International Rate of Return Methods—Recent Developments

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Executive Summary

Energy Networks Australia (ENA) asked us to update a paper on international rate of return methods we wrote for the Australian Energy Regulator (AER) at an earlier stage of the AER's process leading up to the 2022 Rate of Return Instrument. ENA also asked us to review the AER's draft 2022 Rate of Return Instrument and recommend improvements.

This paper describes the methods currently applied in rate of return determinations by regulators in the US, Great Britain, New Zealand, Italy and the Netherlands, and identifies how the method has changed since our 2020 paper for the AER was published. In addition, the paper also documents a recent rate of return decision from each regulator and compares the rate of return authorised by each regulator on a like-for-like basis so far as is possible.

The AER's draft 2022 Rate of Return Instrument suggests that the only material change proposed from the prior method (2018 Rate of Return Instrument) is to adopt an approach of matching the term of equity to the regulatory period. This change effectively shortens the "term" of the return on equity from ten years to five years. This change causes the risk-free rate to go down and the market risk premium to go up, and, on average we would expect the net effect on the equity return to be negative (ie, all else equal, a term of five years would result in a lower authorised return on equity than a term of ten years). Among the methods reviewed in this paper, the usual approach is to rely on a term of ten years (or more). The New Zealand Commerce Commission is the only regulator currently using a five-year term. On that basis we recommend that the AER should not adopt a five-year term, particularly considering that other regulators (including the New Zealand Commerce Commission) have components in their rate of return methods which tend to increase the authorised return and which the AER lacks. For example, some methods explicitly move above the mid-point of the estimate of the rate of return (the New Zealand Commerce Commission does this, and the Competition and Markets Authority did this in its decision on appeal from Ofwat's last price review in Great Britain).

AER's proposed return on equity relative to decisions of other regulators

The return on equity consistent with the proposed method in the AER's draft 2022 RORI is lower than most of the recent decisions of international regulators we have reviewed. Looking to the CAPM inputs, the regulator in the Netherlands (the ACM) and AER stand out as having the lowest market return (the sum of the risk-free rate and the MRP). Because these two inputs typically

move in somewhat opposing directions, a heavy reliance on a historical MRP combined with very low risk-free rates (at the time of the decisions) leads to a low cost of equity estimate. As the AER also has one of the lowest beta estimates, the equity premium is lower than that of all regulators but the ACM. Simply put, other regulators have higher betas or higher risk-free rates or higher MRPs, whereas the AER is among the lowest on all three, leading to a materially lower authorised return on equity than other regulators.

AER's consideration of International experience

More broadly, we note that the AER appears to have given little or no weight to evidence about methods used by international regulators and little or no weight to evidence about rates of return authorised by other regulators. It is true that different regulators use different methods for determining the authorised rate of return. However, in our view, all of the regulators are fundamentally engaged in the same task of estimating the required market-based cost of capital for owning and operating regulated infrastructure—ie, the opportunity cost of capital—necessary to compensate and therefore incentivise efficient investment in new infrastructure assets when needed. Therefore the different methods and their results are potentially informative, at the least as cross-checks.

Suggested improvements to the AER's proposed method

The AER continues to rely exclusively on the CAPM, in common with many of the regulators we reviewed. North American regulators tend to take account of the results of dividend growth models as well, and we think that it is better to rely on more than one model.

When estimating equity beta, the AER continues to rely on estimates for listed infrastructure firms in Australia. This means that the AER is relying on a small sample and out-of-date information. We recommend that the sample be expanded to include international firms and that estimation windows be shorter so that the estimate is up-to-date.

I. Introduction

1. Energy Networks Australia ("ENA") has asked us to prepare a paper for submission to the AER's Rate of Return Instrument (2022 RORI) consultation.[1] Together with colleagues, we wrote a paper for the AER earlier in the AER's process for developing the 2022 RORI which reviewed methods used by regulators internationally to determine the rate of return for energy networks and other infrastructure, and compared outcomes (ie, authorised rates of return) from a set of recent decisions from these regulators.[2] The ENA has asked us to prepare a further paper which updates our 2020 paper and compares the results of recent international regulators' decisions with the AER's draft of the 2022 RORI.[3] The ENA also asked us to address some specific questions about the relevance of international comparisons and differences between international regulators and the AER.

2. In this paper we describe the rate of return method used by other regulators[4] and compare these methods with the method the AER is proposing to use. In addition to comparing the methods, we have also updated our comparison of the regulators' rate of return determinations—that is, we compare the rates of return authorised by the different regulators in recent decisions. Based on these comparisons we comment on the AER's proposed approach and recommend improvements.

3. Our prior paper for the AER explained some important details about the adjustments that may be required in order to make meaningful comparisons between the results of one regulator's rate of return decision and another's. For example, some regulators determine real rates of return and others nominal rates of return. We have not repeated that material in this paper, but refer the reader to our earlier paper for a full description of how and why we make adjustments in order for the comparison to be as meaningful as possible.[5]

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[1] The AER is currently consulting on a draft of the 2022 RORI (see https://www.aer.gov.au/publications/guidelines-schemes-models/rate-of-return-instrument-2022)

[2] *A Review of International Approaches to Regulated Rates of Return*, Brattle paper for the AER, June 2020.

[3] AER, Draft Rate of Return Instrument Explanatory Statement, June 2022 ("2022 Rate of Return Instrument Draft").

[4] The New Zealand Commerce Commission (NZCC); the US Federal Energy Regulatory Commission (FERC); the US Surface Transportation Board (STB); Ofgem and Ofwat in Great Britain; the Dutch Authority for Consumers and Markets (ACM); and the Regulatory Authority for Energy, Networks and Environment (ARERA) in Italy.

[5] See the introductory sections of our prior paper (sections I and II.E).

4. The rate of return that investors in energy networks expect to receive must be at least equal to the opportunity cost of capital—the return that investors could (expect to) get from other investments with similar risk elsewhere. If this condition is not met, energy networks would not be able to attract the capital that they need, because investors can invest elsewhere. Regulators set the rate of return as part of the broader process to set access prices (or "rates") that networks are allowed to charge users. Thus, regulators need to be able to estimate the cost of capital so that they can determine the rate of return component of the revenue requirement.

5. The cost of capital cannot be directly observed, but various financial models are available for estimating it, using market data.[6] There are three main components to estimating the cost of capital: (i) the cost of equity capital; (ii) the cost of debt; and (iii) the appropriate proportions of equity and debt to be used to finance the regulated company. We discuss each component when we review the methods used in the different jurisdictions.

6. Our report is structured as follows. In Section II we describe our understanding of the AER's proposed method and how it has changed since the 2018 RORI, and we also summarise recent developments we have seen in other jurisdictions. In Section III we summarise the methods of the international regulators and compare them with the AER's proposed method. In Section IV we recommend improvements to the AER's proposed method. The detailed description of each international regulator's method is in an appendix.

II. Recent developments in determining the rate of return

A. The AER's draft 2022 RORI

What and How the AER Regulates

7. The Australian Energy Regulator ("AER") determines the revenues that energy networks in Australia (with the exception of Western Australia) can collect from providing regulated services. It regulates revenues for electricity distribution and transmission networks in all jurisdictions except for Western Australia, and for natural gas distribution and transmission pipelines in all

[6] A few methods rely on non-market data such as the risk-premium model, which uses market data on interest rates and historically allowed rates of return. These models do not appear to be used outside North America.

Australian jurisdictions except Western Australia and Tasmania.[7] The AER also engages in other economic regulation of the networks. The businesses that the AER regulates are mostly investor-owned, but some are wholly or partly owned by state governments.[8]

8. The AER's overarching objective is to "to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to: price, quality, safety and reliability and security of supply of electricity; and the reliability, safety and security of the national electricity system…" and "to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas".[9]

9. The revenue determinations typically cover a five-year period, with revenues over the five-year period set equal to a forecast of the efficient costs (including the cost of capital and depreciation) of providing the regulated services. The outcome of the revenue determination is a cap on the revenue that may be collected for each year of the upcoming period, with the cap expressed in real terms. The revenue cap is determined based on a range of building block components including operating expenditure, tax, depreciation of the Regulated Asset Base ("RAB") and a return on the investment in the RAB.

10. AER sets the revenue cap in real terms, and then for the remaining four years adjusts the revenue allowance to include movements in actual inflation. The RAB is also adjusted for actual inflation at the end of the regulatory period, therefore in summary, the AER sets an initial real rate of return and makes adjustments for inflation in subsequent years. This approach intends to index the value of investments in network infrastructure to actual inflation.[10]

WACC Methodology

11. The AER sets a real vanilla WACC with a separate tax allowance which accounts for the impact of franking credits. An estimate of expected inflation is also an input to the calculation of revenues therefore the revenue determination targets a real WACC. The real WACC is calculated as a nominal WACC less expected inflation, determined at the start of the control period and not

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[7] Networks & pipelines, AER, accessed August 8, 2022, https://www.aer.gov.au/networks-pipelines

[8] Guide to Australia's Energy Networks, Energy Networks Australia, accessed August 8, 2022, https://www.energynetworks.com.au/resources/fact-sheets/guide-to-australias-energy-networks/

[9] National Electricity Law, cl. 7; National Gas Law, cl. 23. See also "National Energy Objectives" at https://www.aemc.gov.au/regulation/regulation.

[10] AER, Regulatory Treatment of Inflation—Final Position Paper, December 2020, pp. 9–10.

updated each year. The AER's current approach to estimating the WACC is set out in the 2018 RORI, and the AER is currently consulting on a draft of a replacement 2022 RORI.[11] Table 1 below summarizes an example of the current AER approach using data as of February 2022, and shows the impact of the proposed changes in the 2022 Draft RORI.

TABLE 1.EXAMPLE AER WACC ESTIMATION USING DATA AT END OF FEBRUARY 2022[12]

Parameter		Methodology	Example 2018 Instrument	Example 2022 Instrument
Risk-free rate	[1]	Simple average of the daily 10-year yield to maturity of government bond yields, averaged over period nominated by the regulated business. **(2022 Instrument): Simple average of the daily 5-year yield to maturity of government bond yields, averaged over period nominated by the regulated business**	2.12%	**1.82%**
Leverage	[2]	Benchmark gearing ratio from observed gearing ratios of listed Australian energy networks.	60%	60%
Asset beta	[3]	Not specified, Equity Beta is directly estimated.	n/a	n/a
Equity beta	[4]	Estimate based on empirical estimates of listed Australian energy networks betas'. Use Brealey–Myers formula to de- and re-lever raw estimates to a benchmark.	0.60	0.60
Market risk premium	[5]	Historical average returns on Australian utility equities over and above the 10-year government bond (1988 to 2017), compared to estimates of the MRP from the Dividend Growth Model and surveys. **(2022 Instrument): Historical average returns on Australian utility equities over and above the 5-year government bond (1988 to 2021), based on an averaging period that corresponds to the length of the regulatory control period. There are four regulatory control periods proposed: <=5 years plus 1 month, <= 7 years, <= 9 years, and > 9 years.**	6.10%	**6.80%**
Corporate tax rate	[6]	Statutory corporate income tax rate in a given regulatory year.	30%	30%
Gamma	[7]	Value of the franking credit determined as the result of analysis/consultation done as part of the 2018 rate of return review.	0.585	0.585
Cost of debt	[8]	Estimated on a trailing weighted average basis over 10 years (with equal weighting of each year) of B (two-thirds) and A (one-third) rated yield curves.	4.00%	4.00%
Cost of equity	[9]	[1] + [5] x [4]	5.78%	**5.90%**
Real vanilla WACC	**[10]**	**[8] x [2] + [9] x (1 - [2])**	**4.71%**	**4.76%**

Sources:
AER, Rate of Return Instrument Explanatory Statement, December 2018. ("2018 Instrument")
AER, Draft Rate of Return Instrument Explanatory Statement, June 2022. ("2022 Instument")

[11] This approach applies to both the electricity and gas regulated industries. See AER, Rate of Return Instrument, December 2018; AER, Rate of Return Instrument – Explanatory Statement, December 2018; and AER, Draft Rate of Return Instrument 2022, June 2022.

[12] AER, Draft Rate of Return Instrument 2022, June 2022, Table 0.1.

Cost of Equity

12. AER has proposed a change in how the risk-free rate (RFR) is set. While the 2018 RORI uses the yield on a 10-year government bond, the AER is proposing to move to using the yield on a five-year bond. This change is often referred to as changing the "term of the return on equity". In the example shown above, the substantial change in the risk-free reflects two distinct changes: (i) the 2018 RORI relies on 10-year government bond yields while the 2022 RORI relies on 5-year government bond yields and (ii) government bond yields have changed. AER's proposed approach to calculating the Market Risk Premium (MRP) similarly reflects the proposed change to the term of the return on equity: rather than estimating the MRP as the historical excess returns of equities over the returns on ten-year bonds, the AER now proposes to measure the historical excess returns over the return on five-year bonds, consistent with its proposal on the RFR.

13. The AER's proposed change to the term of the rate of return on equity is driven by the view that the appropriate term (for measuring the RFR and the MRP) is the same as the term of the regulatory period.[13] The AER said: "Matching the term of the allowed return on equity to the length of the regulatory period better aligns our regulatory allowance with the efficient costs of providing regulated services and risks borne by the investors".[14]

14. The cost of equity will still be estimated through the traditional Sharpe-Lintner CAPM, using an "on the day" estimate of the RFR in the first year of the regulatory period. The values of the MRP, equity beta, and leverage are fixed whereas the RFR is updated for each regulated company at their respective revenue determination.[15]

15. AER's 2022 decision for the calculation of the RFR retains flexibility in its averaging period from the 2018 instrument. The regulated business is able to select a period to average across of anywhere between 20 and 60 days. This period must begin no earlier than 8 months and end no later than 4 months before the start of the regulatory period.[16] As-of February 2022, the average yield on 5-year government bond yields over an averaging period of 20 days was 1.82%.

16. The equity beta is to remain fixed at 0.60, which applies to all regulated gas and electricity businesses. The AER determined this value by examining a range of estimates of returns for a

[13] The AER proposes to use different terms for the risk-free rate and the MRP for those firms with a control period longer or shorter than five years.

[14] AER, Draft Rate of Return Instrument 2022, June 2022, p. 14.

[15] Ibid, pp. 13–17.

[16] 2022 Draft Rate of Return Instrument—Explanatory Statement, pp. 10.

variety of individual proxy companies, different portfolios of proxy companies, different time-periods, and weighting (equal vs market- value).[17] The AER has recognized however that listed Australian comparator companies has declined rapidly due to company de-listings and mergers and that likely only one listed comparator firm (APA) would be available for the 2022–26 period. We note that the New Zealand Competition Commission ("NZCC") had already been faced with this issue and elected to estimate equity beta based on international proxy group companies (most of which are in the US).

17. The AER used (i) Ordinary Least Squares to estimate the Equity Beta using weekly returns; (ii) the Brealey–Myers formula to de- and re-lever the Equity Beta[18]; (iii) considered both raw and re-levered estimates of beta; and (iv) did not apply a Blume or Vasicek adjustment.[19] The AER determined the leverage to be 0.60 based on reviewing market evidence from proxy firms.[20] The AER also includes an assumption about the cost of raising debt and equity capital in its revenue determinations. These amounts do not appear in the rate of return, rather the assumed cost of issuing debt is included elsewhere in the operating cost component of the revenue determination, and the assumed cost of issuing equity is included in the forecast of capital additions (and hence RAB).[21]

Cost of Debt

18. The AER has not indicated it will make any changes in the 2022 Rate of Return Instrument Draft from the current approach to estimate the cost of debt (or "return on debt"). The AER plans to continue its 10-year transition from its "on-the-day" approach, which uses a trailing average of the prior 10 estimates on the day yield estimates, to a simple trailing average. For each of the trailing ten regulatory years, if the start date for the regulatory year is before December 17th, 2022, the previously-determined on-the-day cost of debt is used, and if it is after December 17th, 2022, the annual average yield-to-maturity is used. Each of the ten trailing years is weighted equally, and the summation is considered the regulatory return on debt.[22]

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17 Ibid, pp. 142–144.

18 Including an assumption that the debt beta is zero (see AER, Staff Beta Analysis, June 2017, p. 17).

19 AER, Rate of Return Instrument—Explanatory Statement, December 2018, p. 97.

20 AER, Rate of Return Instrument—Explanatory Statement, December 2018, pp. 65–67.

21 See, for example, AER, Draft Decision—Jemena Gas Networks (NSW) Ltd, Access Arrangement 2020 to 2025—Attachment 3 Rate of return, pp. 7–10. Note that part of the AER's methodology is to consider whether the business would need additional equity to support its capital program, given the leverage assumption and the assumed ratio of dividends to earnings. Only if additional equity would be needed, is an allowance made for the cost of issuing it.

22 AER, Draft Rate of Return Instrument, June 2022, pp. 8–11.

19. The AER targets a 10-year BBB+ corporate bond yield, but since there is no such index available, it instead uses a 1/3 2/3 weighted average on the yields on A-rated and BBB-rated bond indexes. The yield data is averaged across Bloomberg, Thomson Reuters, and the Reserve Bank of Australia data providers.[23] The rate of return is thus updated annually (and authorised revenues recalculated annually) to reflect changes in the cost of debt. Over time, the number of years in the trailing average increases until it is a full historical trailing average with a 10-year rolling window. The 10-year debt term is consistent with the available evidence on actual debt terms issued by regulated companies, which the AER determined to be at least 7 years.[24] The indicative return on debt for 2022 is calculated by the AER to be 4.00% (note that this is an "on-the-day" value).

B. Recent developments internationally

20. We have summarised the method taken by each regulator, as well as a recent rate of return decision, in section 0. In this section we briefly highlight recent developments (ie, changes since we wrote our 2020 paper).

Australian Energy Regulator

21. The AER is currently consulting on a draft of its 2022 RORI. The AER has proposed to change the term of the equity return to an effective default of five years (from ten years previously). As a result, the MRP estimated using historical returns on stocks relative to bonds has increased and the RFR has decreased relative to the 2018 RORI. Both changes are due to the term structure of interest rates: the return on ten-year bonds is on average higher than the return on five-year bonds, so the historical MRP measured relative to returns on five-year bonds is higher. For the same reason, the RFR measured using the yield on a five year bond is below the yield on a ten year bond. Otherwise the AER's method has not changed.

New Zealand Commerce Commission

22. Our 2020 paper described the NZCC's rate of return method as applied to the electricity distribution businesses. In this paper we describe a more recent decision applying the method to gas distribution businesses. The method remains the same. However, the MRP has been updated

[23] The AER intends to target a BBB+ 10-year corporate bond yield, but since there is no such index available, it instead uses a weighted average estimation comprising 1/3 A-rated and 2/3 BBB-rated bond indexes.

[24] AER, Rate of Return Instrument—Explanatory Statement, December 2018, pp. 278–279.

(increased by 0.5%). This change purely reflects the addition of more recent data and does not reflect a change in method.[25]

23. The most recent asset beta for gas distribution is 0.4 while the asset beta for electricity distribution is 0.35. An asset beta of 0.4 corresponds to an equity beta of 0.69 at the NZCC's assumed gearing (0.75 when adjusted to match the NZCC's authorised WACC above its mid-point estimates).

US Federal Energy Regulatory Commission (FERC)

24. The FERC has not changed its methodology since 2020, but a U.S. Appeals Court has determined that the FERC's justification for the use of the Risk Premium model invalid. Therefore, we expect the FERC will review its methodology going forward and make changes as necessary to be consistent with the ruling. Additionally, we have updated our figures to use a decision from 2021, which is currently the most recent decision.

US Surface Transportation Board (STB)

25. There are no changes to the STB's methodology since 2020, so the only change we report is an updated decision based on year-end 2021 data.

Ofgem (Great Britain)

26. We previously described Ofgem's rate of return decision based on a methodology decision from May 2019, and the provisional figures it contained. We now describe the final determinations used in setting prices under the RIIO-2 price controls. In addition, some of the networks appealed Ofgem's rate of return decision and were successful in establishing that part of the decision should be overturned.

27. The most significant change is that Ofgem previously proposed to reduce the authorised return on equity by 0.5% to account for "expected out-performance" (ie, it anticipated that the networks would be able to "beat" the price control assumptions in unspecified ways that would result in an extra return equivalent to 0.5% return on equity, and Ofgem felt it appropriate to

[25] Ordinarily the MRP would not be changed until the next input methodologies review, which is currently underway. However, since the NZCC was required to set the rate of return for fibre optic cable operators recently and since the MRP is an economy-wide (rather than sector-specific) parameter, it decided to apply the new value in the gas distribution price reset. (See Amendments to input methodologies for gas pipeline businesses related to the 2022 default price-quality paths – weighted average cost of capital, Reasons paper, NZCC (March 2022), paragraph 3.10.

remove that anticipated out-performance from the authorised return). In its final decision Ofgem implemented the reduction, though the magnitude was 0.25% in the final decision and protections were added to address the risk of the anticipated out performance not eventuating. The Competition and Markets Authority (CMA) required Ofgem to reverse this reduction (and the associated protections) on appeal.

Ofwat (Great Britain)

28. Our 2020 paper described Ofwat's PR19 price review decision from December 2019. Subsequently some of the water companies appealed Ofgem's decision. The appeal changed the rate of return for the companies that appealed because the appeal body (the CMA) increased the cost of equity. The CMA's decision increased the cost of equity in part because it used more recent data and in part because it determined a range and then moved above the mid-point. Ofwat's cost of equity was 4.19% while the CMA's was 4.73%.

ACM (The Netherlands)

29. The ACM's current method is similar to the method we described in our 2020 paper. The more recent decision we describe in this paper uses more recent data and thus has slightly different results.[26] The ACM's result is a very low cost of equity, in part due to the very low (or even negative) risk-free rate which the ACM does not adjust, and significant weight on a geometric mean in estimating the historical MRP.

ARERA (Italy)

30. ARERA's method described in our 2020 paper included an explicit "floor" on the risk-free rate (dealing with the problem of negative real risk-free rates). The floor was 0.5%. ARERA recently updated its method so that instead of a hard floor on the risk-free rate, ARERA starts from the actually-observed risk-free rate and makes certain adjustments. These adjustments are based on theoretical considerations which suggest that government bond yields may underestimate the true risk-free rate. A total of 1.75% is added. In addition, ARERA uses a "total market return" methodology. Parameters have been updated, which means that as the risk-free rate has gone down (because of the changes above as well as interest rate changes), the market risk premium has increased.

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[26] The major networks (TSOs and DSOs) regulated by the ACM are owned by the Dutch government or Dutch provinces and municipalities. Thus, unlike in other jurisdictions there are no independent investors. For that reason the ACM faces a different "investment community" than other regulators.

III. Comparing rate of return decisions

31. In our 2020 paper for the AER we compared rate of return decisions by, where possible, converting the reported figures from each decision to a real vanilla WACC because, in effect, the AER aims to provide a real vanilla return.[27] Thus the real vanilla WACC is the best way to compare returns authorised by other regulators with returns authorized by the AER. This comparison is shown in Table 2 (it is not possible to calculate a real vanilla WACC for the US FERC and STB decisions without using parameters that were not determined by the regulators, so any such calculation would be speculative). For Ofwat a real vanilla WACC is reported, but this figure includes the cost of debt issuance which is not included in the AER's real vanilla WACC. We therefore recalculate a figure in row [27] of Table 2 that is consistent with the AER's approach.

[27] Please see the detailed discussion in our 2020 paper, section II.E.

TABLE 2.

		AER	ACM	FERC	STB	ARERA	NZCC	Ofgem	Ofwat
Decision year		2022	2022	2021	2021	2022	2022	2021	2021
Nominal									
Cost of debt - as reported	[1]	4.00%	1.41%		2.63%		4.04%		
Debt issuance cost	[2]		0.15%				0.25%		
Cost of debt, excluding issuance cost	[3]	*4.00%*	*1.26%*		*2.63%*		*3.79%*		
Cost of equity	[4]	5.90%	3.15%	9.21% *	12.03% *		*7.84%*		
Equity beta	[5]	0.60	0.63	0.55	1.07		*0.74*		
MRP	[6]	6.80%	5.00%	10.20%	7.46%		*7.40%*		
Rf	[7]	1.82%	-0.01%	3.14%	1.98%		2.36%		
Equity premium	[8]	*4.08%*	*3.16%*	*6.07%*	*10.05%*		*5.48%*		
Debt premium	[9]	*2.18%*	*1.27%*		*0.65%*		*1.43%*		
Real									
Cost of debt	[10]	*2.00%*				1.86%		1.82%	2.18%
Debt issuance cost	[11]								0.10%
Cost of debt, excluding issuance cost	[12]	*2.00%*				*1.86%*		*1.82%*	*2.08%*
Cost of equity	[13]	*3.90%*				5.38%		4.55%	4.73%
Equity beta	[14]	*0.60*				0.70		*0.76*	0.71
MRP	[15]	*6.80%*				5.85%		*8.08%*	8.15%
Rf	[16]	*-0.18%*				1.26%		-1.58%	-1.34%
Other factor	[17]					0.41%			
Equity premium	[18]	*4.08%*				*4.12%*		*6.13%*	*6.07%*
Debt premium	[19]	*2.18%*				*0.60%*		*3.40%*	*3.42%*
Gearing, tax and inflation									
Gearing	[20]	60%	45%		17.71%	50%	42%	60%	60%
Tax rate	[21]	30%	25%			30%			
Composite tax rate	[22]					24%			
Expected inflation	[23]	2.00%	1.77%			1.70%	1.94%		
Rate of return									
Nominal vanilla WACC - as reported	[24]	**4.76%**			**10.36%**		**6.15%**		
Nominal vanilla WACC	[25]		*2.30%*				*6.14%*		
Real vanilla WACC - as reported	[26]							**2.93%**	**3.20%**
Real vanilla WACC	[27]	*2.76%*	*0.52%*			*3.62%*	*4.12%*	*2.91%*	*3.14%*
Real pre-tax WACC - as reported	[28]		**1.00%**			**5.23%**			
Nominal after-tax WACC - as reported	[29]		**2.20%**						
Nominal pre-tax WACC - as reported	[30]		**2.94%**						

32. The decisions reported in Table 2 are at different points in time. We would not expect rate of return decisions taken at different points in time to be directly comparable because capital market conditions change over time. In particular, we would expect rate of return decisions to be different if the risk free rates at the decision dates are different. However, we would expect risk premiums to be more stable over time—that is, for example, we would expect the authorised return on equity to be higher if the decision was taken at a point in time when the risk-free rate was high, and lower if it was lower. In Table 3we show the equity (and debt) risk premiums implied by the figures in Table 3. Risk premiums for methods that use a "total market return" are however more volatile over time.

TABLE 3.

		AER	ACM	FERC	STB	ARERA	NZCC	Ofgem	Ofwat
Decision year		2022	2022	2021	2021	2022	2022	2021	2021
Nominal									
Cost of debt, excluding issuance cos	[1]	*4.00%*	*1.26%*		*2.63%*		*3.79%*		
Cost of equity	[2]	5.90%	3.15%	9.21%	12.03%		*7.84%*		
Rf	[3]	1.82%	-0.01%	3.14%	1.98%		2.36%		
Equity premium	[4]	*4.08%*	*3.16%*	*6.07%*	*10.05%*		*5.48%*		
Debt premium	[5]	*2.18%*	*1.27%*		*0.65%*				
Real									
Cost of debt, excluding issuance cos	[6]	*2.00%*				*1.86%*		*1.82%*	*2.08%*
Cost of equity	[7]	*3.90%*				5.38%		4.55%	4.73%
Rf	[8]	*-0.18%*				1.26%		-1.58%	-1.34%
Equity premium	[9]	*4.08%*				*4.12%*		*6.13%*	*6.07%*
Debt premium	[10]	*2.18%*				*0.60%*		*3.40%*	*3.42%*

33. The AER's equity premium (rows [4] and [9]) have increased slightly since our 2020 paper because the AER's MRP has increased. ARERA's equity premium has also increased, principally because ARERA uses a "total market return" approach and the risk-free rate is lower than previously (in part because ARERA has changed the adjustments it uses to address a negative real risk-free rate). Ofgem and Ofwat have both increased their equity premiums because the decisions we described in our 2020 paper were appealed and the cost of equity increased. In Ofwat's case the CMA estimated a mid-point cost of equity and then added 0.25%; in Ofgem's case Ofgem applied a 0.25% reduction to account for anticipated "out-performance", and this reduction was removed on appeal. In New Zealand, the NZCC has not changed its method but has updated the parameters, resulting in an increased equity premium. The ACM's result is a very low cost of equity, in part due to the very low (or even negative) risk-free rate which the ACM does not adjust, and significant weight on a geometric mean in estimating the historical MRP.[28]

34. Relative to the decisions shown in Table 2 and Table 3 the AER's cost of equity and equity premium is among the lowest. This is not consistent with the statement in the AER's draft 2022 RORI explanatory statement to the effect that "[w]hen compared with European regulators our return on equity is around the mid-point".[29] We are not sure what evidence the AER relied on for this statement. Since the AER's draft 2022 RORI was published, the risk-free rate in Australia (and other jurisdictions) has increased. This increase would not change the AER's equity premium, which remains low relative to other decisions.

[28] The major networks (TSOs and DSOs) regulated by the ACM are owned by the Dutch government or Dutch provinces and municipalities. Thus, unlike in other jurisdictions there are no independent investors. For that reason the ACM faces a different "investment community" than other regulators.

[29] AER, Draft Rate of Return Instrument 2022, June 2022 , p. 31.

IV. Recommendations for improving the AER's approach

35. In addition to updating the findings of our 2020 paper, the ENA also asked us to comment on what the AER said about the relevance of international comparisons; on the proposed shift to a five-year term for the equity return; on the results of the draft 2022 RORI relative to recent decisions of other regulators (in terms of the equity risk premium); and more broadly on how the AER's proposed method could be improved.

A. Relevance of international comparisons

36. In the draft 2022 RORI, the AER observes that its allowed return on equity is around the mid-point when compared with European regulators.[30] The AER also stated "After re-considering other regulators' decisions, both in terms of the quantitative results and the methods used, we consider our December 2021 position holds: there is limited value in the use of other regulators' rate of return as a cross check. We note that differences in outcome reflect differences in the underlying methodology".[31] Later in the document the AER also said "other regulators' rate of return estimates should have no role in informing the overall rate of return".[32]

37. The reasons given by the AER for putting little or no weight on the quantitative results or methods used include: time variation—decisions taken at different points in time are hard to compare (presumably because, as capital market conditions vary over time, one would expect the results of any given method to vary);[33] difference of regulatory framework or the nature of the regulated businesses lead to different quantitative results;[34,35] and different methodologies produce different quantitative results.[36,37]

38. We agree with the AER that capital market conditions vary over time, and that one would not expect rate of return decisions taken at different times to produce the same results. Nonetheless,

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[30] ibid, p. 31.
[31] ibid, p. 31.
[32] ibid, p. 262.
[33] ibid, p. 274.
[34] ibid, p. 274,
[35] ibid, p. 278.
[36] ibid, p. 275.
[37] ibid, p. 278.

this does not mean that no useful information can be extracted from decisions taken at different times. For example, in the analysis above we calculated risk premiums implied by each decision (that is, the difference between the authorised cost of equity and the risk-free rate). For methods (like the AER's) that rely on a backwards-looking MRP estimate, the risk premium tends to change less over time than the overall rate of return. Methods that use forward-looking estimates may change more over time (by design, since they are attempting to capture current capital market conditions). Also, many of the European regulators use a "total market return" method which means the cost of equity is relatively stable over time but the equity risk premium is more variable. Nonetheless, since the AER's rate of return decisions remain in place for an extended period without review, the variation of rate of return decisions over time is an indication of the extent to which changing capital market conditions could become out of line with the rate of return authorised at a particular point in time.

39. We do not agree with the AER's assertion that differences in the regulatory framework or in the nature of the regulated businesses in different jurisdictions lead to regulators in different jurisdictions obtaining different results. We consider that the nature of energy networks and how they are operated and regulated in different jurisdictions tends to be similar. Furthermore, even if there is an appreciable difference of business risk between, for example, the water and electricity sectors, or between gas pipelines and railways, the methods used by regulators in different sectors may still be informative.

40. Finally, we agree that different methods produce different results. However, that is precisely why it is helpful for the AER to consider different methods and their results, at least as a cross-check. In our view, the regulators we reviewed are all seeking to do the same thing: to estimate the rate of return required by investors, and to incorporate that estimate into regulated revenues so that investors expect to earn the cost of capital and therefore provide energy networks with capital when it is needed. If different regulators have different methods for doing this which produce different results, we think those facts are relevant for the AER in determining how it should go about this task and whether a proposed method produces reasonable results.

B. The term for the cost of equity

41. We understand that the only material change the AER is proposing to make to its current methodology is to change the effective term of the return on equity from ten years to five years. This change would mean that the risk-free rate will be measured using the yield on five-year government bonds (rather than the yield on ten-year bonds currently), and that the MRP will be measured as the difference between historical equity returns and historical yields on five-year

government bonds (rather than the difference between equity returns and yields on ten-year government bonds currently).

42. We would expect a method relying on five-year returns would usually produce a lower authorised return on equity than an otherwise identical method relying on ten-year returns, since both the risk-free rate and MRP are likely to be influenced to a similar extent (in opposite directions), but MRP is multiplied by beta which is usually less than one for energy networks.[38] Therefore the AER's proposed change to the term of the equity return is likely to produce lower authorised returns in future than if the change were not made.

43. The AER estimates that the change to a term of five years would, on average, reduce the return on equity by 0.3%. A change of 0.3% to the authorised return on equity is significant for investors (and for customers), but the theoretical justification for making such a change is at best arguable. Empirically we showed above that the AER is proposing to set a return on equity that is below the rates authorised by most other regulators.

44. The only other regulator we know of to use a five-year term is the NZCC—all other regulators use a ten-year term (or longer).

45. We also note that the NZCC otherwise uses a similar method to the AER, but includes an explicit adjustment to move above the mid-point of its WACC estimate. There is no equivalent adjustment in the AER's method, and the impact of that adjustment is much larger than the difference between a five-year and a ten-year term for the equity return (the adjustment in the decision we reviewed results in the vanilla WACC increasing by 0.44%, equivalent to the return on equity increasing by 0.76%). The decision to use an above-midpoint WACC was made to "*reduce the risk that the estimate was lower than the true (but unobservable) return required by investors".*[39] Additionally, the NZCC held the view that the "*costs to consumers of using a WACC that was too low would be greater than the costs of using a WACC that was too high".*[40] Initially

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[38] We think that this is consistent with the analysis in the AER's draft 2022 RORI explanatory statement. The *increase* on changing from a ten-year term to a five-year term in the summary of the AER's paper is due to a different dataset being used for the MRP in each case. Our understanding is consistent with the results shown in Table 7.4 of the AER's paper.

[39] NZCC, Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services Reasons paper, October 30, 2014, p. 15.

[40] NZCC, Input methodologies (Electricity Distribution and Gas Pipeline Services) Reasons Paper, December 2010, para. H13.44, p. 588.

the NZCC used the 75th percentile WACC estimate; however, this was later challenged at the High Court in 2014, which resulted in a lowered estimate to the 67th percentile.[41]

46. Other regulators also apply adjustments missing from the AER's method which tend to increase the return on equity. The Competition and Markets Authority when reviewing Ofwat's last water sector price determinations moved 0.25% above its estimate for the cost of equity. ARERA in Italy applies an uplift to the risk-free rate of approximately 1.75% because of a concern that yields on government bonds may be a downwards-biased estimate of the true risk-free rate.

47. The adjustments we note above suggests that the AER's current method may produce results that are too low. We would therefore not recommend a change that would tend to produce a further eeadownwards adjustment, particularly when the theoretical support for the change is at best arguable and, empirically, the change would tend to make the AER's results more extreme relative to those of other regulators.

C. Equity risk premium

48. The equity risk premium is the difference between the authorized ROE and the risk-free rate. While it may be challenging to compare the results across jurisdictions because of differences in timing and in the extent to which monetary policy has impacted the risk-free rate, we make the following observations. Regulators that rely on a "total market return" approach will tend to see an increased MRP if the risk-free rate goes down. For example, ARERA has changed the way in which it estimates the appropriate risk-free rate, and the new rate is lower than when we wrote our 2020 paper. In consequence, ARERA's MRP has increased.

49. In New Zealand, the NZCC's MRP has increased by 0.5% because NZCC updated its estimate (using the same methodology). The AER's MRP would also have increased if AER had kept the same methodology as in the 2018 RORI (albeit by only 0.2% rather than by 0.7%).[42]

50. Equity premiums for Ofwat and Ofgem increased, in part because the decisions we described in our 2020 paper were appealed and the CMA adjusted elements of the decisions.

51. Overall, AER's equity premium is low relative to the decisions we document in this report.

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[41] NZCC, Amendment to the WACC percentile for price-quality regulation for electricity lines services and gas pipeline services Reasons paper, October 30, 2014.

[42] See section II.A.

52. AER is also unusual in relying exclusively on a historical MRP, and several of the other decisions we reviewed have upwards adjustments to the cost of equity that the AER does not apply.

Appendix: International rate of return methods

53. In this section, we describe the methods used by regulators in New Zealand, the United States, the United Kingdom, The Netherlands, Italy, and Singapore. We note that regulators in North America generally rely on multiple methods to determine the cost of equity (e.g., versions of the CAPM and Discounted Cash Flow model), while regulators in New Zealand and Europe tend to rely on the CAPM as does the AER.

A.1 New Zealand Commerce Commission (NZCC)

WHAT AND HOW THE NZCC REGULATES

54. The NZCC is the regulatory body charged with regulating gas distribution and electricity transmission and distribution in New Zealand.[43] The NZCC's objective is to protect consumer interests and promote competition. While efficiency is not explicitly mentioned, we would expect efficiency to be an outcome of promoting competition (and that encouraging efficiency would further protect consumer interests).

55. The Commission targets a real "vanilla WACC" and determines revenues for a five-year control period.[44] The NZCC defines the real vanilla WACC as the pre-corporate tax cost of debt and the after tax cost of equity,[45] which the NZCC uses because the commission explicitly assumes the tax implications of debt and includes this into the regulated return calculation.

56. The NZCC relies on a New Zealand-specific version of the CAPM, the Brennen-Lally CAPM, to estimate the cost of equity, while the cost of debt is determined as the risk free rate plus a debt premium.

57. The NZCC determines the revenue requirement method and the rate of return in separate proceedings. The NZCC only updates the risk free rate and the cost of debt at the time of the revenue determination to calculate the allowed return following a predefined methodology.[46]

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[43] Part 4 of the Commerce Act of 1986 as amended by the Commerce Amendment Act of 2008, Section 52, p. 9.

[44] Throughout this whitepaper, we focus on parameters in regards to the Gas Pipeline Businesses ("GPBs"). The NZCC does use other regulatory periods from three to five years, which pertain to other regulated entities.

[45] NZCC, Guidelines for WACC determinations under the cost of capital input methodologies, May 27, 2021, para. 22, p. 11.

[46] NZCC, Guidelines for WACC determinations under the cost of capital input methodologies, May 27, 2021.

Most of the CAPM parameters (MRP, equity beta, leverage, and debt issuance costs) are fixed for five years and were last updated on May 31st, 2022.[47] The most recent revenue determinations, which updated the non-fixed parameters (RFR and Cost of Debt) have also just been published on May 31st 2022 and cover the regulatory period starting from October 1st 2022 to October 1st 2026.[48]

58. The NZCC is currently reviewing its WACC method.[49]

WACC METHODOLOGY

59. The NZCC calculates both a real vanilla WACC for the purposes of setting prices (since tax expense is directly forecast) and a real post-tax WACC for information purposes. A post-tax WACC estimate is included since it is the more well-known WACC variant and more investors are familiar with it. For the purpose of converting the vanilla WACC into a post-tax WACC, the corporate tax rate is fixed at 28% (the maximum prescribe investor tax rate) and changes in the corporate tax rate (if any) will flow through to future post-tax WACC estimates automatically.[50] The NZCC therefore targets a real return and later the RAB is adjusted for inflation annually by indexing to the Consumer Price Index ("CPI"). Allowed revenues are also indexed to CPI. Table 4 below shows the most recent vanilla and post-tax WACC estimates for the Gas Pipeline Businesses ("GPBs").

[47] NZCC, Gas Transmission Services Input Methodologies Determination 2012 (consolidated April 3, 2018); NZCC, Gas Distribution Services Input Methodologies Determination 2012 (consolidated April 3, 2018), as amended by NZCC, Amendments to input methodologies for gas pipeline businesses related to the 2022 default price-quality paths, Reasons Paper, May 30, 2022 and NZCC, Default price-quality paths for gas pipeline businesses from 1 October 2022, Final Reasons Paper, May 31, 2022.

[48] NZCC, Gas Distribution Services Default Price-Quality Path Determination 2022, May 31, 2022 and NZCC, Gas Transmission Services Default Price-Quality Path Determination 2022, May 31, 2022.

[49] See Part 4 Input Methodologies Review 2023, process and issues paper, NZCC (May 2022).

[50] NZCC, Input Methodologies Review Decisions Consolidated Reasons Papers, December 20, 2016, paras. 262-265, Table 6.1.

TABLE 4. NZCC'S MOST RECENT WACC DECISIONS: REGULATORY PERIOD 2022–2026 (GPBS)

Parameter		Methodology	Estimate
Risk-free rate	[1]	Linearly-interpolated, annualized bid yield to maturity on NZ Govt bonds with maturity matching the regulatory period (four years).	2.36%
Leverage	[2]	Assumed based on average leverage of a survey of 74 listed utility companies in NZ, Australia, and the US.	42%
Asset beta	[3]	Assumed based on average value of survey results of de-levered equity betas of comparable businesses.	0.40
Equity beta	[4]	[3] + ([3] - debt beta) x [2]/(1 - [2])	0.69
Tax adjusted market risk premium (TAMRP)	[5]	Composite rate reflecting average expected long-term returns above the risk free rate on a portfolio of NZ equities. Derived from the Market Risk Premium (MRP) via MRP = TAMRP - RFR x Investor Tax Rate.	7.50%
Corporate tax rate	[6]	Taken from statutory tax rates.	28%
Investor tax rate	[7]	Maximum prescribed investor tax rate under PIE tax regime.	28%
Average debt premium	[8]	Rolling average of difference between [1] and yield on BBB+ corporate bonds with maturity matching the regulatory period (four years).	1.43%
Debt issuance costs	[9]	Based upon estimates of the cost of issuing publicly-traded bonds over a four year regulatory period.	0.25%
Cost of debt	[10]	[1] + [8] + [9]	4.04%
Cost of equity	[11]	[1] x (1 -[7]) + [5] x [4]	6.87%
Mid-point real vanilla WACC	[12]	[10] x [2] + [11] x (1 - [2])	5.68%
Mid-point real post-tax WACC	[13]	[10] x (1 - [7]) x [2] + [11] x (1 - [2])	5.21%
67th percentile real vanilla WACC	**[14]**	**[12] + 0.44 x 0.01015**	**6.14%**
67th percentile real post-tax WACC	[15]	[13] + 0.44 x 0.01015	5.67%

Sources:
NZCC, Default price-quality paths for gas pipeline businesses from 1 October 2022, Final Reasons Paper, May 31, 2022, Table F1;
NZCC, Guidelines for WACC determinations under the cost of capital input methodologies, May 27, 2021, Table 6.

60. The NZCC calculates a range (or distribution) for the WACC.[51] The NZCC estimates the standard error for the WACC based on point-estimates of the standard errors for the asset beta, debt premium, and the tax adjusted market risk premium (TAMRP) parameters. The WACC standard error was set at 1.05% for GPBs.[52] From this standard error, a range of WACC estimates including the 25th, 67th, and 75th percentile are determined as shown in Table 5 below.[53] For all price-quality path regulations the 67th percentile estimate of the vanilla WACC is used.[54]

[51] NZCC, Input methodologies (Electricity Distribution and Gas Pipeline Services) Reasons Paper, December 2010, paras. H11.1 to H11.37 and NZCC, Guidelines for WACC determinations under the cost of capital input methodologies, May 27, 2021, pp. 13.

[52] NZCC, Guidelines for WACC determinations under the cost of capital input methodologies, May 27, 2021, Table 6, p. 13.

[53] Ibid.

[54] NZCC, Input Methodologies Review Decisions Consolidated Reasons Papers, December 20, 2016, Section 18, p. 631.

TABLE 5. WACC ESTIMATE PERCENTILE RANGE

25th percentile	mid-point WACC - 0.674 x standard error
67th percentile	mid-point WACC + 0.440 x standard error
75th percentile	mid-point WACC + 0.674 x standard error

Notes and sources:
NZCC, Guidelines for WACC determinations under the cost of capital input methodologies, May 27, 2021, Table 6, p. 13.

Cost of debt

61. The cost of debt is calculated as the risk-free rate plus a debt premium and an allowance for the cost of issuing debt if debt is issued over a period different than the regulatory period.[55] The most recent estimate for the debt issuance costs is 0.25%, which the NZCC updated when the GPBs were changed to a four-year regulatory period.[56] To confirm that the NZCC's estimates of the calculated cost of debt are realistic, the estimate is compared to confidential information provided by the regulated companies of their actual costs of debt financing.

62. The risk free rate is based on yields of New Zealand government bonds with a term to maturity matching the regulatory period, four years in the case of the GPBs. The risk free rate period was chosen by the NZCC to match the length of the regulatory period. The NZCC found that the approach would neither over-nor-under compensate the utilities for the cost of debt (depending on the yield curve) which the NZCC determined could occur if a longer term was considered.[57]

Cost of Equity

63. The Cost of Equity is estimated using the Simplified Brennan-Lally CAPM.[58] The simplified Brennan-Lally CAPM is a New Zealand specific model that the NZCC has determined best fits the

[55] The cost of debt methodology is described in Chapter 3 of Topic paper 4: Cost of capital issues of the NZCC, Input Methodologies Review Decisions Consolidated Reasons Papers, December 20, 2016. The NZCC explains its current approach with reference to the decisions taking in the original 2010 IMs determination, so we also cite the 2010 reasons papers (NZCC, Input methodologies (Electricity Distribution and Gas Pipeline Services) Reasons Paper, December 2010).

[56] NZCC, Amendments to input methodologies for gas pipeline businesses related to the 2022 default price-quality paths – weighted average cost of capital, Reasons Paper, para. 3.28.

[57] NZCC, Input methodologies (Electricity Distribution and Gas Pipeline Services) Reasons Paper, December 2010, para. X28 , p. vii.

[58] The cost of equity methodology is described in Chapter 4 of Topic paper 4: Cost of capital issues of the NZCC, Input Methodologies Review Decisions Consolidated Reasons Papers, December 20, 2016. The NZCC explains

Continued on next page

features of the New Zealand equity market and taxation system and due to its widespread use in New Zealand.[59] The simplified Brennan-Lally CAPM assumes that (i) dividends are fully imputed and investors receive full benefits from dividend imputation tax credits therefore investors incur no tax on capital gains, and (ii) that the New Zealand capital markets are completely segregated from overseas capital markets.[60]

64. A proxy group, which consists of 74 publically traded utility companies (most of which are in the US) was used to estimate the equity beta.[61]

65. Equity betas are estimated using a range of daily, weekly and monthly estimates across different time windows. The NZCC de-levers the individual equity beta estimates and calculates an unweighted average asset beta of the proxy group. The asset beta is then re-levered at the leverage determination made by the NZCC, which currently is fixed at 42%[62] based on a survey of the proxy group's average leverage.[63] The asset beta as determined by the middle estimate of the survey was set at 0.40 for GPBs to result in an equity beta of 0.69.[64]

66. Due to the particularities of the simplified Brennan-Lally CAPM, the NZCC estimates a Tax Adjusted Market Risk Premium (TAMRP) in place of the more widespread MRP. The TAMRP was assumed as 7.5%, which the NZCC accepts as the average return of owning a portfolio of New Zealand equity investments of average risk over and above the risk-free rate.[65] The NZCC chose this estimate from an analysis carried out by Dr Martin Lally that used a range of sources drawing from both historical and forecast estimates of the return on equity investments with average risk.[66]

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its current approach with reference to the decisions taking in the original 2010 IMs determination, so we also cite the 2010 reasons papers.

59 NZCC, Input methodologies (Electricity Distribution and Gas Pipeline Services) Reasons Paper, December 2010, Section X31, p. viii.

60 NZCC, Cost of Capital Straw Person Example – Electricity distribution industry, p. 1.

61 NZCC, Input Methodologies Review Decisions Consolidated Reasons Papers, December 20, 2016, Section 224.5, p. 65.

62 Ibid.

63 NZCC, Input methodologies (Electricity Distribution and Gas Pipeline Services) Reasons Paper, December 2010, p. 157-161.

64 NZCC, Guidelines for WACC determinations under the cost of capital input methodologies, May 27, 2021, Table 7, p. 13.

65 NZCC, Fibre input methodologies: Main final decisions – reasons paper, October 13, 2020, para. 6.522.

66 Lally, M., Estimation of the TAMRP, Capital Financial Consultants Ltd, September 26, 2019.

A.2 US Federal Energy Regulatory Commission (FERC)

WHAT AND HOW THE FERC REGULATES

67. The US Federal Energy Regulatory Commission ("FERC") determines the maximum prices (or rates) that interstate natural gas pipeline, oil pipelines, and electric transmission utilities can charge. FERC's overarching objective is to "ensure that rates, terms, and conditions of jurisdictional services are just, reasonable, and not unduly discriminatory or preferential".[67] FERC generally relies on original cost for the Regulated Asset Base[68] and uses nominal cost of capital values.[69]

68. Regarding the cost of capital components, the FERC determines the cost of equity, the capital structure (leverage) and the cost of debt with the latter commonly being set at the embedded cost of debt. The FERC issues a decision when an application or a complaint has been reviewed and decisions can be delayed substantially.

WACC METHODOLOGY

69. From the mid-1990's to 2018, the FERC relied exclusively on a version of the Discounted Cash Flow ("DCF") model. However, in October 2018 FERC decided that multiple methods to estimate the cost of capital was valuable.[70] Starting in 2019, the FERC first considered four methods: CAPM, DCF, risk premium and expected earnings.[71] The FERC subsequently reduced the methods to three for electricity transmission, the CAPM, DCF, and a risk premium method, and to just the CAPM and DCF for gas pipelines.[72] Most recently, a U.S. Appeals Court overruled the approach and was especially critical of the risk premium model.[73] Thus, the FERC is likely to revisit the methodology.

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[67] Federal Energy Regulatory Commission, Strategic Plan 2018-2022, September 2018, p. 1.

[68] There are some exceptions for oil pipelines, which are allowed to use trended original cost for the regulated asset base. See, for example, FERC Order 154B; Order 154B - Trended Original Cost Model (TOC), issued June 27, 1985 (ferc.gov).

[69] Federal Energy Regulatory Commission, "Cost of Service Manual", at Cost-of-Service Rates Manual (ferc.gov)

[70] Federal Energy Regulatory Commission, Order Directing Briefs: Docket Nos EL11-66-001 et al, issued October 16, 2018 ("NETO Briefing Order").

[71] The risk premium method looks at the historically allowed returns on equity over and above the risk-free rate and calculates the authorized return on equity. The expected earnings method used forecasted earnings to assess the return on equity.

[72] Federal Energy Regulatory Commission, Opinion No. 569-A, issued May 21, 2020 and Inquiry Regarding the Commission's Policy for Determining Return on Equity, issued May 21, 2020 ("FERC Pipeline Policy").

[73] United States Court of Appeals for the District of Columbia Circuit, "No. 16-1325: MISO Transmission Owners, et al, Petitioners v. Federal Energy Regulatory Commission, Respondent", Decided August 9, 2022.

70. While there are recent decisions by the FERC, the only 2022 decision pertain to 2016–2017.[74] The most recent data pertains to FERC's order on DATC Path 15 LLC in November 2021 and rely on data as of end of March, 2019 and thus is somewhat outdated.[75] Table 6 below shows the parameter values for the most recent electric utility (transmission) WACC decision. The FERC determines a nominal cost of equity and cost of debt, an allowed capital structure, and determines the tax allowance separately. The FERC does not specify a single WACC and does not have a set regulatory period. Instead, the FERC determines cost of equity and rates when a utility, a customer group, or the FERC staff files for a determination of rates.

[74] For example, the March 17, 2022 decision in ER16-2320 for Pacific Gas & Electric Company's transmission assets pertain to 2016–2017 only.

[75] Federal Energy Regulatory Commission, "Opinion 879: DATC Path 15, LLC, Docket No. ER-998-001 et al", issued November 18, 2021.

TABLE 6. FERC RECENT WACC DECISION (DATC PATH 15) BASED ON DATA AS OF MARCH 2019

Parameter		Methodology	Estimate
Risk-free rate	[1]	Yield of 30-year US government bonds. This is calculated as the average of the most recent 6-month's high and low observations.	3.14%
Leverage	[2]	Utility's actual capital structure based on book values.	n/a
Asset beta	[3]	Not specified since Equity betas are directly calculated.	n/a
Equity beta	[4]	Calculated by Value Line using weekly returns over the most recent five years compared to the NYSE for the proxy companies and adjusted by the Blume Adjustment.	0.47 - 0.64
Market risk premium	[5]	Forecasted return on the S&P 500 minus the risk-free rate.	10.20%
Corporate tax rate	[6]	State Tax + (1 - State Tax) x Federal Tax	n/a
Size premium	[7]	Determined using Duff & Phelps' estimation. Range for proxy companies.	-0.30% - 0.86%
CAPM ROE	[8]	Black CAPM using a historical average risk-free rate, a forecasted MRP, and five-year weekly equity betas adjusted by the Blume adjustment.	9.16%
DCF ROE	[9]	Single-stage dividend growth model that uses a six-month average dividend yield and a growth rate (weighted 80% from IBES analysts' company-specific forecasts and 20% from GDP growth).	8.85%
Risk Premium ROE	[10]	Calculated as the sum of the historical risk-free rate and a risk premium obtained by regressing historically allowed returns on equity on the risk-free rate at the time of the decision.	9.93%
Cost of debt	[11]	Determined as the embedded cost of debt of the regulated company.	n/a
Cost of equity	**[12]**	**Commonly, the FERC averages the median ROE estimates for the CAPM, DCF and risk premium method to determine the authorized ROE. However, here the FERC placed DATC Path 15 in the upper end of the composite zone of reasonable ROE instead of relying on a simple average of the method midpoints.**	**10.86%**

Sources:
Federal Energy Regulatory Commission, Opinion No. 569-A, issued May 21, 2020;
Federal Energy Regulatory Comission, Inquiry Regarding the Commission's Policy for Determining Return on Equity, issued May 21, 2020 ("FERC Pipeline Policy");
Federal Energy Regulatory Comission, Order On Briefs And Initial Decision, DATC Path 15, LLC, Docket Nos. ER17-998-001, EL17-61-001, EL18-91-000.

Notes:
[8]: Because the FERC calculates company-specific CAPM-based ROEs and exclude certain outliers, the simple formula of ROE = Risk-free Rate + beta × MRP + Size Premium does not hold.
[12]: Similarly, the FERC excludes certain high end and low end outliers, so the cost of equity is not necessarily equal to the equal weighting of the three ROE calculation methods, even when that unadjusted approach is used.

71. While the FERC has not decided a gas pipeline case in recent years, there is draft decision regarding the Panhandle Pipeline, which assigned equal weight to the median of the CAPM (10.98%) and DCF model (11.88%). The CAPM relied on: (i) a risk-free rate determined as the

average of the high and low observation for the most recent six months (1.77%), (ii) betas based on five years of weekly data and adjusted using the Blume adjustment (from 0.85 to 1.6), (iii) a forecasted MRP (8.87%), and (iv) the Duff & Phelps size adjustment (from negative1.26% to negative 0.29%).[76] This approach resulted in a draft cost of equity of 11.43% for the period October 1, 2019 onward.[77]

72. The FERC allows for the placement of a utility's allowed return on equity above or below the median determined by its methodology. Specifically, the FERC considers the so-called Zone of Reasonableness, which is determined as the average of the minimums determined by the three methods to the average of the maximums determined by the three methods. The Zone of Reasonableness is then split into three areas, where the upper 1/3 consists the upper 1/3 of the zone, the lower 1/3 consists of the lowest 1/3 and the middle 1/3 is in between. A company that is of substantial more risk than the proxy group could be placed at the median of the upper 1/3 and a company that is substantially less risky than the proxy group can be placed at the median of the lowest 1/3.[78]

Cost of Debt

73. The cost of debt is usually determined as the embedded cost of debt of the regulated company and the leverage is usually the target utility's actual capital structure based on book values. The FERC does not rely on any leverage adjustment to its cost of equity estimates and for a tax-paying entity, taxes are determined separately as the implied tax using the statutory tax rate.

Cost of Equity

74. In its most recent decisions regarding the cost of equity methodology, the FERC has settled on the following approach. For electric transmission entities, it uses three models, the CAPM, DCF, and risk premium. The implementation of each model is specified and the FERC currently relies on a Black CAPM[79] using a historical average risk-free rate, a forecasted MRP, and five-year weekly equity betas adjusted by the Blume adjustment. The DCF model is a single-stage dividend growth model that uses a six-month average dividend yield and a growth rate that is weighted

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[76] Federal Energy Regulatory Commission ALJ, Initial Decision (Public Version), Panhandle Eastern Pipe Line Company, LP, March 26, 2021.

[77] The FERC does not have a regulatory period but instead determines the cost of equity and the leverage during a rate case. The determination remains in place until the FERC next hears a case for the same entity.

[78] FERC Order 569-A.

[79] The Black CAPM is distinct from the Sharpe-Lintner in that it does not assume the existence of a riskless asset.

80% by analyst company-specific forecasts from IBES[80] and 20% from GDP growth. The risk premium model is the sum of the historical risk-free rate and a risk premium obtained by regressing historically allowed returns on equity on the risk-free rate at the time of the decision. The risk premium and the risk-free rate are then added to obtain the risk premium result. The FERC tests for outliers and the median of the CAPM and DCF model results in combination with the risk premium result is used for the cost of equity estimation and each of the models are weighted equally. It is the risk premium model that has come into question with the recent ruling of a U.S. Appeals Court.[81]

75. For natural gas and oil pipelines, the FERC relies only on the CAPM and DCF models. It does not use the risk premium model as there are too few publically traded pipeline utilities to use for a statistical analysis. The FERC implements the CAPM in the same manner as for the electric transmission entities, but the growth rate in the DCF model is calculated with 2/3 of the company-specific growth rate via IBES and 1/3 of the GDP growth rate.

76. The FERC uses the CAPM with the following inputs. The RFR is calculated based on the yield of 30-year US government bonds. This is calculated as the average of the most recent 6-months' high and low observations.

77. The Market Risk Premium is a forward-looking MRP, which the FERC calculates as the forecasted return on the S&P 500 minus the risk-free rate specified above. To calculate the forecasted return, the FERC uses company-specific growth rates and dividend yields. Companies that do not pay dividend are eliminated and negative growth rates and/or growth rates above 20% are ignored.

78. The FERC uses equity betas calculated by Value Line[82] and does not de-lever them to calculate asset betas. These betas are calculated using weekly returns over the most recent five years compared to the NYSE. The FERC then adjusts the Value Line betas according to the Blume Adjustment, rounds the Blume-adjusted equity betas to the nearest 0.05 and updates them every 13 weeks. The Blume adjustment can be represented mathematically as:

$$\beta_{adjusted} = 0.67 \times \beta_{raw} + 0.35$$

[80] IBES = Institutional Brokers' Estimate System, a central repository for stock analyst estimations of future earnings of publically traded companies in the United States.

[81] See footnote 73 above.

[82] Value Line is a subscription service that provides historical data, financial analysis and forecast for approximately 1,500 companies. It is commonly used as a data source by U.S. regulators.

79. Having calculated the CAPM using the approach above, the FERC applies a size premium or discount to the cost of equity. The size premium is determined using Duff & Phelps' estimation of the size premium.

A.3 US Surface and Transportation Board (STB)

WHAT AND HOW THE STB REGULATES

80. The US Surface Transportation Board ("STB") regulates certain freight railroad operations, but does not broadly determine prices or revenues that the freight railroads can charge. Instead, the STB annually determines whether the large freight railroads are "revenue adequate".[83] A railroad is deemed revenue adequate if its rate of return on investment equals or exceeds the industry's cost of capital.[84] To that end, the STB annually calculates a single nominal WACC for the railroad industry that applies to all railroads, regardless of their size, by using their market value capital structure. The data for the cost of capital calculations is based on the major publicly listed railroads (currently four major freight railroads). The STB issues a decision for the prior year in August / September of each year (so the 2022 decision pertains to 2021).

WACC METHODOLOGY

81. In 2009, the STB adopted two methods to determine the cost of equity.[85] Specifically, the STB adopted the CAPM and a cash-based version of the DCF method,[86] which are weighted equally to determine the cost of equity. For each model, the aim is to determine the industry cost of equity, which is done by weighting the companies in the industry according to their market capitalisation. The cost of debt is determined using the weighted average of the embedded cost of debt of the railroad companies. The resultant cost of capital is a vanilla nominal WACC with a leverage based on the market value of the railroads' capital structure. Of note, the cost of capital for a given year is calculated the following year, so all parameters are realised at the time of calculation.

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[83] The STB also has jurisdiction in some pipeline, trucking, and ocean shipping matters. *See* Surface Transportation Board Website, https://prod.stb.gov/about-stb/.

[84] Association of American Railroads, Revenue Adequacy: A Calculation to Inform Regulators of Railroads' Financial Health, Factsheet, May 2022.

[85] STB Decision in STB Ex Parte No. 664 (Sub-No. 1), Use of Multi-Stage Discounted Cash Flow Model in Determining the Railroad Industry's Cost of Capital, January 23, 2009. The approach was most recently confirmed in STB's Decision in Docket No. EP 664 (Sub-No. 4), issued June 23, 2020.

[86] The STB uses a multi-stage DCF model. The STB calculated the cash flow that accrue to shareholders for each company and apply company-specific growth rates for the first five years. For years 6-10, the STB applies the average industry growth rate and from year 11 onwards the GDP growth rate.

82. Table 7 shows the most recent cost of capital decision issued by the STB on August 2, 2022.[87]

TABLE 7. STB'S MOST RECENT WACC DECISION AS OF 2021[88]

Parameter		Methodology	Estimate
Risk-free rate	[1]	Average yield on 20-year US Treasury bonds during the year for which the cost of equity is being estimated.	1.98%
Leverage	[2]	Industry weighted average of market value capital structure.	17.71%
Asset beta	[3]	Not specified since Equity betas are directly calculated.	n/a
Equity beta	[4]	Estimated using 5 years of weekly data for a market cap weighted portfolio of Class 1 railroads.	1.07
Market risk premium	[5]	Realized S&P 500 index stock market return minus the income return on 20-year US Treasury bonds using the Morningstar-Ibbotson approach and the period 1926 through the current year.	7.46%
Corporate tax rate	[6]		n/a
CAPM ROE	[7]	[1] + [4] x [5]	9.97%
MSDCF ROE	[8]	Discount rate that equates a firm's market value to the present value of the expected stream of free cash flows that is available for distribution to equity investors.	14.09%
Cost of debt	[9]	Industry weighted average of the market yield to maturity on outstanding railroad bonds.	2.63%
Cost of equity	[10]	([7] + [8]) / 2	12.03%
Nominal vanilla WACC	**[11]**	**[9] x [2] + [10] x (1 - [2])**	**10.36%**

Sources:
Surface Transportation Board Decision, Docket No. EP 558 (Sub-No. 25), Railroad Cost of Capital 2021 (decided August

Cost of Debt

83. The STB uses the market yield to maturity on outstanding railroad bonds to determine the cost of debt for bonds. The STB also calculates the market yield on other outstanding debt and preferred equity.[89] The STB uses market value for traded instruments and book values otherwise

[87] Railroad Cost of Capital Set at 10.37% for 2021 - Railway Age. The aim of the regulation is to produce reasonable maximum rates for situations where there is no competitive alternative.

[88] Surface Transportation Board Decision, Docket No. EP 558 (Sub-No. 25), Railroad Cost of Capital 2021 (decided August 2, 2022).

[89] For example, other debt instruments include: (i) bonds, notes, and debentures (bonds); (ii) equipment trust certificates (ETCs); and (iii) conditional sales agreements (CSAs). The yields of these debt instruments are weighted based on their market values. The cost of preferred equity is determined as the market yield on publicly traded preferred equity railroad instruments; however, preferred equity is a minor component of the railroads' capital structure.

to calculate an industry weighted average cost of debt. These numbers are averaged over the year for which the cost of debt is being determined.

Cost of Equity

84. When determining the cost of equity, the STB currently averages the results from the CAPM model and the Morningstar-Ibbotson Multi-Stage Discounted Cash Flow (MSDCF) model. For the MSDCF model, the cost of equity is the discount rate that equates a firm's market value to the present value of the expected stream of free cash flows that is available for distribution to equity investors.

85. For the CAPM, the market risk premium is calculated as the realised S&P 500 index stock market return minus the income return on 20-year US Treasury bonds using the Morningstar-Ibbotson approach and the period 1926 through the current year (as of now through 2021).[90] The risk-free rate is the average yield on 20-year US Treasury bonds during the year for which the cost of equity is being estimated. Finally, the STB calculates a railroad industry beta using a portfolio approach, where the entities examined comprise the major railroads.[91]

86. The weight assigned to each railroad in the portfolio uses the railroad company's relative market value of equity. Specifically, the STB calculates the weekly stock market value of equity for each railroad over the year and then averages these figures to determine the weight to assign to each railroad company in the beta calculation. The equity beta is then calculated using 5 years of weekly data for the portfolio.[92]

87. The STB uses the railroads' aggregate market value capital structure to determine leverage. The STB assesses common equity, preferred equity, and debt. The latter includes bonds, notes, debentures, equipment trust certificates, and conditional sales agreements and is thus a bit broader than long-term debt.[93] Over the last five years, the STB's estimate of leverage has ranged

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[90] This data was originally compiled in the Morningstar-Ibbotson Classic yearbook, but has since been taken over by Duff & Phelps.

[91] The STB uses a market capitalization weighted portfolio of all publicly traded Class 1 railroads for the estimation. The following companies are currently classified as Class 1 railroads Burlington Northern, CSX, Kansas City Southern, Norfolk Southern and Union Pacific. However, Burlington Northern is not publicly traded so only the remaining four ae used. See, for example, STB Decision in Docket No. EP 558 (Sub-No. 23), August 4, 2020, p. 4.

[92] See, for example, STB, Decision Railroad Cost of Capital - 2013, Docket No. EP 558 (Sub-No. 17), July 31, 2014, p. 8. As the equity beta is calculated using the portfolio, there is no need to de-lever and re-lever beta for individual railroad companies.

[93] Ibid.

from 16.92% (2018) to 20.75% (2016),[94] and is currently at 17.71% (equity percentage of 82.29%) for 2021.[95]

88. This leverage is lower than that of other regulated industries but reflects the STB's use of the market value weighted capital structure of the railroad industry. Railroad revenue is closely linked to the economy and therefore very volatile, which has resulted in the majority of freight railroads having an equity-heavy balance sheet. The solid economy in 2021 resulted in the market value of equity increasing. The majority of the railroads rely heavily on equity financing, so it is not surprising that the resulting industry leverage is low.

89. All cost of equity estimations are based on nominal numbers and there is no consideration of inflation (except as an input to the MSDCF model).

A.4 UK Office for Gas and Electricity Markets (OFGEM)

WHAT AND HOW OFGEM REGULATES

90. The United Kingdom Office for Gas and Electricity Markets ("OFGEM"), is the agency responsible for the regulation of gas and electricity transmission and distribution in England, Wales, and Scotland. Ofgem's principal objective is to protect the interest of consumers by promoting effective competition.[96]

91. Ofgem considers innovation and output objectives for the regulated companies and authorised revenues are set such that an efficient operator can recover its costs, including a reasonable return on the capital employed. While Ofgem must have regard to "financeability", it does so with respect to an efficient operator. It makes general recommendations for actions companies can take to address financeability concerns, but has abandoned specific support mechanisms.[97]

WACC METHODOLOGY

92. Ofgem determines the revenue requirement and the associated cost of capital at the beginning of each 5-year regulatory period. Ofgem's current price review, which was published in February

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[94] Surface Transportation Board Decision, Docket No. EP 558 (Sub-No. 23), August 4, 2020.

[95] Surface Transportation Board, Decision in Docket No. EP 558 (Sub-No. 25), decoded August 2, 2022, p. 20.

[96] Ofgem, About Us page on website, https://www.ofgem.gov.uk/about-us/our-role-and-responsibilities.

[97] For example, Ofgem had earlier considered but ultimately suspended developing a cash flow floor that would provide further assurances to debt holders. Ofgem, RIIO-2 Sector Specific Methodology Decision – Finance, May 24, 2019, pp. 96-99.

2021 and will apply to the regulatory period 2021-2026,[98] is known as "RIIO-2" referring to the second "Revenue = Incentives + Innovation + Outputs" framework.[99] Ofgem sets revenue allowances based on a regulated asset value (RAV) indexed to inflation and an authorized return in real terms. To determine the revenue allowance, Ofgem calculates a real vanilla WACC.

93. The cost of debt is calculated based on a trailing average of the yield of comparable debt and is updated every year based on outturn market data.[100] Ofgem refers to this approach as full indexation.[101]

94. Ofgem calculates the cost of equity based on the CAPM, crosschecks this estimation, and adds an adjustment for expected outperformance.[102] Ofgem compares its cost of equity number with four crosschecks: market-to-asset ratios, bids from OFTO tenders, a Modigliani Miller approach, and infrastructure fund discount rates.[103] Ofgem finds that its crosschecks support its CAPM measure. Ofgem has determined to add a 0.25% uplift to the return on equity for expected outperformance.[104] However, this element of Ofgem's decision was removed on appeal to the Competition and Markets Authority.[105]

95. Ofgem updates its cost of equity and cost of debt estimations for changes in the risk-free rate.[106] The risk-free rate is determined every year based on market rates for the previous year, which implies that the cost of equity changes annually. Table 8 below summarises the most recent WACC estimate as published in Ofgem's final RIIO-2 decision.

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98 The regulatory period for electricity distribution companies starts in 2023. The February 2021 final decision covers electricity and gas transmission, gas distribution, and the electricity system operator.

99 Ofgem, RIIO-2 Core Document, February 3, 2021.

100 Ofgem, RIIO-2 Final Determinations – Finance Annex (Revised), February 3, 2021 ("RIIO-2 Finance Annex"), p. 9.

101 Ibid.

102 Ofgem, RIIO-2 Core Document, p. 54.

103 Ofgem, RIIO-2 Finance Annex, p. 53.

104 Ofgem, RIIO-2 Finance Annex, p. 24.

105 RIIO-2 Energy Licence Modification Appeals, Summary of final determination, Competition and Markets Authority (October 2021), paragraph 29.

106 Ofgem, RIIO-2 Core Document, p. 54.

TABLE 8: OFGEM'S MOST RECENT WACC DECISION: REGULATORY PERIOD 2021–2026

Parameter		Methodology	Estimate
Risk-free rate	[1]	5-year average forecast yield on 20-year inflation indexed government bonds.	-1.58%
Leverage	[2]	Assumed by Ofgem building on estimations in [7]	60%
Asset beta	[3]	[4] + [7] x [8]	0.349
Equity beta	[4]	Average beta estimations of four proxy companies on windows of 2, 5, and 10 years.	0.311
Total market return	[5]	Assumption based on multiple sources (historic averages and investor studies)	6.50%
Market risk premium	[6]	Difference between the historical real total market return and the current/forward-looking real risk free rate.	8.08%
Observed leverage	[7]	Average leverage on a 10-year estimation window of four proxy companies.	50%
Debt beta	[8]	Midpoint of Competition and Markets Authority's (CMA) provisional range of 0.0 to 0.15.	0.075
Notional equity beta	[9]	Assumed by Ofgem building on estimation in [4] and [8].	0.759
CAPM implied cost of equity	[10]	[1] + [9] x [6]	4.55%
Outperformance Wedge	[10]	Assumed by Ofgem to be a reduction of 25 bps for outperformance in RIIO-2, but ordered by CMA to be zero.	0.00%
Cost of debt	**[12]**	**10 to 14 year trailing average of the yield of the iBoxx Utilities ten year index with an additional markup of 0.25% to reflect the additional costs associated with borrowing for all companies.**	**1.82%**
Cost of equity	**[13]**	**Calculated via the CAPM [10] and modified downward based on cross checks and adjustments (incl. outperformance wedge)."**	**4.55%**

Sources:
Ofgem, RIIO-2 Final Determinations – Finance Annex (Revised), February 3, 2021, p. 24.

Cost of Debt

96. Ofgem intends to match debt allowances with expected efficient debt costs. It does so by calculating the cost of debt based on a 10 to 14 year trailing average of the yield of the iBoxx Utilities 10yr index.[107] To this estimation, Ofgem adds a 0.25% mark-up to reflect the additional costs associated with borrowing for all companies.[108] For smaller companies, Ofgem adds an additional 0.06% mark-up as an allowance for smaller companies that would be expected to issue

[107] Ofgem, RIIO-2 Finance Annex, pp. 9-10.

[108] Ofgem, RIIO-2 Finance Annex, p. 9.

debt less frequently.[109] Finally Ofgem deflates the nominal cost of debt by assuming a 5-year forecast of inflation using the Fisher equation to arrive at the real cost of debt.

97. In addition, Ofgem defines a debt beta of 0.075, which is the mid-point estimate of a range provided by the UKRN Study,[110] in addition to Business Plan submissions and regulatory precedent.

Cost of Equity

98. Ofgem follows a three-step process to its calculation of the cost of equity whereby it: (i) calculates the relevant parameters using the CAPM, (ii) crosschecks the resulting CAPM cost of equity against other approaches and sources, and (iii) assesses the extent to which there is a difference between expected return, ie the return it calculates, and the authorised return due to performance incentives within the framework design.

99. The RFR is a forward-looking rate calculated as the 5-year average forecast yield on 20-year inflation indexed government bonds ("Index Linked Gilts"). Ofgem adds an uplift to this value to reflect the difference between the spot and forward average yield of the Retail Price Index, and then adjusts the uplifted yield to be indexed to the Consumer Prices Index including owner occupiers' housing costs (CPIH) estimation of inflation.[111]

100. Ofgem calculates the MRP based on a Total Market Return (TMR) methodology, which measures the MRP as the difference between the historical real TMR and the current or forward-looking real risk free rate. The focus is on the realised market return instead of on the MRP. The assumption underlying the TMR methodology is that the relationship between the real risk-free rate and the real MRP is perfectly negatively correlated. The expected total return to equity is relatively stable in real terms, and that the expected MRP adjusts over time to reflect changes in the real risk free rate. The starting point for Ofgem's determination of the TMR is a study by Wright et. al.,[112] which recommends the use of long-run historical averages and suggests a range of 6-7% in real terms. Ultimately, Ofgem has chosen a MRP of 6.5%.[113]

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[109] Ofgem, RIIO-2 Finance Annex, p. 10.

[110] CEPA, Considerations for UK regulators setting the value of debt beta, Report for the UK regulators network, December 2, 2019.

[111] Ofgem, RIIO-2 Finance Annex, p. 26.

[112] Wright et al, Estimating the cost of capital for implementation of price controls by UK Regulators, June 2018.

[113] Ofgem, RIIO-2 Finance Annex, p. 24.

101. Ofgem calculates an asset beta based on a weighted average of four[114] proxy companies with more weight being given to the observed beta of National Grid.[115] First, unlevered betas are calculated based on windows of 2, 5, and 10 years and averaging the beta estimations with the spot rate.[116] The resulting weighted average unlevered beta of the four proxy companies is 0.311.[117] The asset beta is then calculated assuming a 50% observed leverage[118] and the assumed debt beta of 0.125 to result in an asset beta of 0.349.[119] Finally, the equity beta is calculated based on a notional (assumed) leverage of 60% and the aforementioned debt beta to result in 0.759.[120]

A.5 UK Office for Water (OFWAT)

WHAT AND HOW OFWAT REGULATES

102. The United Kingdom Water Services Regulation Authority ("Ofwat") is the regulatory body for the water and wastewater industry in England and Wales. It oversees 17 monopoly water companies whose business is to secure and treat water resources as well as distribute it through to retail.[121]

103. Ofwat's statutory duties require it to "further the consumer objective to protect the interests of consumers, wherever appropriate by promoting effective competition; secure that water companies properly carry out their functions; secure that the companies are able (in particular, by securing reasonable returns on their capital) to finance the proper carrying out of those functions [the "financeability duty"]; and further the resilience objective to secure the long-term resilience of companies' systems and to secure that they take steps to enable them, in the long term, to meet the need for water supplies and wastewater services".[122]

104. While Ofwat has a financeability duty, it carries out its assessment with respect to a notional, ie efficient, company. The determination of the authorised return is unaffected by financeability

[114] These four proxies are National Grid, PNN, SVT, and UU.
[115] Ofgem, RIIO-2 Finance Annex, pp. 41 – 44.
[116] Ofgem, RIIO-2 Finance Annex, Table 10.
[117] Ofgem, RIIO-2 Finance Annex, p. 24.
[118] Assumed based on the average leverages of the four proxy companies.
[119] Ofgem, RIIO-2 Finance Annex, p. 43.
[120] Ofgem, RIIO-2 Finance Annex, Table 9.
[121] Ofwat, "PR19 Final Determinations – Policy Summary, December 2019, ("Ofwat PR19 – Policy Summary"), p. 4.
[122] Ofwat PR19 – Policy Summary, pp. 18-19 and Water Industry Act 1991.

considerations. However, Ofwat has mechanisms in place for companies to address financeability constraints.[123]

WACC METHODOLOGY

105. Ofwat conducts price reviews to set limits on the revenues regulated companies can charge and regulates the service and incentive packages for companies. Ofwat considers regulatory periods of five years, with the most recent determination "PR19" running from 2020-25. As part of the decision on revenue controls, Ofwat determines the authorised rate of return.

106. Ofwat determines the authorised return companies can earn on the regulated capital value (RCV). The RCV is indexed to inflation over the regulatory period, which requires calculating a vanilla WACC in real terms. Like OFGEM, Ofwat principally relies on the CAPM framework to calculate the cost of equity, and makes crosschecks based on alternative approaches. It calculates the cost of debt as a weighted average of new and old debt, both of which are based on benchmark indices. Ofwat makes company-specific adjustments to the cost of debt allowance for a selection of small companies. Table 9 summarises the parameters from Ofwat's PR19, as modified by the CMA when this decision was appealed by some of the water companies.

[123] Ofwat PR19 – Policy Summary, pp. 59-60. For example, it is possible for companies to "advance revenues" by bringing forward cash flows from future periods. 12 out of the 17 regulated companies make use of this. For details, see Ofwat, "PR19 Final Determinations – Aligning Risk and Return Technical Appendix", pp. 67-99. Note, however, that this was removed on appeal to the CMA (the appeal also made other changes which increased the allowed rate of return).

TABLE 9: OFWAT'S MOST RECENT WACC DECISION: REGULATORY PERIOD 2020–2025

Measure		Source	Estimate	Methodology
Allowed Return on Debt (pre-tax)	[1]	CMA Price Determinations, p. 971	2.18%	Weighted average of new (17%) and existing (83%) debt, plus a 10 bps adder for issuance and liquidity costs
Risk-free Rate	[2]	CMA Price Determinations, p. 790-791	-1.34%	Point estimate based on the midpoint of an inflated 6-month average of the UK 20-yr ILG and a deflated IHS iBoxx £ Non-Gilt AAA 10+ and 10-15 indices.
Total Market Return	[3]	CMA Price Determinations, p. 839	6.81%	Midpoint of the ex-post and ex-ante approaches
Market Risk Premium	[4]	[3] - [2]	8.15%	Difference between the historical real total market return and the current/forward-looking real risk free rate.
Equity Beta	[5]	CMA Price Determinations, p. 870	0.29	Midpoint of the 1-year comparator average unlevered betas from February 2005 to February 2020, and the 5-year comparator average unlevered betas from January 2006 to December 2020.
Comparator gearing	[6]	CMA Price Determinations, p. 880	54.20%	Comparator gearing
Debt Beta	[7]	CMA Price Determinations, p. 881	0.075	External studies
Asset Beta	[8]	[5]+[7]x[6]	0.3307	Unlevered beta using net debt to equity for comparators
Notional Gearing	[9]	CMA Price Determinations, p. 745	60%	Assumption
Notional Equity Beta	[10]	([8]-([7]x[9]))/(1-[9])	0.71	
Cost of Equity (post-tax)	[11]	[2]+[4]x[10] + 0.25%	4.73%	
Appointee Allowed Return on Capital (vanilla)	[12]	[1]x[9]+[11]x(1-[9])	3.20%	
Retail Margin Adjustment	[13]	CMA Price Determinations, p. 1029	0.08%	Adjustment for reduction in systematic risk
Wholesale Allowed Return on Capital (vanilla)	[14]	[12]-[13]	3.12%	

Notes and sources:
Expressed in CPIH-Real terms.
CMA, Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, Final Report, March 17, 2021

Cost of Debt

107. Ofwat considers several elements in its determination of the debt allowance and calculates the cost of debt in part based the cost of old debt (weighted 80%) and in part on new debt (weighted 20%).[124] The 80:20 weighting was estimated by examining company forecasts. Ofwat calculates both the cost of new debt and old debt with reference to the iBoxx bond indices reflecting the cost of debt of A and BBB rated non-financial company indices with 10 years or more to maturity.[125]

108. The cost of new debt is estimated using the current rate with an upwards adjustment of 25bp to account for the expected increase in market rates over the regulatory period, and a downward adjustment of 15bp to account for the outperformance Ofwat believes an efficient company is expected to achieve.[126] Outperformance here refers to the observation that regulated companies

[124] Ofwat – Technical Appendix, p. 73.

[125] Ofwat uses an average A and BBB-rated iBoxx indices. Ofwat PR19 Draft Determinations, p. 74. However, a report by Europe Economics suggests that the average Ofwat uses is unweighted. See Europe Economics, "The Cost of Capital for the Water Sector at PR19", 17 July 2019, p. 46.

[126] Ofwat PR19 – Technical Appendix, p. 78. The uplift is calculated with reference to the term structure of nominal gilts, and is intended to capture the increase in the cost of long-term debt to be issued over the regulatory period, implied by the current term structure.

issue debt at a lower rate relative to the benchmark. The cost of new debt is to be reconciled in the next regulatory period with outturn rates in the benchmark index.[127]

Cost of Equity

Ofwat uses the simple CAPM model to estimate a range for the post-tax cost of equity, and then selects a point estimate that is 0.25% above the midpoint. In their final decision on the appeal, the CMA explained that selecting a point estimate in the upper half of the range promotes investments and lowers the risk of exit of capital in the sector, and also addresses asymmetric risk in outcome delivery incentives, parameter uncertainty in any cost of equity estimation; and the need for cross-checks.

For the risk free rate, the CMA selected the midpoint between the high and low estimates for the RFR.[128] The low estimate is based on the 6-month average of the UK 20-Year index-linked government bond yields (ILGs), while the high estimate is based on the 6-month average of the IHS iBoxx £ Non-Gilt AAA 10+ and 10-15 indices.[129] The CMA calculated both estimates for the period ending on December 31, 2020. This differs from the 1-month average spot yield of 20-year UK ILGs that was the basis of Ofwat's decision in PR19. The low estimate is inflated by a 0.90% "wedge" assumption that is slightly lower than Ofwat's assumption in PR19 of 1.0%, while the high estimate is deflated by CMA's inflation assumption of 2%.[130]

The CMA's estimate for MRP is based on the difference between the total market return and the risk free rate. Similar to the MRP, the total market return reflects an inflation-adjusted range. The low estimate is based on an ex-post approach that relies on historical UK equity returns (from 1900 to the present day). The upper estimate is calculated using models of stock returns that have been fit to historical data to separate ex-ante expectations (the "ex-ante" approach).[131] While the CMA leaves available this range, in the final choice of a point estimate, the midpoint is selected.[132]

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[127] Ofwat PR19 – Technical Appendix, p. 72.

[128] Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report, CMA, March 17, 2021, p. 796.

[129] *Id.* p. 790.

[130] *Id.* p. 744.

[131] Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final report, CMA, March 17, 2021, p. 796.

[132] *Id.* p. 1098.

The CMA determines its final point estimate for its notional equity beta using a midpoint of the low and high estimates for the unlevered beta. Equity beta, the exposure of shareholders to systematic risk, can be calculated,

$$\beta_E = \frac{\beta_A - \beta_D * g}{1 - g}$$

where β_A is the unlevered beta, β_D is the debt beta, and g is the notional gearing. The CMA applies a gearing ratio of 60% for all proceedings, taking this approach to (a) allow companies to set their own financial structure, and (b) ensure that customers pay only for costs that are associated with a theoretical structure.[133] The low and high estimates for asset betas are calculated independently of each other. The lower bound is based on the 1-year average of Severn Trent and United Utilities (SVT/UU) unlevered equity betas from March 2005 to February 2020. The upper bound of the range is based on the average unlevered spot beta for SVT/UU from September 2014 to February 2020.[134] The range for the debt beta was tightened as part of the appeal. On the low end, the CMA increased the debt beta from 0 to 0.05, to reflect that debt betas near zero are usually caused by high standard errors around low debt betas instead of debt betas of zero. On the upper end, the CMA decreased the debt beta from 0.15 to 0.10 in response to the observation that debt premiums have increased. The net effect on the debt beta midpoint is that it remains unchanged as part of the appeal decision.[135]

A.6 The Dutch Authority for Consumers and Markets (ACM)

WHAT AND HOW THE ACM REGULATES

109. The Dutch Authority for Consumers and Markets ("ACM") is the authority responsible for the regulation, among other sectors, of energy transmission and distribution system operators (TSOs and DSOs) in the Netherlands.[136] The Dutch government owns the Dutch gas and electricity TSOs, Gasunie Transport Services and Tennet. The DSOs—primarily held by Dutch provinces and municipalities—operate regional distribution networks. Altogether, the ACM regulates 10 utilities.

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[133] *Id.* p. 744.

[134] *Id.* p. 870.

[135] *Id.* p. 879-880.

[136] In addition to regulating TSOs and DSOs, the ACM's is responsible for regulating many other sectors, including telecoms, pilotage services, drinking water, and district heating, among others.

110. The ACM has the responsibility to determine a regulatory method for the determination of tariffs, including the appropriate return on the invested capital. The legislature has entrusted the ACM with the task of establishing a method whereby the regulated companies have an incentive to act as efficiently as they would in a competitive market, with sufficient financial incentives for quality and efficiency improvement. In addition, when determining the method, the ACM must take into account the importance of security of supply, the importance of sustainability and the importance that network operators can realise a reasonable return on investments.[137] Government ownership of the transmission networks plays no role in the method determination.

111. At the beginning of each regulatory period, the ACM applies a single, common methodology to determine the authorised rate of return for the four sectors (gas transmission and distribution as well as electricity transmission and distribution). However, the ACM distinguishes between existing assets (assets already in the regulated asset base) and new assets (assets that will be built within the regulatory period).[138] We focus on the existing assets below as the method used to calculate the WACC is the same – the only difference being the period over which the cost of debt is calculated.

WACC METHODOLOGY

112. The ACM calculates a real pre-tax WACC based on a cost of equity estimate from the CAPM, a cost of debt estimate based on a trailing average cost of debt, and a leverage of 45.25%. Table 10 below summarizes the ACM's WACC for the most recent decision for the regulatory period 2022-2026.

[137] ACM's legal duties are established in the Dutch electricity and gas acts. See section 1 of the method decisions for the Dutch electricity and gas TSOs, Tennet and Gasunie Transport Services: ACM, Methodebesluit Transporttaken TenneT 2022-2026, September 16, 2021 and ACM, Methodebesluit GTS 2022-2026.

[138] The ACM makes an additional calculation of WACC for the offshore grid run by Tennet as well.

TABLE 10. ACM'S COST OF CAPITAL DETERMINATION 2022-2026: EXISTING CAPITAL FOR 2022

Parameter		Methodology	Estimate
Risk-free rate	[1]	Average of German and Dutch 10-year government bond yields over the most recent 3 years (2017-2020).	-0.01%
Leverage	[2]	Median leverage of liquid proxy companies.	45.25%
Asset beta	[3]	Median asset beta of liquid proxy companies.	0.39
Equity beta	[4]	[3] x (1 + (1 - [6]) x [7])	0.63
Market risk premium	[5]	Simple average of the geometric and arithmetic means of the historical market risk premium for the Eurozone based on the DMS dataset (1900-2019).	5.00%
Corporate tax rate	[6]	Current statutory corporate tax rate	25%
Debt-to-equity ratio	[7]	[2] / (1 - [2])	82.64%
Pre-tax cost of debt	[8]	Average yield on a single A-rated utilities index plus 15 basis points for debt issuance costs. Existing capital based on the staircase model (trailing average over the past 10 years). New capital based on forward looking estimate (average yields over the past three years).	1.41%
After-tax cost of equity	[9]	[1] + [4] x [5]	3.15%
Pre-tax cost of equity	[10]	[9] / (1-[6])	4.20%
Nominal pre-tax WACC	[11]	[2] x [8] + (1-[2]) x [10]	2.94%
Inflation	[12]	Average between historic and forecast rates of inflation in the Netherlands. Historic rates estimated 3-year average CPI and forecast rates of CPI inflation from the Dutch Economic Planning Bureau for 2021-2025.	1.77%
Real pre-tax WACC	**[13]**	**(1+[11]) / (1+[12]) - 1**	**1.15%**

Sources and notes:
Calculation is shown for existing capital for the year 2022.
ACM, Methodebesluit Transporttaken TenneT 2022-2026, September 13, 2021;
ACM, Methodebesluit Transporttaken TenneT 2022-2026, September 13, 2021, Annex 3: WACC Model.

Cost of Debt

113. The ACM calculates the embedded cost of debt of a hypothetical loan portfolio using a "stair case" approach. This approach assumes that network operators finance their existing investments with 10-year loans and that they refinance 10% of their loans each year. Consequently, the cost of debt is calculated as a 10-year average of the yield on a utility index of 10-year bonds with a credit

rating of A and therefore changes each year. The ACM then adds 15 basis points to account for debt issuance costs.[139]

Cost of Equity

114. The ACM relies on the CAPM to determine the cost of equity. To that end, the ACM selects a peer group of publicly traded companies – predominantly in the Eurozone to estimate the leverage and asset beta inputs.[140]

115. In a recent decision in the Caribbean Netherlands that will apply to energy networks in the Netherlands, the ACM chose to use the average yield on 20-year government bonds as the estimate of the risk-free rate.[141] This diverges from the previous approach, which calculated the RFR as the average yield on 10-year government bonds.[142] The 3-year averaging period remains the same.

116. The MRP is based on the historically realised MRP for Eurozone countries. The ACM looks at the simple average of the arithmetic and geometric averages of the historical MRPs in these countries[143] and weighs the countries MRPs according to the capitalisation of the countries' stock markets.[144] The resulting MRP estimation is then compared to a dividend growth model to confirm its reasonableness.[145]

117. The ACM calculates the equity betas predominately using daily data over a 3-year period. The equity beta is calculated by regressing using company-specific returns on the stock index (the Stoxx Europe 600, "SXXP") for the Eurozone.[146] The ACM then performs a test for market

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[139] Dan Harris and Lucrezio Figurelli (Brattle), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, April 7, 2021.

[140] Dan Harris and Lucrezio Figurelli (Brattle), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, April 7, 2021, pp. 17-20.

[141] Dan Harris, Lucrezio Figurelli, Federico Guatri, and Filippo Nezzo (Brattle), The WACC for Electricity and Water Companies in the Caribbean Netherlands for the years 2023-2025, May 10, 2022, pp. 10-14.

[142] Dan Harris and Lucrezio Figurelli (Brattle), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, April 7, 2021, pp. 6.

[143] For the purpose of determining a forward-looking MRP it is the arithmetic average that is relevant. For a discussion of this issue, see, for example, Richard A. Brealey, Stewart C. Myers, and Franklin Allen, Principles of Corporate Finance, 9th edition, 2008, p. 176.

[144] Dan Harris and Lucrezio Figurelli (Brattle), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, April 7, 2021, pp. 7-11.

[145] Ibid, p. 8.

[146] There is also one US based company in the proxy group, TC pipelines, whose beta is estimated in relation to the S&P 500.

imperfections to check for share price movement before or after market index movement in reaction to news.[147] If an effect is present, the ACM uses weekly data to calculate the equity betas instead of daily date. The purpose of this test is to better extract useful beta estimates from noisy data. For the 2022-2026 determination, three of the seven proxy companies were found to require weekly data to accurately estimate equity betas.[148]

118. Asset betas are calculated by delevering the equity betas using the Hamada method. Similarly to the estimation of the betas, the leverage is chosen as the median of the three-year average of the quarterly gearing ratios (net debt divided by market capitalisation) of the proxy companies.[149]

A.7 The Italian Regulatory Authority for Energy, Networks and Environment (ARERA)

WHAT AND HOW THE ARERA REGULATES

119. The Italian Regulatory Authority for Energy, Networks and the Environment (ARERA) carries out regulation and monitoring activities for energy systems in Italy. Regulated energy sectors include transmission and distribution of electricity, and transmission, distribution, metering, storage and regasification of natural gas. ARERA also regulates the water and waste industries, as well as district heating. Snam and Terna, the main gas and electricity TSOs, are listed companies with indirect partial government ownership. Their largest individual shareholder, with around 30% of share capital, is CDP Reti, a subsidiary of Cassa Depositi e Prestiti, a financial institution controlled by the Italian Ministry of Economy and Finance. There are 126 electricity DSOs and 194 gas DSOs operating in Italian regions and provinces, organized with a wide range of legal forms, from listed companies, to privately-held companies, to publicly-owned entities.

120. Per Law no. 481 of 1995, ARERA is an independent authority that works to ensure the promotion of competition and efficiency in public utility services and to protect the interests of users and consumers. ARERA applies sector-specific methodologies for the determination of authorised revenues and tariffs, although the methodology for the rate of return component is common across all the sectors

[147] Dan Harris and Lucrezio Figurelli (Brattle), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, April 7, 2021, pp. 18.

[148] Dan Harris and Lucrezio Figurelli (Brattle), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, April 7, 2021, Table 9.

[149] Dan Harris and Lucrezio Figurelli (Brattle), The WACC for the Dutch Electricity TSO and Electricity and Gas DSOs, April 7, 2021, p. 9.

121. Since 2015, ARERA has followed a common methodology for estimation of WACC in the sectors it regulates. Every six years (divided into two period of three years), ARERA publishes new decisions that set the parameters for each sector. The TIWACC decision is then updated to reflect the new decisions and parameter values. In June of 2021, ARERA issued an update to its methodology and criteria that apply to the 2022-2027 period. ARERA published an addendum to the methodological review in February 2022 that reflects several of the technical aspects of the approach to estimating the cost of capital. The parameters established will be relied on to update the WACC for the entirety of the six-year regulatory period, with a planned update to some (inflation, risk free rate, and market risk premium) for the second sub-period.

122. Once the new WACC parameters are agreed upon, they are reflected in tariffs for the following year.

WACC METHODOLOGY

123. ARERA continues to rely on a pre-tax WACC based on a CAPM model that incorporates both sector-specific and base parameters. A different asset beta is set for each sector regulated by ARERA, and the gearing ratio, while currently the same for most energy sectors, may switch to a sector-specific estimate in the future. All other WACC parameters are common to all regulated sectors.

124. Table 11 uses an asset beta of 0.51, which corresponds to the sector-specific parameter value for storage, and a notional 50% gearing ratio.

TABLE 11. ARERA'S COST OF CAPITAL DETERMINATION 2022–2027

			Electricity Distribution
			[A]
Risk free rate (RFR), nominal	[1]	Notes	-0.22%
Convenience premium (CP)	[2]	Notes	1.00%
Uncertainty premium (UP)	[3]	Notes	0.50%
Forward premium (FP)	[4]	Notes	0.25%
Real risk-free rate (RFr)	[5]	Notes	0.13%
Inflation rate in RFR (isrn)	[6]	Notes	1.40%
Country Risk Premium (CRP), unadjusted	[7]	Notes	0.92%
FP in CRP	[8]	Notes	0.23%
CRP, adjusted	[9]	Notes	1.13%
New debt weight	[10]	Notes	15.00%
Old debt weight	[11]	Notes	85.00%
iBoxx spot yield	[12]	Notes	0.97%
iBoxx 10-Y average yield	[13]	Notes	2.35%
Transition costs (ADD)	[14]	Notes	0.25%
Debt risk premium (DRP)	[15]	Notes	0.50%
Cost of debt, real - new methodology	[16]	Notes	0.79%
Cost of debt, real - original methodology	[17]	Notes	2.39%
Debt graduality coefficient	[18]	Notes	33.33%
Real cost of debt (Kdr)	[19]	Notes	1.86%
Total Market Return (TMR)	[20]	Notes	5.98%
Equity Risk Premium (ERP)	[21]	[20]-[5]	5.85%
Asset Beta	[22]	Notes	0.4
Equity Beta (βlevered)	[23]	Notes	0.70
Real cost of equity (Ker)	[24]	[5]+[9]+[21]x[23	5.38%
Gearing (g)	[25]	Notes	50.00%
Leverage	[26]	Notes	100.00%
Tax rate (T)	[27]	Notes	29.50%
Tax shield (tc)	[28]	Notes	24.00%
Expected inflation rate (ia)	[29]	Notes	1.70%
Tax adjustment factor (F)	[30]	Notes	0.41%
WACC, real pre-tax	**[31]**	Notes	**5.23%**

Cost of Debt

125. ARERA's revised method to calculate the cost of debt diverges significantly from the approach for the 2016–2021 period. The original methodology calculates the cost of debt as the sum of (i) the real risk free rate, (ii) the country risk premium, and (iii) a notional debt premium, calculated by ARERA to be 2.40%. The revised method calculates the real cost of debt based on the sum of (i) the product of old debt and the sum of spot rate of BBB-rated iBoxx index plus a forward premium and uncertainty premium, and (ii) the product of new debt and the same instrument. ARERA established a graduated ramp to convert from the old approach, with a weighted sum based on 1/3rd new method and 2/3rd old for the first sub-period, 2/3rd new method and 1/3rd old for the 2025–2027 sub-period, and only the new method beyond 2027.

126. The real cost of debt, calculated as the sum of three components described above, is converted into a real pre-tax cost of debt by multiplying it by 1 minus the tax shield and dividing it by 1 minus the tax rate.

Cost of Equity

127. The ARERA uses an inflation adjusted risk-free rate (RFR) that has been increased by several premiums, including a convenience premium (CP), forward premium (FP), and uncertainty premium (UP). The CP is based on the spread across government bonds and a hypothetical zero-beta asset. In essence, the concept is that government bonds have money-like features which are beneficial to investors, and which depress yields. The FP measures the expected increase in AAA-rated government bonds over the next few years. The UP reflects the amount of risk that interest rates increase more than forward rates. ARERA selected the upper end of the range for the CP (0.5%–1%, 1% selected) and the UP (0.25%–0.50%, 0.50% selected), and confirmed a value of 0.25% for the FP. The RFR is thus calculated,

$$RFR = \frac{RFR_p^{nominal} + CP + FP + UP - isr_p}{1 + isr_p}$$

where isr_p is the implicit in the RFR. The nominal RFR is the 1-year average of 10-year government bond yields in Germany, France, Belgium, and Netherlands. The isr_p is based on 10-year inflation-linked swap rates.

128. The country risk premium (CRP) is a function of the government bond yield and a forward premium, adjusted for inflation. For the spread, the ARERA measures the 1-year average difference between spreads between 10-year Italy government bonds and AA-rated countries. ARERA calculates the forward premium by measuring the difference between the forward premium for Italy and the forward premium for AA countries.

129. ARERA uses a weighted average of the arithmetic mean (80%) and the geometric mean (20%) of historic returns to calculate the total market return (TMR). To calculate the equity risk premium, the real RFR is subtracted from the TMR.

130. The equity beta is calculated by relevering the asset beta using the Hamada ~~Modigliani Miller~~ formula.[150] ARERA sets a notional gearing ratio of 50%, which corresponds to leverage of 1, and sets sector-specific asset betas. The asset betas are determined in sector-specific tariff reviews, the most recent of which being decision 614/21, *Tasso di remunerazione del capitale investito per i servizi infrastrutturali dei settori elettrico e gas per il periodo 2022-2027*.[151] The asset beta shown in Table 8 is for the electricity distribution sector.

[150] Methodological review of the cost of capital estimation, ARERA, June 2021, p. 22.

[151] Appendix to Tasso di remunerazione del capitale investito per i servizi infrastrutturali dei settori elettrico e gas per il periodo 2022-2027: criteri per la determinazione e l'aggiornamento, ARERA, December 23, 2021, p. 10