosyncratic shock, which could be interpreted as any transitory change to the WACC.

Figure 4.3 Time taken for the true WACC to return to the historical average with and without autocorrelation




Source: Oxera, based on Romeijnders, W. and Mulder, M. (2022), 'Optimal WACC in tariff regulation under uncertainty', *Journal of Regulatory Economics*, **61**, pp. 89–107.

4.41 Third, the risks of persistent underinvestment are greater in New Zealand than in Australia because the NZCC does not index any of the WACC parameters, while the AER indexes the allowed cost of debt.[93] This means that the calculation of the regulated WACC will be adjusted more often in Australia than in New Zealand, reducing the probability that the true WACC would rise above the regulated WACC during this period.

### 4.2.3 Evidence on the impact of network failures

4.42 The assumed cost of network failures is an important determinant of the WACC percentile that should be targeted. This is because higher costs imply that any underinvestment will have more adverse effects on consumers, and therefore provide a rationale to aim up for a higher percentile of the WACC than if the costs of network failure were lower.

4.43 In our 2014 report, we calculated the impact of network failures by dividing the total costs of network outages by the GDP of the relevant country in a number of studies. This gave us the impact of network outages as a proportion of a country's GDP, which we then applied to the GDP of New Zealand to produce

[93] AER (2022), 'Draft Rate of Return Instrument Explanatory Statement', June, p. 20, https://www.aer.gov.au/system/files/Draft%202022%20Rate%20of%20Return%20Instrument%20-%20Explanatory%20Statement%20-%2016%20June%202022.pdf (accessed on 24 January 2023).

an approximate impact of network outages on the New Zealand economy.[94]

4.44 CEPA has updated our analysis by adjusting it for changes in New Zealand's GDP growth rate and the VoLL since 2014. It initially conducted this analysis in 2013 price terms and then inflated it to 2022 prices.[95]

4.45 We have also assessed the two main concerns that CEPA has raised about our approach. CEPA's two concerns are:[96]

1. that we have used the costs of one-off events to estimate the impacts of underinvestment on the New Zealand economy;
2. that we have assumed that the probability of network failures in a world of perfect investment is zero.

4.46 If either of these assumptions were correct then our (and, by extension, CEPA's) estimate of the costs of underinvestment could be inflated. This could suggest that a lower percentile should be targeted (relative to the 80th suggested by CEPA's analysis).

4.47 While it is true that our 2014 study reports the impacts of one-off events,[97] the main damages estimates that we use (of NZ$1bn) are equal to the average of the impacts that we reported for the ASCE study.[98] The ASCE study models the expected annualised impacts of underinvestment on the US economy. It also explains that their modelling allows for network failures to still exist if the investment gap is closed. Specifically, the ASCE says that:[99]

> Even if sufficient investment is made to close the investment gap, the result will not be a perfect network for electricity generation and delivery, but rather one that has dramatically reduced, though not eliminated, power quality and availability interruptions

4.48 We therefore understand that this study covers only the impacts of *incremental network failures* that arise as a result of underinvestment, which is aligned with what we were aiming to assess in our 2014 report.

4.49 Furthermore, it is not necessarily the case that the impacts of one-off events are lower than the annualised effects of underinvestment: they could be higher or lower. It is reasonable

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[94] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', Table 5.1.
[95] CEPA (2022), op. cit., p. 41.
[96] Ibid., p. 39.
[97] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', Table 5.1.
[98] Ibid., first two rows of Table 5.1.
[99] ASCE (2011), 'Failure to Act: The Economic Impact of Current Investment Trends in Electricity Infrastructure', *American Society of Civil Engineers*, January, https://ascelibrary.org/doi/epdf/10.1061/9780784478783 (accessed on 24 January 2023).

to expect that the impacts of network failure on an economy are the same regardless of what causes them, and therefore these studies still provide useful context as to what the possible impacts of network failure events could be on an economy.

4.50 We have updated our summary of the impacts of network failure and present the results of this in Table 4.4 below. While none of the studies in Table 4.4 provides a perfect comparator for New Zealand and the full range of impacts is very wide—between NZ$0.5bn and NZ$21bn—it does suggest that the potential impacts of underinvestment could be even larger than was suggested by CEPA.

Table 4.4 Summary of studies into the economic cost of power outages

| Study | Country | Event period (year) | Cost of outage (US$bn) | GDP in year of study (US$bn)[1] | Cost (percentage of GDP) | NZ GDP in 2021 (NZ$bn) | Implied cost of outages in New Zealand (NZ$bn)[2] |
|---|---|---|---|---|---|---|---|
| Annual studies (i.e. studies of equivalent annualised effect) | | | | | | | |
| ASCE (2011) | USA | 2012–20 | 55 | 18,869 | 0.29 | 355 | 1.0 |
| ASCE (2011) | USA | 2020–40[3] | 97 | 25,648 | 0.38 | 355 | 1.3 |
| LaCommare et al. (2004) | USA | 2004 | 79 | 12,300 | 0.6 | 355 | 2.1 |
| Nexant (2003) | Nepal | 2001 | 0.025 | 6.3 | 0.4 | 355 | 1.4 |
| EPRI (2001) | USA | 2001 | 119–188 | 10,600 | 1.1–1.8 | 355 | 3.9–6.4 |
| Swaminathan and Sen (1997) | USA | 1998 | 39 | 9,100 | 0.4 | 355 | 1.4 |
| Targosz and Manson (2007) | EU-25 | 2003–04 | 180 | 16,546 | 1.1 | 355 | 3.9 |
| Zachariadis and Poullikas (2012) | Cyprus | 2011 | 1.52 | 24.98 | 6.1 | 355 | 21.655 |
| EBP (2020) | USA | 2020–29[3] | 63.7 | 24,525 | 0.26 | 355 | 0.92 |
| Annual, weather-related only | | | | | | | |
| Campbell (2012) | USA | 2012 | 25–55 | 16,200 | 0.15–0.4 | 355 | 0.5–1.4 |
| Council of Economic Advisors et al. (2013) | USA | 2003–12 | 18–33 | 14,116 | 0.13–0.23 | 355 | 0.46–0.82 |
| Specific event | | | | | | | |
| Reichl et al. (2013) | Austria | 2013 | 2.3 | 417.6 | 0.6 | 355 | 2.1 |

Note: [1] GDP is reported in current prices. For studies spanning several years, the average value of the GDP has been taken. Forward GDP figures have been estimated assuming a constant growth of 2% per year. [2] Based on the same proportion of GDP as in the country of occurrence. [3] These studies present simulations of outages in the future. Source: Oxera analysis, based on various academic studies: ASCE (2011), 'Failure to act: The economic impact of current investment trends in electricity infrastructure', *American Society of Civil Engineers*; January; LaCommare, K. and Eto, J. (2004), 'Understanding the cost of power interruptions to U.S. electricity consumers', *Lawrence Berkeley National Lab*, September, https://eta-publications.lbl.gov/sites/default/files/lbnl-55718.pdf (accessed on 24 January 2023); Nexant (2003), 'Economic impact of poor power quality on Industry, *USAID-SARI/Energy Program*, Nepal', October, https://synergyforenergy.files.wordpress.com/2011/06/economicimpact_poorpowerquality_nepal_complete.pdf (accessed on 24 January 2023); EPRI (2001), 'The Cost of Power Disturbances to Industrial & digital economy companies', https://www.epri.com/research/products/3002000476 (accessed on 24 January 2023);

Swaminathan, S. and Sen, R.K. (1997), 'Review of power quality applications of energy storage systems', *Sandia National Lab*, May, https://www.osti.gov/biblio/661550 (accessed on 24 January 2023); Targosz, R. and Manson, J. (2007), 'Pan-European lpqi power quality survey', *19th International Conference on Electricity Distribution*, May, https://www.academia.edu/73221926/Pan_European_Lpqi_Power_Quality_Survey (accessed on 24 January 2023); Zachariadis, T. and Poullikas, A. (2012), 'The cost of power outages: A case study from Cyprus', *Energy Policy*, **51**, December, https://www.researchgate.net/publication/257126288_The_costs_of_power_outages_A_case_study_from_Cyprus (accessed on 24 January 2023); EBP (2020), 'Failure to act: Electric infrastructure investment gaps in a rapidly changing environment', https://www.ebp-us.com/en/projects/failure-act-electric-infrastructure-investment-gaps-rapidly-changing-environment-2020 (accessed on 24 January 2023); Campbell, R.J. (2012), 'Weather-related power outages and electric system resiliency', *Washington, DC: Congressional Research Service, Library of Congress*, August, https://sgp.fas.org/crs/misc/R42696.pdf (accessed on 24 January 2023); Executive Office of the President (2013), 'Economic Benefits of Increasing Electric Grid Resilience to Weather Outages', *Council of Economic Advisors et al.*, August, https://www.energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf (accessed on 24 January 2023); Reichl, J., Schmidthaler, M. and Friedrich, S. (2013), 'Power Outage Cost Evaluation: Reasoning, Methods and an Application', *Journal of Scientific Research & Reports*, **2**:1, April, https://www.researchgate.net/publication/259840992_Power_Outage_Cost_Evaluation_Reasoning_Methods_and_an_Application (accessed on 24 January 2023); Data from World Bank and Statistics New Zealand (2021), 'Regional Gross Domestic Product', March, available here. Oxera (2014), 'Review of the 75th percentile approach', https://www.oxera.com/wp-content/uploads/2018/07/Oxera-review-of-the-75th-percentile-approach.PDF.pdf (accessed on 25 January 2023).

4.51 Despite the possibility of high impacts, we consider that the most reliable estimate of damages is given by the ASCE paper from 2011 and, therefore, by extension, the updates that have been based on this paper, including CEPA's update of NZ$1.9bn discussed above.

4.52 We note that the ASCE published an update to its 2011 paper in 2020. The implied damages from this paper are also included in Table 4.4 above, but these cover only the lost output from businesses. This may therefore be an understatement of the full losses (due to, for example, excluding the impacts on households), and we therefore consider the estimates of NZ$1bn—NZ$1.9bn from the ASCE 2011 paper to be more reliable.

4.53 If the lower end of this range, at NZ$1bn, were taken, the results would be very similar to those that we produced in our 2014 report, where we concluded that the 67th percentile was appropriate. This is because most of the analysis that we conducted in our 2014 report was based on the NZ$1bn assumption for the impacts of underinvestment.

4.54 However, these estimates may understate the true impact of network failure because, if it is not easy or quick to rectify the underinvestment, the effective annualised costs of underinvestment will be greater. This is because it could take several years to rectify the underinvestment, meaning that one year of underinvestment could result in more than one year of the effects of underinvestment.[100] In this context it is important

[100] This can be most easily seen through the following example. Consider an underinvestment problem that results in economic costs of NZ$1bn per annum from year

to note that the NZCC does not consider that it is easy to observe and rectify underinvestment in energy networks,[101] which implies that the annual costs of underinvestment in New Zealand could exceed NZ$1bn–NZ$1.9bn.

4.55 In short, we consider that the updates made by CEPA are reasonable, but consider that these may be underestimates rather than overestimates.

4.56 As mentioned earlier, the evidence base in Table 4.4 above is drawn from studies looking into the impact of reliability on the electricity sector. While we are not aware of studies into the impact of underinvestment in gas networks on reliability,[102] we note that a study has been undertaken in New Zealand that shows that industries that consume 93% of natural gas account for 57% of the value added to the economy.[103] While the authors of the report explain that their findings should not be interpreted as describing the economic value that is attributable exclusively to natural gas,[104] the report does provide evidence that in New Zealand, gas-intensive industries generate significant economic value.

4.2.4 Use of other investment incentive mechanisms

4.57 CEPA explains in its reports that regulators are increasingly aiming straight rather than up on the regulatory allowed WACC, and that part of the reason for this has been the inclusion of 'appropriate incentive and performance-based conditions'.[105] We assume that here CEPA may be referring to, for example, the use of incentive schemes that reward regulated companies if they outperform selected reliability metric(s).

4.58 While we agree that aiming up on the WACC is not the only way in which the NZCC could prevent underinvestment, we consider

t. Suppose that, at year t+2, the regulator identifies the problem and implements a policy (such as an increase of the WACC percentile) that aims to rectify it. However, suppose that this policy takes two years to take effect, for example because there is a two-year lag while the regulated companies receive the higher regulated return, make an investment plan, tender for the new investments, and finally construct those new investments such that the NZ$1bn impact is reversed. In this example, the effective annual costs of the underinvestment are NZ$2bn because the regulator reverses the policy that caused underinvestment in period t+2, but it is only in period t+4 that the effects of the underinvestment are fully reversed.

[101] Commerce Commission (2020), 'Fibre Input Methodologies: Main final decisions – reasons paper', para. 6.798, https://comcom.govt.nz/__data/assets/pdf_file/0022/226507/Fibre-Input-Methodologies-Main-final-decisions-reasons-paper-13-October-2020.pdf (accessed on 24 January 2023).

[102] We have, however, been able to perform an analysis that estimates what the annual impact of underinvestment in gas networks (across both transmission and distribution) would need to be in order for the 67th percentile to be optimal. We find that this would be the case if the annual impact of underinvestment in gas networks were NZ$77m.

[103] NZIER (2012), 'Value added associated with gas demand', https://www.gasindustry.co.nz/assets/DMSDocumentsOld/commissioned-reports/27357.-2012-october-nzier-value-added-associated-with-gas-demand-final.pdf (accessed on 26 January 2023).

[104] This is because the estimates do not cover the willingness to pay for preventing outages, and nor do they take into account the ability of firms to substitute for alternative sources of energy.

[105] CEPA (2022), op. cit., p. 27.

that there are two reasons why changing to an alternative incentive and performance-based mechanism may be inappropriate.

4.59 First, a change in the regulatory mechanism used to prevent underinvestment could create regulatory instability. Therefore, unless the alternative mechanism were materially more effective at preventing underinvestment, it would be unlikely to be net beneficial.

4.60 Stable regulatory regimes provide benefits to consumers because they reduce the regulatory risk that investors need to be compensated for. If regulation becomes more unstable and investors are not compensated for this, there is a risk that they will not invest further and/or divest. This leads to higher required returns for debt and equity holders in regulated networks, and consequently higher consumer prices. Regime stability was an important consideration in our 2014 advice to the NZCC, where we explained that 'any premium should be applied to all RAB assets and applied consistently, as the expected whole-life return on assets should be the relevant test for investors'.[106] This highlighted the regulatory risk of the NZCC choosing a particular WACC percentile at the time, only to change it in future periods.

4.61 Research in the context of the European renewable energy sector showed that retroactive policy changes decrease the investment activity of firms, by 45% for solar PV and 16% for onshore wind, which indicates a lasting impact of policy uncertainty.[107] While these impacts cannot be directly read across to regulated networks, where there is an expectation that elements of the regulatory regime will be tweaked from one regulatory period to the next, it does demonstrate what could happen if a fundamental part of a regulatory regime were removed in its entirety, and without compensation.

4.62 Second, if an alternative mechanism were ever introduced, it is likely that it would be more appropriate to introduce it on at least a net present value (NPV)-neutral basis. This is particularly important because the current regulatory regime in New Zealand appears to remunerate GPBs in line with their required return. This is evident by the NZCC noting in its 'Input Methodologies Review' of 2023 that:[108]

> The rates of return for GDBs and the GTB [gas transmission businesses] were generally in line with our estimates of their reasonable rate of return adjusted for ex post inflation,

[106] Oxera (2014), 'Input Methodologies: Review of the '75th percentile' approach', p. 6.
[107] Sendstad, L.H., Hagspiel, V., Mikkelsen, W.J., Ravndal, R. and Tveitstøl, M. (2022), 'The impact of subsidy retraction on European renewable energy investments', *Energy Policy*, **160**, 112675.
[108] Commerce Commission (2022), 'Part 4 Input Methodologies Review 2023 – Process and Issues paper', May, p. 61.

suggesting that they have generally not made excessive profits over the last seven years.

4.63 In addition, the electricity distribution businesses (EDBs) appear to have underperformed relative to return expectations.[109]

4.64 Therefore, any NPV-negative changes would probably lead to the expected returns of networks falling below their WACC, which would create a potential underinvestment problem and, in extreme cases, divestment.

### 4.2.5 The impact of decarbonisation on natural gas transmission and distribution

4.65 The activities of gas networks are changing substantially due to the energy transition. In some areas, gas networks are expected to slowly decommission assets, in some they are expected to maintain them, and in others they are expected to commission the new infrastructure needed to deliver renewable gases to end-consumers. In the context of this broad role that gas networks have, we have identified three reasons why decarbonisation could provide further reasons for aiming up on the WACC:

- to compensate gas networks for any residual risk that their assets will become stranded (i.e. if any risk is left after an asset beta uplift and accelerated depreciation);
- to enable investment in renewable gas infrastructure;
- to ensure an orderly energy transition.

4.66 We explain each of these in turn.

4.67 As we explain in section 3, decarbonisation can lead to natural gas assets becoming stranded—i.e. partially or wholly under-utilised and financially under-compensated. One of the approaches taken by regulators to mitigate this risk has been to uplift the allowed returns that are given to gas networks in order to compensate them for the additional risk of stranded assets. In section 3, we mention how the French energy regulator, CRE, uplifted the asset beta for gas networks in order to reflect these additional risks.[110]

4.68 In addition, regulators use accelerated depreciation. With this regulatory tool, networks recover their investment in the asset base faster, reducing the probability of the assets becoming economically stranded. As a result, as explained in section 3.2, the risk is reduced, but not eliminated.

4.69 With some assets to be maintained, some built and some decommissioned in light of the energy transition, there are higher chances of introducing inefficiencies into the system relative to times of business-as-usual operation. This is because gas networks could build more than required or decommission

[109] We have not commented on Transpower's profitability because the NZCC also did not comment on it. Commerce Commission (2022), 'Part 4 Input Methodologies Review 2023 – Process and Issues paper', May, pp. 50–52.
[110] See para. 3.16.

assets either too early or too late. With the probability of under-utilisation and subsequent financial losses being potentially higher than over-utilisation and subsequent financial gains, there is likely to be an asymmetry of financial outcomes.

4.70 A general uplift to the WACC, for example through aiming up, would be appropriate if the extent of asset stranding risk cannot be or has not been fully remunerated in other elements of the WACC calculation such as asset beta, or with other regulatory tools such as accelerated depreciation. For example, the Austrian regulator for gas TSOs (E-Control) includes a risk premium in the cost of equity allowance in the 2021–24 price control. The premium is composed of two parts: a sector-wide uplift of 3.5% to the cost of equity allowance, and an individual risk premium for estimated capacity risk of specific regulated networks.[111] The additional income from these two risk premia must be entirely ring-fenced, and therefore cannot be distributed to shareholders and has to be retained by the network companies as reserve to compensate for losses if risk materialises.[112]

4.71 As New Zealand decarbonises its economy, there is likely to be a greater need for it to construct infrastructure for renewable gases. While New Zealand is still in the early stages of developing its Gas Transition plan, with publication expected in late 2023, we understand that a major part of it will focus on the role that renewable gases such as green hydrogen, biomethane and renewable LPG will have in the future.[113] Further details on the role of natural gas in New Zealand's energy transition can be found in Box 4.1 below.

**Box 4.1 The role of gas in New Zealand's energy transition**

As part of the Emissions Reduction Plan, the government of New Zealand is currently developing an overall Energy Strategy, a key input of which will be the Gas Transmission Plan for the natural gas sector. The Gas Transmission Plan outlines actions to be taken up to 2035 to reduce emissions in the natural gas sector, with the goal of a net zero carbon economy by 2050. This includes steps to decarbonise and reduce reliance on natural gas, while some natural gas is expected to remain in use in 2035.

[111] E-Control (2020), 'Methodology pursuant to section 82 Gaswirtschaftsgesetz (Gas Act, GWG) 2011 for the fourth period for transmission systems of Austrian Gas Transmission System Operators (TSOs)', sections II.3 and III.2, https://www.e-control.at/documents/1785851/1811582/E-Control_Cost_Methodology_2021_2024_EN.pdf/81ad7664-3c27-9360-5283-81a39e3a815e?t=1596794285387 (accessed on 24 January 2023).
[112] Ibid., sections II.3 and III.2.
[113] MBIE (2022), 'Terms of Reference – Gas Transition Plan', https://www.mbie.govt.nz/dmsdocument/20265-terms-of-reference-gas-transition-plan (accessed on 24 January 2023).

New Zealand's Gas Transmission Plan has two pillars: the first pillar involves transition pathways for the natural gas sector with a particular focus on the period up to 2035, the identification of additional required measures and actions, and the development of milestones for progress assessment. The second pillar focuses on the development of a cohesive view on renewable gases, focusing on how these can be used to reduce emissions and lower transition costs for customers that currently use natural gas.

Source: New Zealand Ministry of Business, Innovation and Employment (2022), 'Gas Transition Plan', https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/gas-transition-plan/ (accessed on 24 January 2023). The finalised Gas Transition Plan is expected to be published by the end of 2023, with the overall Energy Strategy expected by the end of 2024.

4.72 Ensuring that the efficient investment costs of gas networks are recovered is likely to help with an orderly energy transition. Gas consumers in New Zealand are likely to want to maintain reliable access to the gas network, which will require additional reliability investment (e.g. in the form of maintenance) from gas networks. This will occur precisely at a time when investor appetite for additional investment could be falling, due to the risks of asset stranding. While the precise details of New Zealand's energy transition are yet to be developed, and will evolve over time, it is possible that many of the existing stakeholders in gas (and electricity) infrastructure will remain the same. This could be in the form of gas networks being repurposed for renewable gas or equity and debt investors in gas networks being the same investors that would fund investment in new infrastructure.

4.73 The greater the role that renewable gases have in New Zealand's energy transition, the more important it will be to ensure that new transmission and distribution infrastructure is constructed on a timely basis. This is less likely to happen if the WACC of the (renewable) gas network operator is above the regulated WACC. Due to the high social costs of delaying the energy transition, this risk is likely to increase the asymmetry of the loss function relative to the NZCC's current approach, where the asymmetry arises exclusively from the network reliability framework. This increased asymmetry will provide greater reason to aim for a higher percentile.

## 4.3 WACC percentile conclusions

4.74 We consider that the evidence for aiming up on the WACC remains strong. While it is true that a few regulatory precedents are focused on aiming straight than aiming up, a number of regulators do still aim up, and recent academic research by Romeijnders and Mulder supports this. Furthermore, none of the regulators that now aim straight formally use the same framework as the NZCC to assess the appropriate WACC percentile. The decisions adopted by these regulators may therefore not have direct read-across to the NZCC context.

4.75 The evidence from the NZCC's network reliability framework suggests that, based on CEPA's update of our 2014 analysis, the optimal percentile for the NZCC to aim for would be the 80th. We disagree with CEPA that the benefits of aiming up could be overstated within this framework, and find that there are a number of reasons to consider that the optimal percentile could be even higher. These reasons are that:

- other evidence on the costs of network failures could suggest higher costs than those assumed by CEPA;
- the annual costs of network failures that CEPA has updated could be difficult to reverse;
- if other elements of regulation do not compensate gas networks for the additional risks associated with stranded assets in full, a WACC uplift or aiming up in the range could be applied to compensate for this;
- if the NZCC's network reliability framework is expanded to consider the costs of underinvestment for the energy transition then the loss function considered by the NZCC will become more asymmetric.

4.76 While we agree that performance-based mechanisms can also be used to limit the risks of underinvestment, we do not consider that this would be appropriate in New Zealand. This is because changing the regulatory mechanism could create regulatory risk, thereby increasing the costs of energy to consumers in the medium to long term. Furthermore, there is no clear case for change in New Zealand, especially as the NZCC's own evidence suggests that networks are not being over-remunerated.

4.77 Overall, we find that evidence from the NZCC's network reliability framework supports a percentile above the 67th. We explained in our 2014 paper that there is value in regulatory stability, and therefore consider that an appropriate course of action would be for the NZCC to maintain its previous decision and aim for at least the 67th percentile.

## 5 Other WACC parameters

5.1 In conclusion to our assessment of the asset beta and WACC percentile, we now make a few remarks on other parameters of the NZCC's methodology for the cost of capital allowance.

5.2 Over the last three years, since the start of the COVID-19 pandemic, a number of unusual events have affected capital markets and macroeconomic conditions across the globe. There has been significant volatility in interest rates and therefore the cost of borrowing, in parallel with upward inflationary pressure.

5.3 These events are likely to have influenced the risk premia demanded by investors in various jurisdictions and in various sectors of the economy. Within the capital asset pricing model (CAPM) framework, this could have affected the risk-free rate, the equity risk premium and the beta of regulated utilities. It is also likely to have affected the cost of debt financing for corporates, including regulated utilities.

5.4 Below, we highlight the factors that the NZCC may consider relevant as part of its upcoming IM review in addition to the estimation of the asset beta and the choice of the WACC percentile, especially in light of recent macroeconomic developments.

- **Risk-free rate indexation**: in principle, at times of market uncertainty, a mechanism to account for unexpected changes in specific parameters may be helpful to ensure that companies remain financeable and healthy within price control periods. In the UK, for example, some regulators have adopted an indexation mechanism whereby the risk-free rate is updated on a yearly basis. This method seeks to provide companies with some incentive to outperform while providing protection against market shocks—such that exposure to adverse shocks would be limited to the period between indexation dates. As the benchmark is specified at the beginning of the control period, the adjustment to the allowed returns would be automatic and undertaken with a consistent methodology during the price control period, for transparency. Other mechanisms for managing market uncertainty in interest rates could also be considered by the NZCC, such as reopeners to the cost of capital allowance or allowing headroom above spot rates when setting the allowance ex ante.
- **Risk-free rate convenience premium:** there is a question as to whether it is appropriate to directly read across the current market evidence on government bond yields into the CAPM used in a regulatory context. The academic literature explains that government bonds have special safety, collateral, hedging and liquidity characteristics relative to other securities. The demand for government bonds is also increased by regulatory requirements for banks and other

financial institutions to hold such assets. These features give rise to a convenience premium.[114] The convenience premium pushes the yields on government bonds below the required rate of return for a zero-beta asset. Therefore, in order to be used as a proxy for the risk-free rate, the yields on bonds issued by governments with a high sovereign credit rating would need to be adjusted upwards to remove the impact of the convenience premium. Regulators such as ARERA (Italy) and BNetzA (Germany) specifically uplift the risk-free rate to account for the convenience premium.[115]

- **Financeability test:** holistically, the regulatory control package should allow operators to carry out regulated activities that are efficiently undertaken, with minimal disruption; this is in line with protecting consumer interests in relation to essential services such as energy. This includes seeking to ensure financial resilience of efficient operators in times of uncertain macroeconomic conditions. A financeability test is used to ensure that the allowed returns are set at a level at which operators can comfortably meet their financial expenses and maintain a given credit rating. Financeability tests are especially useful when combined with a number of sensitivities to test the robustness of an operator's financials over the control period.

5.5 The NZCC may wish to consider these topics in the context of the upcoming IMs review alongside other aspects of the cost of capital assessment.

[114] The convenience premium reflects the money-like convenience services offered by government bonds, which have special safety and liquidity characteristics. We explain the concept of the convenience premium in detail in Oxera (2020), 'Are sovereign yields the risk-free rate for the CAPM?', prepared for the Energy Networks Association, 20 May. See also Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), 'The Aggregate Demand for Treasury Debt', *Journal of Political Economy*, **120**:2, April, pp. 233–67.
[115] 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'. Bundesnetzagentur (2021), 'BK4-21-055'.

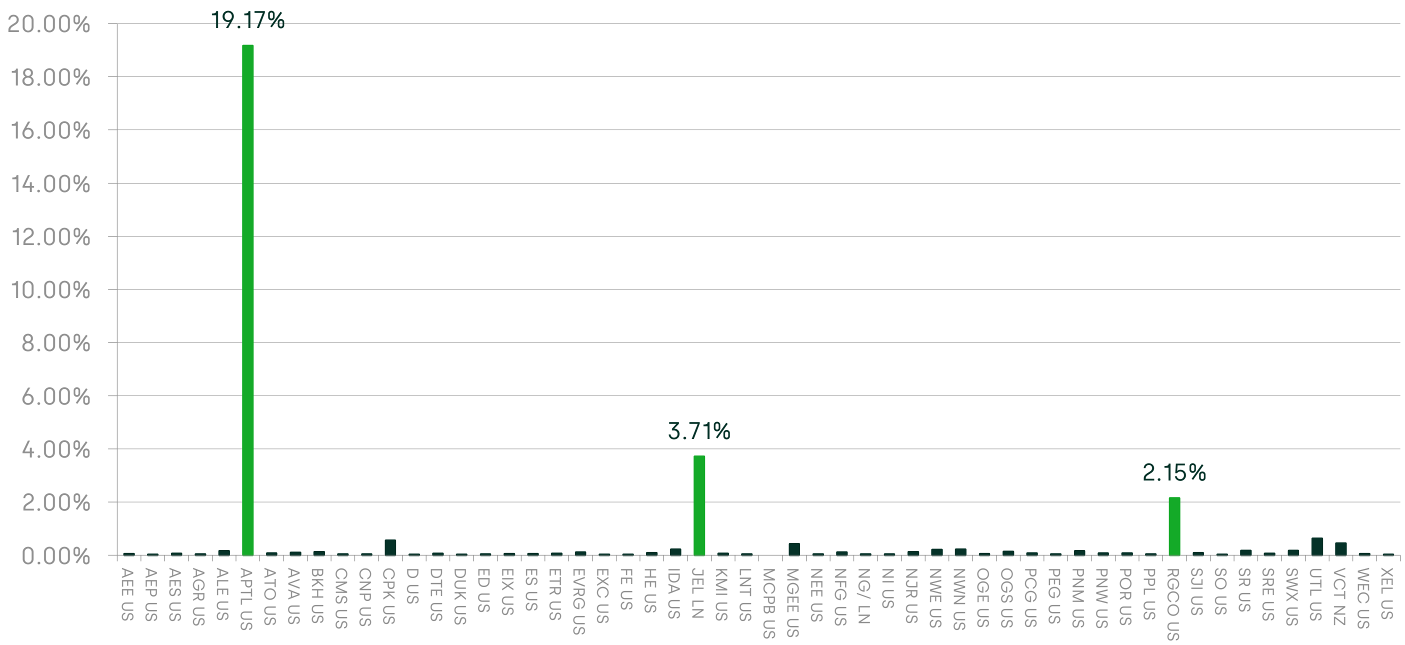
## A1 Oxera liquidity filtering

A1.1 In this appendix, we provide the details of our filtering analysis. We show the results of the following fiters in turn:

- average bid–ask spread;
- average free-float share percentage;
- average share turnover;
- percentage of zero return days;
- equity beta filter.

A1.2 Figure A1.1 shows the **average bid–ask spread** for the initial sample of comparators. The figure shows three clear outliers: Alaska Power and Telephone Co. (19.2%), Jersey Electricity (3.7%) and RGC Resources (2.1%). We exclude these companies from the sample.

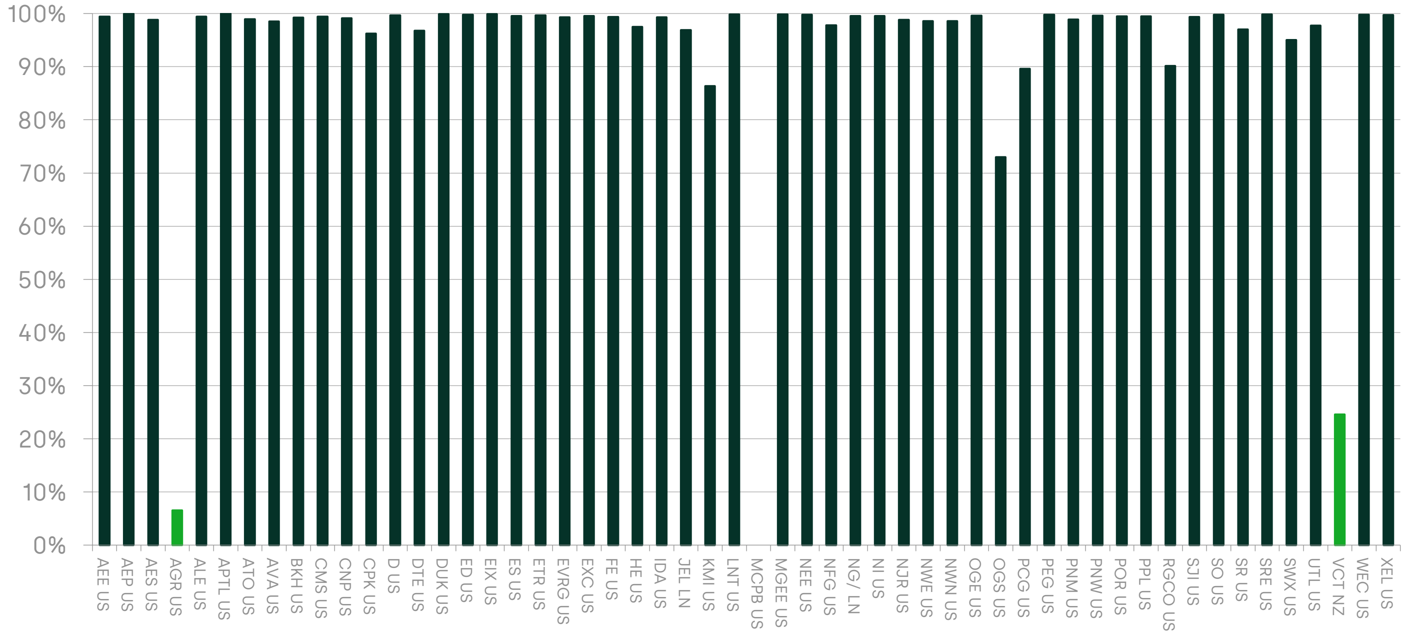
Figure A1.1 Average bid–ask spread (2017–22)




Note: The chart shows the companies included in CEPA's 2022 sample (after removing the three companies that we exclude as a result of the qualitative review of business activities) together with the three companies that NZCC or CEPA excluded from their samples due to the low liquidity (for further information, refer to footnote 35).
Source: Oxera analysis based on data from Bloomberg. The period covered is from 1 October 2017 to 30 September 2022.

A1.3 As for the percentage of free-float shares, without considering Mount Carmel Public Utilities Co., for which no data is available, Avangrid Inc (AGR US) and Vector Limited (VCT NZ) are the comparators showing the lowest values within the sample, at 6.5% and 24.6% respectively (see Figure A1.2).

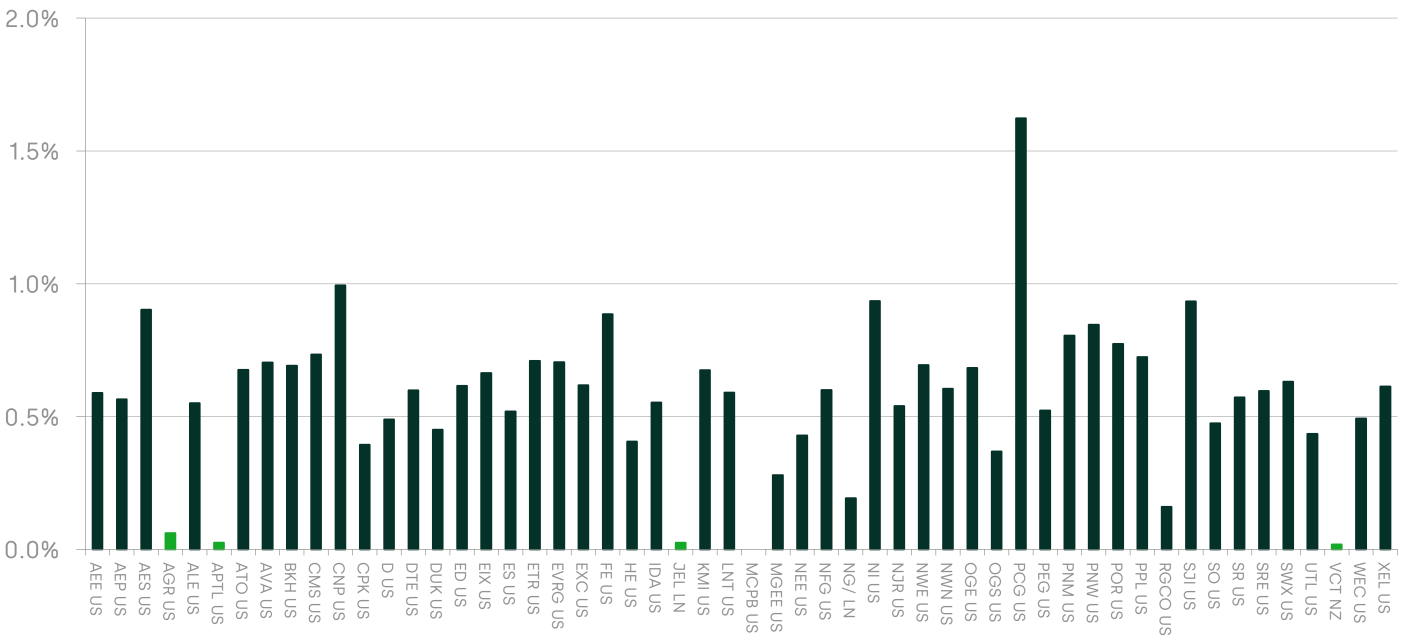
Figure A1.2 Average free-float share percentage (2017–22)




Note: The chart shows the companies included in CEPA's 2022 sample (after removing the three companies that we exclude as a result of the qualitative review of business activities) together with the three companies that NZCC or CEPA excluded from their samples due to the low liquidity (for further information, refer to footnote 35).
Source: Oxera analysis based on data from Bloomberg. The period covered is from 1 October 2017 to 30 September 2022.

A1.4 On the analysis of the average share turnover (Figure A1.3), without considering Mount Carmel Public Utilities Co., for which no data is available, there are four companies showing exceptionally low values of share turnover: Alaska Power and Telephone Co. (0.025%), Vector Limited (0.018%), Jersey Electricity (0.025%), and Avangrid Inc. (0.061%).

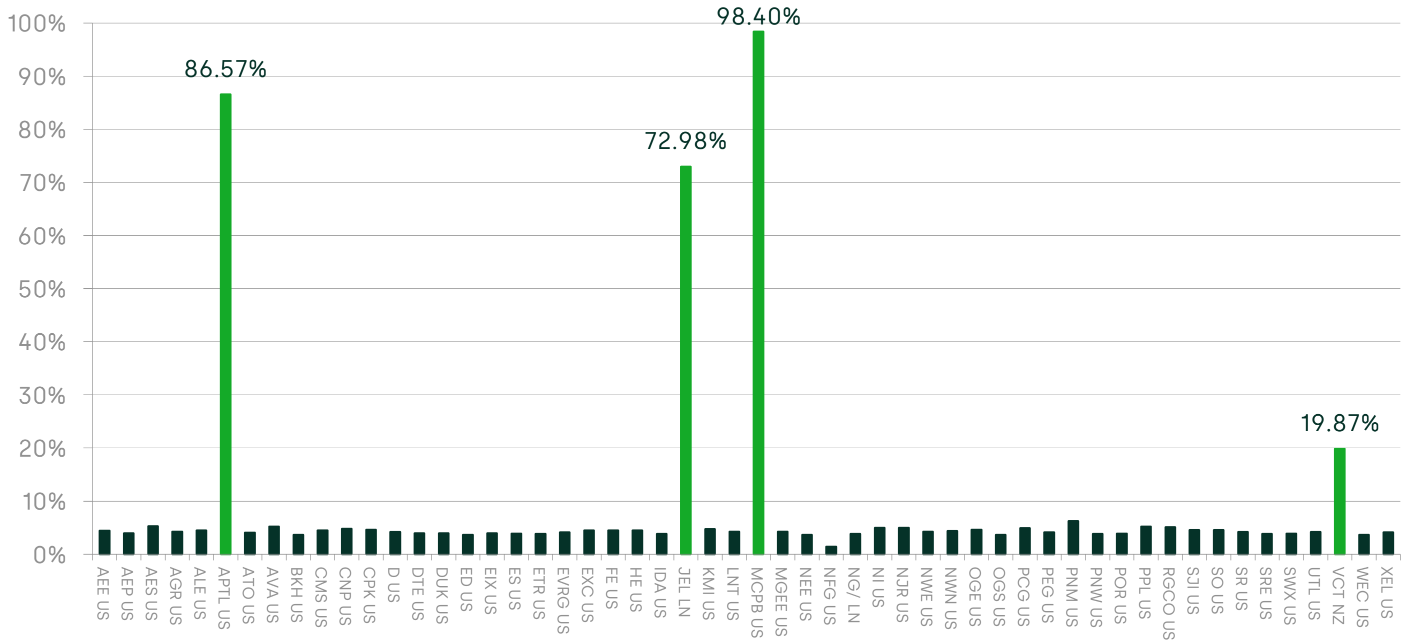
Figure A1.3 Average share turnover (2017–22)



Note: The chart shows the companies included in CEPA's 2022 sample (after removing the three companies that we exclude as a result of the qualitative review of business activities) together with the three companies that NZCC or CEPA excluded from their samples due to the low liquidity (for further information, refer to footnote 35).
Source: Oxera analysis based on data from Bloomberg. The period covered is from 1 October 2017 to 30 September 2022.

A1.5 Figure A1.4 shows the number of trading days with zero return for each comparator. By applying the liquidity filter based on the number of zero return days, three companies would be excluded as outliers: Alaska Power and Telephone Co. (86.6%), Jersey Electricity (73.0%) and Mount Carmel Public Utilities Co. (98.4%). Vector Limited appears to have a percentage of zero return days (19.9%) above the sample average (9.1%).

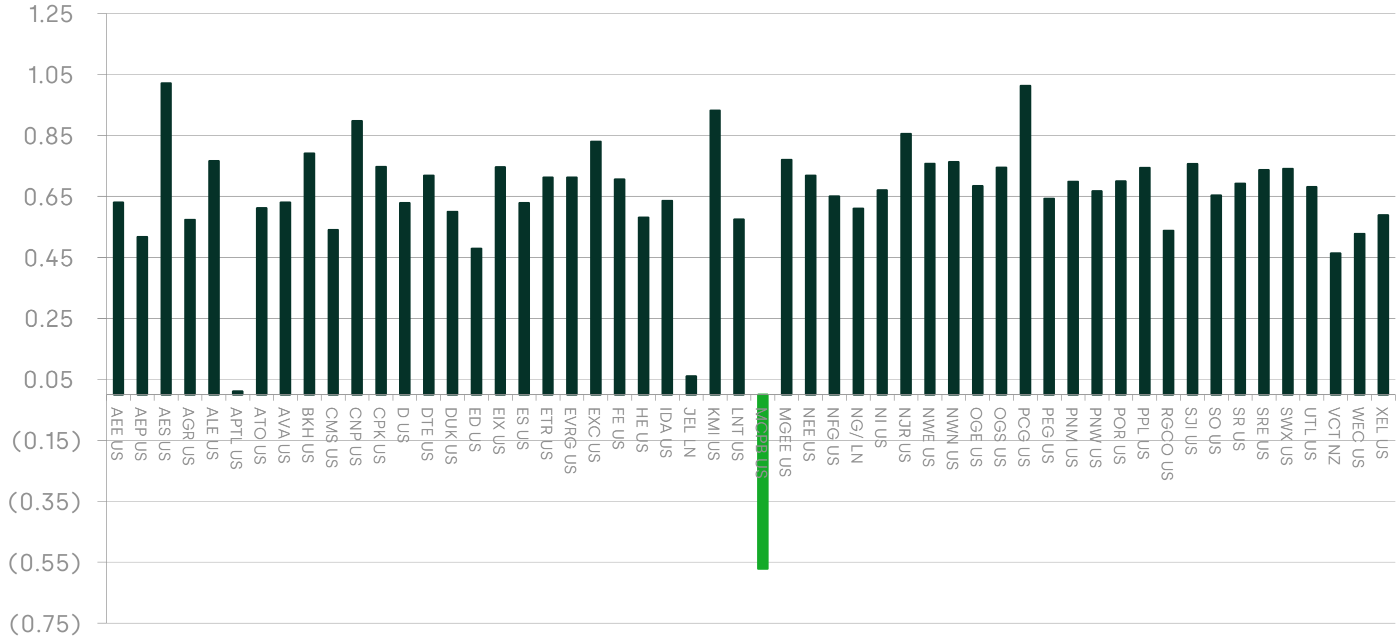
Figure A1.4 Percentage of zero return days (2017–22)




Note: The chart shows the companies included in CEPA's 2022 sample (after removing the three companies that we exclude as a result of the qualitative review of business activities) together with the three companies that NZCC or CEPA excluded from their samples due to the low liquidity (for further information, refer to footnote 35).
Source: Oxera analysis based on data from Bloomberg. The period covered is from 1 October 2017 to 30 September 2022.

A1.6 Figure A1.5 shows the comparators' daily raw equity beta to compare it against the assumed debt beta of zero. In particular, assuming a debt beta equal to zero, the equity beta filter would lead to the exclusion of all companies with negative equity betas, as equity is supposed to be higher risk than debt. Mount Carmel Public Utilities Co. shows a negative equity beta (equal to -0.57), which cannot reflect business risks accurately. It is worth highlighting that Alaska Power and Telephone Co. and Jersey Electricity, assesed to be illiquid based on other filters, show abnormally low daily raw equity betas, at 0.01 and 0.06 respectively. Similarly, RGC Resources shows an abnormally low four-weekly raw equity beta, at 0.02.

Figure A1.5 Daily five-year raw equity beta (2017–22)




Note: Based on a five-year daily regression analysis. The chart shows the companies included in CEPA's 2022 sample (after removing the three companies that we exclude as a result of the qualitative review of business activities) together with the three companies that NZCC or CEPA excluded from their samples due to the low liquidity (for further information refer to footnote 35).
Source: Oxera analysis based on data from Bloomberg. The cut-off date is 30 September 2022 so as to be consistent with the CEPA analysis.

A1.7 As concluded in section 2.2.1, based on the liquidity and equity beta filters, we exclude the following six companies from the sample:

- Jersey Electricity (JEL LN);
- Alaska Power and Telephone Co. (APTL US);
- Mount Carmel Public Utilities Co. (MCPB US);
- RGC Resources (RGCO US);
- Vector Limited (VCT NZ);
- Avangrid Inc (AGR US).

A1.8 Our final sample therefore comprises 48 companies. For further details on Oxera's 2023 sample, please refer to Table A2.1 in Appendix A2.

## A2 Oxera's 2023 sample

A2.9 Table A2.1 shows the comparators contained in Oxera's 2023 sample, together with their geographical area and energy subsample. Our sample contains 48 companies, out of which:

- 27 are integrated energy companies;
- 12 are electricity distribution companies;
- nine are gas distribution companies.

Table A2.1 Oxera's 2023 sample: components, geographical area, energy subsample

| No. | Company name | Ticker code | Energy subsample | Reason for excluding from the Oxera sample |
|---|---|---|---|---|
| 1 | Ameren Corporation | AEE US | Integrated | n.a. |
| 2 | American Electric Power | AEP US | Electricity | n.a. |
| 3 | AES Corp | AES US | Electricity | n.a. |
| 4 | Allete Inc | ALE US | Electricity | n.a. |
| 5 | Atmos Energy Corp | ATO US | Gas | n.a. |
| 6 | Avista Corp | AVA US | Integrated | n.a. |
| 7 | Black Hills Corp | BKH US | Integrated | n.a. |
| 8 | CMS Energy Corp | CMS US | Integrated | n.a. |
| 9 | Centerpoint Energy Inc | CNP US | Integrated | n.a. |
| 10 | Chesapeake Utilities Corp | CPK US | Gas | n.a. |
| 11 | Dominion Energy Inc | D US | Integrated | n.a. |
| 12 | DTE Energy Company | DTE US | Integrated | n.a. |
| 13 | Duke Energy Corp | DUK US | Integrated | n.a. |
| 14 | Consolidated Edison Inc | ED US | Integrated | n.a. |
| 15 | Edison International | EIX US | Electricity | n.a. |
| 16 | Eversource Energy | ES US | Integrated | n.a. |
| 17 | Entergy Corp | ETR US | Electricity | n.a. |
| 18 | Evergy Inc | EVRG US | Electricity | n.a. |
| 19 | Exelon Corp | EXC US | Integrated | n.a. |
| 20 | First Energy Corp | FE US | Integrated | n.a. |
| 21 | Hawaiian Electric Inds | HE US | Electricity | n.a. |
| 22 | Idacorp Inc | IDA US | Electricity | n.a. |
| 23 | Kinder Morgan Inc | KMI US | Gas | n.a. |
| 24 | Alliant Energy Corp | LNT US | Integrated | n.a. |
| 25 | MGE Energy Inc | MGEE US | Integrated | n.a. |
| 26 | Nextera Energy Inc | NEE US | Electricity | n.a. |
| 27 | National Fuel Gas Co | NFG US | Gas | n.a. |
| 28 | National Grid Plc | NG/ LN | Integrated | n.a. |
| 29 | Nisource Inc | NI US | Integrated | n.a. |
| 30 | New Jersey Resources Corp | NJR US | Gas | n.a. |
| 31 | Northwestern Corp | NWE US | Integrated | n.a. |
| 32 | Northwest Natural Holding Co | NWN US | Gas | n.a. |
| 33 | Oge Energy Corp | OGE US | Integrated | n.a. |
| 34 | One Gas Inc | OGS US | Gas | n.a. |
| 35 | P G & E Corp | PCG US | Integrated | n.a. |
| 36 | Public Service Enterprise GP | PEG US | Integrated | n.a. |
| 37 | PNM Resources Inc | PNM US | Electricity | n.a. |

| No. | Company name | Ticker code | Energy subsample | Reason for excluding from the Oxera sample |
|---|---|---|---|---|
| 38 | Pinnacle West Capital | PNW US | Electricity | n.a. |
| 39 | Portland General Electric Co | POR US | Integrated | n.a. |
| 40 | PPL Corp | PPL US | Integrated | n.a. |
| 41 | South Jersey Industries | SJI US | Integrated | n.a. |
| 42 | The Southern Company | SO US | Electricity | n.a. |
| 43 | Spire Inc | SR US | Gas | n.a. |
| 44 | Sempra Energy | SRE US | Integrated | n.a. |
| 45 | Southwest Gas Holdings Inc | SWX US | Gas | n.a. |
| 46 | Until Corp | UTL US | Integrated | n.a. |
| 47 | WEC Energy Group Inc | WEC US | Integrated | n.a. |
| 48 | Xcel Energy Inc | XEL US | Integrated | n.a. |
| Excluded from CEPA sample by Oxera | | | | |
| 49 | ONEOK Inc | OKE US | Gas | Business activities |
| 50 | Centrica Plc | CAN LN | Gas | Business activities |
| 51 | Scottish and Southern Energy plc | SSE LN | Integrated | Business activities |
| 52 | RGC Resources | RGCO US | Gas | Liquidity |
| 53 | Vector Ltd | VCT NZ | Integrated | Liquidity |
| 54 | Avangrid Inc | AGR US | Integrated | Liquidity |

Source: Oxera.

A2.10 Table A2.2 summarises the 2017–22 daily asset betas and leverage estimates of the comparators contained in Oxera's 2023 sample.

Table A2.2 Oxera's 2023 sample: daily asset betas and leverage estimates for 2017–22

| No. | Company name | Ticker code | Daily asset beta | Leverage |
|---|---|---|---|---|
| 1 | Ameren Corporation | AEE US | 0.40 | 37% |
| 2 | American Electric Power | AEP US | 0.30 | 42% |
| 3 | AES Corp | AES US | 0.40 | 61% |
| 4 | Allete Inc | ALE US | 0.53 | 31% |
| 5 | Atmos Energy Corp | ATO US | 0.44 | 28% |
| 6 | Avista Corp | AVA US | 0.36 | 42% |
| 7 | Black Hills Corp | BKH US | 0.41 | 48% |
| 8 | CMS Energy Corp | CMS US | 0.31 | 43% |
| 9 | Centerpoint Energy Inc | CNP US | 0.49 | 46% |
| 10 | Chesapeake Utilities Corp | CPK US | 0.54 | 28% |
| 11 | Dominion Energy Inc | D US | 0.38 | 40% |
| 12 | DTE Energy Company | DTE US | 0.41 | 42% |
| 13 | Duke Energy Corp | DUK US | 0.31 | 48% |
| 14 | Consolidated Edison Inc | ED US | 0.27 | 44% |
| 15 | Edison International | EIX US | 0.39 | 47% |
| 16 | Eversource Energy | ES US | 0.39 | 39% |
| 17 | Entergy Corp | ETR US | 0.34 | 52% |
| 18 | Evergy Inc | EVRG US | 0.42 | 41% |
| 19 | Exelon Corp | EXC US | 0.44 | 47% |
| 20 | First Energy Corp | FE US | 0.34 | 52% |
| 21 | Hawaiian Electric Inds | HE US | 0.56 | 3% |

| No. | Company name | Ticker code | Daily asset beta | Leverage |
|---|---|---|---|---|
| 22 | Idacorp Inc | IDA US | 0.47 | 26% |
| 23 | Kinder Morgan Inc | KMI US | 0.49 | 47% |
| 24 | Alliant Energy Corp | LNT US | 0.37 | 35% |
| 25 | MGE Energy Inc | MGEE US | 0.64 | 16% |
| 26 | Nextera Energy Inc | NEE US | 0.52 | 28% |
| 27 | National Fuel Gas Co | NFG US | 0.43 | 33% |
| 28 | National Grid Plc | NG/ LN | 0.32 | 47% |
| 29 | Nisource Inc | NI US | 0.34 | 49% |
| 30 | New Jersey Resources Corp | NJR US | 0.56 | 34% |
| 31 | Northwestern Corp | NWE US | 0.45 | 41% |
| 32 | Northwest Natural Holding Co | NWN US | 0.47 | 38% |
| 33 | Oge Energy Corp | OGE US | 0.45 | 34% |
| 34 | One Gas Inc | OGS US | 0.49 | 34% |
| 35 | P G & E Corp | PCG US | 0.43 | 57% |
| 36 | Public Service Enterprise GP | PEG US | 0.41 | 36% |
| 37 | PNM Resources Inc | PNM US | 0.37 | 48% |
| 38 | Pinnacle West Capital | PNW US | 0.40 | 41% |
| 39 | Portland General Electric Co | POR US | 0.42 | 40% |
| 40 | PPL Corp | PPL US | 0.42 | 44% |
| 41 | South Jersey Industries | SJI US | 0.38 | 50% |
| 42 | The Southern Company | SO US | 0.36 | 46% |
| 43 | Spire Inc | SR US | 0.38 | 45% |
| 44 | Sempra Energy | SRE US | 0.44 | 40% |
| 45 | Southwest Gas Holdings Inc | SWX US | 0.44 | 41% |
| 46 | Until Corp | UTL US | 0.41 | 40% |
| 47 | WEC Energy Group Inc | WEC US | 0.35 | 33% |
| 48 | Xcel Energy Inc | XEL US | 0.36 | 39% |
| | **Average** | | **0.42** | **40%** |

Note: [1] Assuming a zero debt beta and a notional leverage equal to 40%, re-levered equity betas are calculated using the following formula: $\beta_e = \beta_a$ / (1 - notional leverage). The cut-off date is 30 September 2022.
Source: Oxera's calculations based on the 2016 NZCC Excel model.


Contact

Sahar Shamsi
Partner
+44 (0) 20 7776 6624
sahar.shamsi@oxera.com

oxera.com